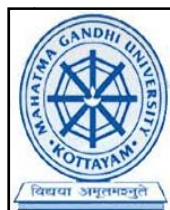


**MAHATMA GANDHI UNIVERSITY,
PRIYADARSHINI HILLS, KOTTAYAM-686560**



**Scheme & Syllabus for
Undergraduate Programme in
Biochemistry**

**Under
Choice Based Credit System 2016**

With Effect from 2016 Admission

MAHATMA GANDHI UNIVERSITY, KOTTAYAM
Undergraduate Programme in Biochemistry (Model I)

Scheme & Syllabus

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The Expert Committee in Biochemistry (UG) acknowledges honourable Vice Chancellor of Mahatma Gandhi University, Dr.Babu Sebastian for the help and guidance extended to us during the syllabus restructuring of B.Sc Biochemistry Programme.

We thank Pro Vice Chancellor, Dr.Sheena Shukoor for her valuable suggestions.

The Expert Committee in Biochemistry thank the members of Mahatma Gandhi University Syndicate for all the support given to us.

We thank the Registrar of the University, Academic and Finance section for extending their service for smooth completion of syllabus restructuring.

The Expert Committee acknowledges the contributions, support, active participation in workshop and recommendations from faculty members in Biochemistry from various colleges in Mahatma Gandhi University in designing this Syllabus.

THANK YOU

For the expert committee in Biochemistry,

Kottayam,
05-05-2016.

Dr.Sandhya C

(Convenor)

3. INTRODUCTION

The Academic Council of the Mahatma Gandhi University at its meeting held on 23rd May 2015 resolved to introduce the UGC Guidelines for Choice Based Credit System from the Academic Year 2016-17 onwards and the Syndicate of the University at its meeting held on 1st August 2015 approved the resolution of the Academic Council. Hence it becomes necessary to modify the existing CBCSS regulation as **“REGULATIONS FOR UNDER GRADUATE PROGRAMMES UNDER CHOICE BASED CREDIT SYSTEM 2016”**

The Undergraduate Programme in Biochemistry explores the chemistry of living organisms and the molecular basis for the changes occurring in living cells. It uses the methods of chemistry, physics, molecular biology and immunology to study the structure and behavior of the complex molecules found in biological material and the ways these molecules interact and communicate within and between cells and organs. The biochemist seeks to determine how specific molecules such as proteins, nucleic acids, lipids, vitamins and hormones function in such processes.

Biochemistry has provided explanations for the causes of many diseases in humans, animals and plants. It can frequently suggest ways by which such diseases may be treated or cured. Biochemistry seeks to unravel the complex chemical reactions that occur in a wide variety of life forms and provides the basis for practical advances in medicine, veterinary medicine, agriculture and biotechnology. It underlies and includes exciting new fields such as molecular genetics and bioengineering.

As the broadest of the basic sciences, biochemistry includes many subspecialties such as neurochemistry, bioorganic chemistry, clinical biochemistry, physical biochemistry, molecular genetics, biochemical pharmacology and immunochemistry. Recent advances in these areas have created links among technology, chemical engineering and biochemistry.

4. AIMS AND OBJECTIVES

The Course aims to prepare students:

- To acquire and apply the relevant biochemical information in order to solve potential biomedical problems.
- Provide students with basic theoretical and practical knowledge of the principal methodologies and techniques for investigation of biomolecules; which can be applied to the investigation and measurement of cell functions.
- Assist students in understanding the scientific methods and help them to develop observation and critical analysis skills, collection, evaluation and classification of data; deducing conclusions; formulating hypotheses.
- Assist students in developing self-learning and the ability to keep knowledge and skills up to date; team work and communication.

The objective of the Course is to provide students with sufficient knowledge of biomolecular structure to understand the determining properties of biological function at the level of cells and the body. This will allow students at a later stage:

- To understand physiology and physiopathology at the molecular level; the molecular basis of diagnosis, therapeutics, disease prevention and health promotion.
- Become familiar with and understand the basic structures and functions of cells in the human body, applying biomedical concepts and terminology.
- Apply biochemical analysis and reasoning in order to solve problems related to physiology and cellular physiopathology.
- Learn to use a biochemical approach in the study of cellular functions that will provide an understanding of future advances in the molecular basis of physiology, physiopathology, diagnostics, therapeutics, disease prevention, health promotion and the continuous updating of knowledge.

5.COURSE DESIGN

5.1.Scheme and Syllabus

- 5.1.1.The U.G. programme in Biochemistry shall include **(a)** Common Courses I and II, **(b)** Core Course(s), **(c)** Complementary/Vocational Courses, and **(d)** Generic Elective Course (GE).
- 5.1.2.There shall be one Generic Elective paper in the fifth semester with a choice of one out of three elective papers from any programme or from the Physical Education department.
- 5.1.3.There shall be one Choice Based paper in the sixth semester with a choice of one out of three elective papers.
- 5.1.4.Credit Transfer and Accumulation system can be adopted in the programme. Transfer of Credit consists of acknowledging, recognizing and accepting credits by an institution for programmes or courses completed at another institution. The Credit Transfer Scheme shall allow students pursuing a programme in one University to continue their education in another University without break.
- 5.1.5.A separate minimum of 30% marks each for internal and external (for both theory and practical) and aggregate minimum of 40% are required for a pass for a paper. For a pass in a programme, a separate minimum of **Grade D** is required for all the individual papers. If a candidate secures **F Grade** for any one of the paper offered in a Semester/Programme, **only F grade** will be awarded for that Semester/Programme until he/she improves this to **D Grade** or above within the permitted period. (See Clause 5.3)
- 5.1.6.Students who complete the programme with 'D' grade in the "Regulations for Under Graduate Programmes under Choice Based Credit System 2016" will have one betterment chance within 12 months, immediately after the publication of the result of the whole programme.

5.1.7. Students discontinued from previous regulations, CBCSS 2013, can pursue their studies in “Regulations for Under Graduate Programmes under Choice Based Credit System 2016” after obtaining readmission. These students have to complete the programme as per “Regulations for Under Graduate Programmes under Choice Based Credit System 2016”.

5.1.8. Practical examinations will be conducted only at the end of even semesters for all programmes. Special sanction shall be given for those programmes which need to conduct practical examinations at end of odd semesters.

5.2. Programme structure

Model I B.Sc.

| | | |
|---|---|-------------|
| a | Programme Duration | 6 Semesters |
| b | Total Credits required for successful completion of the Programme | 120 |
| c | Credits required from Common Course I | 22 |
| d | Credits required from Common Course II | 16 |
| e | Credits required from Core course and Complementary courses including Project | 79 |
| f | Generic Elective (GE) | 3 |
| g | Minimum attendance required | 75% |

6. FACULTY

The Undergraduate Programme in Biochemistry comes under the Faculty of Sciences, Mahatma Gandhi University

7. ELIGIBILITY FOR ADMISSION AND RESERVATION OF SEATS

7.1. Eligibility for admission, norms for admission and reservation of seats for Undergraduate Programme in Biochemistry shall be according to the regulations framed/orders issued by the University in this regard, from time to time.

7.2. Students can opt for any one of the **Generic Elective Papers** offered by different departments of the college in fifth semester (subject to the availability of vacancy in the concerned discipline). If the number of applications exceeds the number of vacancies for a particular Generic elective paper, priority will be given to the students from the parent department (core subject). Selection of students in the generic elective paper will be done in the college based on merit and interest of the students.

8. DURATION OF COURSE AND REGISTRATION

8.1. The duration of U.G. programme in Biochemistry shall be **6 semesters**.

8.2. There shall be two Semesters in an academic year, the 'ODD' semester commences in June and on completion, the 'EVEN' Semester commences after a semester-break of three days with two months vacation during April and May. (The commencement of first semester may be delayed owing to the finalization of the admission processes.)

8.3. A student may be permitted to complete the Programme, on valid reasons, within a period of 12 continuous semesters from the date of commencement of the first semester of the programme.

8.4. The strength of students for each programme shall be as per the existing orders, as approved by the University.

8.5. The college shall send a list of students registered for each programme in each semester giving the details of courses registered including repeat courses to the University in the prescribed form within **20** days from the commencement of the Semester.

8.6. Those students who possess the required minimum attendance during an academic year/semester and could not register for the semester examination are permitted to apply for Notional Registration to the examinations concerned enabling them to get promoted to the next class.

9.MEDIUM OF INSTRUCTION

The medium of instruction can be either English or Malayalam

10. EXAMINATIONS

10.1.The evaluation of each paper shall contain two parts:

- (i) Internal or In-Semester Assessment (ISA)
- (ii) External or End-Semester Assessment (ESA)

10.2.The internal to external assessment ratio shall be 1:4. There shall be a maximum of **20** marks for internal evaluation and a maximum of 80 marks for external evaluation. Both internal and external marks are to be mathematically rounded to the nearest integer. For all papers (theory & practical), grades are given **on a 10-point scale** based on the total percentage of marks, **(ISA+ESA)** as given below:-

| Percentage of Marks | Grade | Grade Point |
|---------------------|--------------------------|-------------|
| 95 and above | S Outstanding | 10 |
| 85 to below 95 | A ⁺ Excellent | 9 |
| 75 to below 85 | A Very Good | 8 |
| 65 to below 75 | B ⁺ Good | 7 |
| 55 to below 65 | B Above Average | 6 |
| 45 to below 55 | C Satisfactory | 5 |
| 40 to below 45 | D Pass | 4 |
| Below 40 | F Failure | 0 |
| | Ab Absent | 0 |

10.3.Credit Point and Credit Point Average

Credit Point (CP) of a paper is calculated using the formula:-

$CP = C \times GP$, where *C* is the Credit and *GP* is the Grade point

Semester Grade Point Average (SGPA) of a Semester is calculated using the formula:-

$SGPA = TCP/TC$, where *TCP* is the Total Credit Point of that semester, ie, $\sum_1^n CP_i$;

TC is the Total Credit of that semesterie, $\sum_1^n C_i$, where n is the number of papers in that semester

Cumulative Grade Point Average (CGPA) is calculated using the formula:-

CGPA = TCP/TC, where TCP is the Total Credit Point of that programmeie, $\sum_1^n C_{Pi}$; TC is the Total Credit of that programme, ie, $\sum_1^n C_i$, where n is the number of papers in that programme

Grade Point Average (GPA) of a Course (Common Course I, Common Course II, Complementary Course I, Complementary Course II, Vocational course, Core Course) is calculated using the formula:-

GPA = TCP/TC, where TCP is the Total Credit Point of course ie, $\sum_1^n C_{Pi}$; TC is the Total Credit of that course, ie, $\sum_1^n C_i$, Where n is the number of papers in that course.

Grades for the different courses, semesters and overall programme are given based on the corresponding CPA as shown below:

| GPA | Grade |
|------------------|------------------------|
| 9.5 and above | S Outstanding |
| 8.5 to below 9.5 | A+ Excellent |
| 7.5 to below 8.5 | A Very Good |
| 6.5 to below 7.5 | B+ Good |
| 5.5 to below 6.5 | B Above Average |
| 4.5 to below 5.5 | C Satisfactory |
| 4.0 to below 4.5 | D Pass |
| Below 4.0 | F Failure |

10.4. Marks Distribution for External Examination and Internal Evaluation

The external theory examination of all semesters shall be conducted by the University at the end of each semester. Internal evaluation is to be done by continuous assessment. For all papers (theory and practical) total marks of external examination is 80 and total marks of internal evaluation is 20.

Marks distribution for external and internal assessments and the components for internal evaluation with their marks are shown below:

10.4.1 For all theory papers

- a) Marks of external Examination : 80
- b) Marks of internal evaluation : 20

All the three components of the internal assessment are mandatory.

| Components of Internal Evaluation of theory | Marks |
|---|-----------|
| Attendance | 5 |
| Assignment /Seminar/Viva | 5 |
| Test paper(s) (1 or 2) (1x10=10; 2x5=10) | 10 |
| Total | 20 |

10.4.2 For all practical papers

- a) Marks of external Examination : 80
- b) Marks of internal evaluation : 20

All the four components of the internal assessment are mandatory.

| Components Internal evaluation of Practical | Marks |
|--|--------------|
| Attendance | 5 |
| Test paper | 5 |
| Record* | 5 |
| Lab involvement | 5 |
| Total | 20 |

*Marks awarded for Record should be related to number of experiments recorded and duly signed by the concerned teacher in charge.

10.4.3 For projects

a) Marks of external Examination : 80

b) Marks of internal evaluation : 20

| Components of External Evaluation of Project | Marks |
|---|--------------|
| Dissertation (External) | 50 |
| Viva-Voce (External) | 30 |
| Total | 80 |

All the four components of the internal assessment are mandatory.

| Components Internal Evaluation of project | Marks |
|--|--------------|
| Punctuality | 5 |
| Experimentation/Data collection | 5 |
| Knowledge | 5 |
| Report | 5 |
| Total | 20 |

10.4.4. Attendance Evaluation

For all papers

| % of attendance | Marks |
|-----------------|-------|
| 90 and above | 5 |
| 85 – 89 | 4 |
| 80-84 | 3 |
| 76-79 | 2 |
| 75 | 1 |

(Decimals are to be rounded to the next higher whole number)

10.4.5. Assignments

Assignments are to be done from 1st to 4th Semesters. At least one assignment should be done in each semester for all papers.

10.4.6. Seminar/Viva

A student shall present a seminar in the 5th semester for each paper and appear for Viva-voce in the 6th semester for each paper.

10.4.7. Internal Assessment Test Papers

At least one internal test-paper is to be attended in each semester for each paper. The evaluations of all components are to be published and are to be acknowledged by the candidates. All documents of internal assessments are to be kept in the college for two years and shall be made available for verification by the University. The responsibility of evaluating the internal assessment is vested on the teacher(s), who teach the paper.

10.4.8. Grievance Redressal Mechanism

Internal assessment shall not be used as a tool for personal or other type of vengeance. A student has all rights to know, how the teacher arrived at the marks. In order to address the grievance of students, a three-level Grievance Redressal

mechanism is envisaged. A student can approach the upper level only if grievance is not addressed at the lower level.

Level 1: Department Level: The Department cell chaired by the HOD, Department Coordinator, Faculty Advisor and Teacher in-charge as members.

Level 2: College level: A committee with the Principal as Chairman, College Coordinator, HOD of concerned Department and Department Coordinator as members.

Level 3: University Level: A Committee constituted by the Vice-Chancellor as Chairman, Pro-Vice-Chancellor, Convener - Syndicate Standing Committee on Students Discipline and Welfare, Chairman- Board of Examinations as members and the Controller of Examination as member-secretary.

10.4.9.The College Council shall nominate a Senior Teacher as coordinator of internal evaluations. This coordinator shall make arrangements for giving awareness of the internal evaluation components to students immediately after commencement of I semester

10.4.10.The internal evaluation marks/grades in the prescribed format should reach the University before the 4th week of October and March in every academic year.

10.4.11.External Examination

- The external theory examination of all semesters shall be conducted by the University at the end of each semester.
- Students having a minimum of 75% average attendance for all the courses only can register for the examination. Condonation of shortage of attendance to a maximum of 10 days in a semester subject to a maximum of 2 times during the whole period of the programme may be granted by the University on valid grounds. This condonation shall not be counted for internal assessment. Benefit of attendance may be granted to students attending University/College union/Co-curricular activities by treating them as present for the days of absence, on production of participation/attendance certificates, within one week, from competent authorities

and endorsed by the Head of the institution. This is limited to a maximum of 10 days per semester and this benefit shall be considered for internal assessment also. Those students who are not eligible even with condonation of shortage of attendance shall repeat the **semester** along with the next batch after obtaining readmission.

- All students are to do a **project in the area of core course**. This project can be done individually or in groups (not more than five students) for all subjects which may be carried out in or outside the campus. Special sanction shall be obtained from the Vice-Chancellor to those **new generation programmes** and programmes on **performing arts** where students have to take projects which involve larger groups. The projects are to be identified during the II semester of the programme with the help of the supervising teacher. The report of the project in duplicate is to be submitted to the department at the sixth semester and are to be produced before the examiners appointed by the University. External Project evaluation and Viva / Presentation is compulsory for all subjects and will be conducted at the end of the programme.
- There will be no supplementary exams. For reappearance/ improvement, the students can appear along with the next batch.
- A student who registers his/her name for the external exam for a semester will be eligible for promotion to the next semester.
- A student who has completed the entire curriculum requirement, but could not register for the Semester examination can register notionally, for getting eligibility for promotion to the next semester.
- A candidate who has not secured minimum marks/credits in internal examinations can re-do the same registering along with the University examination for the same semester, subsequently.
- All programmes, courses and papers shall have unique alphanumeric code. Each teacher working in affiliated institutions shall have a unique identification number

and this number is to be attached with the codes of the courses for which he/she can perform examination duty.

10.4.12. Course Code

Each Course code is an eight digit alphanumeric code that gives a brief description on the following details specific to the course namely: 1. Subject Code (2 Characters) 2. Semester to which the course belongs to (1 Digit) 3. Course type as per syllabus (2 Characters) 4. Whether Theory or Practical (1 Character) 5. Serial number of the course in continuous series (2 Digits). For example the Course code BC1CRT01 indicates that the paper is Biochemistry-1st Semester-Core Course-Theory-1st paper.

11. PATTERN OF QUESTIONS

11.1. Questions shall be set to assess knowledge acquired, standard and application of knowledge, application of knowledge in new situations, critical evaluation of knowledge and the ability to synthesize knowledge. The question setter shall ensure that questions covering all skills are set. She/he shall also submit a detailed scheme of evaluation along with the question paper.

11.2. A question paper shall be a judicious mix of very short answer type, short answer type, short essay type /problem solving type and long essay type questions.

Pattern of questions for external examination for theory paper

| Pattern | Marks | Choice of questions | Total marks |
|---|-----------|---------------------|-------------|
| Very short answer minimum-15 words | 2 | 9/12 | 18 |
| Short answer minimum-40 words | 4 | 6/9 | 24 |
| Short essay minimum-80 words | 6 | 3/5 | 18 |
| Long essay minimum- 120 words | 10 | 2/4 | 20 |
| | | 20/30 | 80 |

Pattern of questions for external examination of practical papers will be decided by the concerned Board of Studies/Expert Committees.

12. MARK CUM GRADE CARD

The University under its seal shall issue to the students a MARK CUM GRADE CARD on completion of each semester, which shall contain the following information:

- (a) Name of the University
- (b) Name of the College
- (c) Title & Model of the Undergraduate Programme
- (d) Name of the Semester
- (e) Name and Register Number of the student
- (f) Date of publication of result
- (g) Code, Title, Credits and Maximum Marks (Internal, External & Total) of each paper opted in the semester.
- (h) Internal, External and Total Marks awarded, Grade, Grade point and Credit point in each paper opted in the semester

- (i) Institutional average (IA) of the marks of all papers and University Average (UA) of the marks of all papers.
- (j) The total credits, total marks (Maximum & Awarded) and total credit points in the semester
- (k) Semester Grade Point Average (SGPA) and corresponding Grade.
- (l) Cumulative Grade Point Average (CGPA), GPA corresponding to Common Courses I and II, Core Course, Complementary Courses, Vocational Courses and Generic Elective paper.
- (m) The final Mark cum Grade Card issued at the end of the final semester shall contain the details of all papers taken during the final semester examination and shall include the final Grade/Marks(SGPA) scored by the candidate from **1st to 5th** semesters, and the overall Grade/Marks for the total programme

13. There shall be **3 level monitoring** committees for the successful conduct of the scheme. They are -

13.1. Department Level Monitoring Committee (DLMC), comprising HOD and two senior-most teachers as members.

13.2. College Level Monitoring Committee (CLMC), comprising Principal, College Council secretary and A.O/Superintendent as members.

13.3. University Level Monitoring Committee (ULMC), headed by the Vice-Chancellor, Pro-Vice-Chancellor, Conveners of Syndicate Standing Committee on Examination, Academic Affairs and Registrar as members and the Controller of Examinations as member-secretary.

14. TRANSITORY PROVISION

Notwithstanding anything contained in these regulations, the Vice-Chancellor shall, for a period of one year from the date of coming into force of these regulations, have the power to provide by order that these regulations shall be applied to any programme with such modifications as may be necessary.

The Vice Chancellor is authorized to make necessary criteria for eligibility for higher education in the grading scheme, if necessary, in consultation with other Universities. The Vice Chancellor is also authorized to issue orders for the perfect realization of the Regulations.

Mahatma Gandhi University

B.Sc. Course in Biochemistry (model I) under Choice Based Credit System

15. Consolidated scheme for all semesters

Theory papers and project work

| Semester | Title with Course Code | Course Category | Hours / week | Credit | Total credit | Marks | |
|-----------------|--|-----------------|--------------|----------|--------------|----------|----------|
| | | | | | | Internal | External |
| First semester | English I | Common | 5 | 4 | 17 | 20 | 80 |
| | English II | Common | 4 | 3 | | 20 | 80 |
| | Second language I | Second language | 4 | 4 | | 20 | 80 |
| | <u>BC1CRT01-Cellular Biochemistry</u> | Core | 2 | 2 | | 20 | 80 |
| | First complementary course- 1 | Complementary | 2 | 2 | | 20 | 80 |
| | Second complementary course- 1 | Complementary | 2 | 2 | | 20 | 80 |
| Second semester | Common English III | Common | 5 | 4 | 17 | 20 | 80 |
| | Common English IV | common | 4 | 3 | | 20 | 80 |
| | Common Second language II | Second language | 4 | 4 | | 20 | 80 |
| | <u>BC2CRT02- Physical aspects of Biochemistry</u> | Core | 2 | 2 | | 20 | 80 |
| | First complementary course- 2 | Complementary | 2 | 2 | | 20 | 80 |
| | Second complementary course- 2 | Complementary | 2 | 2 | | 20 | 80 |

Syllabus for B.Sc Biochemistry Programme (Model I) w.e.f 2016 Admission.

| | | | | | | | |
|----------------------------------|---|-----------------|------------|----------|----------------------|----|----|
| Third semester | Common English V | Common | 5 | 4 | 17 | 20 | 80 |
| | Common Second language III | Second language | 5 | 4 | | 20 | 80 |
| | <u>BC3CRT03-Methods in Biochemistry</u> | Core | 3 | 3 | | 20 | 80 |
| | First complementary course- 3 | Complementary | 3 | 3 | | 20 | 80 |
| | Second complementary course- 3 | Complementary | 3 | 3 | | 20 | 80 |
| Fourth semester | Common English VI | Common | 5 | 4 | 17 | 20 | 80 |
| | Common Second language IV | Second language | 5 | 4 | | 20 | 80 |
| | <u>BC4CRT04- Biomolecules</u> | Core | 3 | 3 | | 20 | 80 |
| | First complementary course- 4 | Complementary | 3 | 3 | | 20 | 80 |
| | Second complementary course- 4 | Complementary | 3 | 3 | | 20 | 80 |
| Fifth semester | <u>BC5CRT05-Physiological Aspects of Biochemistry</u> | Core | 3 | 3 | 15 | 20 | 80 |
| | <u>BC5CRT06-Immunology and Immunological Techniques</u> | Core | 3 | 3 | | 20 | 80 |
| | <u>BC5CRT07-Enzymology and Enzyme Technology</u> | Core | 3 | 3 | | 20 | 80 |
| | <u>BC5CRT08-Metabolism and Bioenergetics</u> | Core | 3 | 3 | | 20 | 80 |
| | Generic elective(One among the three papers offered to students) | Core | 3 | 3 | | 20 | 80 |
| | BC5GET01-Human Health and Nutrition | | | | | | |
| | BC5GET02-Environmental Biochemistry | | | | | | |
| BC5GET03-Waste Management | | | | | | | |
| Project work | Core | 1 | Nil | | No evaluation | | |
| | <u>BC6CRT09- Genetics and Molecular Biology</u> | Core | 3 | 3 | | 20 | 80 |

| | | | | | | | |
|----------------|---|------|-----|---|----|----|----|
| Sixth Semester | <u>BC6CRT10-Clinical Biochemistry</u> | Core | 3 | 3 | 17 | 20 | 80 |
| | <u>BC6CRT11-Pharmaceutical Biochemistry</u> | Core | 3 | 3 | | 20 | 80 |
| | <u>BC6CRT12- Computational Techniques in Biochemistry</u> | Core | 3 | 3 | | 20 | 80 |
| | Choice based paper I (One among the three papers offered to students) | Core | 4 | 3 | | 20 | 80 |
| | <u>BC6CBT01-Human Health and Nutrition</u> | | | | | | |
| | <u>BC6CBT02- Biochemical and Environmental Toxicology</u> | | | | | | |
| | <u>BC6CBT03- Plant Biochemistry</u> | | | | | | |
| | <u>BC6PRP01-Project work</u> | Core | Nil | 2 | | 20 | 80 |

Project work is a single paper spread over fifth and sixth semesters having both internal and external evaluation which will be conducted at the end of the programme.

Practical papers

| Semester | Title with Course Code | Course Category | Hours/week | Credit | Total credit | Marks | |
|----------|--|-----------------|------------|--------|--------------|----------|----------|
| | | | | | | Internal | External |
| First | <u>Practical I- Cellular Biochemistry</u> | Core | 2 | 1 | 3 | No exam | |
| | First complementary practical I | Complementary | 2 | 1 | | | |
| | Second complementary practical I | Complementary | 2 | 1 | | | |
| Second | <u>BC2CRP01-Practical II- Physical aspects of Biochemistry</u> | Core | 2 | 1 | 3 | 20 | 80 |
| | First complementary practical II | Complementary | 2 | 1 | | 20 | 80 |
| | Second complementary practical I | Complementary | 2 | 1 | | 2080 | |
| Third | Practical III-Methods in Biochemistry | Core | 2 | 1 | 3 | No exam | |
| | First complementary practical III | Complementary | 2 | 1 | | | |
| | Second complementary practical III | Complementary | 2 | 1 | | | |
| Fourth | BC4CRP02 -Practical IV- Biomolecules | Core | 2 | 1 | 3 | 20 | 80 |
| | First complementary practical IV | Complementary | 2 | 1 | | 20 | 80 |
| | Second complementary practical IV | Complementary | 2 | 1 | | 20 | 80 |
| Fifth | Practical V- Physiological aspects of Biochemistry | Core | 2 | 1 | 4 | No exam | |
| | Practical VI- Immunology and immunological | Core | 2 | 1 | | | |

| | | | | | | | |
|--------------|--|-------------|----------|----------|----------|-----------|-----------|
| | techniques | Core | 2 | 1 | | | |
| | Practical VII- Enzymology and enzyme technology | Core | 3 | 1 | | | |
| | Practical VIII- Metabolism and Bioenergetics | | | | | | |
| Sixth | <u>BC6CRP03</u>-Practical IX – Genetics and molecular Biology | Core | 2 | 1 | | 20 | 80 |
| | <u>BC6CRP04</u>-Practical X- Clinical biochemistry | Core | 3 | 1 | | 20 | 80 |
| | <u>BC6CRP05</u>-Practical XI- Pharmaceutical Biochemistry | Core | 2 | 1 | 4 | 20 | 80 |
| | <u>BC6CRP06</u>-Practical XII- Computational Techniques in Biochemistry | Core | 2 | 1 | | 20 | 80 |

Generic elective offered to students (5th Semester)

- a. BC5GET01-Human Health and nutrition: 3 credits
- b. BC5GET02-Environmental Biochemistry: 3 credits
- c. BC5GET03-Waste management: 3 credits

Choice based paper I offered to students of the Department of Biochemistry(6th Semester)

- a. BC6CBT01- Human Health and Nutrition: 3 credits
- b. BC6CBT02- Biochemical and Environmental Toxicology 3 credits
- c. BC6CBT03- Plant Biochemistry 3 credits

Consolidated scheme for courses (Model I, II & III) having Biochemistry as a complementary subject

Theory papers

| Semester | Title with Course Code | Course Category | Hours/week | Credit | Total credit | Marks | |
|----------|---|-----------------|------------|--------|--------------|----------|----------|
| | | | | | | Internal | External |
| First | BC1CMT01-Elementary Biochemistry | Complementary | 2 | 2 | 10 | 20 | 80 |
| Second | BC2CMT02-Biomolecules | Complementary | 2 | 2 | | 20 | 80 |
| Third | BC3CMT03-Enzymology and Metabolism | Complementary | 3 | 3 | | 20 | 80 |
| Fourth | BC4CMT04-Molecular Biology, Nutritional and Clinical Biochemistry | Complementary | 3 | 3 | | 20 | 80 |

Practical papers

| Semester | Title with Course Code | Course Category | Hours / week | Credit | Total credit | Marks | |
|----------|---|-----------------|--------------|--------|--------------|----------|----------|
| | | | | | | Internal | External |
| First | Practical I- Elementary Biochemistry | Complementary | 2 | 1 | 2 | No exam | |
| Second | BC2CMP01-Practical II- Biomolecules | Complementary | 2 | 1 | | 20 | 80 |
| Third | Practical III- Enzymology and metabolism | Complementary | 2 | 1 | 2 | No exam | |
| Fourth | BC4CMP02-Practical IV- Molecular Biology, Nutritional and Clinical Biochemistry | Complementary | 2 | 1 | | 20 | 80 |

16.Syllabus for B.Sc Biochemistry-Core

FIRST SEMESTER

Core Course I: BC1CRT01-Cellular Biochemistry

Total hours of instruction: 36.

Hours/week: 2.

Credit: 2

Objective: Introduces the student to the world of Science and Cellular Biochemistry

Unit I: (7 hours)

Introduction to Philosophy of Science - Relationship between History and Philosophy of Science - Basic Components of Science - Scientific Reasoning – Deduction and Induction - Observation and Measurement – Inference - Probability and Induction - Experimentation and Realism - Scientific Explanation – Reductionism and Unity of Science. Scientific Change and Progress - Inductivism and Falsificationism - Paradigms and Research Programmes.

Unit II: (8 hours)

Origin of life on Earth -Theory of Chemical Evolution, Primitive Earth Conditions – anoxic reductive atmosphere, relatively high temperature, Volcanic eruption, radioactivity, high frequency UV radiation. Abiotic formation of sugars, amino acids, organic acids, purines, pyrimidines, glycerol and formation of nucleotides and their polymerization to RNA on reactive Surfaces, polymerization of amino acids to Polypeptides and Proteins. Ribozymes and RNA World, Formation of DNA, Formation of nucleoproteins, Prions, Natural Selection of Self replicating Polymers

Ref: Windows to the Universe, at <http://www.windows.ucar.edu/>

Ref: Cell biology, Genetics, Molecular Biology, Evolution and Ecology by P.S. Verma and V. Agarwal (2008) Publisher: S. Chand & Company Ltd ISBN: 81-219-2442-1 p141

Unit III: (8 hours)

Discovery of cell and Cell Theory; Comparison between plant, animal and microbial cells, Sub cellular particles -Nucleus, chromosomes, mitochondria, chloroplast, ribosomes, endoplasmic reticulum, golgi complex, lysosomes, Cytoskeleton, (microfilaments, microtubules and intermediate filaments), glyoxysomes and peroxysomes.

Ref: - Cell biology, Genetics, Molecular Biology, Evolution and Ecology by P.S. Verma and V. Agarwal (2008) Publisher: S. Chand & Company Ltd ISBN: 81-219-2442-1 p 3, 32, 69, 154, 166, 175, 184, 191, 243, 280, 293

Unit IV: (6 hours)

Plasma membrane- structure and composition, Fluid mosaic model of plasma membrane, Transport across membranes. Exocytosis, Endocytosis, Simple diffusion, facilitated transport- definition, types with examples. Symport, uniport and antiport, Active transport- Primary active transport and secondary active transport

Ref: Cell biology, Genetics, Molecular Biology, Evolution and Ecology by P.S. Verma and V. K. Agarwal (2008) Publisher: S. Chand & Company Ltd ISBN: 81-219-2442-1 p112

Unit V: (7 hours)

Cell cycle- different phases including cell division - Mitosis and meiosis (fundamental study), Apoptosis- definition, difference between apoptosis and necrosis and outline study of apoptotic pathways, role of caspases; tumor - benign and malignant.

Ref: Cell biology, Genetics, Molecular Biology, Evolution and Ecology by P.S. verma and V. K. Agarwal (2008) Publisher: S. Chand & Company Ltd ISBN: 81-219-2442-1 p 318

Suggested Readings

- Molecular Biology of the Cell by Bruce Alberts, Alexander Johnson, Julian Lewis Martin Raff, Keith Roberts, Peter Walter Publisher: Garland Science; 5 edition ISBN-10: 0815341059 ISBN-13: 978-0815341055
- The Cell by Geoffrey M. Cooper, Robert E. Hausman Publisher: Sinauer Associates Inc., U.S.; 4th Revised edition (26 Jun 2006) ISBN-10: 0878932208 ISBN-13: 978-0878932207
- Cell and Molecular Biology by E. D. P. De Robertis Publisher: Lea & Febiger; 8 Sub edition (June 1987) ISBN-10: 0812110129 ISBN-13: 978-0812110128
- Molecular Cell Biology by J. E. Darnell, H. Lodish, David Baltimore, Publisher: W.H. Freeman & Company (May 1986) ISBN-10: 0716714485 ISBN-13: 978-0716714484
- Windows to the Universe, at <http://www.windows.ucar.edu/> at the University Corporation for Atmospheric Research (UCAR). © The Regents of the University of Michigan *Windows to the Universe*® is a registered trademark of UCAR

Question paper Pattern for Core Course I: BC1CRT01-Cellular Biochemistry

| Unit | Section A 2 Marks | Section B 4 Marks | Section C 6 Marks | Section D 10 Marks | Total |
|---|------------------------------|------------------------------|------------------------------|-------------------------------|--------------|
| I | 2 | 2 | 0 | 0 | 4 |
| II | 3 | 1 | 1 | 1 | 6 |
| III | 3 | 2 | 2 | 1 | 8 |
| IV | 2 | 2 | 1 | 1 | 6 |
| V | 2 | 2 | 1 | 1 | 6 |
| Total No.of Questions | 12 | 9 | 5 | 4 | 30 |
| No.of Questions to be answered | 9 | 6 | 3 | 2 | 20 |
| Total Marks | 18 | 24 | 18 | 20 | 80 |

Core Practical I- Cellular Biochemistry

Total hours of instruction: 36

Hours/week: 2.

Credit: 1

Objective: Introduce the students to basic technique of Cell fractionation and separation of sub cellular organelles.

1. Cell Fractionation

- Homogenization media preparation
- Homogenization of Tissue samples
- Preparation of various sub-cellular fraction of rat liver
- Fractionation of leaf cell by Differential centrifugation
- Isolation of mitochondria from rat liver/ plant leaves
- Isolation of Chloroplast from plant leaves
 - ✓ Calculate Chlorophyll content
 - ✓ Determine the chlorophyll a / chlorophyll b ratio in C3 and C4 plants

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

3. Identification of different stages of meiosis from suitable plant material (Onion Buds).

4. Study of mitotic index using onion root tips

References

- Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p 1- 15
- Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p 465 –471
- Hawk's Physiological Chemistry, Bernard L. Oser (ed) TATA McGRAW Hill Publishing Company LTD, New Delhi, p 10- 15.
- Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8, p 13- 17, p 39 - 43

SECOND SEMESTER

Core Course II: BC2CRT02- Physical aspects of Biochemistry

Total hours of instruction: 36.

Hours/week: 2.

Credit: 2

Objectives: Introduce the student to basic concepts of acid and bases and its importance in biological systems, colloidal systems and its applications, measuring concentrations of solutions, understanding the principle of different types of reactions and basics of thermodynamics as applied to biological system

Unit-I: (8hours)

Dissociation of water, ionic product of water, concepts of pH, pOH, simple numerical problems of pH, determination of pH using indicators, pH meter and theoretical calculations. Dissociation of weak acids and electrolytes, Brønsted theory of acids and bases, shapes of titration curve of strong and weak acids and bases. Meaning of K_a and pK_a values, Buffers: buffer action, buffers in biological system, Henderson-Hasselbach equation with derivation, simple numerical problems involving application of this equation.

Ref: Biochemistry: A Students survival Guide by Hiram. F. Gilbert (2002) Publishers: McGraw-Hill ISBN 0-07-135657-6 p 241

Unit II: (8 hours)

Meaning of true solution, colloidal solution, and coarse suspension. Distinction between lyophilic and lyophobic sols, Fundamental study of Donnan equilibrium- application in biological system, membrane permeability, separation of colloidal particles, elementary study of charge on colloids, Tyndall effect, application of colloidal chemistry, emulsion and emulsifying agents.

Ref: Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand & Company Ltd ISBN: 81-219-3016-2 p 32

Unit III: (8hours)

Meaning of normality, molarity, molality, percentage solution, mole fractions, simple numerical problems from the above, Fundamental principles of diffusion and osmosis, definition of osmotic pressure, isotonic, hypotonic and hypertonic solutions, Biological importance of osmosis, General equation for dilute solutions, influence of ionization and molecular size on osmotic pressure.

Ref: - Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand & Company Ltd ISBN: 81-219-3016-2 p 21

Unit IV: (4 hours)

Classification of isomerism, oxidation reduction reactions, substitution, addition, elimination, condensation and decarboxylation with examples for each, Intra and Intermolecular interactions in biological system: Hydrogen bond, Covalent bond, hydrophobic interaction, disulphide bond, Peptide bonds, glycosidic bond, Phosphodiester linkage, Watson- Crick base pairings, Vander Wal's force.

Ref: Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand & Company Ltd ISBN: 81-219-3016-2 p 74

Unit V: (8 hours)

Introduction to chemical kinetics, equilibrium reactions, law of mass action, equilibrium constant, definition of catalysis, Basic principles of thermodynamics: free energy, enthalpy, entropy, reversible and irreversible reactions- as applied to biological systems.

Ref: Biochemistry: A Students survival Guide by Hiram. F. Gilbert (2002) Publishers: McGraw-Hill ISBN 0-07-135657-6 p 261

Ref: - Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand & Company Ltd ISBN: 81-219-3016-2 p 217

Suggested Readings

- E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, A Text Book of Biochemistry, Oxford and IBH Publishing Co., New Delhi, 1974
- Lehninger Principles of Biochemistry, Fourth Edition by David L. Nelson Michael M. Cox Publisher: W. H. Freeman; Fourth Edition edition (April 23, 2004) ISBN-10: 0716743396 ISBN-13: 978-0716743392
- Principles Of Physical Chemistry (2008) by Puri Br, Sharma Lr, Madan S Pathania Vishal PublishingCo, India ISBN: 8188646008 ISBN-13: 9788188646005, 978-8188646005
- Textbook Of Medical Biochemistry (third Edition) (2001) by S. Ramakrishnan Publisher: Orient Longman ISBN: 8125020713, ISBN-13: 9788125020714, 978-8125020714

- Biochemistry: A Students survival Guide by Hiram. F. Gilbert (2002) Publishers: McGraw-Hill ISBN 0-07-135657-6

Question paper Pattern for Core Course II: BC2CRT02- Physical aspects of Biochemistry

| Unit | Section A 2 Marks | Section B 4 Marks | Section C 6 Marks | Section D 10 Marks | Total |
|---------------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|--------------|
| I | 3 | 2 | 2 | 1 | 8 |
| II | 3 | 3 | 1 | 1 | 8 |
| III | 2 | 2 | 1 | 0 | 5 |
| IV | 2 | 1 | 1 | 1 | 5 |
| V | 2 | 1 | 0 | 1 | 4 |
| Total No. of Questions | 12 | 9 | 5 | 4 | 30 |
| No.of Questions to be answered | 9 | 6 | 3 | 2 | 20 |
| Total Marks | 18 | 24 | 18 | 20 | 80 |

Core Practical II-BC2CRP01- Physical aspects of Biochemistry

Total hours of instruction: 36

Hours/week: 2.

Credit: 1

Objective:To Resolve quantitative problems concerning the preparation of solutions and buffers. Have a basic understanding of principles underlying membrane potential.

1. Preparation of solutions:

Percentage solutions, Molar solutions, Normal solutions, Dilution of Stock solutions

2. Standardization of pH meter.

3. Measurements of pH of solutions using pH meters.

4. Preparation of buffers using the Henderson Hasselbach equation

5. Experiments with colloidal gels

- ✓ Dialysis (Diffusion through membranes)
- ✓ Diffusion through gels

6. Experiments on Donnan Equilibrium

- ✓ Demonstration of Donnan equilibrium using a membrane
- ✓ Demonstration of Donnan equilibrium without using a membrane

References

- Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p 1- 15
- Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p 465 –471
- Hawk's Physiological Chemistry, Bernard L. Oser (ed) TATA McGRAW Hill Publishing Company LTD, New Delhi, p 10- 15.
- Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8, p 13- 17, p 39 – 43

THIRD SEMESTER

Core Course III: BC3CRT03- Methods in Biochemistry

Total hours of instruction: 54.

Hours/week: 3.

Credit: 3

Objective: Explain the basis and general methodology of the molecular separation techniques specified in the course. Explain the application of these techniques to the separation of mixtures with known compositions. Explain the basis and general methodology of the molecular characterization techniques and to introduce students to basics of Bioinformatics and Research methodology

Unit I: (14 hours)

Research methodology and Biostatistics: Methodology of scientific research, nature of scientific methods, design of experiments in biochemistry, significance of statistical methods in biological investigations, sampling techniques, statistical evaluation of results, probability theory, random variables and distribution function, point and interval estimation, multiple linear regression, correlation and analysis of variance and covariance, distribution of student's t-test, Chi-square (X^2), correlation coefficient (r), Computer statistical packages for statistical analysis.

Ref: An Introduction to Biostatistics: A Manual for students in Health Sciences by P.Sundar Rao, J.Richard Publishers: Prentice-Hall Pvt Ltd ISBN 81-203-1008-X

Unit II: (10 hours)

Chromatography: - principle, procedure and application of partition chromatography, adsorption chromatography, and ion exchange chromatography, gel permeation chromatography, affinity chromatography, GLC and HPLC.

Ref: Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand &Company Ltd ISBN: 81-219-3016-2 p 183

Unit III: (10 hours)

Electrophoresis: - Principle, procedure and application of free flow, zone electrophoresis (Paper electrophoresis, Gel electrophoresis, Native PAGE, SDS-PAGE, AGE). Isoelectric focussing, High voltage electrophoresis, Immunoelectrophoresis.

Ref: Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand & Company Ltd ISBN: 81-219-3016-2 p 197

Unit IV: (10 hours)

Methods of tissue homogenization, Salt and organic solvent extraction and fractionation, Dialysis, ultra filtration, lyophilization, Centrifugation- principle of sedimentation technique. Different types of centrifuge and rotors, Principle, procedure and application of differential centrifugation, density gradient centrifugation, ultracentrifugation, isopycnic centrifugation.

Ref: Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand & Company Ltd ISBN: 81-219-3016-2 p 177

Unit V: (10 hours)

Colorimetry and Spectrophotometry: - Beer - Lambert's law, UV and visible absorption spectra, molar extinction coefficient and quantitation. Principle of colorimetry, spectrophotometry, nephelometry, fluorimetry, Atomic absorption and emission spectrophotometry.

Ref: Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand & Company Ltd ISBN: 81-219-3016-2 p 166

Suggested Readings

- Physical Biochemistry by David Freifelder Publisher: W.H. Freeman & Co Ltd (September 1976) ISBN-10: 0716705591 ISBN-13: 978-0716705598
- A Biologist's Guide to Principles and Techniques of Practical Biochemistry by Bryan L. Williams, Keith Wilson Hodder Education, ISBN 071312461X (0-7131-2461-X)
- Principles and Techniques of Practical Biochemistry by Keith M. Wilson, John M. Walker Cambridge University Press, ISBN 0521428092 (0-521-42809-2)
- The Tools of Biochemistry by Cooper, T. G. 1977. Publisher: John Wiley & Sons
- Biophysical Chemistry Principles & Techniques Handbook (2003) by Avinash Upadhyay, Kakoli Upadhyay, Nirmalendu Nath Publisher: Himalaya Publishing House ISBN: 8178665883 ISBN-13: 9788178665887, 978-8178665887
- Research Methodology For Biological Sciences (2006) by Gurumani N Publisher: Mjp Publishers ISBN: 8180940160 ISBN-13: 9788180940163, 978-8180940163
- Instrumental Methods Of Chemical Analysis (2006) by M.s. Yadav Publisher: Campus Books International ISBN: 8187815620 ISBN-13: 9788187815624, 978-8187815624

- Introduction to Bioinformatics (2002) by T.K Atwood and D.J Parry- Smith Publisher: Pearson Education Pvt Ltd ISBN 81-7808-507-0
- Introduction to Biostatistics: A textbook of Biometry (2004) by Pranab Kumar Banerjee Publisher S. Chand Company Ltd New Delhi
- Biostatistics (2005) by P.N. Arora, P.K. Malhan Publishers: Himalaya Publishing house ISBN: 81-8318-298-4

Question paper Pattern for Core Course III:BC3CRT03- Methods in Biochemistry

| Unit | Section A 2 Marks | Section B 4 Marks | Section C 6 Marks | Section D 10 Marks | Total |
|---------------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|--------------|
| I | 3 | 3 | 1 | 1 | 8 |
| II | 2 | 1 | 1 | 1 | 5 |
| III | 2 | 1 | 1 | 1 | 5 |
| IV | 2 | 2 | 1 | 1 | 6 |
| V | 3 | 2 | 1 | 0 | 6 |
| Total No. of Questions | 12 | 9 | 5 | 4 | 30 |
| No.of Questions to be answered | 9 | 6 | 3 | 2 | 20 |
| Total Marks | 18 | 24 | 18 | 20 | 80 |

Core Practical III- Methods in Biochemistry

Total hours of instruction: 36.

Hours/week: 2.

Credit: 1

Objectives: To make it possible for the student to have a practical understanding of methodology of the molecular separation techniques specified in the course. Formulate the protocol of a spectrometric determination. Calculate quantities and concentrations of substances from the results of spectrometric determinations.

1. Biochemical separation Techniques

a. Chromatographic techniques

- Separation of amino acids and simple sugars by Paper chromatography (Descending or ascending)
- Separation of amino acids and lipids by Thin Layer chromatography
- Separation of Plant pigments by Column chromatography

2. Centrifugation Technique

Isolation of crude Cytoplasmic fraction from a biological tissue sample

3. Precipitation Technique

Ammonium sulfate fractionation of isolated crude cytoplasmic fraction

4. Dialysis of ammonium sulfate fractions

5. Isoelectric Precipitation of Casein

6. Colorimetry and Spectrophotometry techniques

Verification of Beer Lambert's law.

Verification of molar extinction coefficient of any known compound.

References

- Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p 195 – 303
- Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p 12 - 18

FOURTH SEMESTER

Core Course IV: BC4CRT04-Biomolecules

Total hours of instruction: 54.

Hours/week: 3.

Credit: 3

Objectives: Describe the structural characteristics of the inorganic components of living matter, the different types of simple organic biomolecules, their biologically important derivatives and the structural units of complex biomolecules. Schematize the molecular structure of the different types of complex biomolecules. Identify from a group of molecular formulae, diagrams or models those which correspond to the different types of biomolecules. Explain the physicochemical properties of the different types of biologically important biomolecules.

Unit I: (14 hours)

Carbohydrates: Classification, monosaccharides, D and L designation, open chain and cyclic structures, epimers and anomers, mutarotation, reactions of carbohydrates (due to functional groups - hydroxyl, aldehyde and ketone). Glycosides, Structure and biological importance of disaccharides (sucrose, lactose, maltose, isomaltose, trehalose), trisaccharides (raffinose, melezitose), structural polysaccharides (cellulose, chitin, pectin) and storage polysaccharides (starch, inulin, glycogen), Glycosaminoglycans, Bacterial cell wall polysaccharides.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p 73, 91, 100, 114

Unit II: (10 hours)

Lipids: biochemical functions of lipids, Classification of lipids with examples, classification of fatty acids, chemical constants of fatty acids-saponification number, acid number, iodine number and their application. Essential and non-essential fatty acids with examples. Lipoproteins: Types and functions. Compound lipids: storage and membrane lipids. Structure and functions of phospholipids and glycolipids, Steroids: Structure of steroid nucleus, cholesterol, ergosterol, stigmasterol, calciferol, Biomembranes: Behavior of amphipathic lipids in water- formation of micelles, bilayers, vesicles, liposomes.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p 230, 244, 269

Unit III: (14 hours)

Amino acids: Definition, stereoisomerism, structure of 20 'Standard amino acids' - single letter abbreviations of amino acids, classification of amino acids based on charge and polarity, general reactions of amino acids- side chain, carboxyl and amino group- essential and non essential amino acids, ionization of amino acids. Non-standard amino acids, Amino acid derivatives of biological significance- glutathione. Peptides: Formation of peptide bond. Proteins: Classification based on solubility, shape and function. Determination of amino acid composition of proteins, denaturation and renaturation of proteins, Structural organization of proteins- primary, secondary, tertiary and quaternary structures (E.g. Hemoglobin and Myoglobin), forces stabilizing the structure of protein, Outlines of protein sequencing.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p 132, 204, 214

Unit IV: (10 hours)

Nucleic acids: Nature of nucleic acids, Structure of purines and pyrimidines, nucleosides, nucleotides, Stability and formation of Phosphodiester linkages, Effect of acids, alkali and nucleases on DNA and RNA, Structure of Nucleic acids- Watson-Crick DNA double helix structure, introduction to circular DNA, super coiling, helix to random coil transition, denaturation of nucleic acids- hyperchromic effect, T_m -values and their significance, cot curves and their significance, Types of RNA and DNA, Unusual bases in nucleic acids. DNA sequencing: Sanger and Dideoxy methods.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p 280

Unit V: (6hours)

Vitamins: Definition, classification- fat-soluble and water-soluble: sources, chemical nature (without structure), and functions of vitamins. Minerals: requirements, macro and micro minerals (source and functions).

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p 959, 988

Suggested Readings

- Lehninger Principles of Biochemistry, Fourth Edition by David L. Nelson, Michael M. Cox Publisher: W. H. Freeman; Fourth Edition edition (April 23, 2004) ISBN-10: 0716743396 ISBN-13: 978-0716743392
- E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, A Text Book of Biochemistry, Oxford and IBH Publishing Co., New Delhi, 1974
- Biochemistry [with Cdrom] (2004) by Donald Voet, Judith G. Voet Publisher: John Wiley & Sons Inc ISBN: 047119350X ISBN-13: 9780471193500, 978-0471193500
- Principles Of Biochemistry (1995) by Geoffrey L Zubay, William W Parson, Dennis E Vance Publisher: Mcgraw-hill Book Company – Koga ISBN:0697142752 ISBN-13: 9780697142757, 978-0697142757
- Biochemistry 6th Edition (2007) by Jeremy M. Berg John L. Tymoczko Lubert Stryer Publisher: B.i. publications Pvt. Ltd ISBN:071676766X ISBN-13: 9780716767664, 978-716767664
- Biochemistry (2008) by Rastogi Publisher: Mcgraw Hill ISBN:0070527954 ISBN-13: 9780070527959, 978-0070527959

Question paper Pattern for Core Course IV: BC4CRT04-Biomolecules

| Unit | Section A 2 Marks | Section B 4 Marks | Section C 6 Marks | Section D 10 Marks | Total |
|---------------------------------|----------------------|----------------------|----------------------|-----------------------|-------|
| I | 2 | 3 | 1 | 1 | 7 |
| II | 2 | 1 | 1 | 1 | 5 |
| III | 3 | 2 | 1 | 1 | 7 |
| IV | 3 | 2 | 1 | 1 | 7 |
| V | 2 | 1 | 1 | 0 | 4 |
| Total No. of Questions | 12 | 9 | 5 | 4 | 30 |
| No. of Questions to be answered | 9 | 6 | 3 | 2 | 20 |
| Total Marks | 18 | 24 | 18 | 20 | 80 |

Core Practical IV- BC4CRP02- Biomolecules

Total hours of instruction: 36.

Hours/week: 2.

Credit: 1

Objectives: This course aims to provide the students with an opportunity to develop their qualitative analytical skills. It is expected that the student on completion of this course have a sound knowledge on basic protocols for identification of biomolecules.

1. Reactions of Carbohydrates, Amino acids, Proteins and Lipids

A. Carbohydrates: (Glucose, fructose, Galactose, Xylose, Maltose, Lactose, Sucrose, Starch, dextrin, Glycogen maybe given for analysis).

Molisch's test, Iodine test, Test for reducing sugars (Fehling's test, Benedict's test, Barfoed's test), Seliwanoff's test, Bial's test, Mucic acid test, Acid hydrolysis of Sucrose, Osazone test.

B. Amino acids: (tyrosine, tryptophan, cysteine, cystine, methionine, arginine, proline, histidine may be given for analysis)

Ninhydrin test, Xanthoproteic test, Istatin test, Pauly's diazo test, sakaguchi test, Ehrlich's test, Sodium nitroprusside test, Millon's test, Sullivan's test.

C. Proteins: (Casein, Albumin, Gelatin, peptone may be given for analysis).

Biuret test, Ammonium sulfate precipitation test, Sulphosalicylic acid test, Heat coagulation test.

D. Lipids: Fats- tristearin, Fatty acids- palmitic acid, stearic acid, oleic acid, Glycerol, Steroids, cholesterol

Solubility in Organic solvents, saponification test, Acrolein test, Test for unsaturation: with bromine water or dilute potassium permanganate or Hubl's iodine test, salkowski test, Zak's test.

2. Identification of Monosaccharide, Disaccharide, polysaccharide from a mixture following a systematic scheme of analysis (only two component mixture of above mentioned carbohydrates to be given).

3. Identification of amino acids and proteins following a systematic scheme for analysis (single components only need be given)

4. Identification of lipids following a systematic scheme for analysis (single components only need be given)

References:

- Hawk's Physiological Chemistry, Bernard L. Oser (ed) TATA McGRAW Hill Publishing Company LTD, New Delhi, p 60 – 127, 1317- 1334
- Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8, p 13- 17, p 49 - 72
- Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9 p 15- 23, 33- 35, 50 -57.
- Practical Biochemistry, R.C. Gupta & S. Bhargava (eds) CBS Publishers and Distributors, New Delhi, ISBN 81-239-0124-0 p 9 - 27

FIFTH SEMESTER

Core Course V: BC5CRT05- Physiological Aspects of Biochemistry

Total hours of instruction: 54.

Hours/week: 3.

Credit: 3

Objectives: Discuss the physiological functions of the biological system. The aim here is to provide an overall, introductory view on some specialized tissues.

Unit I: (8 hours)

Digestion and absorption: Digestion and absorption of carbohydrates, proteins, and lipids. Composition and function of bile, role of bile salts in Lipid digestion and absorption.

Ref: Biochemistry by Debajyoti das. Academic publishers. Kolkata.p 323 – 349

Ref: Text book of Biochemistry by Edward Staunton West, Wilbert R Todd, Howard S Manson and John T Van Bruggen. Macmillan Publishing Company Inc. New York.p 494 – 535.

Unit II: (12 hours)

Biochemistry of Blood: Constituents of blood, types of cells, components of plasma, types of plasma proteins and function, Mechanism of blood clotting (intrinsic and extrinsic pathway) Clotting factors, anticoagulants, fibrinolysis, Structure and function of hemoglobin, Transport of oxygen and carbon dioxide in blood, carbonic anhydrase, chloride shift, oxygen dissociation curve and Bohr effect. Buffer systems of blood.

Ref: - Biochemistry by Debajyoti das. Academic publishers. Kolkata.p 350 – 390

Ref: Text book of Biochemistry by Edward Staunton West, Wilbert R Todd, Howard S Manson and John T Van Bruggen. Macmillan Publishing Company Inc. New York.p 550 – 629.

Unit III: (10 hours)

Structure of nephrons, renal excretory mechanism, composition of urine, regulation of water and electrolyte balance, Role of aldosterone and antidiuretic hormones and mechanism of urine formation, renal regulation of pH.

Ref: Biochemistry by Debajyoti das. Academic publishers. Kolkata.p 614 – 635

Ref: Text book of Biochemistry by Edward Staunton West, Wilbert R Todd, Howard S Manson and John T Van Bruggen. Macmillan Publishing Company Inc. New York.p 665 – 731.

Unit IV: (12 hours)

Biochemistry of Specialized tissues: Muscle- types of muscles, muscle proteins, organization of contractile protein and mechanisms of muscle contraction. Sources of energy for muscle contraction.

Neurons- structure, mechanism of nerve impulse transmission, neurotransmitters, acetylcholine, GABA, serotonin, dopamine

Bone- Role of calcium, phosphorus, vitamin D and hormones in bone metabolism.

Ref: Text Book of Biochemistry by D M Vasudevan and Sreekumari S. Jaypee Brothers, Medical Publishers Pvt Ltd. New Delhi. p 467 – 475.

Ref: Biochemistry by Debajyoti das. Academic publishers. Kolkata.p 636 – 660

Ref: Illustrated Medical Biochemistry by S M Raja and Bindu Madak. Jaypee Brothers Medical Publishers Pvt Ltd. New Delhi.p 221 – 231

Unit V: (12 hours)

Endocrinology: Organization of endocrine system. Classification of hormones -Peptide, amino acid derived and steroid hormones. Mechanism of action of hormones, Brief study of the site of biosynthesis and major physiological functions of insulin, glucagon, epinephrine, thyroxine, growth hormone, thyroid stimulating hormone, gonadotropic hormone, vasopressin, oxytocin, parathyroid hormone and calcitonin. gastrointestinal hormones.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008)
Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p 835

Suggested Readings

- Textbook Of Medical Physiology, 11/e With Student Consult Access (2005) by Arthur C Guyton, John E Hall Publisher: Else ISBN: 8181479203 ISBN-13: 9788181479204, 978-8181479204
- Human Physiology (2001) by Bipin Kumar Publisher: Campus Books International ISBN: 8187815604 ISBN-13: 9788187815600, 978-8187815600
- Human Physiology (2001) by K.c. Sawant Publisher: Dominant Publishers & Distributors
- ISBN: 8178880202 ISBN-13: 9788178880204, 978-8178880204
- Human Physiology (2001) by Andrew Davies, Asa Gh Blakeley, Cecil Kidd Publisher: Churchill Livingstone ISBN:0443046549, ISBN-13: 9780443046544, 978-0443046544

- Principles Of Biochemistry, 6e (1959) by Abraham White, Philip Handler
Publisher: Tata Mcgraw-hill Publishing Company
Limited ISBN:0070590494 ISBN-13: 9780070590496, 978-0070590496

Question paper Pattern for Core Course V: BC5CRT05- Physiological Aspects of Biochemistry

| Unit | Section A 2 Marks | Section B 4 Marks | Section C 6 Marks | Section D 10 Marks | Total |
|---------------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|--------------|
| I | 3 | 2 | 0 | 1 | 6 |
| II | 2 | 2 | 1 | 1 | 6 |
| III | 1 | 1 | 0 | 1 | 3 |
| IV | 3 | 2 | 2 | 1 | 8 |
| V | 3 | 2 | 2 | 0 | 7 |
| Total No. of Questions | 12 | 9 | 5 | 4 | 30 |
| No.of Questions to be answered | 9 | 6 | 3 | 2 | 20 |
| Total Marks | 18 | 24 | 18 | 20 | 80 |

Core Practical V-Physiological Aspects of Biochemistry

Total hours of instruction: 36.

Hours/week: 2.

Credit: 1

Objectives: This Practical course introduces the students to analysis of various important body fluids

1. Experiments on saliva
 - Digestion of starch by salivary amylase
 - Preparation of Mucin
2. Preparation of Artificial Gastric juice
 - From Commercial Pepsin
3. Preparation of Pepsinogen Extract
4. Product of Gastric Digestion
5. Experiments on Gastric Digestion
 - Influence of Different Temperature
 - Optimum acidity of Peptic Digestion
 - Differentiation between Pepsin and Pepsinogen
 - Quantitative determination of Rennin
6. Determination of pepsin activity with Albumin Substrate
7. Determination of tryptic activity with Casein Substrate

Reference:

- Hawk's Physiological Chemistry, Bernard L. Oser (ed) TATA McGRAW Hill Publishing Company LTD, New Delhi, p 459- 487
- Practical Clinical Chemistry, Harold Varley, CBS Publishers and Distributors, New Delhi, p327 – 348

Core Course VI: BC5CRT06-Immunology and Immunological Techniques

Total hours of instruction: 54. Hours/week: 3. Credit: 3

Objectives: To introduce the students in understanding the basis of the science of immunology at the molecular, cellular, and whole-organism levels

Unit I: (8 hours)

Organs of Immune system: Primary and secondary lymphoid organs, Cells of Immune system- lymphoid cells, stem cells, B and T lymphocytes, Null cells, Mononuclear cells, granulocytic cells.

Ref: Elements Of Immunology by S C Rastogi (2006) Publisher: Cbs Publishers & Distributors ISBN: 8123907737 ISBN-13: 9788123907734, 978-8123907734

Unit II: (10 hours)

Immunity: Innate immunity (Non specific) - Anatomic barriers, Physical barrier, Phagocytic, Inflammatory. Adaptive (Specific) Immunity- Humoral and cell mediated immune responses, Recognition of antigens by B and T lymphocytes. Processing and presentation of antigens, Cellular interaction for generation of humoral and cell mediated response.

Ref: Elements Of Immunology by S C Rastogi (2006) Publisher: CBS Publishers & Distributors ISBN: 8123907737 ISBN-13: 9788123907734, 978-8123907734

Unit III: (12 hours)

Antigens: Factors that influence immunogenicity, epitopes, haptens, Immunoglobulins- Structure of immunoglobulins, Classes of immunoglobulins and their functions. Monoclonal antibody preparation and application. Complement system: The function of complement, complement activation. Major histocompatibility complex (elementary study), Transplantation immunology.

Ref: Elements Of Immunology by S C Rastogi (2006) Publisher: Cbs Publishers & Distributors ISBN: 8123907737 ISBN-13: 9788123907734, 978-8123907734

Unit IV: (12 hours)

Antigen-antibody interactions: Precipitation reaction, agglutination, ELISA, RIA, Immunoprecipitation, Immunofluorescence, T- cell receptors, maturation, activation

and differentiation, B- Cell receptors, maturation, activation and proliferation, Cytokine-structure and function.

Ref: Immunology by Roitt Publisher: Mosby ISBN: 0702025496 ISBN-13: 9780702025495, 9780702025495

Unit V: (12 hours)

Vaccine: Active and passive immunization, types of vaccines. Autoimmune diseases- Definition, Types of immune diseases like systemic lupus erythromatus, Multiple sclerosis, Rheumatoid arthritis, scleroderma, Hyper-sensitivity and allergy.

Ref: Immunology by Roitt Publisher: Mosby ISBN: 0702025496 ISBN-13: 9780702025495, 978-0702025495

Suggested Readings:

- Immunology: An Introduction by Ian R Tizard (2006) Publisher: Cengage Learning (Thompson) ISBN: 8131500039, ISBN-13: 9788131500033, 978-8131500033
- Immunology and Immunotechnology by Chakravarty (2006) Publisher: Oxford University Press N Delhi ISBN: 0195676882, ISBN-13: 9780195676884, 978-0195676884
- Kuby Immunology by Thomas J. Kindt (2006) Publisher: W H Freeman & Co ISBN: 0716785900, ISBN-13: 9780716785903, 978-0716785903
- Elements of Immunology (2009) by Khan Publisher: Dorling Kindersley (India) Pvt Ltd ISBN: 8131711587 ISBN-13: 9788131711583, 978-8131711583
- Immunology by K.R. Joshi (2007) Publisher: Agrobios (India) ISBN: 8177541749, ISBN-13: 9788177541748, 978-8177541748
- Basic Immunology, 3ed by: Abbas Publisher: Elser ISBN: 8131217477, ISBN-13: 9788131217474, 978-8131217474
- Immunology by P.R. Yadav (2004) Publisher: Discovery Publishing House ISBN: 8171418570, ISBN-13: 9788171418572, 978-8171418572
- Immunology by David A. Marcus, Richard A. Goldsby, Barbara A. Osborne (2003) Publisher: W.h. Freeman & Company ISBN: 0716749475 ISBN-13: 9780716749479, 978-0716749479
- Immunology by Roitt Publisher: Mosby ISBN: 0702025496 ISBN-13: 9780702025495, 978-0702025495

Question paper Pattern for Core Course VI: BC5CRT06-Immunology and Immunological Techniques

| Unit | Section A 2 Marks | Section B 4 Marks | Section C 6 Marks | Section D 10 Marks | Total |
|---------------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|--------------|
| I | 1 | 0 | 1 | 1 | 3 |
| II | 3 | 1 | 1 | 1 | 6 |
| III | 4 | 2 | 2 | 1 | 9 |
| IV | 2 | 4 | 0 | 0 | 6 |
| V | 2 | 2 | 1 | 1 | 6 |
| Total No. of Questions | 12 | 9 | 5 | 4 | 30 |
| No.of Questions to be answered | 9 | 6 | 3 | 2 | 20 |
| Total Marks | 18 | 24 | 18 | 20 | 80 |

Core Practical VI: Immunology and Immunological Techniques

Total hours of instruction: 36.

Hours/week: 2.

Credit: 1

Objectives: This Practical course aims to introduce the students to basic protocols in Immunology

Commercially available Teaching Kits can be used for Demonstrations of the Practicals of this paper wherever necessary:

1. Demonstration of antigen – antibody interactions: Ouchterlony technique
2. Demonstration of Enzyme linked immunosorbant assay (ELISA): antibody capture assay
3. Purification of bovine serum immunoglobulin G (IgG) fraction by ammonium sulfate precipitation (micro method)
4. Haemagglutination
 - Direct agglutination reaction: determination of human blood group antigens
 - Indirect (Passive) Haemagglutination test
5. Coating of Red Blood Cells with Antigens
 - Direct adsorption of Antigens by Red Cells
 - Tanned Cells technique for attachment of Antigens
6. Bacterial Agglutination
 - Widal test

References

- Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8, p 245-261
- Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p 339- 389
- A Handbook of Practical and Clinical Immunology 2nd ed G.P. Talwar and S.K. Gupta (eds) (2005) Publishers: CBS Publishers and distributors ISBN: 81-239-0017-1 , p195 - 207

Core Course VII: BC5CRT07- Enzymology and Enzyme Technology

Total hours of instruction: 54.

Hours/week: 3.

Credit: 3

Objectives: This course aims to describe the structural characteristics of enzymes; explain their functional properties and their role in control of metabolism and industrial application of enzymes.

Unit I: (10hours)

Introduction to enzymes: Holoenzyme, apoenzyme, and prosthetic group. Interaction between enzyme and substrate- lock and key model, induced fit model, Features of active site, activation energy, enzyme specificity and types Enzyme Commission system of classification and nomenclature of enzymes (Class and subclass with one example) Ribozymes, Abzymes. Coenzymes and their functions - NAD, NADP⁺, FAD, FMN, lipoic acid, TPP, pyridoxal phosphate, biotin and cyanocobalamin.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p 269

Unit II: (8 hours)

Nature of non-enzymatic and enzymatic catalysis, Measurement and expression of enzyme activity, enzyme assays. Definition of IU, katals, enzyme turnover number and specific activity, Elementary study – isolation of enzymes and the criteria of purity.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p 349

Unit III: (13 hours)

Enzyme kinetics: study of the factors affecting the velocity of enzyme catalyzed reaction- enzyme concentration, temperature, pH, substrate concentration, inhibitors and activators (explanation with graphical representation). Derivation of Michaelis - Menten equation. Km value determination and its significance, Definition of V_{max} value of enzyme and its significance, Lineweaver- Burk plot (Only for single substrate enzyme catalyzed reaction), Enzyme inhibition: Reversible and irreversible – examples. Reversible- competitive, noncompetitive and uncompetitive inhibition- explanation of inhibition types with double reciprocal plot and examples of each type of enzyme inhibition.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p 372, 384, 385,

Unit IV: (13 hours)

Enzyme regulation – covalently modulated enzymes with examples of adenylation and phosphorylation and allosteric regulation- example Aspartate transcarbamoylase, Isoenzymes- Lactate dehydrogenase and creatine phosphokinase, Zymogen form of enzyme and zymogen activation, Multienzyme complexes and their role in regulation of metabolic pathways.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p 397

Unit V: (10 hours)

Immobilization of enzymes, methods of immobilization, Industrial uses of enzymes: production of glucose from starch, cellulose and dextrans, use of lactase in dairy industry, production of glucose fructose syrup from sucrose, use of proteases in food, leather and detergent industry. Diagnostic and therapeutic enzymes (brief study of name of enzyme and role in diagnosis and therapy)

Suggested Readings

- Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins by Nicholas C. Price, Lewis Stevens, and Lewis Stevens (2000) Publisher: Oxford University Press, USA ISBN: 019850229X ISBN-13: 9780198502296, 978-0198502296
- Enzyme Kinetics: A Modern Approach Book: Enzyme Kinetics: A Modern Approach by Alejandro G. Marangoni (2003) Publisher: Wiley-Interscience ISBN: 0471159859 ISBN-13: 9780471159858, 978-0471159858
- Enzyme Kinetics and Mechanisms by Taylor Publisher: Spring ISBN: 8184890478 ISBN-13: 9788184890471, 978-8184890471
- Enzyme Mechanism by P.K. Shivraj Kumar (2007) Publisher: RBSA Publishers ISBN: 8176114235 ISBN-13: 9788176114233, 978-8176114233
- Enzymes and Enzyme Technology by Kumar (2009) Anshan Pub ISBN: 1905740875, ISBN-13: 9781905740871, 978-1905740871
- Enzymes in Industry: Production And Applications by Aehle W (2007) Publisher: John Wiley & Sons Inc ISBN: 3527316892 ISBN-13: 9783527316892, 978-3527316892
- Enzymes: Biochemistry, Biotechnology, Clinical Chemistry (second Edition) by Trevor Palmer, Philip Bonner (2007) Publisher: Horwood Publishing Limited ISBN: 1904275273 ISBN-13: 9781904275275, 978-1904275275

Question paper Pattern for Core Course VII: BC5CRT07- Enzymology and Enzyme Technology

| Unit | Section A 2 Marks | Section B 4 Marks | Section C 6 Marks | Section D 10 Marks | Total |
|---------------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|--------------|
| I | 3 | 4 | 2 | 0 | 9 |
| II | 2 | 1 | 0 | 1 | 4 |
| III | 3 | 1 | 2 | 1 | 7 |
| IV | 2 | 1 | 1 | 1 | 5 |
| V | 2 | 2 | 0 | 1 | 5 |
| Total No. of Questions | 12 | 9 | 5 | 4 | 30 |
| No.of Questions to be answered | 9 | 6 | 3 | 2 | 20 |
| Total Marks | 18 | 24 | 18 | 20 | 80 |

Core Practical VII- Enzymology and Enzyme Technology

Total hours of instruction: 36.

Hours/week: 2.

Credit: 1

Objectives: The objective here is to make the students understand the basic steps involved in extraction and determination of enzymatic activities. Calculate enzymatic activities from experimental data

1. Extraction of enzymes:

- Acid phosphatase from Fresh Potato (*Solanum tuberosum*)
- β - amylase from Sweet potato (*Ipomoea batates*)
- Catalase from Bovine /Porcine liver
- Urease from Jack bean (*Canavalia ensiformis*)
- Phytase from Seeds

2. Enzyme Assay: Enzyme extracted from above source can be used for the assay

- Acid phosphatase
- β - amylase
- Catalase
- Urease from Jack bean
- Phytase

3. Effect of substrate Concentration on velocity of Enzyme catalyzed reaction:

- Determination of K_M and V_{max} using Michaelis- Menten Curve for amylase

References

- Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8, p 173- 187
- Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p 110 – 155
- Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p 184 – 255

Core Course VIII: BC5CRT08-Metabolism and Bioenergetics

Total hours of instruction: 54.

Hours/week: 3.

Credit: 3

Objectives: Explain the general principals of cellular energy metabolism. Explain and schematize the oxidative pathways of carbohydrates, Lipids, Proteins & Nucleic acids. Explain and schematize the final mitochondrial oxidative pathways: oxidative tricarboxylic cycle and mitochondrial respiratory chain, as well as its coupling to ATP synthesis.

Unit I: (5 hours)

Bioenergetics: Laws of thermodynamics- Role of high-energy phosphates in energy transfer, free energy concept, Biological oxidation, redox potential, phosphate potential, coupled reactions. General features of metabolism: use of intact organisms, bacterial mutants, tissue slices and radioactive isotopes.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p 434

Unit II: (16 hours)

Carbohydrate metabolism: (Reaction sequence with structure, name of enzymes and coenzymes involved expected) Glycolysis, oxidation of pyruvate, fate of pyruvate in alcoholic fermentation, TCA cycle, metabolism of glycogen-, gluconeogenesis, pentose phosphate pathway, glyoxylate pathway, Mitochondrial electron transport, oxidative phosphorylation. Regulation of committed step in each pathway.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p 458,481,522,

Unit III: (12 hours)

Metabolism of lipids: Biosynthesis of fatty acids, Fatty acid elongation. Detailed study on β - oxidation of palmitic acid and its energy balance sheet, Metabolism of ketone bodies, Cholesterol synthesis (structure not needed) and significance, Synthesis of steroid hormones from cholesterol, Regulation of committed step in each pathway.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p 564, 594

Unit IV: (12 hours)

Metabolism of proteins: proteolytic enzymes. transamination, oxidative deamination, reductive amination, non-oxidative deamination and decarboxylation of amino acids Urea cycle. Brief outline of metabolism of aromatic amino acids (reaction sequences with structures) metabolic fate of amino acids- glucogenic, ketogenic and gluco-ketogenic, biosynthesis of amino acids, Regulation of committed step in each pathway.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p 641, 687

Unit V: (9 hours)

Metabolism of nucleotide: Biosynthesis of purine and pyrimidine nucleotides –*de novo* and salvage pathway (no structure required) end products of purine and pyrimidine metabolism. Regulation of committed step in each pathway.

Ref: Biochemistry (2008) by Rastogi. Publisher: McgrawHill ISBN: 0070527954 ISBN13: 9780070527959, 978-0070527959

Suggested Readings

- Lehninger Principles of Biochemistry, Fourth Edition by David L. Nelson Michael M. Cox Publisher: W. H. Freeman; Fourth Edition edition (April 23, 2004) ISBN-10: 0716743396 ISBN-13: 978-0716743392
- E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, A Text Book of Biochemistry, Oxford and IBH Publishing Co., New Delhi, 1974
- Biochemistry [with Cdrom] (2004) by Donald Voet, Judith G. Voet Publisher: John Wiley & Sons Inc ISBN: 047119350X ISBN-13: 9780471193500, 978-0471193500
- Principles Of Biochemistry (1995) by Geoffrey L Zubay, William W Parson, Dennis E Vance Publisher: Mcgraw-hill Book Company – Koga ISBN: 0697142752 ISBN-13: 9780697142757, 978-0697142757
- Principles Of Biochemistry, 4/e (2006) by Robert Horton H , Laurence A Moran, Gray Scrimgeour K Publisher: Pearsarson ISBN: 0131977369, ISBN-13: 9780131977365, 978-0131977365
- Biochemistry 6th Edition (2007) by Jeremy M. Berg John L. Tymoczko Lubert Stryer Publisher: B.i. publications Pvt. Ltd ISBN: 071676766X ISBN-13: 9780716767664, 978-716767664
- Biochemistry (2008) by Rastogi Publisher: Mcgraw Hill ISBN: 0070527954 ISBN-13: 9780070527959, 978-0070527959

Question paper Pattern for Core Course VIII: BC5CRT08-Metabolism and Bioenergetics

| Unit | Section A 2 Marks | Section B 4 Marks | Section C 6 Marks | Section D 10 Marks | Total |
|---------------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|--------------|
| I | 5 | 1 | 0 | 0 | 6 |
| II | 2 | 4 | 2 | 2 | 10 |
| III | 2 | 1 | 1 | 1 | 5 |
| IV | 2 | 2 | 2 | 0 | 6 |
| V | 1 | 1 | 0 | 1 | 3 |
| Total No. of Questions | 12 | 9 | 5 | 4 | 30 |
| No.of Questions to be answered | 9 | 6 | 3 | 2 | 20 |
| Total Marks | 18 | 24 | 18 | 20 | 80 |

Core Practical VIII: Metabolism and Bioenergetics

Total hours of instruction: 54.

Hours/week: 3.

Credit: 1

Objectives: To introduce the students to protocols of spectrophotometric determination. Calculate quantities and concentrations of biomolecules from standard curves

A. Separation and Estimation of Carbohydrates: (Any 5 experiments to be done)

1. Isolation and determination of Liver Glycogen
2. Isolation and determination of Starch in Plant Tissue
3. Estimation of Cellulose
4. Estimation of crude fiber
5. Determination of total sugars by ferricyanide method (Colorimetric)
6. Quantitation of total sugars by anthrone method
7. Determination of reducing sugars by Nelson – Somogyi's method
8. Estimation of reducing sugars by dinitrosalicylate method
9. Determination of fructose by Roe's resorcinol method

B. Separation and Estimation of Lipids: (Any 5 experiments to be done)

1. Extraction and estimation of total lipid content from a biological tissue sample
2. Separation and identification of various lipids by Column Chromatography
3. Separation of various components in different lipid fractions by thin layer chromatography
4. Quantitative estimation of different lipid fractions separated by thin layer Chromatography
5. Estimation of Cholesterol by Zak's method
6. Determination of acid value of fats
7. Determination of saponification value of fats
8. Determination of iodine number of oils
9. Determination of peroxide value of oils

C. Separation and Estimation of Proteins and Amino acids: (Any 4 experiments to be done)

1. Determination of Crude protein by micro- Kjeldahl's method
2. Estimation of protein by Lowry's method
3. Determination of protein by Biuret method
4. Determination of free amino acid content in germinating seeds by Ninhydrin method
5. Determination of tyrosine by nitrosonaphthol method
6. Estimation of tryptophan by Spies and Chamber's method

D. Separation and Estimation of Nucleic acids (All 3 experiments need to be done)

1. Extraction of total nucleic acid from plant tissue
2. Estimation of DNA by Diphenylamine method
3. Determination of RNA by orcinol method

E. Separation and Estimation of Minerals and Vitamins (Any 4 experiments to be done)

1. Preparation of biological sample for mineral analysis by ashing method
2. Wet digestion procedure of sample preparation for mineral analysis
3. Determination of Phosphorus content in plant material (Colorimetric method)
4. Colorimetric estimation of iron in foodstuffs by α α dipyridyl method
5. Estimation of β - carotene in carrots
6. Estimation of ascorbic acid in Lemon juice

References

- Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8, p 81- 126
- Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p 15 – 109
- Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p 49- 181, p 269- 285.

SIXTH SEMESTER

Core Course IX: BC6CRT09-Genetics and Molecular Biology

Total hours of instruction: 54.

Hours/week: 3.

Credit: 3

Objectives: Explain the molecular bases of mechanisms of transmission, recombination and protection of genetic information. Describe the gene structure and gene expression mechanism in eukaryotes: transcription, posttranscriptional processes and translation & Protein degradation

Unit I: (15 hours)

Mendel's laws of inheritance, Dominance relationship-complete, incomplete and co-dominance, multiple alleles, linkage, Chromosomal aberrations: Monosomy, trisomy. Translocations, inversions, duplications, deletions. Linkage, crossing over, Genetic and cytological mapping of chromosome, sex linked inheritance, determination of sex and sex differentiation, genetic recombination and gene transfer.

Ref: Cell biology, Genetics, Molecular Biology, Evolution and Ecology by P.S. Verma and V. K. Agarwal (2008) Publisher: S. Chand & Company Ltd ISBN: 81-219-2442-1 p 22, 84, 93, 106, 134, 145, 151

Unit II: (13 hours)

Identification of genetic materials, Chemical nature of gene, central dogma of molecular biology, C- value paradox, chromatin organization, Meselson and Stahl experiment, DNA replication in prokaryotes, Mutation and its types, Mutagens- Physical and chemical, Mutagenesis, DNA damage and repair.

Ref: Cell biology, Genetics, Molecular Biology, Evolution and Ecology by P.S. Verma and V. K. Agarwal (2008) Publisher: S. Chand & Company Ltd ISBN: 81-219-2442-1 p 9, 16, 27, 201

Unit III: (16 hours)

Transcription in prokaryotes and posttranscriptional modifications, Genetic code and wobble hypothesis, Reverse transcription, Translation in prokaryotes, Posttranslational modifications. Inhibitors of protein synthesis.

Ref: Cell biology, Genetics, Molecular Biology, Evolution and Ecology by P.S. Verma and V. K. Agarwal (2008) Publisher: S. Chand & Company Ltd ISBN: 81-219-2442-1 p 44, 66, 75

Unit IV: (10 hours)

Regulation of gene expression in prokaryotes, Operon concept, Lac operon, tryptophan operon, Introduction to recombinant DNA technology: Vectors- plasmids, cosmids, phages, restriction endonucleases Polymerase chain reaction, DNA finger-printing, blotting techniques, Application of genetic engineering (Brief study).

Ref: Cell biology, Genetics, Molecular Biology, Evolution and Ecology by P.S. Verma and V. K. Agarwal (2008) Publisher: S. Chand & Company Ltd ISBN: 81-219-2442-1 p 91, 110

Suggested Readings

- Genes IX by Benjamin Lewin (2008) Publisher: J&b ISBN:0763752223 ISBN-13: 9780763752224, 978-0763752224
- Molecular Biology Of The Gene 5/e (s) by James D Watson, Tania A Baker, Stephen P Bell (2008) Publisher: Dorling Kindersley (India) Pvt Ltd ISBN: 8177581813 ISBN-13: 9788177581812, 978-8177581812
- Cell and Molecular Biology, 3e (2003) by Karp Publisher: Jw ISBN: 0471268909 ISBN-13: 9780471268901, 978-0471268901

Question paper Pattern for Core Course IX: BC6CRT09-Genetics and Molecular Biology

| Unit | Section A 2 Marks | Section B 4 Marks | Section C 6 Marks | Section D 10 Marks | Total |
|--------------------------------|----------------------|----------------------|----------------------|-----------------------|-------|
| I | 1 | 3 | 1 | 1 | 6 |
| II | 4 | 2 | 1 | 1 | 8 |
| III | 4 | 3 | 1 | 1 | 9 |
| IV | 3 | 1 | 2 | 1 | 7 |
| Total No. of Questions | 12 | 9 | 5 | 4 | 30 |
| No.of Questions to be answered | 9 | 6 | 3 | 2 | 20 |
| Total Marks | 18 | 24 | 18 | 20 | 80 |

Core Course Practical IX- BC6CRP03-Genetics and Molecular Biology

Total hours of instruction: 36.

Hours/week: 2.

Credit: 1

Objective: To introduce the student to simple basic techniques of Molecular biology

1. Molecular biology Experiments:

- DNA isolation - from Plant cell, or Animal cell (goat liver), or Human Blood (Fresh / Stored / Frozen)
- Spectrophotometric analysis of isolated DNA sample
- Agarose Gel electrophoresis
- Gel documentation & photography
- DNA molecular size determination

References:

- Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p 15 – 109

Core course X: BC6CRT10-Clinical Biochemistry

Total hours of instruction: 54.

Hours/week: 3.

Credit: 3

Objective: To provide an understanding of future advances in the molecular bases of physiology, physiopathology, diagnostics, therapeutics.

Unit I: (8 hours)

Sample collection and preservation-collection and preservation procedures of blood, plasma, serum, cerebrospinal fluid, urine, feces, pleural fluid, peritoneal fluid and semen, Analysis of urine: Normal and abnormal constituents, cerebrospinal fluid analysis, Principle of estimation of semen fructose and acid phosphatase.

Ref: Clinical Biochemistry Principles and Practices by Praful B Godkar, Bhalani publishing house. Bombay. India. p 87- 93

Ref: Text Book of Biochemistry by D M Vasudevan and Sreekumari S. Jaypee Brothers, Medical Publishers Pvt Ltd. New Delhi. p 512 - 516.

Ref: Text book of Medical Biochemistry by M.N. Chatterjee and Rana Shinde, Jaypee Brothers, Medical Publishers Pvt Ltd. New Delhi. p 952 - 987.

Unit II: (14 hours)

Blood analysis and Hematology: Principles of estimation, normal values and clinical significance of the following parameters of blood -glucose, glycosylated hemoglobin, GTT, insulin levels, uric acid, lipid profiles, acid phosphatase, creatine phosphokinase, Na⁺, K⁺, Cl⁻ and phosphate. Principles of determination, clinical significance of the following parameters- Total count, Differential count, Erythrocyte sedimentation rate, packed cell volume and prothrombin time. Brief study of blood groups, anticoagulants, storage and transfusion of blood.

Ref: Text book of Medical Biochemistry by M.N. Chatterjee and Rana Shinde, Jaypee Brothers, Medical Publishers Pvt Ltd. New Delhi. p 284 - 322

Ref: Clinical Biochemistry Principles and Practices by Praful B Godkar, Bhalani publishing house. Bombay. India. p 115, 110, 111 – 114

Unit III: (18 hours)

Organ function tests: Function of liver, Biochemical mechanism of detoxification with examples. Principles of the following test of liver function and the interpretation of the results- Total protein, albumin, globulin, albumin – globulin ratio, Total and conjugated

bilirubin, AST, ALT, alkaline phosphate, Thyroid function test: T3, T4, TSH, Renal function tests: Urea, creatinine, urea clearance test, creatinine clearance test.

Ref: Text book of Medical Biochemistry by M.N. Chatterjee and Rana Shinde, Jaypee Brothers, Medical Publishers Pvt Ltd. New Delhi. p 168 - 202.

Ref: Text Book of Biochemistry by D M Vasudevan and Sreekumari S. Jaypee Brothers, Medical Publishers Pvt Ltd. New Delhi. p 517 - 525.

Ref: Clinical Biochemistry Principles and Practices by Praful B Godkar, Bhalani publishing house. Bombay. India. p 87- 93

Unit IV: (4 hours)

Clinical correlation of biochemical parameters analyzed in blood analysis, Organ function tests (liver, kidney, and thyroid).

Ref: Text book of Medical Biochemistry by M.N. Chatterjee and Rana Shinde, Jaypee Brothers, Medical Publishers Pvt Ltd. New Delhi. p 168 - 202.

Ref: Text Book of Biochemistry by D M Vasudevan and Sreekumari S. Jaypee Brothers, Medical Publishers Pvt Ltd. New Delhi. p 517 - 525.

Ref: Clinical Biochemistry Principles and Practices by Praful B Godkar, Bhalani publishing house. Bombay. India. p 87- 93

Unit V: (10 hours)

Nutritional and hormonal disorders, Obesity, Starvation, PCM, pellagra, beriberi, scurvy, deficiency of fat soluble vitamins, Hypervitaminosis, Disturbances in metabolism of trace elements - iron, iodine, copper and fluorine. Diabetes mellitus, GTT, hyperinsulinism and hypoglycemia.

Ref: Clinical Biochemistry Principles and Practices by Praful B Godkar, Bhalani publishing house. Bombay. India. p 258 – 271, 233 – 251, 92 – 117.

Ref: Text Book of Biochemistry by D M Vasudevan and Sreekumari S. Jaypee Brothers, Medical Publishers Pvt Ltd. New Delhi. p 428 – 451, 480 – 484, 537 - 549.

Ref: Text book of Medical Biochemistry by M.N. Chatterjee and Rana Shinde, Jaypee Brothers, Medical Publishers Pvt Ltd. New Delhi. p 668 - 808.

Suggested Readings

- Notes on Clinical Biochemistry by John K. Candlish (1992) Publisher: World Scientific Publishing Company ISBN: 9810210663 ISBN-13: 9789810210663, 978-9810210663
- Clinical Biochemistry: Metabolic And Clinical Aspects by William J. Marshall, Stephen K. Bangert, Elizabeth S.m. Ed. S.m. Ed. Marshall (2008) Publisher: Elsevier Science Health Science Div ISBN: 0443101868 ISBN-13: 9780443101861, 978-0443101861
- Biochemistry by John K. Joseph (2006) Publisher: Campus Books International ISBN: 8180301109 ISBN-13: 9788180301100, 978-8180301100
- Basic Medical Biochemistry: A Clinical Approach by Dawn B., PH.D. Marks, Allan D. Marks Colleen M. Smith (1996) Publisher: Lippincott Williams & Wilkins; illustrated edition ISBN-10:068305595X ISBN-13: 978-0683055955
- Clinical Chemistry, 6/e 1e by William J Marshall, Stephen K Bangert (2008) Publisher: Else ISBN: 0723434603, ISBN-13: 9780723434603, 978-0723434603
- Tietz Fundamentals of Clinical Chemistry, 6/e by Carl A Burtis, Edward R Ashwood (2008) Publisher: Else ISBN: 8131213749, ISBN-13: 9788131213742, 978-8131213742

Question paper Pattern for Core course X: BC6CRT10-Clinical Biochemistry

| Unit | Section A 2 Marks | Section B 4 Marks | Section C 6 Marks | Section D 10 Marks | Total |
|--------------------------------|----------------------|----------------------|----------------------|-----------------------|-------|
| I | 1 | 1 | 0 | 1 | 3 |
| II | 4 | 4 | 2 | 0 | 10 |
| III | 2 | 3 | 2 | 1 | 8 |
| IV | 1 | 0 | 0 | 1 | 2 |
| V | 4 | 1 | 1 | 1 | 7 |
| Total No. of Questions | 12 | 9 | 5 | 4 | 30 |
| No.of Questions to be answered | 9 | 6 | 3 | 2 | 20 |
| Total Marks | 18 | 24 | 18 | 20 | 80 |

Core Course Practical X-BC6CRP04-Clinical Biochemistry

Total hours of instruction: 54.

Hours/week: 3.

Credit: 1

Objectives: Apply biochemical analysis and reasoning in order to solve problems related to physiology and cellular physiopathology.

1. Qualitative tests of urine: Abnormal constituents

- Proteins (Coagulation test, sulfosalicylic acid test, test for Bence-Jones proteins)
- Sugars (Benedicts test)
- Haemoglobin (Benzidine test)
- Ketone bodies (Rothera test, Gerhardt's test)
- Bile pigments (Fouchet's test, Gmelin's test)
- Bile salts (Hay's test)

2. Quantitative estimation in urine:

- Sugar by Nelson – Somogyi Method
- Chloride
- Urea by Diacetylmonoxime Method
- Uric acid using Phosphotungstic acid reagent
- Creatinine by Jaffe's reaction
- Bilirubin by van den Bergh reaction

3. Preparation of Blood Serum & Plasma

4. Quantitative estimation in Blood/ Serum:

- Glucose by Nelson – Somogyi Method
- Cholesterol by Zak & Henly's Method
- Urea by Diacetylmonoxime Method
- Iron by α α dipyridyl method
- Total Protein by Biuret Method
- Albumin: Globulin ratio

- Uric acid using Phosphotungstic acid reagent
- Bilirubin by van den Bergh reaction
- Hemoglobin content by cyanmethaemoglobin method

5. ESR, PCV, TC/DC count,

6. Clinical Enzymology:

- Assay of serum alkaline phosphatase
- Assay of Serum alanine amino transferases (ALT/SGPT)
- Assay of serum aspartate amino transferases (AST/SGOT)
- Assay of serum Lactate dehydrogenases

References

- Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8, p 191 -241
- Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p 15 – 109
- Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p 49- 181, p 269- 285
- Practical Clinical Chemistry, Harold Varley, CBS Publishers and Distributors, New Delhi, p327 – 348.

Core Course XI:BC6CRT11- Pharmaceutical Chemistry

Total hours of instruction: 54.

Hours/week: 3.

Credit: 3

Objectives: To introduce the student the basics about Pharmacology so that the student develops an idea about action of drugs that are commonly used for therapy

UNIT I: (6 hours)

Introduction to pharmacology, sources of drugs, dosage forms & routes of administration, principle of drug action, combined effect of drugs, factors modifying drug action, tolerance & dependence, absorption, distribution. Adverse responses and side effects of drugs: allergy, Drug intolerance, Drug addiction, drugs abuses and their biological effects.

Ref: Essential of Medical Pharmacology by Tripathi K.D (2003) Publisher: Jaypee Brothers Medical ISBN: 8180611876, ISBN-13: 9788180611872, 978-8180611872

UNIT II: (10 hours)

Classification of drugs based on sources: mode of administration, site of action, and absorption of drugs, Drugs distribution and elimination, Role of kidney in elimination drug metabolism: chemical pathways of drug metabolism, Phase I and Phase II reactions, role of cytochrome P450, drug metabolizing enzymes.

Ref: Essential of Medical Pharmacology by Tripathi K.D (2003) Publisher: Jaypee Brothers Medical ISBN: 8180611876, ISBN-13: 9788180611872, 978-8180611872

UNIT III: (12 hours)

Chemotherapy: General Principles of Chemotherapy: Chemotherapy of Parasitic infections, Tuberculosis, Leprosy, Malaria, Fungal infections, viral diseases, Introduction to Immunomodulators and Chemotherapy of Cancer.

Ref: Essential of Medical Pharmacology by Tripathi K.D (2003) Publisher: Jaypee Brothers Medical ISBN: 8180611876, ISBN-13: 9788180611872, 978-8180611872

UNIT IV: (14 hours)

Mode of action, uses, structure- activity relationship of the following classes of Drug:

- Androgens and Anabolic steroids – Testosterone, Stanozolol.

- Estrogens and Progestational agents – Progesterone, Estradiol.
- Adrenocorticoids – Prednisolone, Dexamethasone, Betamethasone.
- Antibiotics-Penicillins, streptomycin, tetracyclines, Cephalosporins.

Ref: Organic Chemistry Vol-1 6th Edition (s) by Finar II (2008) Publisher: Dorling Kindersley (India) Pvt Ltd ISBN: 8177585428 ISBN-13:9788177585421, 978-8177585421

Ref:Organic Chemistry Vol-2 5th Edition (s) by Finar I.I Publisher: Dorling Kindersley (India) Pvt Ltd (2008) ISBN: 817758541X, ISBN-13: 9788177585414, 978-8177585414

Indian Pharmacopoeia – Latest edition, British Pharmacopoeia - Latest edition

UNIT V: (12 hours)

Molecular basis of drug action:

- a) Receptor: Drug Receptor Interaction: Basic ligand concept, agonist, antagonist, partial agonist, inverse agonist, receptor Theories - Occupancy, Rate & Activation Theories, receptor Binding Assays.
- b) Enzyme Inhibition –enzyme Inhibitors as drugs - ACE, leukotrienes, Lipoxygenase, Cyclooxygenase, Aromatase, Xanthine oxidase, DNA Polymerase Inhibitors, HIV - Protease / Reverse Transcriptase, Integrase and Cytochrome P-450 Inhibitors.
- c) Drug binding to nucleic acid -- Antimalarial, anti-cancer, antiviral.

Ref: Essential of Medical Pharmacology by Tripathi K.D (2003) Publisher: Jaypee Brothers Medical ISBN: 8180611876, ISBN-13: 9788180611872, 978-8180611872

Suggested Reading

- Organic Pharmaceutical Chemistry by Harkishan Singh, Kapoor Vk (2004) Publisher: Vallabh Publications / Prakashan ISBN: 8185731209, ISBN-13: 9788185731209, 978-8185731209
- Organic Chemistry Vol-1 6th Edition (s) by Finar II (2008) Publisher: Dorling Kindersley (India) Pvt Ltd ISBN: 8177585428 ISBN-13:9788177585421, 978-8177585421
- Organic Chemistry Vol-2 5th Edition (s) by Finar I.I Publisher: Dorling Kindersley (India) Pvt Ltd (2008) ISBN: 817758541X, ISBN-13: 9788177585414, 978-8177585414

- Principles Of Organic Medicinal Chemistry by Rama Rao Nadendla (2004) Publisher: New Age International (p) Limited ISBN: 8122415717, ISBN-13: 9788122415711, 978-8122415711
- Basic & Clinical Pharmacology by Bertram G. Katzung (2006) Publisher: Mcgraw-hill Medical Publishing ISBN: 0071451536 ISBN-13: 9780071451536, 978-0071451536
- Essential of Medical Pharmacology by Tripathi K.D (2003) Publisher: Jaypee Brothers Medical ISBN: 8180611876, ISBN-13: 9788180611872, 978-8180611872
- Handbook Of Experimental Pharmacology by Kulkarni SK (2007) Publisher: Vallabh Publications / Prakashan ISBN: 8185731128, ISBN-13: 9788185731124, 978-8185731124

Question paper Pattern for Core Course XI: BC6CRT11- Pharmaceutical Chemistry

| Unit | Section A 2 Marks | Section B 4 Marks | Section C 6 Marks | Section D 10 Marks | Total |
|---------------------------------------|----------------------|----------------------|----------------------|-----------------------|-----------|
| I | 4 | 4 | 1 | 1 | 10 |
| II | 2 | 2 | 1 | 0 | 5 |
| III | 2 | 1 | 1 | 1 | 5 |
| IV | 1 | 1 | 1 | 1 | 4 |
| V | 3 | 1 | 1 | 1 | 6 |
| Total No. of Questions | 12 | 9 | 5 | 4 | 30 |
| No.of Questions to be answered | 9 | 6 | 3 | 2 | 20 |
| Total Marks | 18 | 24 | 18 | 20 | 80 |

Core Course Practical XI-BC6CRP05-Pharmaceutical Chemistry

Total hours of instruction: 36.

Hours/week: 2.

Credit: 1

Objective: The student is expected to have an in-depth practical analysis of natural products on completion of this course

1. Thin Layer Chromatography of Plant Metabolites:

- TLC of Volatile Oils
- TLC of Alkaloids
- TLC of Glycosides
- TLC of Flavonoid drugs

2. Extractions, Isolation and Analysis of Phytopharmaceuticals:

- Different Extraction Protocols: Infusion, Decoction, Digestion, Maceration, Soxhlet extraction
- Selection of suitable extraction Process
- Extraction of High Molecular Weight Carbohydrates
- Collection and Purification of Exudates
- Extraction of Total Alkaloids
- Isolation and Colorimetric estimation of Solanine from Potato
- Isolation and Spectrophotometric estimation of Cinchona Alkaloids from Cinchona bark
- Extraction of Oleoresins from black pepper and ginger
- Isolation and spectrophotometric analysis of Tannins
- Estimation of Total Phenols
- Estimation of Flavanols

References:

- Herbal Drug Technology, S. S. Agarwal & M. Paridhavi (eds), Universities Press, Hyderabad, India, ISBN 13:978-81-7371-579-2 p 231 - 439
- Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p 49- 181, p 287 – 302.

Core Course XII: BC6CRT12-Computational Techniques in Biochemistry

Total hours of instruction: 54.

Hours/week: 3.

Credit: 3

UNIT I: (12 hours)

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

UNIT II: (12 hours)

Basic bioinformatics-Introduction to bioinformatics, its importance and scope, Pattern recognition and prediction, data submission tools (Webin, Sequin, Bankit) and data retrieval tools (DBGET, BioRS), data mining of biological databases- NCBI, DDBJ, EMBL, PDB, KRGG. Basic Local Alignment search Tool (BLAST)

Ref: Introduction to Bioinformatics (2002) by T.K Atwood and D.J Parry-Smith Publisher: Pearson Education Pvt Ltd ISBN 81-7808-507-0 p35

UNIT III: (10 hours)

Detailed study of various databanks-Biological databases, primary and secondary sequence databases, NCBI, EMBnet, Genbank, EMBL, DDBJ, PDB and KEGG

UNIT IV: (10 hours)

Genome analysis-Comparative genomics- Sequence alignment and analysis, pairwise alignment (BLAST, flavors of BLAST & FASTA), MSA (ClustalW), scoring matrices, alignment algorithms, tools for alignment of sequences.

UNIT V: (10 hours)

Application of bioinformatics-Docking, Molecular docking, Homology modeling, structure based drug designing.

Databases of drugs: drug bank, Cambridge structural database (CSD). Virtual screening, Application of bioinformatics in drug designing process

Ref: www.drugbank.ca

Ref: www.ccdc.cam.ac.uk/products/csd/

References:

- Bioinformatics: Genes, proteins and computers. C.A. Orengo, D.T.Jones and J.M. Thornton
- www.drugbank.ca
- www.ccdc.cam.ac.uk/products/csd/
- Bioinformatics methods and Application: genomics, proteomics and drug discovery by S.C.Rastogi, N Mendiratta, P.Rastog
- Essentials of drug designing ;V.kothekar, Dharuv publications, New Delhi.

Question paper Pattern for Core Course XII: BC6CRT12-Computational Techniques in Biochemistry

| Unit | Section A 2 Marks | Section B 4 Marks | Section C 6 Marks | Section D 10 Marks | Total |
|---------------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|--------------|
| I | 3 | 2 | 1 | 0 | 6 |
| II | 2 | 2 | 1 | 1 | 6 |
| III | 2 | 1 | 1 | 1 | 5 |
| IV | 2 | 2 | 1 | 1 | 6 |
| V | 3 | 2 | 1 | 1 | 7 |
| Total No. of Questions | 12 | 9 | 5 | 4 | 30 |
| No.of Questions to be answered | 9 | 6 | 3 | 2 | 20 |
| Total Marks | 18 | 24 | 18 | 20 | 80 |

Core Course Practical XII-BC6CRP06- Computational Techniques in Biochemistry

Total hours of instruction: 36.

Hours/week: 2.

Credit: 1

Objective:- To provide students a practical knowledge on bioinformatic tools.

Bioinformatics:

- Internet basics
- Introduction to NCBI Web sites
- Introduction to Data bases
- Alignment of sequences of amino acids using BLAST
- Alignment of sequences of amino acids using alignment programme uniport

Ref: Introduction to Bioinformatics (2002) by T.K Atwood and D.J Parry-Smith Publisher: Pearson Education Pvt Ltd ISBN 81-7808-507-0 p35

**Generic Elective Course Offered to
Students (5th Semester)**

Generic elective course I: BC5GET01-Human Health and Nutrition

Total hours of instruction: 54

Hours/week: 3.

Credit: 3

Objectives: To provide the students with an in-depth study on different aspects of Human health and nutrition

Unit I: (10 hours)

Basic concept of food, nutrition and health: Concepts of nutrition, classification, protein, fat, carbohydrate, fiber, and vitamin, mineral and trace elements. principal foods- Cereals, pulses, vegetables, fruits, nuts, oil seeds, animal foods, milk and milk products, egg, fish, meat, drinks and spices. Nutritional requirements- concepts, energy, Energy requirements protein quality, fat carbohydrate Balanced diet- for different ages, sex, occupation etc Functions of food, Socio-Economic Aspects of Nutrition, Health status in India, & Kerala, Nutrigenomics and customized nutrition.

Unit II: (8 hours)

Nutritional Programmes: National programmes related to nutrition, Vitamin A deficiency programme, National iodine deficiency disorders (IDD) programme, Mid-Day meal programme, Integrated child development scheme (ICDS).

Unit III: (8 hours)

Food additives- colors, preservatives, Food adulteration, Household level food preservation and storage, Food labeling.

Unit IV: (8 hours)

Food Processing: (i) Methods of cooking, (ii) Healthy cooking practices, (iii) Food hygiene: Potable water- sources and methods of purification, Food and Water born infections.

Unit V: (20 hours)

Major nutritional deficiency diseases- Protein Energy Malnutrition, Vitamin A deficiency, Iron deficiency anemia, Iodine deficiency disorders, their causes, symptoms, treatment, prevention and government if any. Life style related diseases- hypertension, diabetes mellitus, and obesity- their causes and prevention through dietary/lifestyle modifications. Social health problems- smoking, alcoholism, drug dependence and

Acquired Immuno Deficiency Syndrome (AIDS), Obesity and malnutrition including protein-energy malnutrition, Lifestyle diseases including circulation and coronary heart diseases, Diabetes and inherited metabolic diseases, Food allergy.

Suggested Readings

- Food Additives Characteristics Detection & Estimation by Mahindru S N (2000) Publisher: Tata Mcgraw Hill Publishing Co Ltd ISBN: 0074637355 ISBN-13: 9780074637357, 978-0074637357
- Potable Water by S.N. Mahindru (2004) Publisher: Aph Publishing Corporation ISBN:8176487252, ISBN-13: 9788176487252, 978-817648725
- Food: the Chemistry Of Its Components 4th/ed by T. P. Coultate (2002) Publisher: Royal Society Of Chemistry ISBN:0854046151 ISBN-13: 9780854046157, 978-0854046157
- Food Hygiene by Kavita Ed Marwaha (2007) Publisher: Daya Publishing House ISBN: 8189729721 ISBN-13: 9788189729721, 978-8189729721
- Principles Of Human Nutrition by Martin Eastwood (2003) Publisher: Atlantic Publishers & Distributors ISBN: 1405120290 ISBN-13: 9781405120296, 978-1405120296
- Health, Nutrition And Diseases by Chatterjee, G. (2000) Publisher: Rajat Publication ISBN: 8187317566 ISBN-13: 9788187317562, 978-8187317562
- Nutrition And Dietetics by Shubhangini A Joshi (2007) Publisher: Tata Mgraw Hill ISBN:0070472920 ISBN-13: 9780070472921, 978-0070472921
- A Handbook Of Foods And Nutrition by: F.C. Blank (2007) Publisher: Agrobios (India) (ISBN: 8177541633 ISBN-13: 9788177541632, 978-8177541632
- Chemical Analysis Of Foods And Food Products, by M B Jacobs (1999) Publisher: Cbs ISBN: 8123906439 ISBN-13: 9788123906430, 978-8123906430
- Nutrition Research: Current Scenario And Future Trends by Krishnaswamy Publisher: Oxford & Ibh Publishing Co. Pvt Ltd ISBN: 8120413245 ISBN-13: 9788120413245, 978-8120413245

Question paper Pattern for Generic elective course I: BC5GET01-Human Health and Nutrition

| Unit | Section A 2 Marks | Section B 4 Marks | Section C 6 Marks | Section D 10 Marks | Total |
|---------------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|--------------|
| I | 3 | 2 | 0 | 1 | 6 |
| II | 1 | 2 | 1 | 1 | 5 |
| III | 1 | 1 | 1 | 1 | 4 |
| IV | 2 | 2 | 1 | 1 | 6 |
| V | 5 | 2 | 2 | 0 | 9 |
| Total No. of Questions | 12 | 9 | 5 | 4 | 30 |
| No.of Questions to be answered | 9 | 6 | 3 | 2 | 20 |
| Total Marks | 18 | 24 | 18 | 20 | 80 |

Generic elective course II: BC5GET02-Environmental Biochemistry

Total hours of instruction: 54.

Hours/week: 3.

Credit: 3

Objective:- To provide the students a basic knowledge of the various environmental problems, how it will affect the human population and its social impacts.

Unit I: (10 hours)

Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, ocean estuaries)

Unit II: (10 hours)

Environmental Pollution: Definition, Causes, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear pollution

Unit III: (14 hours)

Natural Resources:

- Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
- Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
- Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources,
- Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity,
- Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources,
- Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

Unit IV: (10 hours)

Human Population and the Environment: Population growth, variation among nations, Population explosion – Family Welfare Programmes, Environment and human health, human Rights, Value Education, HIV / AIDS, Women and Child Welfare, Role of Information Technology in Environment and Human Health

Unit V: (10 hours)

Social Issues and the Environment: From unsustainable to sustainable development, Urban problems and related to energy, Water conservation, rain water harvesting, watershed management, Climate change, global warming, acid rain, ozone layer depletion, wasteland reclamation, Consumerism and waste products, Environmental Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation.

Suggested Readings:

- Environmental Chemistry by Soumitro Ghose Publisher: Dominant Publishers & Distributors (2003) ISBN: 8178881381 ISBN-13: 9788178881386, 978-8178881386
- Environmental Chemistry by Colin Baird, Michael Cann (2008) Publisher: W.H. Freeman & Company ISBN: 1429201460 ISBN-13: 9781429201469, 978-1429201469
- Environmental Chemistry In Society by James M. Beard (2008) Publisher: Taylor & Francis ISBN: 1420080253 ISBN-13: 9781420080254, 978-1420080254
- Fundamental Concepts Of Environmental Chemistry by G.S. Sodhi (2005) Publisher: Narosa Publishing House ISBN: 8173196923 ISBN-13: 9788173196928, 978-8173196928
- An Introduction To Environmental Chemistry by J.E. Andrews (2003) Publisher: Blackwell Science Ltd ISBN: 0632059052 ISBN-13: 9780632059058, 978-0632059058
- Introductory Chemistry For Environmental Science by Harrison R.M, De Mora S. J (1998) Publisher: Cambridge University Press ISBN: 0521586887 ISBN-13: 9780521586887, 978-0521586887
- Environmental Chemistry by Sindhu P.S (2002) Publisher: New Age International (p) Ltd ISBN: 812241401X ISBN-13: 9788122414011, 978-8122414011

Question paper Pattern for Generic elective course II: BC5GET02-Environmental Biochemistry

| Unit | Section A 2 Marks | Section B 4 Marks | Section C 6 Marks | Section D 10 Marks | Total |
|---------------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|--------------|
| I | 2 | 2 | 0 | 1 | 5 |
| II | 4 | 3 | 2 | 1 | 10 |
| III | 2 | 2 | 1 | 1 | 6 |
| IV | 1 | 1 | 1 | 1 | 4 |
| V | 3 | 1 | 1 | 0 | 5 |
| Total No. of Questions | 12 | 9 | 5 | 4 | 30 |
| No.of Questions to be answered | 9 | 6 | 3 | 2 | 20 |
| Total Marks | 18 | 24 | 18 | 20 | 80 |

Generic elective course III: BC5GET03-Waste Management

Total hours of instruction: 54.

Hours/week: 3.

Credit: 3

Objective: The primary goal of this course is to provide students with a comprehensive understanding of solid waste management from an environmental/public health perspective.

Unit I: (10 hours)

Basics of Environment and Energy: Basic principle of Environmental science, factors influencing environment: Energy and environment: Sun as source of energy, solar radiation and its characteristics, Fossil fuels: Classification, composition energy content of coal, petroleum and natural gases. Bioenergy: energy from biomass and biogas. Environmental implication of energy use: carbon dioxide emissions, global warming, air pollution

Unit II: (12 hours)

Introduction, Characterization & Monitoring of Solid Waste: Origin of solid waste: Sources of Solid Waste. Types of solid waste – Municipal waste, urban -, rural - and industrial wastes, Special waste: tyres, household hazardous wastes, debris, demolition waste, wet batteries; factory waste; domestic waste; sewage sludge and municipal waste; slaughterhouse waste; agricultural waste; dredged material; Mining waste Hazardous wastes, unknown solid wastes. Environment monitoring; biomonitoring of solid wastes and their disposal facilities.

Unit III: (12 hours)

Waste Management: Need, Planning & Techniques: Waste generation, Need and requirements for management and planning, Waste minimization Systems of waste reduction and materials recovery, Waste reduction at source; Collection techniques, Materials and resource recovery/recycling, Transport of solid waste and its optimization; Waste management practices: Quality assurance and quality control checks.

Public education; Solid waste management policies for 21st century; Treatment and disposal techniques Open dumping, Simple Landfill, Environmentally safe landfill, Simple composting, Vermi-composting, Incineration, non-incineration thermal techniques.

Unit IV: (10 hours)

Environmental Toxicology and Management of Hazardous Waste: What is Hazardous waste; Environmental problems of Hazardous wastes Health risks associated with hazardous wastes Management of Radioactive waste; Dangers of dumping of hazardous wastes, Generation, collection, segregation, treatment, transport, and disposal of hazardous waste Evaluation of Toxicity: Evaluation of LC_{50} , LD_{50} , LCIC and IT, Biochemical Effects of Heavy Metals Hg, Pb, As, CN, Cd Lead and Mercury poisoning, Toxic Chemical in the Environment Hazardous waste

Unit V: (10 hours)

Management of Biomedical /Hospital Waste: Introduction, Classification of hospital wastes; their types and composition, Types of solids, liquids, sharps, blood and blood tissue, radioactive material, biological and chemical material. Requirement of management Hospital effluents: Nature and composition; Levels of Generation in a small clinic, nursing home, Documentation of Biomedical waste types, Storage of hospital waste; Types of bags and containers used for storage; Segregation of biomedical waste into different type; Handling and transport of hospital waste; Transport of medical waste, Methods / treatments required for disposal of pathogens.

Suggested Readings

- Solid Waste Management in India/R.K. Sinha. Delhi, Indian Pub., 2000, 127 p., ISBN 81-7341-168-9.
- Handbook of Solid Waste Management Edition Number 2 By George Tchobanoglous, Frank Kreith ISBN 0071356231 / 9780071356237 Publisher McGraw-Hill Country United States
- Integrated Solid Waste Management: A Life Cycle Inventory (2nd edition) Authors: Forbes McDougall, Peter White, Marina Franke, Peter Hindle, Procter & Gamble (www.pg.com) Publisher:Blackwell Science Ltd., 2001, ISBN 0-632-05889-7
- Environmental and Health Impact of Solid Waste Management Activities R M Harrison (Editor), Ron E Hester (Editor) ISBN: 978-0-85404-285-2
- The Solid waste handbook: a practical guide By William D. Robinson Contributor William D. Robinson Edition: illustrated Published by Wiley-IEEE, 1986 ISBN 0471877115, 9780471877110
- Improving municipal solid waste management in India: a sourcebook for policymakers and practitioners By Da Zhu, P. U. Asnani, World Bank Institute, Chris Zurbrugg,

Sebastian Anapolsky, Shyamala Mani Edition: illustrated Published by World Bank Publications, 2007 ISBN 0821373617, 9780821373613

- Basics of solid and hazardous waste management technology By Kanti L. Shah Edition: 7, illustrated Published by Prentice Hall, 2000 Original from the University of Michigan Digitized 4 Dec 2007 ISBN 0139603786, 9780139603785
- Waste management practices: municipal, hazardous, and industrial By John Pichtel Edition: illustrated Published by CRC Press, 2005 ISBN 0849335256, 9780849335259
- Hazardous waste management By Michael D. LaGrega, Phillip L. Buckingham, Jeffrey C. Evans Edition: illustrated Published by McGraw-Hill, 1994 Original from the University of Michigan Digitized 4 Dec 2007 ISBN 0070195528, 9780070195523
- Integrated Modelling of Solid Waste in India Published by IIED ISBN 1843693046, 9781843693048
- Environmental science: systems and solutions By Michael L. McKinney, Robert M. Schoch Edition: 3, illustrated Published by Jones & Bartlett Publishers, 2003 ISBN 0763709182, 9780763709181
- Environmental pollution and control By Ruth F. Weiner, P. Aarne Vesilind Edition: 4, illustrated Published by Elsevier, 1997 ISBN 0750698993, 9780750698993

Question paper Pattern for Generic elective course III: BC5GET03-Waste Management

| Unit | Section A 2 Marks | Section B 4 Marks | Section C 6 Marks | Section D 10 Marks | Total |
|---------------------------------------|----------------------|----------------------|----------------------|-----------------------|-----------|
| I | 4 | 2 | 1 | 0 | 7 |
| II | 2 | 4 | 1 | 1 | 8 |
| III | 2 | 1 | 1 | 1 | 5 |
| IV | 3 | 1 | 1 | 1 | 6 |
| V | 1 | 1 | 1 | 1 | 4 |
| Total No. of Questions | 12 | 9 | 5 | 4 | 30 |
| No.of Questions to be answered | 9 | 6 | 3 | 2 | 20 |
| Total Marks | 18 | 24 | 18 | 20 | 80 |

**Choice Based Course Offered to
Students of Department of Biochemistry
(6th Semester)**

Choice based course I: BC6CBT01- Human Health and Nutrition

Total hours of instruction: 72.

Hours/week: 4.

Credit: 3

Objectives: To provide the students with an in-depth study on different aspects of Human health and nutrition

Unit I: (20 hours)

Basic concept of food, nutrition and health: Concepts of nutrition, classification, protein, fat, carbohydrate, fiber, and vitamin, mineral and trace elements. Nutritional profile. principal foods- Cereals, pulses, vegetables, fruits, nuts, oil seeds, animal foods, milk and milk products, egg, fish, meat, drinks and spices. Nutritional requirements- concepts, energy, Energy requirements protein quality, fat carbohydrate Balanced diet- for different ages, sex, occupation etc Functions of food, Components of food- nutrients, their functions and sources. Food groups and the concept of balanced diet Nutritional status indicators, Nutritional needs during the life cycle (infancy to old age) including physiological conditions like pregnancy and lactation. Socio-Economic Aspects of Nutrition, Health status in India, & Kerala, Nutrigenomics and customized nutrition.

Unit II: (12 hours)

Nutritional Programmes: National programmes related to nutrition, Vitamin A deficiency programme, National iodine deficiency disorders (IDD) programme, Mid-Day meal programme, Integrated child development scheme (ICDS), National and International agencies working towards food/nutrition: NIPCCD, CARE, FAO, NIN, CFTRI (Central food technology & research institute) etc.

Unit III: (8 hours)

Food additives- colors, preservatives, Food adulteration, Household level food preservation and storage, Food labeling.

Unit IV: (8 hours)

Food Processing: (i) Methods of cooking, (ii) Healthy cooking practices, (iii) Food hygiene: Potable water- sources and methods of purification, Food and Water born infections.

Unit V: (24 hours)

Major nutritional deficiency diseases- Protein Energy Malnutrition, Vitamin A deficiency, Iron deficiency anemia, Iodine deficiency disorders, their causes, symptoms, treatment, prevention if any. Life style related diseases- hypertension, diabetes mellitus, and obesity- their causes and prevention through dietary/lifestyle modifications. Social health problems- smoking, alcoholism, drug dependence and Acquired Immuno Deficiency Syndrome (AIDS), Diseases related to mineral deficiency, e.g. osteomalacia and anemia. Obesity and malnutrition including protein-energy malnutrition, Lifestyle diseases including circulation and coronary heart diseases, Diabetes and inherited metabolic diseases, Food allergy. Diseases related to nutrition in the developing countries versus the industrialized world.

Suggested Readings

- Food Additives Characteristics Detection & Estimation by Mahindru S N (2000) Publisher: Tata Mcgraw Hill Publishing Co Ltd ISBN: 0074637355 ISBN-13: 9780074637357, 978-0074637357
- Potable Water by S.N. Mahindru (2004) Publisher: Aph Publishing Corporation ISBN:8176487252, ISBN-13: 9788176487252, 978-817648725
- Food: the Chemistry Of Its Components 4th/ed by T. P. Coultate (2002) Publisher: Royal Society Of Chemistry ISBN:0854046151 ISBN-13: 9780854046157, 978-0854046157
- Food Hygiene by Kavita Ed Marwaha (2007) Publisher: Daya Publishing House ISBN: 8189729721 ISBN-13: 9788189729721, 978-8189729721
- Principles Of Human Nutrition by Martin Eastwood (2003) Publisher: Atlantic Publishers & Distributors ISBN: 1405120290 ISBN-13: 9781405120296, 978-1405120296
- Health, Nutrition And Diseases by Chatterjee, G. (2000) Publisher: Rajat Publication ISBN: 8187317566 ISBN-13: 9788187317562, 978-8187317562
- Nutrition And Dietetics by Shubhangini A Joshi (2007) Publisher: Tata Mgraw Hill ISBN:0070472920 ISBN-13: 9780070472921, 978-0070472921
- A Handbook Of Foods And Nutrition by: F.C. Blank (2007) Publisher: Agrobios (India) (ISBN: 8177541633 ISBN-13: 9788177541632, 978-8177541632

- Chemical Analysis Of Foods And Food Products, by M B Jacobs (1999) Publisher: Cbs ISBN: 8123906439 ISBN-13: 9788123906430, 978-8123906430
- Nutrition Research: Current Scenario And Future Trends by Krishnaswamy Publisher: Oxford & Ibh Publishing Co. Pvt Ltd ISBN: 8120413245 ISBN-13: 9788120413245, 978-8120413245

Question paper Pattern for Choice based course I: BC6CBT01- Human Health and Nutrition

| Unit | Section A 2 Marks | Section B 4 Marks | Section C 6 Marks | Section D 10 Marks | Total |
|---------------------------------------|----------------------|----------------------|----------------------|-----------------------|-----------|
| I | 3 | 2 | 0 | 1 | 6 |
| II | 1 | 2 | 1 | 1 | 5 |
| III | 1 | 1 | 1 | 1 | 4 |
| IV | 2 | 2 | 1 | 1 | 6 |
| V | 5 | 2 | 2 | 0 | 9 |
| Total No. of Questions | 12 | 9 | 5 | 4 | 30 |
| No.of Questions to be answered | 9 | 6 | 3 | 2 | 20 |
| Total Marks | 18 | 24 | 18 | 20 | 80 |

Choice based course II: BC6CBT02-Biochemical and Environmental Toxicology

Total hours of instruction: 72.

Hours/week: 4.

Credit: 3

Objectives: This course intends to introduce the students into basics of toxicology and to make them understand the mechanisms by which biological systems are affected by pollutants

Unit I: (15 hours)

Definition and scope of toxicology: Eco-toxicology and its environmental significance, Toxic effects: basis for general classification & nature. Dose- Response relationship: Synergism and Antagonism. Determination of ED₅₀ & LD₅₀ values Acute and chronic exposure Factors influencing toxicity, Principles and procedures of testing for acute toxic effects: mammalian systems affected & Clinical signs of systemic toxicity.

Unit II: (15 hours)

Toxicity testing: Test protocol, Genetic toxicity testing & Mutagenesis assay.

In vitro test systems: bacterial mutation tests- Reversion test, Ames test, Fluctuation test, and Eukaryotic mutation test.

In vivo test systems: Mammalian mutation test- Host mediated assay and Dominant Lethal test. Biochemical basis of toxicity: Mechanism of toxicity: Disturbance of excitable membrane function, Altered Calcium hemostasis, Covalent binding to cellular macromolecules & genotoxicity

Unit III: (15hours)

Environmental consequences of Pesticide toxicology, Toxicology of: food additives, metals, common drugs like Paracetamol.

Common air pollutants and their sources, Air pollution and its effect on Ozone layer, Industrial effluent toxicology and its effect on environment and health Toxic effects on mammalian tissues.

Unit IV: (15hours)

Xenobiotic metabolism: Absorption and distribution, Phase I reaction- Oxidation-reduction, hydrolysis & hydration, Phase II reaction- Conjugation: Methylation, Glutathione and amino acid conjugation. Detoxification.

Unit V: (12 hours)

Overview of regulatory agencies, management of toxicological risks, regulatory approaches, Regulatory system and organization

Suggested Readings

- Principles Of Toxicology by: Karen E. Stine, Thomas M. Brown 2006 Publisher: Crc Press ISBN:084932856X ISBN-13: 9780849328565, 978-0849328565
- Principles Of Biochemical Toxicology by John A. Timbrell Publisher: Informa Healthcare ISBN:0849373026 ISBN-13: 9780849373022, 978-0849373022
- Environmental Toxicology by Sigmund F. Zakrzewski, (2002) Publisher: Oxford University Press, USA ISBN:0195148118 ISBN-13: 9780195148114, 978-0195148114

Question paper Pattern for Choice based course II: BC6CBT02-Biochemical and Environmental Toxicology

| Unit | Section A 2 Marks | Section B 4 Marks | Section C 6 Marks | Section D 10 Marks | Total |
|---------------------------------------|----------------------|----------------------|----------------------|-----------------------|-----------|
| I | 4 | 2 | 1 | 0 | 7 |
| II | 4 | 3 | 1 | 1 | 9 |
| III | 2 | 4 | 1 | 1 | 8 |
| IV | 1 | 0 | 1 | 1 | 3 |
| V | 1 | 0 | 1 | 1 | 3 |
| Total No. of Questions | 12 | 9 | 5 | 4 | 30 |
| No.of Questions to be answered | 9 | 6 | 3 | 2 | 20 |
| Total Marks | 18 | 24 | 18 | 20 | 80 |

Choice based course III: BC6CBT03- Plant Biochemistry

Total hours of instruction: 72.

Hours/week: 4.

Credit: 3

Objectives: - This course intends to introduce the students into basics of plant biochemistry. This course will make them aware of the different type of biochemical reactions taking place in plants. Also the students are exposed to the value added products of plants.

Unit I: (12 hours)

Photosynthesis: Ultra structure and organization of chloroplast membranes, lipid composition of chloroplast membranes, electron transport chain. Thylakoid membrane protein complexes. Calvin cycle: Biochemistry of RuBP carboxylase/oxygenase, activation of RUBISCO, oxygenation reaction, stereochemistry of RUBISCO, Hatch and slack pathway, CAM plants; productivity of C4 plants, photorespiration and compensation point, photosynthetic efficiency and plant productivity.

Unit II: (12 hours)

Nitrogen Metabolism: Nitrogen fixation, nitrogenase complex, electron transport chain and mechanism of action of nitrogenase. Structure of 'NIF' genes and its regulation, Hydrogen uptake and bacterial hydrogenases, Nitrate Metabolism: Enzymes of nitrate metabolism, regulation of their synthesis and activity. Ammonium assimilation enzymes: glutamine synthetase, glutamate synthase and GDH.

Unit III: (10 hours)

Plant growth regulators: Auxins, gibberellins, Cytokines, abscisic acid and ethylene-biosynthesis and their metabolic functions, synthetic growth hormones, inhibitors. Biosynthetic origin of secondary metabolites from primary metabolites.

Distinction between primary and secondary metabolites, Occurrence and distribution of secondary metabolites in taxonomically distinct plants, Distribution in various plant parts and at different developmental stages in plants

Unit IV: (18 hours)

Major chemical classes of secondary metabolites: A brief account of the following classes: Alkaloids, terpenoids, flavonoids, phenolics and phenolic acids, steroids, coumarins, quinines, acetylenes, cyanogenic glycosides, amines and non-protein amino

acids, gums, mucilages, resins etc. (Structures not necessary. Give examples of the compounds and the plants in which present and their importance).

Importance of secondary metabolites: Protection of the producer plant from predators and insects; importance to man as active principles exerting physiological effects to mammalian systems. Uses of secondary metabolites to man: as drugs, precursors of drugs in pharmaceutical industry, as natural pesticides/insecticides; other uses of secondary metabolites.

Unit V: (20 hours)

General biosynthetic pathways and functions of the following classes of secondary metabolites (structures of intermediates not necessary):

- Terpenoids: Isoprene as precursor, hemi, mono, sesqui, di, triperenes and polyterpenes with examples and important members; their functions.
- Phenols: simple phenols, phenol carboxylic acids, phenylpropanes, flavan derivatives, and phenolic glycosides. Broad outline of their biosynthesis and functions in plants and uses
- Alkaloids: Definition of true and pseudo alkaloids; phenylethylamines, pyrrolidone alkaloids, piperidine alkaloids, pyridine alkaloids, tropane alkaloids, quinoline and isoquinoline alkaloids, indole alkaloids, purine alkaloids, isoprenoid alkaloids, steroidal alkaloids.

Suggested Readings

- Plant Metabolism by H.D. Kumar and H.N. Singh (1980) Publisher: Macmillan (Mar 1980) ISBN-10: 0333256387 ISBN-13: 978-0333256381
- Biotechnology: Secondary Metabolites by K.G. Ramawat, (2000) Publisher: Science Publishers,U.S. ISBN-10: 1578080576 ISBN-13: 978-1578080571
- Plant Biochemistry by P. M. Dey and J. B. Harborne (Editors) (1997) Publisher: Academic Press ISBN-10: 0122146743, ISBN-13: 978-0122146749
- Plant Metabolism by Prof David T. Dennis, Prof David H. Turpin, Dr Daniel D. Lefebvre and Dr David B. Layzell (Editors) (1997) Publisher: Longman; ISBN-10: 0582259061, ISBN-13: 978-582259065

- Plant Biochemistry by Hans-Walter Heldt Professor Em (3ed 2004) Publisher: Academic ISBN-10: 0120883910 ISBN-13: 978-0120883912
- The Principles of Plant Biochemistry by Muriel Wheldale Onslow (1931) Publisher: Cambridge University Press ASIN: B002BJMX1M

Question paper Pattern for Choice based course III: BC6CBT03- Plant Biochemistry

| Unit | Section A 2 Marks | Section B 4 Marks | Section C 6 Marks | Section D 10 Marks | Total |
|---------------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|--------------|
| I | 5 | 2 | 1 | 1 | 9 |
| II | 4 | 1 | 1 | 1 | 7 |
| III | 1 | 3 | 1 | 1 | 6 |
| IV | 1 | 1 | 1 | 1 | 4 |
| V | 1 | 2 | 1 | 0 | 4 |
| Total No. of Questions | 12 | 9 | 5 | 4 | 30 |
| No.of Questions to be answered | 9 | 6 | 3 | 2 | 20 |
| Total Marks | 18 | 24 | 18 | 20 | 80 |

17. Syllabus for B.Sc Biochemistry as a Complementary Subject

SYLLABUS FOR B.Sc BIOCHEMISTRY AS A COMPLEMENTARY SUBJECT

FIRST SEMESTER

Complementary course I: BC1CMT01-Elementary Biochemistry

Total hours of instruction: 36

Hours/week: 2

Credit: 2

Objective:To introduce the student basic principle of different types of chemical interactions in biological systems, an understanding on the basics of membrane biochemistry, importance of biochemistry of blood and to have a basic understanding of biochemical separation techniques.

Unit-I Physical Aspects of Biochemistry (10 hours)

Structure of water, Interactions in aqueous systems- covalent bond, hydrophobic interactions, Ionic interactions, hydrogen bond and van der Waals interactions. Ionization of water, strong and weak acids and bases and their dissociation, Henderson-Hasselbalch equation with derivation. Concepts of pH and Buffers. Buffers in biological systems – Phosphate buffer, Bicarbonate Buffer, Hemoglobin buffer.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p: 230, 244, 269

Ref: Lehninger Principles of Biochemistry by Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008) 5th Edition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman and Company, New York p:43-64.

Unit-II - Membrane Biochemistry (8hours)

Fluid mosaic model of membrane. Types of membrane proteins (peripheral, integral and amphitropic). Solute transport across membranes (passive transport—simple diffusion and facilitated diffusion, active transport- primary and secondary, uniport, symport, antiport). Osmosis. Fundamental study of Donnan equilibrium-application in biological system.

Ref: Biochemistry fifth edition by Campbell Farrell (2006) Thomson Brooks Cole Ltd p: 34- 54

Ref: Biochemistry by J. M. Berg, J. L. Tymoczko, L. Stryer 6th edition (2007) W. H. Freeman and Company, New York p: 510-555

Unit-III Blood (6 hours)

Biochemistry of blood, constituents of blood, types of blood cells. Components of plasma, types of plasma proteins and functions clotting factors. Mechanism of blood clotting, anticoagulants, fibrinolysis.

Ref: Essentials of Medical physiology by Sembulingum, Prema sembulingum 5th edition Jaypee (2010) p: 49-150

Ref: Harper's illustrated Biochemistry by R.K Murray et al 25th edition (1999) Publisher: Appleton & Lange:588-632

Unit-IV- Techniques in Biochemistry (12 hours)

Colorimetry and spectrophotometry

Chromatography- Paper, TLC, HPTLC, Gel Filtration, Affinity chromatography

Electrophoresis- PAGE, AGE

Blotting Techniques- Western, Southern and Northern Blotting

Introduction to proteomics-MALDI-TOF MS

Ref: Practical Biochemistry Principles and Techniques by Keith Wilson and John Walker 5th edition (2005), Cambridge University Press, p: 580-681

Ref: Biophysical Chemistry Principles and Techniques by Upadhyay, Upadhyay, Nathhimalaya publishing house (2002), p: 175-270, 344-421, 422-478.

Suggested Readings

- A Text Book of Biochemistry, E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, Oxford and IBH Publishing Co., New Delhi, 1974
- Textbook Of Medical Biochemistry (third Edition) (Paperback-2001) by S. Ramakrishnan. Publisher: Orient Longman ISBN: 8125020713 ISBN13: 9788125020714, 8125020714
- Introduction to Biophysics by Pranab Kumar Banarjee, S. Chand & Company Ltd. 2008
- Biochemistry third edition by Mathews, van Holde, Ahern Pearson Education
- Human Physiology by C C Chatterjee 11th edition 1987
- Biochemistry by Debajyoti Das. Academic Publishers. Kolkata.
- Introduction to Biophysics by Pranab Kumar Banarjee (2008) S. Chand & Company Ltd

Question paper Pattern for Complementary course I: BC1CMT01-Elementary Biochemistry

| Unit | Section A 2 Marks | Section B 4 Marks | Section C 6 Marks | Section D 10 Marks | Total |
|---------------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|--------------|
| I | 4 | 3 | 1 | 1 | 9 |
| II | 1 | 2 | 1 | 1 | 5 |
| III | 3 | 2 | 1 | 1 | 7 |
| IV | 4 | 2 | 2 | 1 | 9 |
| Total No. of Questions | 12 | 9 | 5 | 4 | 30 |
| No.of Questions to be answered | 9 | 6 | 3 | 2 | 20 |
| Total Marks | 18 | 24 | 18 | 20 | 80 |

Complementary course Practical I- Elementary Biochemistry

Total hours of instruction: 36

Hours/week: 2

Credit:1

Objective:To resolve quantitative problems concerning preparation of solutions and buffers and to have an understanding of basic separation techniques.

1. Preparation of solutions:

- Percentage solutions
- Molar solutions
- Normal solutions
- Dilution of Stock solutions

2. Preparation of buffers using the Henderson Hasselbach equation

3. Determination of pH using pH meter (Demonstration)

4. Biochemical separation Techniques

a. Chromatographic techniques (**Any one to be performed**)

- Separation of amino acids and simple sugars by Paper chromatography (Descending or ascending)
- Separation of amino acids and lipids by Thin Layer chromatography
- Separation of Plant pigments by Column chromatography

b. Electrophoretic techniques (Demonstration)

- Analysis of proteins and nucleic acids (PAGE, AGE)

5. Colorimetry and Spectrophotometry techniques

- Verification of Beer Lambert's law

References

- Hawk's Physiological Chemistry, Bernard L. Oser (ed) TATA McGRAW Hill Publishing Company LTD, New Delhi p 10- 15.
- Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande, I.K International Pvt. LTD, New Delhi, ISBN 81-88237-41-8, p 13- 17, p 39 – 43.
- Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p 1- 15, 195-303
- Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p 12 - 18

SECOND SEMESTER

Complementary course II: BC2CMT02-Biomolecules

Total hours of instruction: 36

Hours/week: 2

Credit:2

Objective:To describe structural characteristics of simple organic biomolecules and their biologically important derivatives indicating the constituent units, linkage between them etc.

Unit I: Carbohydrates (10 hours)

Isomerism of carbohydrates, D and L forms of glyceraldehyde, epimers, mutarotation and its explanation by ring structures, anomers, Structure (linear and cyclic) of glucose, galactose, mannose and fructose. Reducing action of sugars, Structure ((Haworth perspective formula) of disaccharides - maltose, sucrose, lactose) (elucidation of the structures of mono-, di-, and polysaccharides is not included). Structure and important properties of the following Homopolysaccharides – Starch, glycogen, cellulose and chitin. Heteropolysaccharides-hyaluronic acid, heparin.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p:73

Ref: Lehninger Principles of Biochemistry by Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008) 5th Edition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman and Company, New York p: 239-255

Unit II: Lipids (6 hours)

Basic ideas about classification and physiological functions of lipids, Fatty acids – classification, structure of the following fatty acids – stearic acid, oleic acid, linoleic acid. Structure of triacylglycerol. Structure of: phosphatidic acid, lecithin, cephalin, and phosphatidyl serine. Functions of Sphingolipids. Chemical structure and functions of cholesterol and ergosterol. Definition of saponification number, acid number and iodine number of fats.

Ref: Lehninger Principles of Biochemistry by Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008) 5th Edition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman and Company, New York p:345-356

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p:230

Unit III: Aminoacids and Protein (10 hours)

Name (with one letter and three letter code) and structures of the 20 standard aminoacids occurring in proteins, Representation of amino acid in the zwitter ionic form. Classification and function of Proteins. Elementary study of primary, secondary, tertiary and quaternary structure of proteins. Denaturation of proteins. Specialised proteins – structure and functions of Collagen

Ref: Lehninger Principles of Biochemistry by Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008) 5th Edition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman and Company, New York. p: 75-90, 127-129

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p:132

Unit IV: Nucleic acids (10 hours)

Chemical nature of nucleic acids- Structure of purines and pyrimidines, deoxyribose, ribose, nucleosides, nucleotides. Formation of phosphodiester linkages, Watson-Crick model of DNA-Chargaff rule, Different forms of DNA-A, B and Z DNA. Denaturation of nucleic acids- hyperchromic effect, T_m -values and their significance, Structure and function of mRNA, rRNA and tRNA.

Ref: Lehninger Principles of Biochemistry by Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008) 5th Edition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman and Company, New York. p: 273-300

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p:280

Suggested Readings

- A Text Book of Biochemistry by E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, Oxford and IBH Publishing Co., New Delhi, 1974
- Biochemistry by Donald Voet, Judith G. Voet Publisher: John Wiley & Sons Inc (2004) ISBN: 047119350X ISBN-13: 9780471193500, 978-0471193500
- Principles Of Biochemistry by Geoffrey L Zubay, William W Parson, Dennis E Vance Publisher: Mcgraw-hill Book Company – Koga (1995) ISBN: 0697142752 ISBN-13: 9780697142757, 978-0697142757
- Principles Of Biochemistry, 4/e by Robert Horton H, Laurence A Moran, Gray Scrimgeour K Publisher: Pearsarson (2006) ISBN: 0131977369, ISBN13: 9780131977365, 978-0131977365
- Biochemistry (6th Edition) by Jeremy M. Berg, John L. Tymoczko, Lubert Stryer Publisher: B.I. Publications Pvt. Ltd (2007) ISBN: 071676766X ISBN13: 9780716767664, 978716767664

- Biochemistry by Rastogi Publisher: McgrawHill (2008) ISBN:0070527954 ISBN13: 978 0070527959, 978-0070527959
- Textbook of Biochemistry for medical students by Vasudevan, D. M., Sreekumari, S., &Vaidyanathan, K. (2010). Jaypee Brothers Publishers. p: 76

Question paper Pattern for Complementary course II: BC2CMT02-Biomolecules

| Unit | Section A 2 Marks | Section B 4 Marks | Section C 6 Marks | Section D 10 Marks | Total |
|---------------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|--------------|
| I | 4 | 3 | 1 | 1 | 9 |
| II | 3 | 3 | 1 | 1 | 8 |
| III | 3 | 0 | 1 | 1 | 5 |
| IV | 2 | 3 | 2 | 1 | 8 |
| Total No. of Questions | 12 | 9 | 5 | 4 | 30 |
| No.of Questions to be answered | 9 | 6 | 3 | 2 | 20 |
| Total Marks | 18 | 24 | 18 | 20 | 80 |

Complementary course Practical II- BC2CMP01- Biomolecules

Total hours of instruction: 36

Hours/week: 2

Credit:1

Objective:To provide the students an opportunity to develop their qualitative skills and to have a sound knowledge on basic protocols for identification of biomolecules.

1. Qualitative analysis of a given unknown sample (Carbohydrates/proteins/amino acids/lipids/NPN substance)

i. Reactions of Carbohydrates, Amino acids, Proteins , Lipids and NPN substance

a. Carbohydrates: (Glucose, fructose, Maltose, Lactose, Sucrose, Starch, Dextrin maybe given for analysis).

Molisch test, Iodine test, Test for reducing sugars (Fehling's test, Benedict's test, Barfoed's test), Seliwanoff's test, Bial's test, Mucic acid test, Acid hydrolysis of Sucrose, Osazone test

b. Amino acids: (tyrosine, tryptophan, cysteine, cystine, methionine, arginine, proline, histidine may be given for analysis)

Ninhydrin test, Xanthoproteic test, Istatin test, Pauly's diazo test, sakaguchi test, Ehrlich's test, Sodium nitroprusside test, Millon's test, Sullivan's test

c. Proteins: (Casein, Albumin, Gelatin, peptone may be given for analysis).

Biuret test, Ammonium sulfate precipitation test, Sulphosalicylic acid test, Heat coagulation test, test for inorganic phosphate

d. Lipids: Fats (tristearin), Fatty acids (palmitic acid, stearic acid, oleic acid), Glycerol, Steroids, and cholesterol

Solubility in Organic solvents, saponification test, Acrolein test, Test for unsaturation: with bromine water or dilute potassium permanganate or Hubl's iodine test, Salkowski test, Zak's test

e. Non Protein nitrogenous compounds: (Urea, Uric acid, Creatinine)

Urease test, Phosphotungstic acid test and Jaffe's test

ii. Identification of Monosaccharide, Disaccharide, Polysaccharide following a systematic scheme of analysis (Single component from among the above mentioned carbohydrates to be given).

iii. Identification of amino acids and proteins following a systematic scheme for analysis (single components only need be given)

iv. Identification of lipids following a systematic scheme for analysis (single components only need be given)

- v. Identification of NPN following a systematic scheme for analysis (single components only need be given)

References

- Hawk's Physiological Chemistry, Bernard L. Oser (ed) TATA McGRAW Hill Publishing Company LTD, New Delhi p 10- 15. , p 60 – 127, 1317- 1334
- Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande, I.K International Pvt. LTD, New Delhi, ISBN 81-88237-41-8, p 13- 17, p 49-72
- Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9 p 15- 23, 33- 35, 50 -57.
- Practical Biochemistry, R.C. Gupta & S. Bhargava (eds) CBS Publishers and Distributors, New Delhi, ISBN 81-239-0124-0 p 9 - 27

THIRD SEMESTER

Complementary course III: BC3CMT03-Enzymology and Metabolism

Total hours of instruction: 54

Hours/week: 3

Credit: 3

Objective: To introduce the student basics of enzyme catalysis and explain the major pathways of carbohydrate, protein and lipid metabolism.

Unit I -Enzymology (16 hours)

Classification of enzymes- six major classes of enzymes with one example each. Cofactors and coenzymes. Elementary study of the factors affecting velocity of enzyme catalysed reactions- effect of substrate concentration, enzyme concentration, temperature and pH. Michaelis-Menten equation (without derivation). K_m and its significance. The Lineweaver- Burk plot. Enzyme specificity- an example each for group specificity, optical specificity, geometrical specificity and cofactor specificity of enzymes. Enzyme inhibition- competitive, noncompetitive and uncompetitive inhibition (explain using LB plot). Allosteric regulation of enzymes- explain using aspartate transcarbamoylase.

Ref: Biochemistry by U. Satyanarayana and U. Chakrapani. Fourth Edition, co-published by Elsevier Books and Allied (P) Ltd, ISBN: 978-81-312-3601-7, p:86-101

Ref: Lehninger Principles of Biochemistry by Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008) 5th Edition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman and Company, New York, p:184-220.

Unit –II Carbohydrate metabolism (16 hours)

Glycolysis (with structure). Gluconeogenesis. Fates of pyruvate, lactic acid fermentation, alcohol fermentation. pyruvate dehydrogenase complex, Citric acid cycle (with structure), substrate level phosphorylation, electron transport chain and oxidative phosphorylation. Glycogen metabolism-glycogenesis and glycogenolysis. Regulation of glycogen metabolism.

Ref: Biochemistry by U. Satyanarayana and U. Chakrapani. Fourth Edition, co-published by Elsevier and Books and Allied (P) Ltd, ISBN: 978-81-312-3601-7, p:225-265.

Ref: Lehninger Principles of Biochemistry by Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008) 5th Edition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman and Company, New York, p:528-707.

Unit-III Protein metabolism (12 hours)

Metabolism of aminoacids-Decarboxylation, deamination and transamination of aminoacids (without molecular mechanism).Urea cycle (with structure).Glucogenic and Ketogenic amino acids with examples. Non symbiotic nitrogen fixation

Ref: Biochemistry byU. Satyanarayana and U. Chakrapani. Fourth Edition, co-published by Elsevier and Books and Allied (P) Ltd, ISBN: 978-81-312-3601-7, p:144-375.

Ref: Lehninger Principles of BiochemistrybyNelson, D. L., Lehninger, A. L., & Cox, M. M. (2008), 5thEdition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman and Company, New York,p:677-878

Unit IV- Lipid metabolism (10 hours)

Fatty acid biosynthesis (with structure), Oxidation of fatty acids-Fatty acid activation, carnitine shuttle, β - oxidation (with structure) of fatty acids-explain using palmitic acid and ATP yield . Ketone bodies. Outline study of cholesterol biosynthesis (without structure).

Ref: Biochemistry byU. Satyanarayana and U. Chakrapani. Fourth Edition, co-published by Elsevier and Books and Allied (P) Ltd, ISBN: 978-81-312-3601-7, p: 287-309.

Ref: Lehninger Principles of Biochemistry byNelson, D. L., Lehninger, A. L., & Cox, M. M. (2008), 5thEdition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman and Company, New York, p:650-831

Suggested Readings

- A Text Book of Biochemistryby E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, Oxford and IBH Publishing Co., New Delhi, 1974
- Harper's Biochemistry by Robert K. Murray , Daryl K. Granner, Peter A. Mayes and Victor W. Rodwell, Publisher: Appleton & Lange; 25th Revised edition edition (1 July 1999), ISBN-10: 0838536840, ISBN-13: 978-0838536841
- Biochemistry Seventh Edition by Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, Publisher: W. H. Freeman; Seventh Edition edition (December 24, 2010), ISBN-10: 1429229365, ISBN-13: 978-1429229364
- Biochemistry by Donald Voet, Judith G. Voet, Publisher: John Wiley & Sons (2011), Fourth Edition,ISBN-10: 0071737073, ISBN-13: 978-0071737074
- Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain, Nithin Jain (2008), Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7

Question paper Pattern for Complementary course III: BC3CMT03-Enzymology and Metabolism

| Unit | Section A 2 Marks | Section B 4 Marks | Section C 6 Marks | Section D 10 Marks | Total |
|---------------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|--------------|
| I | 6 | 2 | 2 | 1 | 11 |
| II | 3 | 2 | 1 | 1 | 7 |
| III | 2 | 2 | 0 | 1 | 5 |
| IV | 1 | 3 | 2 | 1 | 7 |
| Total No. of Questions | 12 | 9 | 5 | 4 | 30 |
| No.of Questions to be answered | 9 | 6 | 3 | 2 | 20 |
| Total Marks | 18 | 24 | 18 | 20 | 80 |

Complementary course Practical III- Enzymology and Metabolism

Total hours of instruction: 36

Hours/week: 2

Credit: 1

Objective: To make the student understand the basic steps involved in extraction and determination of enzyme activity.

1. Extraction of enzymes: (Minimum of 2 experiments to be done)
 - Acid phosphatase from Fresh Potato (*Solanum tuberosum*)
 - β - amylase from Sweet potato (*Ipomoea batatas*)
 - Urease from Jack bean (*Canavalia ensiformis*)
2. Enzyme Assay: (Minimum of 2 experiments to be done, enzymes extracted from above experiment can be used)
 - Acid phosphatase
 - β - amylase
 - Urease from Jack bean

References

- Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8, p: 173-187
- Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p: 110 – 155
- Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p: 49- 181, 184 – 255

FOURTH SEMESTER

Complementary course IV: BC4CMT04-Molecular Biology, Nutrition and Clinical Biochemistry

Total hours of instruction: 54

Hours/week: 3

Credit: 3

Objective: To Introduce the student basics of central dogma of molecular biology. Explain and schematize the nutritional and biological importance of vitamins and minerals. Explain the clinical significance of organ based function tests and describe the biochemical basis of some important metabolic disorders.

Unit I -Molecular biology (14 hours)

Central Dogma, Replication, transcription and translation in prokaryotes. Genetic code. Post transcriptional and post translational modifications, wobble hypothesis.

Ref: Cell biology, Genetics, Molecular Biology, Evolution and Ecology by P.S. Verma and V. K. Agarwal (2008) Publisher: S. Chand & Company Ltd ISBN: 81-219-2442-1 p: 9, 16, 27, 44, 66, 75, 201

Unit II- Nutritional biochemistry (12 hours)

Concepts of nutrition, Nutritional requirements, Principle foods-Cereals, pulses, vegetables, fruits, nuts, milk, egg, meat, fish. Calorific value of foods, Respiratory quotient, Basal metabolic rate. Biological value of proteins, essential and non-essential amino acids and essential and non-essential fatty acids. Sources, nutritional importance and deficiency disorders of vitamin A, D, E, K, C, B1, B2, pyridoxine, nicotinic acid, B12 and folic acid (structure not required). Biological and nutritional importance of macro and micro minerals- calcium, magnesium, sodium, potassium, iron, copper, selenium and their deficiency disorders.

Ref: Textbook of Biochemistry for Medical Students by Vasudevan, D. M., Sreekumari, S, & Vaidyanathan, K. (2010). Jaypee Brothers Publishers. p: 74, 196, 271-281, 300-315, 317, 320, 321, 322.

Unit III- Clinical biochemistry (16 hours)

Sample collection and preservation of blood, plasma, serum and urine. Liver function tests - total protein, albumin, globulin, albumin-globulin ratio. Total and conjugated bilirubin, AST, ALT, ALP, GTT. Thyroid function tests- T3 and T4, TSH. Renal function

tests-Urea, creatinine, urea clearance test and creatinine clearance test (Normal values of the above tests must be included).

Ref: Text book of Medical Biochemistry by M.N. Chatterjee and Rana Shinde, Jaypee Brothers, Medical Publishers Pvt Ltd. New Delhi. p: 168 - 202.

Ref: Text Book of Biochemistry by D M Vasudevan and Sreekumari S. Jaypee Brothers, Medical Publishers Pvt Ltd. New Delhi.p: 517 - 525.

Ref: Clinical Biochemistry Principles and Practices by Praful B Godkar, Bhalani publishing house. Bombay. India. p: 87- 93

Unit IV- Biochemical basis of Metabolic disorders (12 hours)

Biochemical basis of Lactose intolerance, Diabetes mellitus, hypoglycaemia, galactosemia, hyperlipidemia, atherosclerosis, ketosis, obesity.

Ref: Clinical Biochemistry Principles and Practices by Praful B Godkar, Bhalani publishing house. Bombay. India. p: 258 – 271, 233 – 251, 92 – 117.

Ref: Text Book of Biochemistry by D M Vasudevan and Sreekumari S. Jaypee Brothers, Medical Publishers Pvt Ltd. New Delhi. p: 428 – 451, 480 – 484, 537 - 549.

Ref: - Text book of Medical Biochemistry by M.N. Chatterjee and Rana Shinde, Jaypee Brothers, Medical Publishers Pvt Ltd. New Delhi. p: 668 - 808.

Suggested Readings

- Lehninger Principles of Biochemistry, Fourth Edition by David L. Nelson Michael M. Cox. Publisher: W. H. Freeman; (2004) ISBN-10: 0716743396 ISBN-13: 978-0716743392
- A Text Book of Biochemistry by E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, Oxford and IBH Publishing Co., New Delhi, 1974
- Biochemistry (2004) by Donald Voet, Judith G. Voet Publisher: John Wiley & Sons Inc ISBN: 047119350X ISBN-13: 9780471193500, 978-0471193500
- Principles Of Biochemistry (1995) by Geoffrey L Zubay, William W Parson, Dennis E Vance Publisher: Mcgraw-hill Book Company Koga ISBN:0697142752 ISBN-13: 9780697142757, 978-0697142757
- Principles Of Biochemistry, 4/e (2006) by Robert Horton H , Laurence A Moran, Gray ScrimgeourK Publisher: Pearsarson ISBN: 0131977369, ISBN-13:9780131977365, 978-0131977365
- Biochemistry 6th Edition (2007) by Jeremy M. Berg John L. Tymoczko L. Ubert Stryer Publisher: B.I. publications Pvt. Ltd ISBN:071676766X ISBN13: 9780716767664, 978-716767664

- Biochemistry (2008) by Rastogi Publisher: McgrawHill ISBN:0070527954 ISBN13: 978 0070527959, 978-0070527959
- Notes on Clinical Biochemistry by John K. Candlish (1992) publisher: World Scientific Publishing Company ISBN: 9810210663 ISBN-13: 9789810210663, 978-9810210663
- Clinical Biochemistry: Metabolic And Clinical Aspects by William J. Marshall, Stephan K. Bangert, Elizabeth S.M. Ed. S.M (ed) Marshall (2008) Publisher: Elsevier Science Health Science Div ISBN: 0443101868 ISBN-13: 9780443101861, 978-0443101861
- Biochemistry by John K. Joseph (2006) Publisher: Campus Books International ISBN: 8180301109 ISBN -13: 9788180301100, 978-8180301100
- Basic Medical Biochemistry: A Clinical Approach by Dawn B PH.D. Marks, Allam D. Marks colleen M. Smith (1996) Publisher; Lippincott Williams & Wilkins; illustrated edition ISBN -10: 068305595X ISBN-13: 978-0683055955

Question paper Pattern for Complementary course IV: BC4CMT04-Molecular Biology, Nutrition and Clinical Biochemistry

| Unit | Section A 2 Marks | Section B 4 Marks | Section C 6 Marks | Section D 10 Marks | Total |
|---------------------------------------|----------------------|----------------------|----------------------|-----------------------|-----------|
| I | 3 | 3 | 1 | 1 | 8 |
| II | 4 | 2 | 2 | 1 | 9 |
| III | 2 | 2 | 1 | 1 | 6 |
| IV | 3 | 2 | 1 | 1 | 7 |
| Total No. of Questions | 12 | 9 | 5 | 4 | 30 |
| No.of Questions to be answered | 9 | 6 | 3 | 2 | 20 |
| Total Marks | 18 | 24 | 18 | 20 | 80 |

Complementary course Practical IV- BC4CMP02- Molecular Biology, Nutrition and Clinical Biochemistry

Total hours of instruction: 36

Hours/week: 2

Credit:1

Objective: To introduce the student protocols of quantitative analysis of biomolecules using colorimetric technique and to familiarize qualitative analysis of body fluids

1. Estimation of Carbohydrates: (Colorimetric) (Any 2 to be done)
 - Quantitation of total sugars by phenol sulphuric acid method
 - Estimation of reducing sugars by dinitrosalicylate method
 - Determination of fructose by Roe's resorcinol method
2. Separation and Estimation of Lipids: (Colorimetric) (Any 1 to be done)
 - Estimation of Cholesterol by Zak's method
 - Determination of saponification value of fats
 - Determination of iodine number of oils
3. Estimation of Proteins and Amino acids: (Colorimetric) (Any 2 to be done)
 - Estimation of protein by Lowry's method
 - Determination of protein by Biuret method
 - Estimation of tryptophan by Spies and Chamber's method
4. Estimation of Nucleic acids: (Colorimetric) (Any 1 to be done)
 - Estimation of DNA by Diphenylamine method
 - Determination of RNA by orcinol method
5. Estimation of Minerals and Vitamins (Colorimetric) (Any 1 to be done)
 - Colorimetric estimation of iron in foodstuffs by α α -dipyridyl method
 - Quantitative determination of thiamine in cereals and food
 - Estimation of ascorbic acid in Lemon juice
6. Qualitative tests of urine: Abnormal constituents) (Any 2 to be done)
 - Proteins (Coagulation test, sulfosalicylic acid test, test for Bence-Jones proteins)
 - Sugars (Benedict's test)
 - Haemoglobin (Benzidine test)
 - Ketone bodies (Rothera test, Gerhard's test)
 - Bile pigments (Fouchet's test, Gmelin's test)
 - Bile salts (Hay's test)

References

- Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8, p: p 81-126.
- Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p: 15 – 109.
- Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p: 49- 181, 184 – 255.

18. Model Question papers for B.Sc Biochemistry-Core

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

First Semester

Core Course- Biochemistry- BC1CRT01-Cellular Biochemistry

Time: Three Hours

Maximum Marks: 80

Section A (Very Short Answer Type Questions)

Answer any **nine** questions. Each question carries **two** marks

1. What is meant by deduction and induction?
2. What do you mean by prions?
3. Write a short note on nucleus?
4. Define necrosis.
5. What is meant by facilitated transport?
6. What is the importance of chromosomes?
7. What are the functions of Golgi complex?
8. Define apoptosis.
9. What is symport?
10. Define radioactivity
11. What is meant by abiotic formation of sugars?
12. Define probability. (9x2=18)

Section B (Short Answer Type Questions)

Answer any **six** questions. Each question carries **four** marks

13. What is role of caspases?
14. Define the terms benign and malignant?
15. Differentiate between exocytosis and endocytosis?
16. Briefly explain about marker enzymes?
17. Write a short note on the relation between history and philosophy of science?
18. Define the terms inductivism and falsification?
19. Write a short note on Ribozymes and RNA world.

20. Explain the structure and functions of glyoxysomes and peroxysomes
21. Discuss briefly on fluid mosaic model of plasma membrane (6x4=24)

Section C (Short Essay type Questions)

Answer any **three** questions. Each question carries **six** marks

22. Differentiate between plant, animal and microbial cells
23. Explain briefly the structure and functions of Endoplasmic reticulum
24. Give a detailed account on active transport.
25. Outline the apoptotic pathways?
26. Explain natural selection of self-replicating polymers (3x6=18)

Section D (Long Essay Type Questions)

Answer any **two** questions. Each question carries **ten** marks

27. Explain in detail the structure and composition of plasma membrane
28. Explain in detail subcellular particles mentioning their marker enzymes
29. What are the different phases of cell cycle?
30. Write an essay on Origin of life on earth. (10x2=20)

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

Second Semester

Core Course- Biochemistry-BC2CRT02-Physical Aspects of Biochemistry

Time: Three Hours

Maximum Marks: 80

Section A (Very Short Answer Type Questions)

Answer any **nine** questions. Each question carries **two** marks

1. Define ionic product of water.
2. What is a buffer.
3. Define true solution.
4. Explain Tyndall effect.
5. Define a hypotonic solution.
6. Give a short note on osmosis.
7. What is a redox reaction?
8. Define peptide bond.
9. Explain the Law of Mass action.
10. Define enthalpy.
11. What are emulsions?
12. Explain buffer action. (9x2=18)

Section B (Short Answer Type Questions)

Answer any **six** questions. Each question carries **four** marks

13. Define Bronsted theory of acids and bases with examples.
14. Differentiate between lyophilic and lyophobic colloids.
15. Comment on the various methods of expressing the concentration of solutions.
16. Write a brief note on coupled reactions with an example.
17. Write a brief note on the importance of charge on colloids.
18. Comment on the reversible and irreversible reactions.

19. Give a note on the influence of ionization and molecular size on osmotic pressure
20. Explain the following terms: (a) K_a (b) Indicator (c) Weak electrolyte (d) pOH.
21. Give an account on important applications of colloidal chemistry. (6 x 4 = 24)

Section C (Short Essay type Questions)

Answer any **three** questions. Each question carries **six** marks

22. What is a titration curve? Explain the titration curve of weak acid and a strong base.
23. Differentiate between true solution, colloidal solution and suspension
24. What is osmotic pressure? Comment on the significance of osmosis in biology with suitable examples.
25. Explain the following terms: (a) peptide bond (b) glycosidic bond (c) phosphodiester bond.
26. Comment on the various methods for measuring pH. (3x6= 18)

Section D (Long Essay Type Questions)

Answer any **two** questions. Each question carries **ten** marks

27. Derive Henderson-Hasselbalch equation and comment on various buffering systems in biology.
28. Explain Donnan membrane equilibrium and comment on its relevance in biological systems.
29. Explain in detail the various interactions maintaining the structure of biomolecules with suitable examples.
30. Give a detailed account on basic principles of thermodynamics as applicable to biological systems. (2x10= 20)

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

Third Semester

Core Course-Biochemistry-BC3CRT03-Methods in Biochemistry

Time: Three Hours

Maximum Marks: 80

Section A (Very Short Answer Type Questions)

Answer any **nine** questions. Each question carries **two** marks

1. State Beer-Lambert's law
2. What is ultrafiltration?
3. Name the different types of centrifuges
4. What is the principle of fluorimetry
5. What are the applications of SDS-PAGE?
6. Give the principle of gel permeation chromatography
7. Define correlation coefficient
8. Write a short note on sampling techniques
9. Differentiate between partition and adsorption chromatography
10. Define probability theory
11. What is isoelectric focussing
12. What is the difference between colorimetry and spectrophotometry (9x2=18)

Section B (Short Answer Type Questions)

Answer any **six** questions. Each question carries **four** marks

13. Write a short note on chi-square test
14. Define random variables and distribution functions.
15. Write a note on principle and application of affinity chromatography
16. Explain principle and application of immunoelectrophoresis
17. Give an account on different types of tissue extraction and fractionation.
18. Describe isopycnic centrifugation

19. Write a detailed account on molar extinction coefficient and quantitation
20. Discuss briefly on atomic absorption spectrophotometer
21. What is multiple linear regression analysis? (6 x 4= 24)

Section C (Short Essay type Questions)

Answer any **three** questions. Each question carries **six** marks

22. Give an account on the significance of statistical methods in biochemical investigations.
23. Explain in detail principle and application of GLC and HPLC
24. Describe in detail different types of centrifuge rotors
25. Outline the procedure for Gel electrophoresis
26. Explain the principle of nephelometry (3x6=18)

Section D (Long Essay Type Questions)

Answer any **two** questions. Each question carries **ten** marks

27. Explain in detail the principle and application of zone electrophoresis
28. Explain in detail the computer statistical packages
29. Give a detailed account on principle procedure and application of differential and density gradient centrifugation
30. Write in detail the principle, procedure and application of ion exchange chromatography (10x2=20)

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

Fourth Semester

Core Course-Biochemistry-BC4CRT04-Biomolecules

Time: Three Hours

Maximum Marks: 80

Section A (Very Short Answer Type Questions)

Answer any **nine** questions. Each question carries **two** marks

1. Explain epimerism with example?
2. What are liposomes?
3. Differentiate nucleotide and nucleoside?
4. What is acid number and iodine number?
5. What are cot curves?
6. Write the physiological significance of vitamin E?
7. Write the structure of sucrose and maltose?
8. Write the structure of glutathione?
9. Explain hyperchromic effect of nucleic acids.
10. Explain stereoisomerism with the structure of aminoacids.
11. Give a short note on denaturation of proteins
12. What is the nutritional importance of iron? (9x2=18)

Section B (Short Answer Type Questions)

Answer any **six** questions. Each question carries **four** marks

13. Explain protein sequencing?
14. Differentiate starch and Cellulose?
15. Classification of lipids?
16. Write a note on Bacterial cell wall polysaccharides
17. Explain the structure of tRNA?
18. Write a note on vitamin deficiency disorders
19. What is T_m -value? What is its significance?

20. Write a note on classification of proteins

21. Give an account on glycosaminoglycans

(6x4=24)

Section C (Short Essay type Questions)

Answer any **three** questions. Each question carries **six** marks

22. Give a note on general reactions of amino acids.

23. Write a note on biological importance of disaccharides

24. Explain dideoxy method of DNA sequencing

25. Write a note on fat soluble vitamins

26. Write the structure and functions of cholesterol and ergosterol?

(3x6=18)

Section D (Long Essay Type Questions)

Answer any **two** questions. Each question carries **ten** marks

27. Explain Structural organization of proteins?

28. Explain the structure and functions of structural and storage polysaccharides?

29. What are the different types of DNA? Explain Watson and Crick model of DNA?

30. Write the structure and functions of phospholipids and glycolipids

(2x10=20)

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

Fifth Semester

Core Course-Biochemistry-BC5CRT05-Physiological Aspects of Biochemistry

Time: Three Hours

Maximum Marks: 80

Section A (Very Short Answer Type Questions)

Answer any **nine** questions. Each question carries **two** marks

1. What is ptyalin?
2. Mention the sources of energy for muscle contraction
3. Which are the major functions of Insulin?
4. What is an axon?
5. What are plasma cells?
6. What are chylomicrons?
7. What do you mean by neurotransmitters? Give example.
8. Give an account on chloride shift
9. What is the role of bile salts in lipid digestion?
10. What is calcitriol?
11. What is the function of Oxytocin?
12. Define anticoagulants (9 x 2=18)

Section B (Short Answer Type Questions)

Answer any **six** questions. Each question carries **four** marks

13. Write a note on buffer systems of blood .
14. Give an account on the mechanism of urine formation.
15. What are the clotting factors?
16. Explain the significance of Ca in Muscle contraction.
17. Write a note on classification of hormones.
18. Comment on the role of hormones in bone metabolism.
19. How carbohydrates are digested in our body?

20. Biosynthesis of dopamine

21. Give an account of composition and function of bile (6 x 4 =24)

Section C (Short Essay type Questions)

Answer any **three** questions. Each question carries **six** marks

22. Explain the mechanism of nerve impulse transmission.

23. Comment on the mechanism of hormone action

24. Explain mechanism of blood clotting

25. Explain the site of biosynthesis and functions of vasopressin

26. Explain the biochemical events that occur during muscle contraction and relaxation.
(3 x 6 = 18)

Section D (Long Essay Type Questions)

Answer any **two** questions. Each question carries **ten** marks

27. Explain the digestion and absorption of lipids.

28. Explain the structure and function of hemoglobin. Describe the oxygen binding curve of hemoglobin.

29. Explain the water and electrolyte balance of the body.

30. Describe the role of calcium, phosphorous, Vitamin D and hormones in bone metabolism.
(2 x 10 =20)

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

Fifth Semester

Core Course- Biochemistry-BC5CRT06- Immunology and Immunological Techniques

Time: Three Hours

Maximum Marks: 80

Section A (Very Short Answer Type Questions)

Answer any **nine** questions. Each question carries **two** marks

1. What is an epitope?
2. Explain Null cells.
3. What is meant by processing of antigens?
4. Comment on immunoprecipitation.
5. Distinguish between humoral and cell mediated immune response
6. What are haptens?
7. What is complement activation?
8. Differentiate between active and passive immunization.
9. Define autoimmune diseases.
10. What are cytokines?
11. Comment on innate immunity
12. Write a note on MHC (9x2=18)

Section B (Short Answer Type Questions)

Answer any **six** questions. Each question carries **four** marks

13. Give an account on RIA
14. Illustrate the structure of Ig G.
15. Differentiate T cell and B cells.
16. Write a note on hyper sensitivity and allergy
17. What is ELISA.
18. Give a short note on antigen antibody interactions.

19. Types of immune diseases
20. Explain Complement activation.
21. Give an account on structure and function of cytokines (6x4=24)

Section C (Short Essay type Questions)

Answer any **three** questions. Each question carries **six** marks

22. What are antigen presentation cells?
23. Write a note on transplantation immunology
24. Explain preparation of monoclonal antibody and its application.
25. Write a note on primary and secondary lymphoid organs
26. Give an account on types of vaccines. (3x6=18)

Section D (Long Essay Type Questions)

Answer any **two** questions. Each question carries **ten** marks

27. Write an essay on cellular interaction for generation of humoral and cell mediated immune responses
28. Write a detailed note on cells of immune system.
29. Give a detailed account on structure, function and classes of immunoglobulins
30. Explain in detail about autoimmune diseases. (2x10=20)

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

Fifth Semester

Core Course-Biochemistry-BC5CRT07-Enzymology and Enzyme technology

Time: Three Hours

Maximum Marks: 80

Section A (Very Short Answer Type Questions)

Answer any **nine** questions. Each question carries **two** marks

1. What is apoenzyme?
2. Define active site
3. Describe the functions of cyanocobalamin
4. What is enzyme turnover number?
5. Define IU of enzyme
6. Draw Lineweaver- Burk plot
7. What is the significance of V_{max} value of enzyme?
8. Define diagnostic enzymes
9. Give brief account of use of lactase in dairy industry
10. What do you mean bycovalently modified enzymes?
11. What is zymogen?
12. State Michaelis-Menten equation. (9x2=18)

Section B (Short Answer Type Questions)

Answer any **six** questions. Each question carries **four** marks

13. Write a short note on Ribozymes and Abzymes
14. Give brief account of enzyme specificity
15. What is Km value? Mention its significance
16. Explain Isoenzymes with two examples
17. Write a short note on immobilization of enzymes
18. What is meant by enzyme catalysis?
19. Give a brief account of use of proteases in food industry

20. What are the functions of biotin and NADP⁺

21. Give an account on enzymes (6x4=24)

Section C (Short Essay type Questions)

Answer any **three** questions. Each question carries **six** marks

22. Give an account of the classification and nomenclature of enzymes

23. Derivation of Michaelis -Menten equation and its significance

24. Write a short note on Enzyme inhibition

25. Explain zymogen activation

26. Describe the lock and key model and induced fit model of enzyme catalysis

(3x6=18)

Section D (Long Essay Type Questions)

Answer any **two** questions. Each question carries **ten** marks

27. Describe the industrial uses of enzymes

28. Write a short note on isolation of enzymes and the criteria of purity

29. Explain the factors affecting the velocity of enzyme catalyzed reaction

30. Give an account of the allosteric regulation of enzymes (2x10=20)

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

Fifth Semester

Core Course- Biochemistry-BC5CRT08-Metabolism and Bioenergetics

Time: Three Hours

Maximum Marks: 80

Section A(Very Short Answer Type Questions)

Answer any **nine** questions. Each question carries **two** marks

1. Explain Free energy concept?
2. Explain alcoholic fermentation and its significances?
3. Explain the role of cAMP in glycogen metabolism?
4. What is the role of high energy phosphates in energy transfer?
5. What is the function of carnitine?
6. What are proteolytic enzymes with an example?
7. Comment on redox potential?
8. State laws of thermodynamics.
9. What are ketone bodies?
10. Comment on the role of coupled reactions. Give an example?
11. Point out the committed steps in purine biosynthetic pathway.
12. Explain transamination? (9x2=18)

Section B (Short Answer Type Questions)

Answer any **six** questions. Each question carries **four** marks

13. What is meant by oxidative phosphorylation?
14. Give a short note on pyrimidine biosynthesis
15. Explain lactic acid fermentation?
16. Explain the ATP yield during fatty acid oxidation ?
17. Explain glyoxylate pathway and its importance?
18. Write down the importance of carnitine shuttle system in fatty acid metabolism?
19. Write a short note on pyruvate dehydrogenase complex in glycolysis?

20. State the difference between Glucogenic and ketogenic amino acids with an example?
21. Write a note on the different approaches for studying metabolism (6x4=24)

Section C (Short Essay type Questions)

Answer any **three** questions. Each question carries **six** marks

22. Write a short note on cholesterol synthesis?
23. Explain Urea cycle and its significance?
24. Explain Glycolysis with structure?
25. Detail note on Decarboxylation, transamination and deamination?
26. Explain the pathway of gluconeogenesis. (3x6=18)

Section D (Long Essay Type Questions)

Answer any **two** questions. Each question carries **ten** marks

27. Write a note on β -oxidation and explain β -oxidation of palmitic acid?
28. Explain TCA cycle with structure and its bioenergetics?
29. Write a note on mitochondrial electron transport and oxidative phosphorylation?
30. Write a brief note of purine and pyrimidine biosynthesis? (2x10=20)

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

Sixth Semester

Core Course- Biochemistry-BC6CRT09-Genetics and Molecular Biology

Time: Three Hours

Maximum Marks: 80

Section A (Very Short Answer Type Questions)

Answer any **nine** questions. Each question carries **two** marks

1. What is point mutation?
2. What are cosmids?
3. What are stop codons?
4. What is meant by chromosomal aberrations?
5. What is C-value paradox?
6. What do you mean by lagging and leading strands?
7. What is operon concept?
8. Give an example each of physical and chemical mutagen.
9. Give a short note on wobble hypothesis ?
10. What is Taq Polymerase?
11. What is reverse transcription?
12. Comment on the inhibitors of protein synthesis. (9 x 2=18)

Section B (Short Answer Type Questions)

Answer any **six** questions. Each question carries **four** marks

13. Explain co-dominance.
14. What do you mean by central dogma of molecular biology?
15. What is genetic code?
16. Explain complete and incomplete linkage.
17. Enumerate the initiation factors in transcription.
18. What do you mean by splicing?
19. Explain DNA finger printing

20. What do you mean by gene transfer?

21. Write a short note on chemical nature of gene (6 x 4 =24)

Section C (Short Essay type Questions)

Answer any **three** questions Each question carries **six** marks

22. Explain post-translational modification of proteins.

23. Give a detailed account on mutagenesis.

24. Differentiate between linkage and crossing over.

25. Describe blotting Techniques

26. Explain Lac Operon (3 x 6 = 18)

Section D (Long Essay Type Questions)

Answer any **two** questions. Each question carries **ten** marks

27. Give an account of structural aberrations of chromosomes.

28. Explain DNA replication.

29. Describe the mechanism of transcription.

30. Write a detailed account on Recombinant DNA technology (2 x10 =20)

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

Sixth Semester

Core Course- Biochemistry-BC6CRT10-Clinical Biochemistry

Time: Three Hours

Maximum Marks: 80

Section A (Very Short Answer Type Questions)

Answer any **nine** questions. Each question carries **two** marks

1. Name two widely used anticoagulant for clinical analysis of plasma.
2. Comment on Wilson's disease.
3. What is the role of Albumin-Globulin ratio in liver function tests.
4. Point out liver function tests?
5. What is the clinical significance of ESR.
6. Comment on Conn's Syndrome
7. What is hypervitaminosis.
8. What is the normal fasting blood sugar level?
9. Give two examples of urine preservatives.
10. What is scurvy?
11. Comment on the abnormalities of thyroid function.
12. What is PCV? (9x2=18)

Section B (Short Answer Type Questions)

Answer any **six** questions. Each question carries **four** marks

13. Comment on the principle of creatinine clearance test.
14. Explain GTT.
15. What are anticoagulants?
16. Explain the deficiency disorders of fat soluble vitamins.
17. Describe biochemical mechanism for detoxification.
18. Explain thyroid function tests.
19. Comment on the significance of total count and differential count

20. What is the significance of glycosylated haemoglobin.
21. Write a short note on principle for estimation serum acid phosphatase (6 x 4 =24)

Section C (Short Essay type Questions)

Answer any **three** questions Each question carries **six** marks

22. Comment on hyperinsulinism and hypoglycaemia.
23. Explain the significance of AST and ALT in liver disease.
24. Explain ABO blood groups.
25. Explain the clinical significance of serum alkaline phosphatase.
26. Write a note on blood transfusion. (3 x 6 = 18)

Section D (Long Essay Type Questions)

Answer any **two** questions. Each question carries **ten** marks

27. Give a detailed account on kidney function tests
28. Explain the collection and preservation procedures of blood, urine and cerebrospinal fluid.
29. Describe in detail the biochemical parameters for blood analysis
30. Write a detailed note on nutritional and hormonal disorders. (2x10 =20)

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

Sixth Semester

Core Course- Biochemistry-BC6CRT11-Pharmaceutical Biochemistry

Time: Three Hours

Maximum Marks: 80

Section A (Very Short Answer Type Questions)

Answer any **nine** questions. Each question carries **two** marks

1. Define the term lethal dose
2. What is drug intolerance?
3. Comment on drug addiction.
4. What is the role of kidney in drug metabolism?
5. What are drug metabolising enzymes?
6. Give a short note on the mode of action of chloramphenicol.
7. What are antifungal agents.
8. Explain receptor binding assays.
9. Name two different immunomodulators.
10. Define the term Reverse transcriptase.
11. Name any two enzyme inhibitors functioning as drugs.
12. What are the main side effects of drugs? (9x2=18)

Section B (Short Answer Type Questions)

Answer any **six** questions. Each question carries **four** marks

13. Write a short note on phase I reactions of drug metabolism.
14. What is the role of cytochrome P450 in drug metabolism?
15. What are the biological effects of drug abusing?
16. Explain the routes of drug administration.
17. Give an account on mode of action of estrogens.
18. What are the steps involved in chemotherapy of fungal infections.

19. Comment on DNA polymerase inhibitors.
20. Briefly explain the principle of drug action.
21. Write a short note on factors modifying drug action (6x4=24)

Section C (Short Essay type Questions)

Answer any **three** questions. Each question carries **six** marks

22. Explain chemical pathways of drug metabolism.
23. What are the general principles of chemotherapy?
24. Give a detailed account on the mechanism of action of anti HIV agents.
25. Discuss on structure-activity relationship of adrenocorticoids
26. Explain the different routes of administration of drugs. (3x6=18)

Section D (Long Essay Type Questions)

Answer any **two** questions. Each question carries **ten** marks

27. Explain in detail the adverse responses and side effects of drugs.
28. Give a detailed account on mode of action of different antibiotics.
29. What are the different steps involved in chemotherapy of cancer.
30. Give a detailed note on drug receptor interactions (2x10=20)

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

Sixth Semester
Core Course- Biochemistry-BC6CRT12-Computational Techniques in
Biochemistry

Time: Three Hours

Maximum Marks: 80

Section A (Very Short Answer Type Questions)

Answer any **nine** questions. Each question carries **two** marks

1. Expand DDBJ and KEGG
2. Name two data submission tools
3. What is BLAST?
4. Comment on drug bank.
5. What is molecular docking?
6. Differentiate between software and Hardware.
7. What do you mean by comparative genomics?
8. Describe flow chart
9. What do you mean by an IP address?
10. Describe virtual screening
11. Give an account on genbank.
12. What is HTML? (9x2=18)

Section B (Short Answer Type Questions)

Answer any **six** questions. Each question carries **four** marks

13. Explain biological databases.
14. What are scoring matrices?
15. Explain ClustalW.
16. Write notes on internet
17. What are the applications of bioinformatics?
18. Explain PDB.

- 19. Write notes on homology modeling
- 20. Comment on programming languages
- 21. Comment on NCBI (6x4=24)

Section C (Short Essay type Questions)

Answer any **three** questions. Each question carries **six** marks

- 22. Explain the role of bioinformatics in drug designing process.
- 23. Describe the structural organization of a computer. List the major operating systems.
- 24. Explain sequence alignment. What are the methods for sequence alignment and describe its applications
- 25. Give a detailed account on datamining of biological databases
- 26. Comment on primary and secondary sequence databases (3x6=18)

Section D (Long Essay Type Questions)

Answer any **two** questions. Each question carries **ten** marks

- 27. Give a detailed account on databanks.
- 28. Explain in detail bioinformatics tools employed in genome analysis.
- 29. Write an essay on the drug databases
- 30. Explain data submission and data retrieval tools (2x10=20)

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

Fifth Semester

Generic elective Course I- BC5GET01-Human Health and nutrition

Time: Three Hours

Maximum Marks: 80

Section A (Very Short Answer Type Questions)

Answer any **nine** questions. Each question carries **two** marks

1. Define balanced diet.
2. What is a food additive?
3. What is goitre?
4. What are Principal foods?
5. Name two waterborne diseases
6. Comment on food hygiene.
7. Define nutrigenomics.
8. What is hypovitaminosis?
9. Define AIDS.
10. What is ICDS?
11. Define obesity.
12. What is atherosclerosis? (9x2=18)

Section B (Short Answer Type Questions)

Answer any **six** questions. Each question carries **four** marks

13. Discuss the various international and national agencies working in the field of food and nutrition.
14. Write a brief note on Vitamin A deficiency programme.
15. Explain the socioeconomic aspects of nutrition.
16. Write a brief note on the nutritional importance of (a) fiber (b) fats.
17. Write a brief note on healthy cooking practices.

18. Comment on various food preservatives.
19. Discuss the term drug dependence
20. Write brief notes on: (a) Osteomalacia (b) Anaemia.
21. Discuss on household level of food preservation. (6x4=24)

Section C (Short Essay type Questions)

Answer any **three** questions. Each question carries **six** marks

22. Comment on life style diseases
23. Write brief notes on: (a) National iodine deficiency disorders programme (b) Mid-Day meal programme.
24. Discuss about the common food adulteration methods.
25. Explain the various water purification methods.
26. Explain protein deficiency disorders. (3x6=18)

Section D (Long Essay Type Questions)

Answer any **two** questions. Each question carries **ten** marks

27. Explain in detail about national nutritional programmes.
28. Comment on various food and water borne infections.
29. Explain in detail the various methods of food preservation.
30. Explain in detail the nutritional profiles of principal foods. (2x10=20)

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

Fifth Semester

Generic elective Course II- BC5GET02-Environmental Biochemistry

Time: Three Hours

Maximum Marks: 80

Section A (Very Short Answer Type Questions)

Answer any **nine** questions. Each question carries **two** marks

1. Which are the major sources of environmental pollution.
2. Classify pollutants based on their nature.
3. Define air pollution.
4. Define Food web.
5. Comment on Inorganic pollutants of water.
6. Describe global warming.
7. Comment on wildlife protection Act
8. Write a note on forest ecosystem
9. Comment on family welfare programmes
10. Give a short note on noise pollution.
11. What are the effects of over utilization of ground water
12. Give a note on ozone layer depletion (9x2=18)

Section B (Short Answer Type Questions)

Answer any **six** questions. Each question carries **four** marks

13. Write a note on condensation methods in air pollution.
14. What is the importance of grass land ecosystem
15. Sedimentation tanks.
16. What is the meant by acid rain?
17. Write a note on benefits and problems of dam
18. Explain the effect of modern agriculture on food resources
19. Comment on family welfare programmes in India

20. Which are the steps involved in waste water treatment for tannery.
21. Give a brief note on structure and function of aquatic ecosystem (6x4=24)

Section C (Short Essay type Questions)

Answer any **three** questions Each question carries **six** marks

22. Explain the role of IT in environment and human health
23. Explain environmental effects of extraction of mineral resources
24. Which are the different types of water pollution?
25. Comment on waste land reclamation
26. What are the effects of thermal pollution (3x6=18)

Section D (Long Essay Type Questions)

Answer any **two** questions. Each question carries **ten** marks

27. Which are the control devices for air pollution.
28. Give a detailed account on land as a resource
29. Explain structure and function of forest ecosystem
30. Explain in detail the relation between environment and human health (2x10=20)

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

Fifth Semester

Generic elective Course III- BC5GET03-Waste Management

Time: Three Hours

Maximum Marks: 80

Section A

(Very Short Answer Type Questions)

Answer any **nine** questions. Each question carries **two** marks

1. Define global warming
2. Give brief account of carbon dioxide emissions
3. Write a short note on principle of environmental science
4. What is LCIC?
5. Define fossil fuels
6. Comment on the sources of solid waste.
7. Give brief account of agricultural waste
8. Define vermi-composting
9. Define incineration
10. What is hazardous waste?
11. Define LC₅₀
12. Point out any two water borne diseases (9x2=18)

Section B (Short Answer Type Questions)

Answer any **six** questions. Each question carries **four** marks

13. Explain fossil fuels and their classification, composition energy content of coal, petroleum and natural gases
14. Write a short note on biochemical effects of lead poisoning.
15. Explain the characterization & monitoring of solid wastes
16. Give an account of the environment monitoring
17. Evaluation of ground water pollution

18. Write a short note on treatment and disposal techniques of solid wastes
19. Explain characteristics of hospital waste.
20. Give an account of monitoring of solid waste sites in mining waste dumps.
21. Write a note on sources of solid waste (6x4=24)

Section C (Short Essay type Questions)

Answer any **three** questions. Each question carries **six** marks

22. How do we obtain the energy from biomass and biogas?
23. Explain vadose and saturated zone monitoring of solid wastes in mining waste dumps.
24. Give an account of the waste management practices
25. Explain integrated waste management
26. Give a brief account of markers and indicators of pollutants in the body (3x6=18)

Section D (Long Essay Type Questions)

Answer any **two** questions. Each question carries **ten** marks

27. Give a detailed account of the different types of solid waste
28. Explain biomedical waste and their treatment and disposal methods
29. Describe the salient features and methods of waste recycling and waste disposal
30. How do you manage the radioactive wastes? Explain the dangers of dumping of hazardous wastes.

(2x10=20)

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

Fifth Semester

Choice based Course I- BC6CBT01-Human Health and nutrition

Time: Three Hours

Maximum Marks: 80

Section A (Very Short Answer Type Questions)

Answer any **nine** questions. Each question carries **two** marks

1. Define balanced diet.
2. What is a food additive?
3. What is goitre?
4. What are Principal foods?
5. Name two waterborne diseases
6. Comment on food hygiene.
7. Define nutrigenomics.
8. What is hypovitaminosis?
9. Define AIDS.
10. What is ICDS?
11. Define obesity.
12. What is atherosclerosis? (9x2=18)

Section B (Short Answer Type Questions)

Answer any **six** questions. Each question carries **four** marks

13. Discuss the various international and national agencies working in the field of food and nutrition.
14. Write a brief note on Vitamin A deficiency programme.
15. Explain the socioeconomic aspects of nutrition.
16. Write a brief note on the nutritional importance of (a) fiber (b) fats.
17. Write a brief note on healthy cooking practices.

18. Comment on various food preservatives.
19. Discuss the term drug dependence
20. Write brief notes on: (a) Osteomalacia (b) Anaemia.
21. Discuss on household level of food preservation. (6x4=24)

Section C (Short Essay type Questions)

Answer any **three** questions. Each question carries **six** marks

22. Comment on life style diseases
23. Write brief notes on: (a) National iodine deficiency disorders programme (b) Mid-Day meal programme.
24. Discuss about the common food adulteration methods.
25. Explain the various water purification methods.
26. Explain protein deficiency disorders. (3x6=18)

Section D (Long Essay Type Questions)

Answer any **two** questions. Each question carries **ten** marks

27. Explain in detail about national nutritional programmes.
28. Comment on various food and water borne infections.
29. Explain in detail the various methods of food preservation.
30. Explain in detail the nutritional profiles of principal foods. (2x10=20)

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

Sixth Semester

Choice based Course I- BC6CBT02-Biochemical and Environmental Toxicology

Time: Three Hours

Maximum Marks: 80

Section A (Very Short Answer Type Questions)

Answer any **nine** questions. Each question carries **two** marks

1. Define eco-toxicology?
2. What is Ames test?
3. Which are the common air pollutants?
4. What is Synergism and Antagonism?
5. What is called detoxification?
6. Write the regulatory organisations in toxicological risk management?
7. What is fluctuation test?
8. What is genotoxicity?
9. Explain toxicology of paracetamol.
10. Which are the clinical signs of systemic toxicity?
11. Differentiate between ED₅₀ & LD₅₀.
12. What is meant by host mediated assay? (9x2=18)

Section B (Short Answer Type Questions)

Answer any **six** questions. Each question carries **four** marks

13. Explain effect of air pollution on Ozone layer?
14. Discuss the environmental impact of pesticide toxicology
15. What is mutagenesis assay?
16. Write a note on Dominant Lethal test.
17. Explain the acute and chronic exposure factors influencing toxicity?

18. Write a note on air pollutants
19. What is genetic toxicity testing? What is its significance?
20. What are the toxicological effects of food additives?
21. Describe factors affecting acute toxicity studies. (6x4=24)

Section C (Short Essay type Questions)

Answer any **three** questions. Each question carries **six** marks

22. What are the health toxic effects of industrial effluent on mammalian tissues?
23. Briefly explain the biochemical basis of toxicity.
24. Explain conjugation reactions
25. Write a note on the regulatory approaches against toxicological risks.
26. Write the procedures of testing for acute toxic effects in mammalian tissues. (3x6=18)

Section D (Long Essay Type Questions)

Answer any **two** questions. Each question carries **ten** marks

27. Explain phase I reaction and phase II reactions in xenobiotic metabolism?
28. Explain the methods of toxicity testing?
29. Explain the management of toxicological risks? Which are the regulatory agencies involved?
30. Write the environmental consequences of pesticide toxicology. (2x10=20)

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

Sixth Semester

Choice based Course I- BC6CBT03-Plant Biochemistry

Time: Three Hours

Maximum Marks: 80

Section A (Very Short Answer Type Questions)

Answer any **nine** questions. Each question carries **two** marks

1. Define photosynthesis.
2. What is nitrogen metabolism
3. What is significance of glutamine synthase?
4. What is function of RUBISCO?
5. What is oxygenation reaction in photosynthesis?
6. What are the components of ETC?
7. What is meant by CAM plants?
8. Name four plant growth regulators.
9. Name the enzymes involved in nitrogen fixation?
10. Explain the term GDH?
11. Define true and pseudoalkaloids?
12. What is meant by simple phenols? (9x2=18)

Section B (Short Answer Type Questions)

Answer any **six** questions. Each question carries **four** marks

13. Explain the structure of chloroplast membranes
14. Explain the structure and regulation of NIF gene
15. How will you differentiate between primary and secondary metabolites?
16. What are synthetic growth hormones explain with examples?
17. Write a note on cytokines.
18. Explain the functions and uses of Phenols in plants?
19. Explain the activation of RUBISCO

20. What are plant growth inhibitors explain with examples

21. Write a note on photorespiration

(6 x 4= 24)

Section C (Short Essay type Questions)

Answer any **three** questions. Each question carries **six** marks

22. Write a note on calvin cycle.

23. Explain the uses of secondary metabolites to man

24. Explain the general biosynthetic pathway of Terpenoids?

25. Explain the biochemistry of RuBP carboxylase/oxygenase.

26. Briefly explain the biosynthetic origin of secondary metabolites from primary metabolites?

(3x6=18)

Section D (Long Essay Type Questions)

Answer any **two** questions. Each question carries **ten** marks

27. Write an essay on nitrogen fixation

28. Explain on plant growth regulators

29. Write an essay on major classes of secondary metabolites

30. Write an essay on biochemical mechanism of photosynthesis

(10x2=20)

**MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION
Second Semester**

Core Course- Biochemistry-BC2CRP01-Practical I &II

Time: Three Hours

Maximum Marks: 80

Question No.1

Problems based on preparation of solutions – 10 marks

Question No.2

Problems based on Henderson Hasselbalch equation – 10 marks

Question No.3

Dilution of acids/alkali and measurement of pH using pH meter –10 marks

Question No.4

Demonstrate stages of mitosis in onion root preparation or demonstrate stages of meiosis in flower bud preparation -20 marks

Question No.5

Identify the given spotters (3 numbers) -15 marks

Question No.6

Viva - 10 marks

Question No.7

Record - 5 marks

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

Fourth Semester

Core Course-Biochemistry-BC4CRP02-Practical III & IV

Time: Three Hours

Maximum Marks: 80

Question No.1

Verification of Beer Lambert's law.

25 Marks

OR

Perform paper chromatography by TLC and identify the amino acid/sugar given as test sample. Standard amino acid/sugar to be provided and Rf value for the standard for the solvent system being used to be given to the students.

Question No.2

Following a systematic scheme for analysis identify the given sample of carbohydrate

25 Marks

OR

Following a systematic scheme for analysis identify the given sample of NPN

Question No.3

Identify the given spotters (3 numbers)

15 marks

Question No.4

General viva (Based on Practical) -

10 marks

Question No.5

Record

5 marks

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

Sixth Semester

Core Course- Biochemistry-BC6CRP03-Practical VI & IX

Time: Three Hours

Maximum Marks: 80

Question No.1

Perform the isolation of DNA from the given sample and determine its molecular weight
(35 marks)

Question No.2

Determination of human blood group antigens (10 marks)

Question No.3

Identify the given spotters (4 numbers) (20 marks)

Question No.4

General viva (Based on Practical) - (10 marks)

Question No.5

Record (5 marks)

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

Sixth Semester

Core Course- Biochemistry-BC6CRP04-Practical V & X

Time: Three Hours

Maximum Marks: 80

Question No.1

Determination of pepsin activity using albumin as substrate 35 Marks

Question No.2

Qualitative analysis of the given sample of urine 15 Marks

Question No.3

Identify the given spotters (3 numbers) 15 Marks

Question No.4

General viva (Based on Practical) - 10 marks

Question No.5

Record 5 marks

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

Sixth semester

Core Course- Biochemistry-BC6CRP05-Practical VII & XI

Time: Three Hours

Maximum Marks: 80

Question No.1

- a. In the first 10 minutes, write down in an additional sheet, the principle, procedure/tabular column, method of calculation which you would use for the determination of.....activity in the.....extract

OR

- b. Write down the principle and procedure for isolation of volatile oils using TLC?

(10 marks)

Question No. 2

- a. Prepare a crude extract of Acid Phosphatase from Potato/ β -amylase from Sweet Potato or Barley Seeds. Using the crude extract, determine the activity of Acid Phosphatase/ β -amylase using a standard graph. You are provided with different concentrations of standards, its OD values and required reagents

(35 marks)

OR

- b. Isolation and Colorimetric estimation of total phenols from the given plant sample

Question No.3

Identify the given spotters (4 numbers)

(20 marks)

Question No.4

General viva (Based on Practical) -

(10 marks)

Question No.5

Record

(5 marks)

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

Sixth semester

Core Course- Biochemistry-BC6CRP06-Practical VIII & XII

Time: Three Hours

Maximum Marks: 80

Question No.1

Estimate the amount of protein in the given solution by Biuret/Lowry's method. You are provided with standard of known concentration and required reagents.

(35 marks)

Question No. 2

Write down the steps involved in BLAST and FASTA?

(15 marks)

Question No.3

Identify the given spotters (2 numbers)

(10 marks)

Question No.4

General viva (Based on Practical) -

(15 marks)

Question No.5

Record

(5 marks)

**Model Question papers for
Biochemistry as a complementary subject**

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

First Semester

**Complementary Course-Biochemistry-BC1CMT01- Elementary Biochemistry
(Common for all programmes having Biochemistry as a complementary subject)**

Time: Three Hours

Maximum Marks: 80

Section A (Very Short Answer Type Questions)

Answer any **nine** questions. Each question carries **two** marks

1. What is fibrinolysis?
2. What is meant by the term strong acid?
3. Differentiate between serum and plasma.
4. Define Beer Lambert's Law
5. Name four different types of interactions in aqueous systems?
6. What is PAGE?
7. What is meant by ionic product of water?
8. Which are the different types of solute transport across membranes
9. Define electrophoresis
10. What do you mean by hydrophobic interactions
11. Write any four important functions of plasma proteins.
12. Define R_f value? (9x2=18)

Section B (Short Answer Type Questions)

Answer any **six** questions. Each question carries **four** marks

13. What is a buffer? Explain the action of a buffer, with an example.
14. Explain principle and applications of colorimetry?
15. Explain briefly about Plasma proteins
16. Write a note on anticoagulants

17. Explain fluid mosaic model of membrane
18. Give the principle and application of Gel filtration
19. Derive Henderson Hasselbach Equation.
20. Explain briefly about the composition of blood
21. Discuss the application of Donnan equilibrium in biological systems (6x4=24)

Section C (Short Essay type Questions)

Answer any **three** questions. Each question carries **six** marks

22. Explain important types of membrane proteins
23. Explain Donnan Membrane equilibrium.
24. Write a note on Western Blotting.
25. Discuss briefly on different types of blood cells.
26. Explain MALDI-TOF MS (3x6=18)

Section D (Long Essay Type Questions)

Answer any **two** questions. Each question carries **ten** marks

27. Explain buffers in biological system
28. What are the different clotting factors in blood . Explain mechanism of blood clotting.
29. Explain the principle and applications of different types of chromatography
30. Explain different transport systems across membranes. (2x10=20)

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

Second Semester

**Complementary Course- Biochemistry-BC2CMT02- Biomolecules
(Common for all programmes having Biochemistry as a complementary subject)**

Time: Three Hours

Maximum Marks: 80

Section A (Very Short Answer Type Questions)

Answer any **nine** questions. Each question carries **two** marks

1. Define acid number and saponification number?
2. What is zwitter ion?
3. Write the structure of Stearic acid and linoleic acid
4. Give pyranose ring structure of glucose
5. What are nucleosides and nucleotides?
6. What is an anomer? Give one example
7. Give any two physiological importance of sphingolipids
8. Which are the monosaccharide units present in sucrose? Explain how the units are joined to form sucrose
9. Define melting temperature (T_m) of DNA?
10. State two industrial application of starch
11. Write the structure of two acidic amino acids
12. What is meant by isoelectric point of amino acid (9x2=18)

Section B (Short Answer Type Questions)

Answer any **six** questions. Each question carries **four** marks

13. Write the names and structures of purine and pyrimidine bases present DNA
14. What is epimerism? Explain with examples
15. Differentiate between DNA and RNA.

16. Write down the structure of phosphatidic acid, lecithin , Cephalin, Phosphatidyl serine
17. Write a note on physiological functions of lipids
18. Discuss the structural features of starch
19. Explain hyperchromic effect
20. Explain structure of triacylglycerol
21. Discuss briefly on reducing action of sugars (6x4=24)

Section C (Short Essay type Questions)

Answer any **three** questions. Each question carries **six** marks

22. Write a note on heteropolysaccharides
23. Explain structure and functions of collagen
24. Write the structure of cholesterol and mention its functions.
25. Explain different types of RNAs
26. Explain denaturation of nucleic acids (3x6=18)

Section D (Long Essay Type Questions)

Answer any **two** questions Each question carries **ten** marks

27. Describe the structural organization of proteins
28. Explain Watson Crick model of DNA structure.
29. Give the structure and properties of the following:
(a) Maltose (b) Chitin (c) Glycogen (d) Lactose
30. How are lipids classified? explain with examples and structure (2x10=20)

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

Third Semester

**Complementary Course- Biochemistry- BC3CMT03-Enzymology and Metabolism
(Common for all programmes having Biochemistry as a complementary subject)**

Time: Three Hours

Maximum Marks: 80

Section A (Very Short Answer Type Questions)

Answer any **nine** questions. Each question carries **two** marks

1. What is Lineweaver burk plot?
2. Write down the Michaelis- Menten equation and explain the terms
3. What is meant by an allosteric site on an enzyme?
4. What is substrate level phosphorylation
5. What is glycogenolysis
6. What is allosteric activation
7. Define cofactors
8. What is km of enzymes?
9. What is deamination of aminoacids?
10. What is the function of Carnitine?
11. Name two ketogenic aminoacids
12. Name the electron carriers in electron transport chain (9x2=18)

Section B (Short Answer Type Questions)

Answer any **six** questions. Each question carries **four** marks

13. Explain competitive and noncompetitive enzyme inhibition with proper examples
14. Specificity of enzymes
15. Explain alcohol fermentation
16. What are glucogenic amino acids

17. What is meant by non symbiotic nitrogen fixation explain briefly
18. What is meant by activation of fatty acid?
19. Write a short note on ketone bodies
20. Briefly explain Chemiosmotic hypothesis
21. Discuss on the ATP yield during oxidation of palmitic acid (6x4=24)

Section C (Short Essay type Questions)

Answer any **three** questions. Each question carries **six** marks

22. Name the six major classes of enzymes with examples
23. Explain Carnitine shuttle
24. Explain the role of cyclic AMP in glycogen metabolism
25. Explain gluconeogenesis
26. Give an outline of cholesterol synthesis. (3x6 =18)

Section D (Long Essay Type Questions)

Answer any **two** questions. Each question carries **ten** marks

27. Explain in detail the factors affecting enzyme catalysed reactions
28. Describe TCA cycle and the energy yield of the cycle.
29. Explain Urea cycle
30. Explain β oxidation of fatty acids with energetics (2x10=20)

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

Fourth Semester

**Complementary Course-Biochemistry- BC4CMT04-Molecular Biology, Nutritional and
Clinical Biochemistry
(Common for all programmes having Biochemistry as a complementary subject)**

Time: Three Hours

Maximum Marks: 80

Section A (Very Short Answer Type Questions)

Answer any **nine** questions. Each question carries **two** marks

1. Define central dogma of molecular biology
2. What is the Genetic Code?
3. What is Respiratory Quotient?
4. What Are Essential and Non-Essential Amino Acids?
5. How do you preserve blood?
6. Give brief account of okazaki fragments.
7. What is ketosis?
8. What is hypoglycaemia?
9. Mention any two nutritional importance of Nicotinic acid
10. Define creatinine clearance test
11. What is hyperlipidemia?
12. Define basal metabolic rate (9x2=18)

Section B (Short Answer Type Questions)

Answer any **six** questions. Each question carries **four** marks

13. What is wobble hypothesis? Discuss its significance
14. What are Post transcriptional modifications? Discuss its significance
15. Explain the biochemical basis of DNA replication
16. Describe the sources and nutritional importance of B12 and folic acid

17. Write a short note on Biological value of proteins
18. Give an account of the Sample collection and preservation of serum and urine
19. Explain GTT
20. What is galactosemia?
21. Write a note on lactose intolerance (6x4=24)

Section C (Short Essay type Questions)

Answer any **three** questions. Each question carries **six** marks

22. Give an account for the process of translation in prokaryotes
23. Explain Biological and nutritional importance of calcium, iron and selenium
24. Explain AST, ALT and ALP
25. What is the biochemical importance of essential and non-essential fatty acids?
26. Give a brief account of biochemical basis of Atherosclerosis (3x6=18)

Section D (Long Essay Type Questions)

Answer any **two** questions Each question carries **ten** marks

27. Describe the salient features and process of Transcription in prokaryotes
28. Explain the sources and nutritional importance of vitamin A, D, E, K and C
29. Explain Liver function tests and thyroid function tests
30. Give a detailed account of the biochemical basis of Diabetes mellitus (2x10=20)

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

Second Semester

**Complementary Course- Biochemistry-BC2CMP01- Practical I & II
(Common for all programmes having Biochemistry as a complementary subject)**

Time: Three Hours

Maximum Marks: 80

Question No.1

Verification of Beer Lambert's law.

(20 Marks)

OR

Perform paper chromatography by TLC and identify the amino acid/sugar given as test sample. Standard amino acid/sugar to be provided and R_f value for the standard for the solvent system being used to be given to the students.

Question No.2

Following a systematic scheme for analysis identify the given sample of carbohydrate

(30 Marks)

OR

Following a systematic scheme for analysis identify the given sample of NPN &

Problem based on preparation of solutions.

Question No.3

Identify the given spotters (3 numbers)

(15 marks)

Question No.4

General viva (Based on Practical) -

(10 marks)

Question No.5

Record

(5 marks)

MODEL QUESTION PAPER FOR B.Sc. DEGREE (C.B.C.S) EXAMINATION

Fourth Semester

**Complementary Course- Biochemistry-BC4CMP02- Practical III & IV
(Common for all programmes having Biochemistry as a complementary subject)**

Time: Three Hours

Maximum Marks: 80

Question No.1

- a. In the first 10 minutes, write down in an additional sheet, the principle, procedure/tabular column, method of calculation which you would use for the determination of.....activity in the.....
.....extract

OR

- b. Write down the principle, procedure and method of calculation for estimation ofbymethod. (10 marks)

Question No. 2

- c. Estimate the amount of protein in the given solution by Biuret/Lowry's method. You are provided with standard of known concentration and required reagents.

OR

- d. Prepare a crude extract of Acid Phosphatase from Potato/ β -amylase from Sweet Potato or Barley Seeds. Using the crude extract, determine the activity of Acid Phosphatase/ β -amylase using a standard graph. You are provided with different concentrations of standards, its OD values and required reagents (30 marks)

Question No.3

Identify the given spotters (4 numbers) (20 marks)

Question No.4

General viva (Based on Practical) - (15 marks)

Question No.5

Record (5 marks)