

**KONGUNADU ARTS AND SCIENCE COLLEGE
(AUTONOMOUS)**

COIMBATORE – 641029



DEPARTMENT OF BIOCHEMISTRY (PG)

CURRICULUM AND SCHEME OF EXAMINATIONS (CBCS)

(2026 - 2027 and onwards)

KONGUNADU ARTS AND SCIENCE COLLEGE
(AUTONOMOUS)
COIMBATORE – 641029

DEPARTMENT OF BIOCHEMISTRY (PG)

PG & RESEARCH DEPARTMENT OF BIOCHEMISTRY-

Vision:

To identify local and global issues that need intervention by a biochemist and to develop intelligent strategies and Biochemical approaches towards problem- solving.

Mission:

- To provide opportunities to get hands- on experience in Research-oriented education in Biochemistry.
- To provide Entrepreneurship in Biochemistry related areas.
- To give a broad based knowledge in concepts and principles of biochemistry.

PG PROGRAMME OUTCOMES

PO1: To presume, question and evaluate, solve problems, integrate knowledge and widen perspective.

PO2: To understand that communication comprises attentiveness and listening, reading and comprehension, to communicate and collect information through oral and written formats.

PO3: To apply contemporary research methods, skills and techniques in a scientific discipline.

PO4: To reveal empathetic social concern and national development, and the ability to act with an informed awareness of issues and participate in civic life through Volunteering.

PO5: To understand the issues of environmental contexts and sustainable development and to engage in independent and life-long learning.

PROGRAMME SPECIFIC OUTCOMES

PSO1: Understanding of structure and metabolism of macromolecules, regulation and disorders of metabolic pathways.

PSO2: Investigate the impact of science in society and plan to pursue research

PSO3: Gain proficiency in laboratory techniques in both biochemistry and molecular biology and be able to apply the scientific method to the processes of experimentation and Hypothesis testing.

PSO4: Understand the application of biochemistry in clinical laboratory.

PSO5: Acquire thorough knowledge in biochemical techniques, immunology, physiology, molecular biology, genetic engineering and biotechnology.

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**Programme Name: M.Sc. Biochemistry
Curriculum and Scheme of Examination under CBCS
(Applicable to the students admitted during the Academic Year 2026-2027)**

Semester	Subject code	Title of the paper	Instruction hours/cycle	Exam Marks				Credits
				CIA	ESE	Total	Duration of Exam (hours)	
I	26PBC101	Core paper 1 Chemistry of Biomolecules	5	25	75	100	3	4
	26PBC102	Core paper 2 Bioanalytical Techniques	5	25	75	100	3	4
	26PBC103	Core paper 3 Enzymes and Enzyme Technology	5	25	75	100	3	4
	26PBC104	Core paper 4 Cellular Biochemistry	5	25	75	100	3	4
	26PBC1CL	Core practical 1: Lab in Biomolecules, Bioinstrumentation, Enzymology and Cell Biology	5	40	60	100	6	4
	26PBC1E1	Major Elective- I	5	25	75	100	3	5
Total Hours			30			600	-	25
II	26PBC205	Core paper 5 Plant Biochemistry	5	25	75	100	3	4
	26PBC206	Core paper 6 Metabolism and Metabolic Regulation	5	25	75	100	3	4
	26PBC207	Core paper 7 Molecular Biology	5	25	75	100	3	4
	26PBC208	Core paper 8 Pharmaceutical Biochemistry	5	25	75	100	3	4
	26PBC2CM	Core Practical 2 : Lab in Plant Biochemistry, Microbiology and Molecular Biology	5	40	60	100	6	4
	26PBC2E2	Major Elective- II	5	25	75	100	3	5
Total Hours			30			600	-	25
III	26PBC309	Core paper 9 Immunology and Immunological Techniques	6	25	75	100	3	5
	26PBC310	Core paper 10 Research methodology, Biostatistics and Data Science	6	25	75	100	3	4
	26PBC311	Core paper 11 Advanced Clinical Biochemistry	7	25	75	100	3	4
	26PBC3CN	Core practical 3 : Lab in Immunology, Genetic Engineering and Clinical	5	40	60	100	6	4

		Biochemistry						
	26PBC3N1	Non-Major Elective – 1	4	25	75	100	3	4
	-	EDC	2	100	-	100	3	2
	26PBC3IT	Internship training*	-		-			-
Total Hours			30			600	-	23
IV	26PBC412	Core paper 12 Hormonal Biochemistry	6	25	75	100	3	5
	26PBC413	Core paper 13 rDNA technology	5	25	75	100	3	5
	26PGI4N2	Non-Major Elective –2	4	100	-	100	3	4
	26PBC4Z1	Project and Viva-voce	15 [#]	20	80	100	-	3
Total Hours			30			400		17
GRAND TOTAL			120			2200		90

15hrs allotted for project will not be allocated to staff workload

Note:

CBCS – Choice Based Credit system

CIA– Continuous Internal Assessment

ESE – End of Semester Examinations

**** The students shall undergo Internship training/ field work for a minimum period of 14 working days at the end of the second semester during summer vacation and submit the report in the third semester, which will be evaluated for 100 marks by the concerned guide and followed by an Internal viva-voce by the respective faculty or HOD as decided by the department. According to their marks, the grades will be awarded as given below.

Marks %	Grade
85-100	O
70-84	D
60-69	A
50-59	B
<40	U (Reappear)

Major Elective Papers (2 papers are to be chosen from the following 6 papers)

1. Nanobiotechnology
2. Microbial Technology
3. Bioinformatics
4. Bioethics, Biosafety and IPR
5. Environmental management
6. Biopharmaceuticals

Non Major Elective Papers (2 papers are to be chosen from the following 4 papers)

1. # Fundamentals of Information Security
 2. Competitive Sciences
 3. Bioprocess Technology
 4. Cancer Biology
- #to be offered by the respective departments

Sub. Code & Title of the Extra Departmental Course (EDC):

26PBC3X1 – EDC Paper 1 - Nutritional Biochemistry

Note: In core subjects, no of papers both theory and practical are included wherever applicable. However, the total credits and marks for core subjects remain the same as stated below.

Tally Table:

Subject	No. of Subjects	Total Marks	Credits
Core – Theory / Practical / Project	17	1700	70
Major Elective Papers	2	200	10
EDC Paper	1	100	2
Non Major Elective Paper	2	200	8
Grand Total	22	2200	90

- 100 % CIA for Information Security and EDC.
- The students should complete any **MOOC on learning platforms like SWAYAM, NPTEL, IIT Bombay spoken Tutorial, e-Pathshalab.**, with a minimum of 4 weeks in duration before the completion of the 3rd semester and the course completion certificate should be submitted through the HOD to the Controller of Examinations. Extra credits will be given to the candidates who have successfully completed.
- **Onsite Training** preferably relevant to the course may be undertaken as per the discretion of the faculty or HOD.
- Extra credits shall be awarded for innovative products/ individual paper presentations and publications in reputed national/ international proceedings and in indexed journals by the PG students for their original research contributions.
 - Product development through Technology Readiness Levels:
 - Phase 1 Level (TRL 1-3) : Basic research: 1 credits
 - Phase 2 Level (TRL 4 -6) : Development and validation : 2 credits
 - Phase 3 Level (TRL 7-9) : Deployment : 3 credits
 - National / International level paper presentation in conferences and publications of full papers in reputed Scopus/ web of Science indexed journals

- National Level : 1 credit/ paper
- International Level : 2 credits/ paper
- Open access Journals are not included

➤ Extra credits shall be awarded to students who prefer to opt any course out of their programme on self learning mode. No internal components. 100% ESE.

Teaching Pedagogy

Smart Classroom/Powerpoint presentation/Seminar/Quiz/Discussion/Flipped Classroom/Peer Learning/Experimental Learning/Blended learning
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Flipped Classroom

Preamble:

- Under flipped classroom model, students review foundational content before class, with class time dedicated to practice, discussion, and problem – solving where the role of the teachers will be facilitating discussions and enabling students to embark on a holistic learning perspectives

Work instructions:

- One flipped session / unit is made mandatory and the course In-charge shall identify and specify the topic to be covered in the flipped session in the lesson plan.
- Detailed session plans must be intimated to all students at least one week in advance.
- Curated content such as LORs, video lectures, animations, and other relevant digital content shall be provided to students in advance to facilitate effective preparation for the flipped classroom session.
- Peer Learning

Preamble:

- Peer Assisted learning enables students to learn from each other sharing knowledge in a collaborative learning environment.
- Development of leadership skills and student engagement through student to student academic support.
- Reduce drop out/failure rates of the students and create a supportive academic culture where a high performing or trained student assists peers academically.

Work Instructions:

- Course In-charge shall supervise the programme by periodically reviewing its implementation, conducting review meetings, and monitoring the progress reports.
- Course In-charge shall identify 5 to 6 fast learners based on their academic performance

in internal and external examinations.

- Course In-charge shall also identify students who require additional academic support and assign 4 to 5 such students to each fast learner to facilitate peer learning.

- This team will operate remedial classes on a peer learning mode as per the following:

- a) One session / week / course and each session shall be for 30 minutes in duration, with follow-up learning activities.

- b) The faculty In-charge shall review attendance records and monitor the academic progress of the students.

Blended learning

Preamble :

- Blended learning integrates traditional in class instruction with digital tools exposing students to a myriad options for learning from subject experts across the globe

- It is provided with online learning sessions on recorded videos, lecture captured sessions (included under guided library hours), digital resources, and guided sessions facilitated by internal faculty members and external experts through Zoom meets etc.,

Work Instructions:

- For every course, students will be motivated to attend additional webinar/online courses through any interactive learning tools such as, telepresence systems, podcasts, interactive videos etc. with minimum of 2 sessions/course and maximum of 3 sessions/course.

Extra credit courses:

ADVANCED LEARNERS COURSE (UNDER SELF STUDY SCHEME) (Optional)

26PBCOD1	Forensic Science
26PBCOD2	Nutraceuticals and Functional foods
26PBCOD3	Stem Cell Biology

JOB ORIENTED COURSE

Subject code	Title of the paper	Instruction hours/cycle	Exam Marks				Credits
			CIA	ESE	Total	Duration Exam(hours)	
26PBCOJ1	Bio entrepreneurship	4	25	75	60	3	2
26PBCOJ2	Food safety and Quality control	4	25	75	60	3	2
26PBCOJ3	Clinical and therapeutic nutrition	4	25	75	60	3	2

CERTIFICATE COURSE ON MEDICAL LABORATORY TECHNOLOGY

26CCL101	Paper I: Biochemistry
26CCL102	Paper II: Clinical Pathology and Microbiology-I
26CCL1CL	Clinical Biochemistry Practical- I
26CCL1Z1	On the Job training and Viva voce

CERTIFICATE COURSE ON BAKING SCIENCE AND TECHNOLOGY

26CBS101	Paper I: FACTS OF BAKING SCIENCE
26CBS102	Paper II: HYGIENE AND BAKERY SETUP
26CBS103	Practical I: BAKERY TECHNOLOGY PRACTICALS
26CBS101	Paper I: FACTS OF BAKING SCIENCE

- 25 % CIA is applicable to all subjects except JOC, ALC and COP which are considered as extra credit courses.

Components of Continuous Internal Assessment

Components		Marks	Total
Theory			
CIA I	75	(75+75) = 150/10 15	25
CIA II	75		
Objective Capacity Testing* /Seminar		5	
Attendance		5	
Practical			
CIA Practical		25	40
Observation Notebook		10	
Attendance		5	
Project			
Review		15	20
Regularity		05	

*** Objective Capacity Testing:**

For the first assessment, questions shall be set from 2 ½ units (25 questions) and evaluation for 5 marks. The assessment shall be conducted through any authentic online platform, one week prior to the commencement of I CIA theory examinations.

For the second assessment, questions shall be set from 2 ½ units (25 questions) and evaluation for 5 marks. The assessment shall be conducted through any authentic online platform, one week prior to the commencement of II CIA theory examinations.

The average of the first and second assessment scores shall be considered for the final **5 marks** allocation.

BLOOM'S TAXONOMY BASED ASSESSMENT PATTERN

K1-Remembering;K2-Understanding;K3-Applying;K4-Analyzing;K5-Evaluating

1. Theory Examination

CIA I & II and ESE: 75 Marks

Knowledge Level	Section	Marks	Description	Total
K1 Q1 to 10	A (Answer all)	10 x 1 = 10	MCQ	75
K1 - K5 Q11 to 15	B (Either or pattern)	5 x 5 = 25	Short Answers	
K2 - K5 Q16 to 20	C (Either or pattern)	5 x 8 = 40	Descriptive / Detailed	

2. Practical Examination:

Knowledge Level	Section	Marks	Total
K3	Experiments	50	60
K4		Record Work	
K5			

3. Project Viva Voce:

Knowledge Level	Section	Marks	Total
K3	Project Report	60	80
K4		Viva voce	
K5			

Practical Examination mark breakup:

Knowledge Level	Section
K3	Experiments:
	Major:
↑	Protocol -15
	Performance-5
↓	Result-5
	Minor:
K5	Protocol -5
	Performance-5
	Result-5
	Q&A - 5
	Viva - 5
	Record work - 10

Project mark breakup:

Knowledge Level	Section
K3 ↕ K5	Project Report: Content – 20 Presentation – 20 R&D – 10 Review – 10
	Viva Voce: Layout of presentation – 10 Clarity – 5 Defense – 5

BLOOM'S TAXONOMY BASED ASSESSMENT PATTERN

K1-Remembering;**K2**-Understanding;**K3**-Applying;**K4**-Analyzing;**K5**-Evaluating

1. Theory Examination

CIA I & II and ESE: 75 Marks

Knowledge Level	Section	Marks	Description	Total
K1 Q1 to 10	A (Answer all)	10 x 1 = 10	MCQ	75
K1 - K5 Q11 to 15	B (Either or pattern)	5 x 5 = 25	Short Answers	
K2 - K5 Q16 to 20	C (Either or pattern)	5 x 8 = 40	Descriptive / Detailed	

2. Practical Examination:

Knowledge Level	Section	Marks	Total
K3	Experiments	50	60
K4		Record Work	
K5			

3. Project Viva Voce:

Knowledge Level	Section	Marks	Total
K3	Project Report	60	80
K4		Viva voce	
K5			

Practical Examination mark breakup:

Knowledge Level	Section
K3 ↑ K5	Experiments: Major: Protocol -15 Performance-5 Result-5 Minor: Protocol -5 Performance-5 Result-5 Q&A - 5 Viva - 5
	Record work - 10

Project mark breakup:

Knowledge Level	Section
<p style="text-align: center;">K3</p> <p style="text-align: center;">↑</p> <p style="text-align: center;">↓</p> <p style="text-align: center;">K5</p>	<p>Project Report:</p> <p>Content – 20</p> <p>Presentation – 20</p> <p>R&D – 10</p> <p>Review – 10</p>
	<p>Viva Voce:</p> <p>Layout of presentation – 10</p> <p>Clarity – 5</p> <p>Defense – 5</p>

**KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)
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**THE MODALITIES FOR THE CONDUCT OF 100% CIA
EXAMINATIONS**

PREAMBLE

As per the recommendations of the Curriculum Development Cell in its meeting held on 27.08.2021, and decision taken in the General Board of Studies meeting held on 16.03.2022, the courses **Cyber Security and Information Security** were introduced in the III semester for all the UG programmes and in the even semester for the PG programme respectively for the students admitted from the academic year 2022-2023 and onwards. Also, it was unanimously decided to conduct 100 % CIA examinations (No End of Semester Examinations) for these courses. The name of the Courses Cyber Security and Information Security are renamed as **Basics of Cyber Security and Fundamentals of Information Security** as per the decision taken in the General Board of Studies meeting held on 26.03.2026 for the students to be admitted from the academic year 2026-2027 & onwards. As per the recommendations of the Curriculum Development Cell in its meeting held on 07.03.2022, it was approved in the BOS meeting held on 19.03.2022 to conduct 100% CIA Examinations for the **Extra Departmental Courses** offered in the UG and PG Programmes for the students admitted from the academic year 2022-2023 and onwards. The cited decisions had been approved by the Academic council in its meeting held on 18.04.2022. As per the recommendations of the Curriculum Development Cell in its meeting held on 27.02.2024, and decision taken in the General Board of Studies meeting held on 02.05.2024, the course **Basics of IPR** was introduced in the VI semester for all the UG programmes for the students admitted from the academic year 2024-2025 and onwards and decided to conduct 100 % CIA examinations (NO End of Semester Examinations) for the course.

Hence, the modalities is recommended for the following:

- (i) Conduct of I & II CIA Examinations
- (ii) Question Paper Pattern
- (iii) CIA Examination Mark Breakup
- (iv) Attendance Calculation

CONDUCT OF I & II CIA EXAMINATIONS

1. The CIA Examinations I & II for the above said courses must be conducted along with the other courses under centralized system.
2. The students must appear I & II CIA Examinations compulsorily, since **End of Semester Examinations will NOT be conducted** for the above said courses.
3. If any of the student (s) could not appear for CIA Examinations for the above said courses, with reasons mentioned in the College Calendar, re-examination shall be conducted as per the existing procedures.

QUESTION PAPER PATTERN

The following question paper pattern will be followed for the above said courses:

Section A - Multiple Choice	(10 × 1 = 10 Marks)
Section B - Either or Type	(5 × 5 = 25 Marks)
Section C - Either or Type	(5 × 8 = 40 Marks)

Maximum Marks : 75

Duration : 3 Hours

CIA EXAMINATION MARK BREAKUP

The CIA Examination mark breakup for the courses **Basics of Cyber Security, Fundamentals of Information Security and Basics of IPR** is given below:

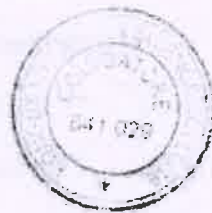
S.No.	Distribution Component	Marks
1	CIA I – 75 Marks Converted to 30	30
2	CIA II – 75 Marks Converted to 30	30
3	Seminar/Objective Capacity Testing	10
4	Seminar/Objective Capacity Testing	10
5	Attendance	05
6	Any Case Study related to Cyber Security (as a Group)	15
	Total	100


The CIA Examination mark breakup for the **Extra Departmental Courses** offered for UG/PG Programmes is given below:

S.No.	Distribution Component	Marks
1	CIA I – 75 Marks Converted to 40	40
2	CIA II – 75 Marks Converted to 40	40
3	Seminar/Objective Capacity Testing	05
4	Seminar/Objective Capacity Testing	05
5	Attendance	05
6	Others (Group Discussion, Flipped Class room, etc.,)	05
	Total	100

ATTENDANCE CALCULATION

1. Separate attendance register must be maintained for **Basics of Cyber Security, Fundamentals of Information Security and Basics of IPR** in the Department and the final consolidated Attendance must be submitted to the COE along with the assessment Marks.
2. The attendance must be calculated by using the following formula:
$$\text{Attendance percentage} = \frac{\text{Number of Classes attended}}{\text{Number of Classes conducted}} \times 100$$
3. The students should be allowed to write the CIA examinations as per the existing norms related to attendance. The staff in charge of the respective courses have the responsibility to calculate the attendance percentage and submit the same to the Coordinator of the CIA Examination Committee during the I CIA and II CIA Examinations.
4. If the staff in charge finds that students have not put up enough attendance during the I CIA Examinations, he/she shall counsel the student(s) appropriately so that at the end of the course they have sufficient Attendance.




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**KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)
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**THE MODALITIES FOR THE CONDUCT OF 100% CIA PRACTICAL
EXAMINATIONS (For EDC Courses)**

CONDUCT OF 100% CIA PRACTICAL EXAMINATIONS

1. The Students shall appear for **TWO** CIA practical examinations which are evaluated as 100% internal examinations.
2. The students must appear **TWO** CIA practical examinations compulsorily, since End of Semester examinations will NOT be conducted for the above said course.
3. If any of the student(s) could not appear for CIA Examinations, as per reasons mentioned in the College Calendar, re-examination shall be conducted as per the existing procedures and norms.

The CIA Practical Examination mark breakup for the Extra Departmental Courses (EDC) offered for the UG & PG Programme is given below:

S.No.	Component Distribution	Marks
1.	CIA Practical I – 60 marks converted to 30	30
2.	CIA Practical II – 60 marks converted to 30	30
3.	Continuous assessment of practical (Observation to be submitted*) (15 Experiments/Programs x 2 = 30 marks)	30
4.	Record	05
5.	Attendance	05
Total		100

* In case a student is absent for an Experiment/Program conducted on a particular day, the student will not be allowed to compensate that Experiment/Program and will be awarded zero for that particular Experiment/Program and shall be marked absent. In case any student has an attendance lack; the concerned faculty handling the course in consultation with HoD may permit the student who has an attendance lack to compensate one or two Experiment/Programs as the case may be to enable them to become eligible with mandate of 75% attendance to appear for the Continuous Internal Practical Examinations. However the compensated Experiment/Programs will not be awarded any marks whatsoever.

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**KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)
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**MODALITIES FOR THE AWARD OF APPROPRIATE EXTRA CREDIT
TO THE STUDENTS WHO PREFER TO OPT ANY COURSE OUT OF
THEIR PROGRAMME ON SELF LEARNING MODE**

PREAMBLE

The Curriculum Development Cell (CDC) meeting was convened on 16.10.2025 and recommended to motivate the students to opt any course(s) other than their core programme of study (theory papers only) through self-learning mode and extra credits can be awarded on their successful completion. However, such students availing this option shall not opt for any of the 100% CIA courses. This skill set will broaden intellectual horizons, foster holistic and integrative learning and equip diverse skill sets. This is applicable for the students to be admitted from the academic year 2026-2027 and onwards.

1. Semester Restriction:

Students may choose the courses offered only within their current semester. Courses beyond the semester in which they are enrolled shall not be permitted.

2. Course Type:

Only **theory courses** may be opted under this provision. Practical courses, Extra Departmental Courses (EDC), and courses assessed entirely through Continuous Internal Assessment (CIA) shall not be eligible.

3. Evaluation Method:

A **100% End of Semester Examination (ESE)** shall be conducted for the chosen course.

4. Marks & Scheme:

The ESE shall be conducted in accordance with the marks prescribed for the particular course in the approved scheme, along with its corresponding credit allocation.

5. **Conversion of Marks:**

The marks obtained by the student in the ESE shall be converted to a scale of **100 marks** for uniformity.

6. **Award of Credits:**

The credits allotted to the course in the scheme shall be transferred to the student as **Extra Credit**, provided the student secures the prescribed pass mark in the ESE.




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**KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)
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**MODALITIES FOR THE CONDUCT OF OPEN BOOK EXAMINATION
SYSTEM FOR THE COURSES BASICS OF CYBER SECURITY AND
FUNDAMENTALS OF INFORMATION SECURITY FOR ALL UG AND
PG PROGRAMMES RESPECTIVELY**

PREAMBLE

The Curriculum Development Cell (CDC) meeting was convened on 16.10.2025 and recommended to implement an open book examination system for the courses, Basics of Cyber Security and Fundamentals Information Security for all UG and PG programmes to improvise conceptual understanding skills, promote deep learning, enhance assessment quality and strengthen comprehensive skills, for the students to be admitted from the academic year 2026-2027 and onwards.

1.Purpose

To provide guidelines for conducting open book examinations that encourage critical thinking, application of knowledge, and analytical skills.

2.Scope

Applicable to Basics of Cyber Security and Fundamentals of Information Security courses for the undergraduate and postgraduate programmes respectively.

3. Examination Guidelines

Question Paper Design

- ❖ Questions should be Focused on higher-order thinking (analysis & evaluation)
- ❖ Avoid direct recall questions

Communication to Students and Staff Members

- ❖ Inform students in advance about the format, rules, and allowed resources.

- ❖ Provide sample questions to familiarize them with the OBE style.
- ❖ All the Staff members should be familiar about the prescribed Books of the Basics of Cyber Security and Fundamentals of Information Security.
- ❖ Students are permitted to carry the prescribed Books (in original or xerox copy) duly signed by the respective staff in charge of courses to the examination Hall.
- ❖ Invigilators of the respective examination halls should permit the students with the prescribed book (in original or xerox copy) and not to allow the students with other than the prescribed Books.




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**KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)
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**MODALITIES FOR THE CONDUCT OF 100% CIA FOR THE ONE
CREDIT SELF- STUDY COURSE AND THE MARK DISTRIBUTION
PATTERN FOR THE PART III THEORY PAPER OF APPLICABLE
COURSE**

PREAMBLE

The Curriculum Development Cell (CDC) meeting was convened on 16.10.2025 and recommended to have one credit Self Study Course for applicable programmes in both UG & PG programme in the V and II semester respectively for the students to be admitted from the academic year 2026-2027 and onwards.

In order to foster independent learning, enhance academic flexibility, and encourage students to explore knowledge, the institution introduces the One Credit Self Study Course. This initiative is designed to provide students with an opportunity to pursue structured self-learning during the regular programme of study.

The one credit Self Study Course for applicable UG & PG programme in the V and II semester respectively, for the students admitted from the academic year 2026-2027 and onwards.

1. CIA COMPONENTS FOR ONE CREDIT COURSE

CIA shall be conducted by the department concerned.

CIA I	50 (Converted to 10)	20	25
CIA II	50 (Converted to 10)		
Case Study		5	

QUESTION PAPER PATTERN

Duration : 2 Hours

Knowledge Level	Section	Marks	Description	Total
K1 Q1 to Q6	A (Answer all)	6 x 1 = 6	MCQ	50
K2 - K4 Q7 to Q 10	B (Either or pattern)	4 x 5 = 20	Short Answers	
K2 - K5 Q11 to Q 13	C (Either or pattern)	3 x 8 = 24	Descriptive / Detailed	

2. PART III THEORY APPLICABLE COURSE

(CIA : 20 MARKS, ESE : 55 MARKS)

CIA: 20 Marks

CIA I	55	(55+55)	20
CIA II	55	Converted to 10	
Objective Capacity Testing /Seminar		5	
Attendance		5	

ESE : 55 Marks

QUESTION PAPER PATTERN

Knowledge Level	Section	Marks	Description	Total
K1 Q1 to 10	A (Answer all)	10 x 1 = 10	MCQ	55
K2 - K4 Q11 to 15	B (Either or pattern)	5 x 3 = 15	Short Answers	
K2 - K5 Q16 to 20	C (Either or pattern)	5 x 6 = 30	Descriptive / Detailed	



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Programme Code: 07		M.Sc Biochemistry		
Title of the paper: Core paper 1 - Chemistry of Biomolecules				
Batch	Hours/week	Total Hours	Credits	Employability/skill
2026-2028	5	75	4	development/Entrepreneurship

Course Objectives

1. To learn about the chemistry and structures of Biomolecules
2. To know the properties of different Biomolecules
3. To know the physiological functions of Biomolecules

Course Outcomes (CO)

K1	CO1	Correlate the classification and functions of Biomolecules in energy Production.
	CO2	Apply the link between the structure and function of amino acids and Proteins in biological system.
TO	CO3	Able to know about execute of Biomolecules in human health
	CO4	Analyze and study the chemical and biochemical properties pharmacogenetics field
K5	CO5	Apply the structural studies to biological processes like replication, transcription and translation.

Syllabus

Unit I

(15 Hours)

Water: Water and its physicochemical properties, Ionization of water, pH scale, Henderson-Hasselbalch equation.

Carbohydrates: Structure, distribution and biological functions of Monosaccharides, Disaccharides, O-linked and N-linked oligosaccharides, Polysaccharides: Homoglycans: Structure, occurrence, properties and biological functions of starch, cellulose, glycogen and chitin. Heteroglycans: Structure, occurrence, properties and biological functions of glycosaminoglycans. Structure and biological role of glycoproteins and proteoglycans.

Unit II

(15 Hours)

Amino acids : Structure, nomenclature, classification, acid-base behavior and chemical reactions of amino acids; Stereoisomerism and optical properties of amino acids; Non- protein amino acids. Amino acid derivatives.

Sub. Code: 26PBC101

Unit III**(15 Hours)**

Proteins: Structural organization of protein: Primary structure. Determination of protein structure: Ramachandran plot. Polypeptide synthesis. Secondary structures – α -helix, β -sheet and β -turns, Pauling and Corey model for fibrous proteins, Reverse Turns and supersecondary structures, Collagen triple helix. Tertiary structure – α and β domains. Conformational properties of silk fibroin. Quaternary structure of proteins: Structure and functions of myoglobin and hemoglobin. Protein denaturation and its misfolding diseases.

Unit IV**(15 Hours)**

Lipids: *Classification, structure, functions and properties of lipids. Fatty acids - saturated and unsaturated. Structure and functions: Phospholipids and glycolipids. Eicosanoids-structure and biological role of prostaglandins, thromboxanes and leucotrienes. Steroids: structure and functions of cholesterol. Lipoproteins- classification and composition. Amphipathic lipids- emulsions and liposomes.

Unit V**(15 Hours)**

Nucleic acids: Structure of nucleic acids, DNA double helical structure– Watson and Crick model. A, B and Z DNA, Palindromes, Inverse repeats, cruciform and hairpins, Triple and quadruple structures. DNA sequencing Methods: – Maxam–Gilbert sequencing and Sanger's Dideoxy chain termination method. Properties of DNA: UV absorption spectra, buoyant density, denaturation and renaturation, cot curves, DNA hybridization, DNA super coiling and linking number. Structure and * **biological functions of major forms of RNA: mRNA, rRNA and tRNA.**

* denotes Self study

Text Books

1. Nelson, D. L., & Cox, M. M. (2017). *Lehninger Principles of Biochemistry* (7th ed.). W. H. Freeman and Company, New York.
2. Satyanarayana, U. (2017). *Biochemistry* (5th ed.). Books and Allied (P) Ltd., India.

Reference Books

1. Voet, D., Voet, J. G., & Pratt, C. W. (2013). *Principles of Biochemistry* (4th ed.). John Wiley & Sons, New Delhi.
2. Garrett, R. H., & Grisham, C. M. (2013). *Principles of Biochemistry* (5th ed.). Saunders College Publishers.

Sub. Code: 26PBC101

3. Conn, E. E., Stumpf, P. K., Bruening, G., & Doi, R. H. (2005). *Outlines of Biochemistry* (5th ed.). John Wiley & Sons, Singapore.
4. Moran, L. A., Horton, H. R., Scrimgeour, K. G., Perry, M. D., & Rawn, J. D. (2013). *Principles of Biochemistry* (5th ed.). Pearson Education, United Kingdom.

E-Resources

1. <https://nptel.ac.in>
2. <https://www.khanacademy.org/science/biology>
3. <https://pubmed.ncbi.nlm.nih.gov>

MAPPING



	PSO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO						
CO1		H	S	S	M	H
CO2		M	H	H	S	M
CO3		S	M	S	H	H
CO4		S	H	S	M	H
CO5		S	H	M	S	H

S-Strong

H-High

M-Medium

L-Low

Content prepared by (Based on Inputs)	
	
Signature of the course in-charge Dr. S. Monisha	Signature of the HOD

Head
 Department of Biochemistry
 (PG & Research)
 Kongu Arts and Science College
 (Autonomous)
 Department of Biochemistry
 Kongu Arts and Science College
 Coimbatore-641 029

Programme Code: 07		M.Sc Biochemistry		
Title of the paper: Core Paper 2 – Bio analytical Techniques				
Batch	Hours/week	Total Hours	Credits	Employability/skill
2026-2028	5	75	4	development

Course Objectives

1. To learn the principle and instrumentation of various separation techniques
2. To know the applications of various separation techniques in biological fields
3. To learn the concept of radioactivity and explore its role in various fields.

Course Outcomes (CO)

K1	CO1	Recall the principle and applications of bioinstrumentation
	CO2	The students will discern the principle, Instrumentation of different types of Bio analytical techniques
	CO3	The students also discern about applying the instrumentation techniques of Centrifugation, Electrophoresis and Chromatography in various research
	CO4	The students will determine the knowledge and practice concerning modern analytical instrumentation and students can able to enter into large scale Industries.
K5	CO5	Appreciate the principle, instrumentation and difference between various spectroscopic methods.

Syllabus

Unit I

(15 Hours)

Introduction: Extraction and isolation of biomolecules, Pre-treatment and Stabilization of biological samples. **Electrophoretic Techniques:** Principle technique and application of Agarose gel electrophoresis, gradient electrophoresis, horizontal and vertical gel electrophoresis, isoelectric focusing, capillary electrophoresis .

Unit II

(15 Hours)

Chromatography and purification: *Classification, principles, techniques and applications of adsorption, reverse phase, ion exchange, size exclusion, TLC, Paper chromatography, bio-affinity and pseudo affinity chromatographic techniques. Sophisticated chromatographic technique: Principle, techniques and applications of HPLC, GCMS, LC-MS. Applications in biochemical and clinical analysis

Unit III

(15 Hours)

Spectroscopy: Basic principles of spectroscopy, Interaction of electromagnetic radiation with biomolecules. Principles, techniques and applications of UV-Visible spectroscopy, FTIR, Spectro fluorimetry, Flame photometry,

Sub.Code:26PBC102

Fluorescence spectroscopy, Raman spectroscopy, NMR Spectroscopy.

Unit IV (15 Hours)

Microscopic and nanomechanical microscopic Characterization: *overview of microscopy, Morphology and identification of cells using Cell fractionation and flow cytometry , SEM, TEM and Confocal Microscopy, EDAX, Elemental mapping, - Differential Scanning Calorimeter (DSC) and its applications in biomolecular studies.

Unit V (15 Hours)

Clinical instrumentation: Diagnostic and therapeutic equipments – Blood pressure monitor, electrocardioscope, pulse ox meter, pH meter, autoanalyser, Pace makers, ultra sound imaging system-micro and macro,* **CT scan**, Applications of diagnostic imaging in clinical practice.

* denotes Self study

Text books

1. Upadhyay, A., Upadhyay, K., & Nath, N. (2012). *Biophysical Chemistry: Principles and Techniques* (4th Revised ed.). Himalaya Publishing House Pvt. Ltd., Mumbai.
2. Wilson, K., & Walker, J. (2000). *A Biologist's Guide to Principles and Techniques of Practical Biochemistry* (5th ed.). Cambridge University Press, New York.
3. Katoch, R. (2011). *Analytical Techniques in Biochemistry and Molecular Biology*. Springer, New York.
4. Campbell, I. D. (1984). *Biological Spectroscopy*. Benjamin/Cummings Publishing Company, California.
5. Asenjo, J. A. (1990). *Separation Processes in Biotechnology*. CRC Press/Taylor & Francis, Boca Raton.

Reference books

1. Holme, D. J., & Peck, H. (2003). *Analytical Biochemistry* (1st ed.). CBS Publishers & Distributors, New Delhi.
2. Skoog, D. A., West, D. M., Holler, F. J., & Crouch, S. R. (2008). *Fundamentals of Analytical Chemistry* (8th ed.). Thomson Brooks/Cole, USA.
3. Wilson, K., & Walker, J. (2011). *Principles and Techniques of Biochemistry and Molecular Biology* (7th ed.). Cambridge University Press, New York.
4. Chatwal, G. R., & Anand, S. K. (2005). *Instrumental Methods of Chemical Analysis* (5th ed.). Himalaya Publishing House, Mumbai.


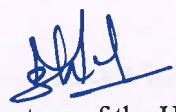
E - Resources

1. <https://ocw.mit.edu>
2. <https://www.jove.com/science-education>
3. <https://www.ncbi.nlm.nih.gov/books>

MAPPING

PSO \ CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	M	S	H	M
CO2	H	S	M	M	S
CO3	H	M	S	H	M
CO4	M	S	S	H	S
CO5	M	S	H	S	S

S-Strong
H-High
M-Medium
L-Low

Content prepared by (Based on Inputs)	
 Signature of the course in-charge Dr-S. Monisha	 Signature of the HOD Head (i/c)

Department of Biochemistry
(PG & Research)
Kongunadu Arts and Science College
(Autonomous)
Coimbatore - 641 029

Programme Code: 07		M.Sc Biochemistry		
Title of the paper: Core Paper 3 – Enzymes and Enzyme Technology				
Batch	Hours/week	Total Hours	Credits	Employability/skill
2026-2028	5	75	4	development

Course Objectives

1. To know the classification and properties of enzymes
2. To learn about the mechanism of enzyme action
3. To know the applications of enzymes in clinical and diagnostic fields

Course Outcomes (CO)

K1 TO	CO1	Remember the fundamentals of enzyme properties
	CO2	Conceive the different procedures involved in enzyme technology
	CO3	Able to assay the enzyme and their kinetics and also apply to this in the industry and other technological field
	CO4	Estimate enzyme technology for the commercialization purpose of biotechnological products
K5	CO5	Apply purification techniques of enzymes and immobilization techniques.

Syllabus

Unit I

(15 Hours)

Enzymes: Nomenclature and classification of enzymes, isolation and purification of enzymes – by Enzyme assays, criteria of purity - specific activity. Enzyme units - Katal, IU. Active site - determination of active site amino acids - chemical probe, affinity label, and site-directed mutagenesis, intrinsic and extrinsic regulations. Investigation of 3- D structure of active site.

Unit II

(15 Hours)

Mechanism of Enzyme Action and Regulation : Enzyme specificity, Mechanism of enzyme action - general acid-base catalysis, covalent catalysis, proximity and orientation effects, role of metal ion in enzyme catalysis, mechanism of serine proteases - chymotrypsin, lysozyme, and ribonuclease.

Regulation of enzyme activity- covalently modified regulated enzymes, allosteric enzymes, multienzyme complex - occurrence, isolation and properties. Mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthase. Isoenzymes-LDH.Zymogen activation.

Unit III

Enzyme kinetic and inhibition : Kinetics of single substrate enzyme - catalysed reactions - Michaelis - Menten equation, importance of V_{max} , K_m , turnover number; Line weaver - Burk plot, Eadie - Hofstee plot, Hanes - Woolf plot .

Kinetics of Allosteric enzymes - MWC and KNF models Hill' equation coefficient. Kinetics of multi - substrate enzyme - catalysed reactions - Ping-pong bi-bi, random order and compulsory order mechanism. Reversible inhibition -competitive, uncompetitive, noncompetitive, mixed, substrate and allosteric inhibition. Irreversible inhibition. Feedback inhibition

Unit IV**(15 Hours)**

Coenzymes: Coenzymes - prosthetic group, classification - vitamin and non vitamin derived coenzymes, thiamine pyrophosphate - mechanism of oxidative and non oxidative decarboxylation, transketolase reaction, FMN / FAD - flavoprotein enzymes NAD / NADP role in enzyme catalysis, PLP and PMP - role of PLP in transamination and decarboxylation reaction, ***Coenzyme A involved reactions**, biotin - folate and vitamin B 12 .

Unit V**(15 Hours)**

Enzyme Technology : Industrial uses of enzymes (Lactase, amylase, protease and pectinase), thermophilic enzymes, amylases, glucose isomerase, cellulose degrading enzymes, lipases, proteolytic enzymes in meat and leather industry (Papain, trypsin and alkaline protease), Applications in detergents and cheese production.

Clinical enzymology - Enzymes as thrombolytic agents, anti-inflammatory agents, digestive aids. Therapeutic Enzymes asparaginase, streptokinase. Immobilization of enzymes and their applications. Abzymes

Immobilization techniques and applications: Adsorption, microencapsulation, entrapment, covalent and ionic bonding. Biosensors: Calorimetric, Potentiometric, Amperometric, immunosensors and optical biosensors. Ribozyme, abzyme.

* denotes Self study

Text Books

1. Palmer, T. (2001). *Enzymes: Biochemistry, Biotechnology and Clinical Chemistry*. Horwood Publishing Limited, Chichester, UK.

- Kumar, A., & Garg, S. (2015). *Enzymes and Enzyme Technology*. Viva Books Private Limited, New Delhi.

Reference Books

- Talwar, G. P. (2012). *Textbook of Biochemistry and Human Biology* (3rd ed.). Prentice-Hall of India Private Limited, New Delhi.
- Balasubramanian, D., Bryce, C. F. A., Dharmalingam, K., Green, J., & Jayaraman, K. (2015). *Concepts in Biotechnology*. Universities Press (India) Private Limited, Hyderabad.
- Conn, E. E., Stumpf, P. K., Bruening, G., & Doi, R. H. (2010). *Outlines of Biochemistry* (5th ed.). John Wiley & Sons, New York, USA.
- Whitehurst, R. J., & Van Oort, M. (2010). *Enzymes in Food Technology* (2nd ed.). John Wiley & Sons Ltd., Oxford, UK.
- Nelson, D. L., & Cox, M. M. (2013). *Lehninger Principles of Biochemistry* (6th ed.). W. H. Freeman and Company, New York.
- Polaina, J., & MacCabe, A. P. (Eds.). (2007). *Industrial Enzymes: Structure, Function and Applications*. Springer, Dordrecht, Netherlands.

E-Resources

- <https://www.brenda-enzymes.org>
- <https://www.expasy.org>
- <https://nptel.ac.in>

MAPPING



PSO \ CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	M	H	S
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CO4	S	H	S	H	S
CO5	S	M	H	S	M

S–Strong

H–High

M–Medium

L –Low

<p>Content prepared by (Based on Inputs)</p>  <p>Signature of the course in-charge Dr. S. Monisha</p>	 <p>Signature of the HOD Head (i/c)</p>
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**Department of Biochemistry
(PG & Research)
Kongunadu Arts and Science College
(Autonomous)
Coimbatore - 641 029**

Programme Code: 07		M.Sc Biochemistry		
Title of the paper: Core Paper 4 – Cellular Biochemistry				
Batch	Hours/week	Total Hours	Credits	Employability/skill
2026-2028	5	75	4	development/Entrepreneurship

Course Objectives

1. To learn the models and functions of biological membrane
2. To learn about the structure and functions of cytoplasmic organelles
3. To learn the mechanism of membrane transport in cells

Course Outcomes (CO)

K1	CO1	Recall the basic concepts of cells.
	CO2	Understand the knowledge of cell structure and function
	TO	Employ their knowledge of cell biology to selected examples of changes or Losses in cell function.
	CO4	Analyze the cell structure, cell signaling and cell functions
K5	CO5	Decipher the intracellular signaling modes in mitochondria

Syllabus

Unit I

(15 Hours)

Cellular organization: Introduction and contributions to membrane and its models Membrane models, chemical composition and bonds of membrane, membrane proteins, carbohydrates, and lipids, Transport and bulk transport across the cell membrane (osmosis, diffusion, endocytosis, phagocytosis, artificial liposomes) and its application.

Unit II

(15 Hours)

Sub-cellular organelles: Structure and functions of intracellular organelles such as cytosol, Golgi bodies, endoplasmic reticulum (rough and smooth), ribosomes, mitochondria, chloroplasts, lysosomes, peroxisomes, glyoxisomes, nucleus (nuclear membrane, nucleoplasm, nucleolus, chromatin).

Unit III

(15 Hours)

Cell division and interactions: Over view of Cell division - mitosis and meiosis. Cell cycle – stages of interphase and M-phase – cell synchrony and its applications. Cell-Cell interactions - Cell adhesion molecules, Junctions, Metabolic cooperation, electrical coupling, contact inhibition, autocrine,

paracrine and endocrine signalling. Adaptation to various ecological zones

Unit IV

(15 Hours)

Cell locomotion: Cytoskeletal elements - Microtubules, ***microfilaments** (actin and myosin), intermediary filaments - cell locomotion (amoeboid, flagella and ciliary), muscle and nerve cells as terminally differentiated cells, muscle cells, general structure of skeletal and smooth muscles, microfilament organization in skeletal and smooth muscles – sliding filament mechanism of contraction. Nerve cells – general structure of a neuron – synapses – types (electrical and chemical).

Unit V

(15 Hours)

Cell differentiation, senescence and death **Cell differentiation in plants:** Fertilization, initial divisions, seed formation, germination, primordial layer formation, organogenesis (only sources of organs from each layer). **Cell differentiation in animals:** fertilization, implantation, blastula formation, gastrulation, primordial germ layers, organogenesis (only sources of organs from each layer). **Cell senescence:** Biochemical changes during senescence – role of telomere and telomerase. **Cell death** – necrosis and * **programmed cell death (apoptosis, paraptosis and autophagy).**

* denotes Self study

Text Books

1. Rastogi, V. B. (2018). *A Textbook of Cell Biology and Genetics*. KNRN Publishers, Meerut.
2. Verma, P. S., & Agarwal, V. K. (2014). *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology*. S. Chand & Company Ltd., New Delhi.

Reference Books

1. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Scott, M. P., Bretscher, A., Ploegh, H., & Matsudaira, P. (2007). *Molecular Cell Biology* (6th ed.). W. H. Freeman and Company, New York.
2. Garrett, R. H., & Grisham, C. M. (2013). *Principles of Biochemistry* (5th ed.). Brooks/Cole, Cengage Learning.
3. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2014). *Molecular Biology of the Cell* (6th ed.). Garland Science, New York.
4. Sadava, D. E. (2004). *Cell Biology: Organelle Structure and Function*. Panima Publishing Corporation, New Delhi.
5. Karp, G. (2001). *Cell and Molecular Biology: Concepts and Experiments* (3rd ed.). John Wiley & Sons, New York.

6. Cooper, G. M., & Hausman, R. E. (2009). *The Cell: A Molecular Approach* (5th ed.). ASM Press, Washington, D.C.

E-Resources

1. <https://www.biointeractive.org>
2. <https://openstax.org/details/books/biology-2e>
3. <https://www.ncbi.nlm.nih.gov/books/NBK21054/>

MAPPING




PSO CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	S	H	M	S
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CO4	S	M	M	H	S
CO5	S	M	M	S	S

S-Strong

H-High

M-Medium

L-Low

Content prepared by (Based on Inputs)	
	
Signature of the course in-charge	Signature of the HOD
	Head (i/c)
	Department of Biochemistry
	(PG & Research)

Kongunadu Arts and Science College
(Autonomous)
Coimbatore - 641 029

Programme Code: 07		M.Sc Biochemistry		
Title of the paper: Core Practical 1 – Lab in Biomolecules, Bioinstrumentation, Enzymology and Cell Biology				
Batch	Hours/week	Total Hours	Credits	Employability/skill development/Entrepreneurship
2026-2028	5	75	4	

Course Objectives

1. To get practical experience in analyzing the biochemical metabolites in biological samples, bioinstrumentation, enzyme technology and cell biology techniques
2. To have hands on experience on chromatography, electrophoresis, enzyme and cell biology techniques
3. To develop familiarity with bioanalytical techniques and applications of enzyme and cell biology in research and industries

Course Outcomes (CO)

K3	CO1	Reproduce various concepts in Biomolecules, Enzyme and Cell biology.
	CO2	Conceive the amount of Biomolecules, isolation, determination of enzyme, preparation of buccal smears purification
TO	CO3	Apply the enzyme technology and cell biology skill in basic research projects
	CO4	Assign the principles of Biomolecules, enzyme and cell biology techniques to discovery novel drug development
K5	CO5	Be competent to perform various biochemical analysis.

Syllabus

Biomolecules

1. Isolation and estimation of starch from potato
2. Isolation and estimation of glycogen from liver.
3. Estimation of Fructose in fruits
4. Estimation of β -Carotene from carrot.

Bioinstrumentation

5. Separation of plant pigments by paper chromatography
6. Separation of amino acids by thin layer chromatography
7. PCR and Agarose gel electrophoresis with gel documentation (Demo)
8. GC and HPLC (Demo)

Enzymology

9. Effect of pH, Temperature and Substrate concentration on Catalase activity
10. Effect of pH, Temperature and Substrate concentration on Salivary amylase activity
11. Assay of SGPT & SGOT in Serum and Liver

Cell Biology

12. Animal cell types (Demo)
13. Cell Counting – RBC and WBC
14. Buccal smear – Identification of Barr body
15. Mitosis in onion root tip

Text Books

1. Sadasivam, S., & Manickam, A. (2018). *Biochemical Methods* (3rd ed.). New Age International Publishers, New Delhi.
2. Jayaraman, J. (2020). *Laboratory Manual in Biochemistry*. New Age International Publishers, New Delhi.

Reference Books

1. Wilson, K., & Walker, J. M. (2019). *Principles and Techniques of Practical Biochemistry* (5th ed.). Cambridge University Press, Cambridge, UK.
2. Palanivelu, P. (2019). *Laboratory Manual for Analytical Biochemistry and Separation Techniques*. Madurai Kamaraj University, Madurai.

MAPPING

PSO CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	S	H	M	M
CO2	H	S	S	M	M
CO3	M	H	H	S	S
CO4	M	M	M	S	S
CO5	M	M	S	H	M



S–Strong

H–High

M–Medium

L –Low

Sub.Code: 26PBC1CL

<p>Content prepared by (Based on Inputs)</p> <p></p> <p>Signature of the course in-charge Dr. S. Kaviltha</p>	<p></p> <p>Signature of the HOD Head (I/c)</p>
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**Department of Biochemistry
(PG & Research)
Kongunadu Arts and Science College
(Autonomous)
Coimbatore - 641 029**

Sub Code: 26PBC205

Programme Code: 07		M.Sc Biochemistry		
Title of the paper: Core Paper 5–Plant Biochemistry				
Batch	Hours/week	Total Hours	Credits	Skill development
2026-2028	5	75	4	

Course Objectives

1. To learn the mechanism and importance of photosynthesis in plants
2. To learn the role of hormones in the growth metabolism of plants
3. To know the latest genetic engineering techniques for plant development

Course Outcomes (CO)

K1 TO	CO1	Recall the biosynthesis of primary and secondary metabolites, nitrogen metabolism involved in plants
	CO2	Understand the concept of plant tissue culture and plant transformation techniques
	CO3	Know about applications of phytoconstituents in development of new drug
	CO4	Experiment on new technologies in plant biotechnology
K5	CO5	Evaluate various gene transfer techniques

Syllabus**Unit I****(15 Hours)**

Pigments: Plant genome organization. Introduction to the Structure, function and mechanisms of action of phytochromes (pigment system I and II), cryptochromes and phototropins, movement, transpiration: stomatal, cuticular and lenticular transpiration, photoperiodism and biological clocks, plant movement.

Unit II**(15 Hours)**

Photosynthesis: Importance of photosynthesis (C3, C4 and CAM), cellular respiration and photorespiration pathways and their significance.

Nitrogen metabolism: Role of micro and macro nutrients in plant growth. Significance of nitrogen. Ammonification, nitrification, nitrate reduction, Physical and biological nitrogen fixation- symbiotic, non-symbiotic. Symbiotic nitrogen fixation in leguminous plants, biochemistry of nitrogen fixation, denitrification and nitrogen cycle. Organic manures in nitrogen enrichment - Panchagavya

Unit III**(15 Hours)**

Plant hormones: characteristics and classification of plant hormones. Chemistry, biosynthesis, physiological effects, applications of auxins, gibberellins, cytokinins, abscisic acid, ethylene. Factors affecting the growth of plants. Natural plant growth regulators in traditional farming

Sub Code: 26PBC205

Unit IV**(15 Hours)**

Plant transformation techniques: Agrobacterium mediated gene transfer and its applications, Ti plasmid, the process of T-DNA transfer to plants: Mechanism. Agrobacterium mediated gene transfer in tobacco. Bt-crops and golden rice production. Drought and herbicide resistance. Transformation methods: Particle bombardment, polyethyleneglycol (PEG) mediated transformation and electroporation. Validation of transformation – resistance genes, marker genes and * **transgene DNA**. Role of medicinal plants in Indian systems

Unit V**(15 Hours)**

Secondary metabolites and plant tissue culture: Biosynthesis, Functions and applications of of terpenoids, Functions of alkaloids, anthocyanins, Tannins and lignin. Applications of secondary metabolites. Plant tissue culture-Micropropagation, Callus induction, cell and protoplast culture, organogenesis and somatic embryogenesis. Haploid production-Anther, pollen, embryo and ovule culture and their applications. Applications of plant tissue culture.***Soma clonal variation**. Plant toxins and their mechanisms. Indigenous seed conservation systems and biodiversity protection

* denotes Self study

Text Books

1. Jain, V. K. (2016). *Fundamentals of Plant Physiology* (18th ed.). S. Chand & Company Pvt. Ltd., New Delhi.
2. Verma, S. K., & Verma, M. (2008). *A Textbook of Plant Physiology, Biochemistry and Biotechnology* (2nd ed.). S. Chand & Company Pvt. Ltd., New Delhi.

Reference Books

1. Dey, P. M., & Harborne, J. B. (Eds.). (2000). *Plant Biochemistry*. Academic Press, London.
2. Slater, A., Scott, N. W., & Fowler, M. R. (2008). *Plant Biotechnology: The Genetic Manipulation of Plants* (2nd ed.). Oxford University Press, Oxford.
3. Stewart, C. N., Jr. (2008). *Plant Biotechnology and Genetics: Principles, Techniques, and Applications*. John Wiley & Sons, Chichester, UK.
4. Hopkins, W. G., & Hüner, N. P. A. (2008). *Introduction to Plant Physiology* (4th ed.). John Wiley & Sons, New York.
5. Razdan, M. K. (2003). *An Introduction to Plant Tissue Culture* (2nd ed.). Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

E-Resources

1. <https://www.plantcellatlas.org>
2. <https://plantphys.info>
3. <https://nptel.ac.in>

MAPPING



PSO CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	M	S	H	S	M
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CO3	M	H	M	S	S
CO4	S	M	S	H	M
CO5	S	M	H	S	H

S-Strong

H-High

M-Medium

L-Low

Content prepared by (Based on Inputs)	
	
Signature of the course in-charge <i>Dr. S. Karilka</i>	Signature of the HOD Head

Department of Biochemistry
(PG & Research)
Kongunadu Arts and Science College
(Autonomous)
Coimbatore - 641 029

Sub.Code: 26PBC206

Programme Code: 07		M.Sc Biochemistry		
Title of the paper: Core Paper 6 – Metabolism and Metabolic Regulation				
Batch	Hours/week	Total Hours	Credits	skill development
2026-2028	5	75	4	

Course Objectives

1. To learn the metabolism of various Biomolecules in our system
2. To provide a basic understanding of the biochemical reactions of molecules
3. To study the interrelationship of various metabolic pathways

Course Outcomes (CO)

K1	CO1	Remember commemorate the overall concept of cellular metabolism
	CO2	Explain the metabolism of various biochemical pathways
TO	CO3	Execute the diseases associated with defective nucleotide biosynthesis
	CO4	Analyze the role of fat in energy production and membrane synthesis
K5	CO5	Define and explain the metabolism in various nutritional status and starvation.

Syllabus**Unit I (15 Hours)****Overview of metabolism**

Interconversion of food stuffs. Metabolic profile of the liver, adipose tissue and brain. Integration of metabolic pathways- overview. Feedback and reciprocal regulation of metabolic pathways. Metabolic variations under altered nutritional/physiological status- starvation, well fed and pregnancy. Compartmentalization of metabolic pathway in the cell. Metabolic fuels: definition and Caloric value of metabolic fuels. Energy metabolism: ATP as energy currency, High energy phosphate compounds, Redox carriers (NAD⁺, NADP⁺, FAD).

UNIT II (15 Hours)**Carbohydrate metabolism and regulation**

Introduction to metabolism of cells, Glycolysis - Energetics of glycolysis. Gluconeogenesis, substrate cycle & reciprocal regulation of glycolysis & gluconeogenesis. Metabolism of glycogen & regulation. Maintenance of blood sugar by liver. Citric acid cycle and energetics. HMP shunt, Uronic acid pathway, Cori's cycle, Glyoxylate pathway. Metabolism of fructose, Galactose & Mannose.

UNIT III (15 Hours)**Fatty acid metabolism and regulation**

Oxidation of saturated & unsaturated fatty acids. Oxidation of fatty acids with even & odd

numbered carbon atoms. Alpha, Beta & Omega oxidation. Ketogenesis, Fatty acid biosynthesis and regulation. Mitochondrial and microsomal chain elongation. Metabolism of complex lipids, Cholesterol metabolism, lipoprotein metabolism. Arachidonic acid metabolism – Prostaglandins, Prostacyclins and thromboxanes metabolism.

UNIT IV**(15 Hours)****Amino acid metabolism and regulation**

Degradation of amino acids – transamination, oxidative and non - oxidative deamination, decarboxylation - Urea cycle and regulation. Catabolism of amino acids - carbon skeleton of amino acids to amphibolic intermediates, key role of glutamate dehydrogenase in nitrogen metabolism. Biosynthesis of biologically important molecules derived from amino acids (serotonin, catecholamines, GABA, melanin, creatine). Integration of Metabolism - Interrelationship of Carbohydrates, lipid and Protein metabolism. Metabolism of individual amino acids.

UNIT V**(15 Hours)****Nucleic acid Metabolism**

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

Metabolism of Nucleotides, De novo synthesis and Salvage pathway of Purine nucleotides, degradation of Purine nucleotides, De novo synthesis and Salvage pathway of Pyrimidine nucleotides. Degradation of Pyrimidine nucleotides, ***Inhibitors of Nucleotide metabolism**

* denotes Self study

Text Books

1. Satyanarayana, U., & Chakrapani, U. (2013). *Biochemistry* (4th ed.). Books and Allied (P) Ltd., Kolkata, India.
2. Murray, R. K., Granner, D. K., Rodwell, V. W., & Botham, K. M. (2012). *Harper's Illustrated Biochemistry* (29th ed.). McGraw-Hill Education, New Delhi.

Reference Books

1. Voet, D., Voet, J. G., & Pratt, C. W. (2013). *Fundamentals of Biochemistry: Life at the Molecular Level* (4th ed.). John Wiley & Sons, New Delhi.
2. Garrett, R. H., & Grisham, C. M. (2012). *Principles of Biochemistry* (5th ed.). Brooks/Cole, Cengage Learning.

3. Nelson, D. L., & Cox, M. M. (2008). *Lehninger Principles of Biochemistry* (5th ed.). W. H. Freeman and Company, New York.
4. Vasudevan, D. M., Sreekumari, S., & Vaidyanathan, K. (2011). *Textbook of Biochemistry for Medical Students* (6th ed.). Jaypee Brothers Medical Publishers (P) Ltd., New Delhi.

E-Resources

1. <https://www.genome.jp/kegg/pathway.html>
2. <https://metacyc.org>
3. <https://www.khanacademy.org>

MAPPING



PSO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO					
CO1	H	S	S	M	S
CO2	S	H	M	S	M
CO3	M	S	H	S	S
CO4	H	S	S	M	H
CO5	S	H	S	M	H

S-Strong

H-H igh

M-Medium

L -Low

Content prepared by (Based on Inputs)	
	
Signature of the course in-charge Dr. S. MONISHA	Signature of the HOD Head (ile)

Department of Biochemistry
(PG & Research)
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(Autonomous)
Coimbatore - 641 029

Programme Code: 07		M.Sc Biochemistry		
Title of the paper: Core Paper 7 –Molecular Biology				
Batch	Hours/week	Total Hours	Credits	Employability/skill development/Entrepreneurship
2026-2028	5	75	4	

Course Objectives

1. To understand the molecular organization of genes and chromosomes
2. To learn the process of DNA synthesis, repair and function
3. To learn the various molecular events occurring in DNA with proposed theories

Course Outcomes (CO)

K1	CO1	Able to define the basic concepts of gene
	CO2	Recognize the different processes involved in replication, transcription and Translation
TO	CO3	Integrate scientific and technological knowledge on the use of genetics and molecular biology for industrial products on the cell and process level
	CO4	Examine the molecular mechanisms behind DNA damage and repair
K5	CO5	Appraise the various concepts of regulation of genes.

Syllabus

Unit I

(15 Hours)

Concept of gene: Molecular structure of gene and chromosomes. Mendelian Principles: Mono and dihybrid cross. Incomplete Dominance, over dominance, Codominance, Epistasis. Linkage and crossing over, Sex determination and Sex linkage in diploids. Polygenic inheritance. Chromosomal aberrations. Karyotyping. Human Genetic Diseases - Down's syndrome, Turner's syndrome, Klinefelter's syndrome.

Unit II

(15 Hours)

Gene mutation and recombination: Gene Mutation-Classification of mutations, DNA as a genetic material (Transformation, Conjugation and Transduction). Genetics of viruses: Lytic and Lysogenic life cycles of phages. Genetic Recombination (Homologous recombination-Holliday model). Modern concept of genes. Population genetics: Hardy-Weinberg law. Quantitative genetics and multifactorial interactions, causes of variation and artificial selection.

Sub.Code: 26PBC207

Unit III**(15 Hours)**

Replication: Central dogma of life. Mechanism of replication in prokaryotes and eukaryotes, Theta and rolling circle model, Enzymology of replication. Replication of RNA genome- replicase and reverse transcriptase. Termination of replication-circular and linear replications.

Unit IV**(15 Hours)**

Transcription and Translation: Universal genetic code and its feature. Prokaryotic and eukaryotic transcription. RNA processing and post- transcriptional modification. Regulatory sequences in protein coding genes. Transcription initiation by RNA polymerase I, II and III. Processing of eukaryotic pre mRNA, RNA splicing, snRNA, spliceosome. RNA editing.

Translation- activation of amino acids, initiation, elongation, termination in prokaryotes and eukaryotes. Translational proof-reading- Posttranslational processing of protein.

Unit V**(15 Hours)**

Regulation of transcription and translation: Positive and negative control, Repressor and Inducer, concept of operon, lac-, ara-, trp operons. Catabolic repression, attenuation, anti- termination and methylation. Macromolecular transport across the nuclear envelope. Synthesis and targeting of peroxisomal proteins. ***Overview of secretory pathway.** Translocation of secretory products across ER membrane.

*** denotes Self study**

Text Books

1. Verma, P. S., & Agarwal, V. K. (2014). *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology*. S. Chand & Company Ltd., New Delhi.
2. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Scott, M. P., Bretscher, A., Ploegh, H., & Matsudaira, P. (2007). *Molecular Cell Biology* (6th ed.). W. H. Freeman and Company, New York.

Reference Books

1. De Robertis, E. D. P., & De Robertis, E. M. F. (2001). *Cell and Molecular Biology* (8th ed.). Lippincott Williams & Wilkins, Philadelphia.
2. Chandar, N., & Viselli, S. (2010). *Lippincott Illustrated Reviews: Cell and Molecular Biology*. Lippincott Williams & Wilkins (LWW), Philadelphia.
3. Weaver, R. F. (2011). *Molecular Biology* (5th ed.). McGraw-Hill Education, New York.

Sub.Code: 26PBC207

4. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2014). *Molecular Biology of the Cell* (6th ed.). Garland Science, New York.
5. Lewin, B. (2007). *Genes IX* (9th ed.). Jones & Bartlett Learning, Burlington, MA.

E-Resources

1. <https://www.ncbi.nlm.nih.gov/education>
2. <https://learn.genetics.utah.edu>
3. <https://www.nature.com/scitable>

MAPPING


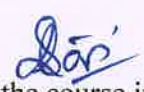
PSO CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	S	S	M	S
CO2	S	M	M	S	H
CO3	S	M	M	H	S
CO4	M	S	H	M	S
CO5	S	M	H	S	M

S-Strong

H-High

M-Medium

L-Low

Content prepared by (Based on Inputs)	 Signature of the HOD Head (I/c) Department of Biochemistry
 Signature of the course in-charge Dr. S. Kavitha	(PG & Research) Kongunadu Arts and Science College (Autonomous) Coimbatore - 641 029

Programme Code: 07		M.Sc Biochemistry		
Title of the paper: Core paper 8 Pharmaceutical Biochemistry				
Batch	Hours/week	Total Hours	Credits	Employability/skill
2026-2028	5	75	4	development

Course Objectives

1. To learn the mechanism of drug action in various diseases
2. To learn about different drugs available for treatment
3. To learn about the designing mechanisms for drug development

Course Outcomes (CO)

K1 TO K5	CO1	Repeat the concept of pharmacology
	CO2	Describe the mechanism of action of drug inside the system
	CO3	Employ the drug discovery and drug design procedures.
	CO4	Examine the treatment of various disorders using drug molecules
	CO5	Contribute in understanding the mode of action of antibiotics.

Syllabus

Unit I

(15 Hours)

General Pharmacology

Introduction to pharmacology,* **sources of drugs**, Classification of drugs, dosage forms, route of administration, site of action of drugs. Mechanism of action- concept of receptors. combined effect of drugs, factors modifying drug action. Dose response curve- gradal and quantal, therapeutic index, ED50 and LD50. Traditional drug sources in Ayurveda and Siddha systems, basic concepts of Rasayana drugs and plant-derived therapeutics.

Unit II

(15 Hours)

Pharmacodynamics

Definition. Drug receptors: Types, classification, drug- receptor interaction (binding and affinity, signal transduction, efficacy, receptor regulation and drug tolerance). Pharmacological activities: consequences of non-specific interaction.

Drug metabolism: Chemical pathways of drug metabolism– Biotransformation reactions- Phase I and phase II reactions , Microsomal and non-microsomal metabolism of drugs, role of cytochrome p450 enzyme system. Herb–drug interactions in traditional medicines.

Unit III**Drug Therapeutics and chemotherapy**

General principles of chemotherapy: Biochemical mode of action of antibiotics- penicillin and chloramphenicol, actions of alkaloids, antiviral and antimalarial substances. Biochemical mechanism of drug resistance- sulphonamides. Drug potency and drug efficacy. chemotherapy of parasitic infections, fungal infections, viral diseases. Introduction to immunomodulators and chemotherapy of cancer.

Unit IV:**(15 Hours)****Screening for pharmacological activity**

Analgesic, anti-inflammatory and antipyretic agents, gastrointestinal drugs- antiulcer and laxatives, antioxidants, anticancer and anti-fertility agents. Drugs for metabolic disorders like antidiabetic, anti-hyperlipidemic, anti-obesity and hepatoprotective agents.

Unit V:**(15 Hours)****Clinical Toxicology**

Definition, classification of toxicity – occupational, environmental and pharmaceutical. Types of toxins and their mechanism of action. Factors affecting toxicity- Methods of toxicity detection. Drug abuses and their biological effects. Rational prescription of drugs. Toxicity of anticancer drugs. Clinical symptoms of toxicity and ***marker parameters**.

*** denotes Self study**

Text Books

1. Verma, P. S., & Agarwal, V. K. (2014). *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology*. S. Chand & Company Ltd., New Delhi.
2. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Scott, M. P., Bretscher, A., Ploegh, H., & Matsudaira, P. (2007). *Molecular Cell Biology* (6th ed.). W. H. Freeman and Company, New York.

Reference Books

1. De Robertis, E. D. P., & De Robertis, E. M. F. (2001). *Cell and Molecular Biology* (8th ed.). Lippincott Williams & Wilkins, Philadelphia.
2. Chandar, N., & Viselli, S. (2010). *Lippincott Illustrated Reviews: Cell and Molecular Biology*. Lippincott Williams & Wilkins (LWW), Philadelphia.
3. Weaver, R. F. (2011). *Molecular Biology* (5th ed.). McGraw-Hill Education, New York.

Sub.Code:26PBC208

4. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2014). *Molecular Biology of the Cell* (6th ed.). Garland Science, New York.
5. Lewin, B. (2007). *Genes IX* (9th ed.). Jones & Bartlett Learning, Burlington, Massachusetts.




E-Resources

1. <https://go.drugbank.com>
2. <https://pubchem.ncbi.nlm.nih.gov>

MAPPING

PSO CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	S	M	S
CO2	S	M	S	H	L
CO3	H	S	M	S	M
CO4	S	H	M	M	H
CO5	S	H	M	S	M

S-Strong H-High M-Medium L-Low

Content prepared by (Based on Inputs)  Signature of the course in-charge 	 Signature of the HOD Head (i/c)
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Department of Biochemistry
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(Autonomous)
Coimbatore - 641 029

Sub.Code:26PBC2CM

Programme Code: 07		M.Sc Biochemistry		
Title of the paper: Core Practical 2 – L a b i n Plant Biochemistry, Microbiology and Molecular Biology				
Batch	Hours/week	Total Hours	Credits	Employability/skill
2026-2028	5	75	4	development/Entrepreneurship

Course Objectives

1. To learn the techniques of plant tissue culture
2. To get an hands-on-training on molecular techniques
3. To implement the applications of plant tissue culture, microbes, genetics and molecular techniques in research and industries

Course Outcomes (CO)

K1 TO	CO1	Correlate the principles of plant biochemistry, microbes, molecular biology and genetic techniques
	CO2	Demonstrate the technical skills involved in plant tissue culture, counting cells, identification of gene and its expressions
	CO3	Develop and apply the modern technology of plant biochemistry, microbial techniques, molecular biology and genetics in industries and research
	CO4	Examine the results obtained using plant biochemistry, sterilization techniques, molecular biology and genetics
K5	CO5	Be competent in handling the microbial cultures and plant samples.

Syllabus

Plant Biochemistry



1. Preparation of plant tissue culture media and sterilization*
2. Estimation of chlorophyll
3. Estimation of flavonoids
4. Estimation of total phenols

Microbiology

5. Maintenance of microbial cultures
6. Isolation and biochemical identification of bacteria from soil
7. Motility test
8. Bacterial growth curve (Demo)
9. Antibiotic susceptibility test by Kirby-Bauer method

Molecular Biology

10. Isolation of Genomic DNA from onion and separation using Agarose gel electrophoresis*
11. Isolation of Plasmid DNA from bacteria*

<p>Content prepared by (Based on Inputs)</p> <p></p> <p>Signature of the course in-charge Dr. S. Monisha</p>	<p></p> <p>Signature of the HOD Head (i/c)</p>
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Coimbatore - 641 029**

12. Estimation of DNA by Diphenyl amine method
13. Estimation of RNA by Orcinol method
14. SDS-PAGE*
15. Western blotting (demo)
16. Animal housekeeping, care, feed preparation and breeding of common laboratory animal-mice
17. Laboratory ethics (IAEC guidelines)

*Denotes group experiments

Text Books

1. Sadasivam, S., & Manickam, A. (2018). *Biochemical Methods* (3rd ed.). New Age International Publishers, New Delhi.
2. Jayaraman, J. (2020). *Laboratory Manual in Biochemistry*. New Age International Publishers, New Delhi.

Reference Books

1. Wilson, K., & Walker, J. M. (2019). *Principles and Techniques of Practical Biochemistry* (5th ed.). Cambridge University Press, Cambridge, UK.
2. Palanivelu, P. (2019). *Laboratory Manual for Analytical Biochemistry and Separation Techniques*. Madurai Kamaraj University, Madurai.

MAPPING

PSO CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	S	H	M	M
CO2	H	S	M	H	M
CO3	M	H	H	S	S
CO4	H	M	M	S	H
CO5	S	H	M	S	H

S-Strong

H-High

M-Medium

L-Low

Programme Code: 07		M.Sc Biochemistry		
Title of the paper: Core Paper 9 – Immunology and Immunological Techniques				
Batch	Hours/week	Total Hours	Credits	Employability/skill
2026-2028	6	90	5	development/Entrepreneurship

Course Objectives

1. To learn about the various cells of immune system and their functions
2. To know about the specificity of antigen-antigen interaction and their possible mechanisms
3. To know the role of immunological cells in the treatment of different diseases

Course Outcomes (CO)

K1 TO K5	CO1	Recall the types and functions of different immune cells
	CO2	Employ the mechanism of action of different immune cells and their resultant reaction responses
	CO3	Decipher the underlying causes of inherited or autoimmune diseases and consequences
	CO4	Experiment the new technologies involving immune cells in treating many diseases
	CO5	Contribute in understanding the important concepts of recombinant vaccine.

Syllabus

Unit I

(18 Hours)

Lymphoid organs and cells: Introduction to immunology and immune system, **organs:** primary and secondary lymphoid organs. **Cells:** Lineages (lymphoid and myeloid), Differentiation and maturation of B-cells and T-cells. Primary and secondary immune responses: Phagocytosis, inflammation, NK activity, ADCC, fever, chemical defenses.

Unit II

(18 Hours)

Antigens, antibodies and complement Antigens – types and properties of antigens and requirement for antigenicity. Antigen processing and presentation cells (TCRs and BCRs). Antibodies - general structure, classes, properties and functions of immunoglobulins. Complement – Outlines of classical and alternative pathways, intermediates formed and biological functions.

Unit III

(18 Hours)

Cell mediated immunity and immune response – Innate and acquired immunities: Humoral and

cell – mediated immunities. Mechanism of T cell and NK cell mediated lysis, antibody dependent cell mediated cytotoxicity and macrophage mediated cytotoxicity, Cytokines and their role in immune regulation, Immune suppression and immune tolerance.

Unit IV

(18 Hours)

Disorders of the Immune System: Hypersensitivity – elementary concepts of hypersensitivities – Types I-IV, Autoimmunity – basic concepts, causes and types of auto immune diseases, organ specific - Hashimoto's thyroiditis and Systemic Lupus - Erythematosus. Transplantation immunology – organ and bone marrow, immunity to infectious diseases- bacteria and virus.

Unit V

(18 Hours)

Vaccine technology: Over view of Recombinant vaccines and Immunization procedures. Role of B and T epitopes for vaccine development. Vaccines – killed, attenuated, toxoids, recombinant, DNA, synthetic peptide, mRNA vaccines, vector vaccines, and biomaterial-based vaccines.

Immuno techniques – Separation of lymphocytes. Features of antigen–antibody interactions. Precipitation reactions – immunodiffusion, immune electrophoresis. Agglutination reactions – blood grouping, haemagglutination. Assays with tagged antigen/antibody – RIA, *ELISA, immunoblotting, immunofluorescence, western blot, FCS.COVID vaccine*

* denotes Self study

Text Books

1. Kuby, J., Kindt, T. J., Osborne, B. A., & Goldsby, R. A. (2018). *Kuby Immunology* (10th ed.). W. H. Freeman and Company, New York.
2. Rao, C. V. (2002). *An Introduction to Immunology*. Narosa Publishing House, New Delhi.

Reference Books

1. Roitt, I. M., Brostoff, J., & Male, D. K. (2012). *Roitt's Essential Immunology* (12th ed.). Wiley-Blackwell Publishers, Oxford.
2. Tizard, I. R. (2005). *Immunology: An Introduction* (4th ed.). Saunders College Publishing, New York.
3. Rao, C. V. (2006). *An Introduction to Immunology* (2nd ed.). Narosa Publishing House, New Delhi.
4. Kuby, J., Goldsby, R. A., Kindt, T. J., & Osborne, B. A. (2007). *Immunology* (6th ed.). W. H. Freeman and Company, New York.

5. Paul, W. E. (Ed.). (2003). *Fundamental Immunology* (5th ed.). Lippincott Williams & Wilkins, Philadelphia.

E-Resources

1. <https://www.immunopaedia.org.za>
2. <https://www.biointeractive.org>

MAPPING



PSO CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	S	S	M	H
CO2	M	H	H	S	M
CO3	S	M	S	H	H
CO4	S	H	S	M	H
CO5	S	S	M	S	H

S-Strong

H-High

M-Medium

L-Low

Content prepared by (Based on Inputs)	
 Signature of the course in-charge Dr. S. Kavitha	 Signature of the HOD Head (C/C)

Department of Biochemistry
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Kongunadu Arts and Science College
(Autonomous)
Coimbatore - 641 029

Sub.Code : 26PBC310

Programme Code: 07		M.Sc Biochemistry		
Title of the paper: Core Paper 10 – Research methodology, Biostatistics and Data science				
Batch 2026-2028	Hours/week 6	Total Hours 90	Credits 4	Employability/Entrepreneurship

Course Objectives

1. To learn the different methods of collecting data and processing
2. To know about the different statistical methods to interpret the collected statistical data
3. To know the concept of article writing, report writing and thesis making so on

Course Outcomes (CO)

K1	CO1	State an idea on choosing the appropriate method of collecting data
	CO2	Employ the statistical method and process the collected data
	CO3	Illustrate the device and standardize the statistical methods
	CO4	Discriminate the concept in preparing a report, publishing an article and writing a project thesis
K5	CO5	Contribute the research knowledge in report writing.

Syllabus

Unit I

(18 Hours)

Nature of biological and clinical experiments – Collection of data in experiment- Primary and secondary data. Methods of data collection. Classification and tabulation. Different forms of diagrams and graphs related to biological studies. Measures of Averages- Mean, Median, and mode. Use of these measures in biological studies.

Research: Definition, Introduction, objectives, motivation, types, approaches, significance. Research Methods versus Methodology.

Unit II

(18 Hours)

Measures of Dispersion for biological characters – Quartile deviation, Mean deviation, Standard deviation and coefficient of variation. Measures of skewness and kurtosis. Correlation and regression – Rank correlation – Regression equation. Simple problems based on biochemical data.

Research problem and Research Design: Selection, necessity and techniques-Introduction, necessity, features, concepts relating to research design, types of research design, basic principles of experimental design

E-Resources

1. <https://swayam.gov.in>
2. <https://www.r-project.org>
3. <https://www.coursera.org/browse/data-science>

MAPPING


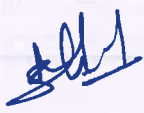
PSO CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	S	S	M	H
CO2	M	H	H	S	M
CO3	S	M	S	H	H
CO4	S	H	S	M	H
CO5	S	S	M	H	S

S-Strong

H-High

M-Medium

L-Low

Content prepared by (Based on Inputs)	
	
Signature of the course in-charge Dr. S. MONISHA	Signature of the HOD Head (i/c)

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Coimbatore - 641 029

Sub.Code : 26PBC310

Unit III (18 Hours)

Basic concepts of sampling- Simple random sample stratified sample and systemic sampling. Sampling distribution and standard error. Test of significance based on large samples. Test for mean, difference of means, proportions and equality of proportions.

Methods of Data Collection: Collection of Primary Data- Collection of Secondary Data

Unit IV (18 Hours)

Small sample tests – Students't' test for mean, difference of two way means, tests for correlation and regression coefficients. Chi-square test for goodness of a non independence of attributes. F test for equality of variances. ANOVA- one way and two way. Basic concept related to biological studies

Unit V (18 Hours)

Interpretation and Report Writing: Introduction, Techniques and precautions in interpretation, Report writing – significance, different steps, Publication in a scientific journal. Project proposal writing to funding agencies, Career opportunities in research and funding agencies.

Data science: Introduction to Data Science,-Definition of data science, importance, and basic applications, Machine Learning Algorithms, Deep Learning, Artificial Neural Networks and their Application. Application of AI in medical, health and pharma industries.

* denotes Self study

Text Books

1. Kothari, C. R. (2004). *Research Methodology: Methods and Techniques* (2nd ed.). New Age International (P) Limited Publishers, New Delhi.
2. Gurumani, N. (2015). *An Introduction to Biostatistics*. MJP Publishers, Chennai.
3. Gupta, S. P. (2009). *Statistical Methods* (38th ed.). Sultan Chand & Sons, New Delhi.

Reference Books

1. Rao, P. S. S. S., & Richard, J. (2009). *An Introduction to Biostatistics* (4th ed.). Prentice-Hall of India Private Limited, New Delhi.
2. Dutta, N. K. (2002). *Fundamentals of Biostatistics: A Practical Approach*. Kanishka Publishers, New Delhi.
3. Gupta, S. P. (2016). *Fundamentals of Statistics* (7th ed.). Sultan Chand & Sons, New Delhi.

Programme Code: 07		M.Sc Biochemistry		
Title of the paper: Core Paper11– Advanced Clinical Biochemistry				
Batch 2026-2028	Hours/week 7	Total Hours 105	Credits 4	Employability/skill development/Entrepreneurship

Course Objectives

1. To learn the methodologies for the detection of abnormalities in blood
2. To learn the process of different sample collection and processing
3. To know about the markers in the various metabolic disorders like cancer

Course Outcomes (CO)

TO	K1	CO1	Corelate the important laboratory biochemical tests
		CO2	Employ the methods of specimen collection and processing and analyzing the results
		CO3	Investigate the role of enzymes in clinical diagnosis of diseases
		CO4	Critisize the diagnostic procedures for tumor development
K5		CO5	Evaluate the role of free radicals in various diseases.

Syllabus

Unit I

(21 Hours)

Clinical chemistry/biochemistry: concept, definition and scope; Biological samples: types, collection, processing, stability and storage; **Collection of urine:** Timed urine specimens, urine preservatives. Clinical significance of urinary components with reference to sugars, proteins, ketone bodies, and bilirubin. Physical and chemical examinations of urine samples. Microscopic examination of urine, Abnormal and normal constitute of urine. Body fluids-CSF, gastric juice, ascitic fluid, synovial fluid and amniotic fluid: Composition, collection and analysis.

Unit II

(21 Hours)

Serology and hematology: Introduction. Anti serum, anti sera raising, chick and snake venom antibody. Principle of agglutination and precipitation. C-reactive protein and pregnancy test, Rheumatoid arthritis (RA) test. ESR, Coagulation test, prothrombin test. WIDAL test, ELISA, chemiluminescence, CMIA, ECLIA, flow cytometry. **Hemoglobin:** Normal and abnormal Hb, Separation of hemoglobin by electrophoresis. Hemoglobinopathies and its types.

Unit III

(21 Hours)

Clinical enzymology and endocrinology: Factors affecting enzyme levels in blood. Principle, assay and clinical significance of liver markers: AST, ALT, gamma- glutamyl transferase, amylase and lipase. Cardiac markers: creatine kinase, CKMB, lactate dehydrogenase, troponin (I

and T). Bone markers: ALP. Prostate marker: ACP. Clinical significance of pancreatic hormones and TFT.

Unit IV

(21 Hours)

Organ function test and related disorders: Jaundice, cirrhosis, hepatitis (HBV virus and types), fatty liver and gall stones. Renal function test and related disorder: Acute renal failure, glomerular disease. Gastric and pancreatic function test. Hyper and hypo lipoproteinemias and diagnostic test for lipoprotein disorders. Diabetes mellitus. Investigations of diabetes mellitus – OGTT – Indications, procedure, Interpretation and types of GTT curve. HbA1c. Fatty acid disorder – atherosclerosis.

Unit V

(21 Hours)

Free radicals and Antioxidants: Introduction, *Types of free radicals. Generation of free radicals (DPPH, ABTS, NO and ferric oxide) and lipid peroxidation Antioxidants: Role of free radicals, (Enzymic: SOD, Catalase, Glutathione Peroxidase, Glutathione Reductase; Non Enzymic: Vitamin A, *Ascorbic acid, Tocopherol, Reduced Glutathione). Herbal therapeutics.

* denotes Self study

Text Books

1. Shanmugam, A. (2008). *Fundamentals of Biochemistry for Medical Students* (7th ed.). Wolters Kluwer (India) Pvt. Ltd., New Delhi.
2. Stevens, C. D. (2016). *Clinical Immunology and Serology: A Laboratory Perspective* (4th ed.). F. A. Davis Company, Philadelphia.

Reference Books

1. Burtis, C. A., Ashwood, E. R., & Bruns, D. E. (2012). *Tietz Textbook of Clinical Chemistry and Molecular Diagnostics* (5th ed.). Elsevier Saunders, St. Louis, Missouri.
2. Vasudevan, D. M., Sreekumari, S., & Vaidyanathan, K. (2011). *Textbook of Biochemistry for Medical Students* (6th ed.). Jaypee Brothers Medical Publishers (P) Ltd., New Delhi.
3. Devlin, T. M. (2010). *Textbook of Biochemistry with Clinical Correlations* (7th ed.). John Wiley & Sons, Inc., Hoboken, New Jersey.
4. Longo, D. L., Fauci, A. S., Kasper, D. L., Hauser, S. L., Jameson, J. L., & Loscalzo, J. (2015). *Harrison's Principles of Internal Medicine* (19th ed., Vols. I & II). McGraw-Hill Education, New York.

E-Resources

1. <https://labtestsonline.org.uk>
2. <https://www.medscape.com>

MAPPING



PSO CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	S	S	M	H
CO2	M	H	H	S	M
CO3	S	M	S	H	H
CO4	S	H	S	M	H
CO5	S	M	H	S	M

S-Strong

H-High

M-Medium

L-Low

Content prepared by (Based on Inputs)  Signature of the course in-charge Dr. S. Kavitha	 Signature of the HOD Head (i/c) Department of Biochemistry
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(PG & Research)
Kongunadu Arts and Science College
(Autonomous)
Coimbatore - 641 029

Programme Code: 07		M.Sc Biochemistry		
Title of the paper: Core Practical 3 – Lab in Immunology, Genetic Engineering and Clinical Biochemistry				
Batch	Hours/week	Total Hours	Credits	Employability/skill development/Entrepreneurship
2026-2028	5	75	4	

Course Objectives

1. To enhance the students to have practical experience on techniques in immunological tests
2. To learn the methods of estimation of clinical parameters
3. To have hands on experience in genetic engineering

Course Outcomes (CO)

TO	K1	CO1	Recall the basic principles involved in immunology, clinical biochemistry and genetic engineering
		CO2	Demonstrate the techniques involved in immunology, clinical biochemistry and genetic engineering
		CO3	Develop and apply the recent technology involved in diagnostic techniques of immunology, clinical biochemistry and genetic
		CO4	Examine and analyze the results involved in immune techniques, clinical biochemistry and genetic engineering
K5		CO5	Be competent in handling the blood and urine samples.

Syllabus

Immunology

1. ELISA method
2. WIDAL test
3. Single radial immunodiffusion
4. Double immunodiffusion
5. Ouchterlory double diffusion
6. Immunoelectrophoresis
7. Rocket immune electrophoresis

8. Restriction digestion and ligation*

9. cDNA synthesis*

10. Bacterial transformation*

Estimation of the following parameters in urine

11. Urea

12. Uric acid

13. Creatinine

14. Glucose by Benedict's method

15. Bilirubin

16. Sodium

Estimation of the following parameters in blood

17. Hemoglobin

18. Total cholesterol

19. Glucose by GOD/POD method

*Denotes group experiments

Text Books

1. Sadasivam, S., & Manickam, A. (2018). *Biochemical Methods* (3rd ed.). New Age International Publishers, New Delhi.
2. Jayaraman, J. (2020). *Laboratory Manual in Biochemistry*. New Age International Publishers, New Delhi.

Reference Books

1. Wilson, K., & Walker, J. M. (2019). *Principles and Techniques of Practical Biochemistry* (5th ed.). Cambridge University Press, Cambridge, UK.
2. Palanivelu, P. (2019). *Laboratory Manual for Analytical Biochemistry and Separation Techniques*. Madurai Kamaraj University, Madurai.

MAPPING



PSO CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	M	S	M	S
CO2	H	S	S	S	M
CO3	M	M	H	M	S
CO4	S	H	M	H	M
CO5	S	M	H	S	M

S-Strong

H-High

M-Medium

L-Low

Content prepared by (Based on Inputs)	
 Signature of the course in-charge Dr. S. Monisha	 Signature of the HOD Head (i/c)

Department of Biochemistry
 (PG & Research)
 Kongunadu Arts and Sci
 (Autonomous)
 Coimbatore - 641 029

Programme Code: 07		M.Sc Biochemistry		
Title of the paper: Core Paper 12 – Hormonal Biochemistry				
Batch	Hours/week	Total Hours	Credits	Employability/skill
2026-2028	5	75	5	development/Entrepreneurship

Course Objectives

- 1.To learn about the system of hormonal functioning in biological systems
- 2.To know the regulation and action of different hormones at different conditions
- 3.To get an in depth knowledge on diabetes mellitus

Course Outcomes (CO)

K1	CO1	List the diverse group of hormones and their specific mechanism of action in the bodily metabolism
	CO2	Understand the regulatory functions of various hormones and their interrelationship in the endocrine disorders
	CO3	Discuss the pathophysiology, diagnosis, treatment and management of endocrine disorders
K5	CO4	Differentiate the role of hormones in various biological organs
	CO5	Evaluate the biological action of different hormones .

Syllabus

Unit-I

(15 Hours)

Concepts of endocrinology: History, definition and classification of hormones, normal range, Scope of Endocrinology, Hormone Secretion, Transport, and Degradation. Functions of Hormones – Growth, Maintenance of Homeostasis and Reproduction. Hormonal Feedback Regulatory Systems-Paracrine and autocrine control, Hormonal Rhythms.

Unit-II

(15 Hours)

Hormone Receptor - Receptor Families, hormone Action through Receptors – Membrane, Nuclear and Cytosolic Receptors.

Hypothalamus and pituitary hormones: Hypothalamic and pituitary axis hormones- Chemistry & biochemical functions; Hypothalamic releasing factors. Pituitary gland:hormones of the pituitary gland- Chemistry& biochemical functions. Pineal gland- hormones of the pineal gland- Chemistry& biochemical functions.

Unit-III

(15 Hours)

Parathyroid hormone and Pancreatic hormones: Chemistry and biochemical functions.

Parathyroid hormone: Calcitonin and its functions. Pancreatic hormone: Insulin, glucagon, somatostatin, pancreatic polypeptide-chemistry and biochemical functions.

Unit-IV**(15 Hours)**

Adrenal gland: Hormones of adrenal gland-chemistry and biochemical functions; FSH, TSH, Gastrointestinal hormones-cholecystokinin, Substance P, summary of the neuroendocrine control of GI; Neurohormones- the brain-renin-angiotensin and urotensin.

Unit-V**(15 Hours)**

Reproductive endocrinology: Male reproductive system: androgens: Source, synthesis, chemistry, metabolism, Physiological roles, mechanism of action and pathophysiology. Female reproductive system: estrogen and progesterone Synthesis, physiological role and mechanism of action of ovarian steroid hormones. Endocrinology of pregnancy, parturition and lactation, ***Hormonal contraception**, menopause and pathophysiology.

* denotes Self study

Text Books:

1. Hadley, M. E. (2000). *Endocrinology* (5th ed.). Prentice Hall International Inc., New Jersey.
2. Jameson, J. L. (Ed.). (2017). *Harrison's Endocrinology* (4th ed.). McGraw-Hill Education, New York.

Reference Books

1. Longstaff, A. (2002). *Instant Notes in Neuroscience* (1st Indian ed.). BIOS Scientific Publishers Ltd., Oxford, UK.
2. Hall, J. E. (2016). *Guyton and Hall Textbook of Medical Physiology* (13th ed.). Elsevier, Philadelphia.
3. Hall, J. E., Vaz, M., Kurpad, A., & Raj, T. (2016). *Guyton and Hall Textbook of Medical Physiology* (2nd South Asian ed.). Elsevier India, New Delhi.
4. Melmed, S., Polonsky, K. S., Larsen, P. R., & Kronenberg, H. M. (2011). *Williams Textbook of Endocrinology* (12th ed.). Elsevier Saunders, Philadelphia.

E-Resources

1. <https://www.ncbi.nlm.nih.gov/books/NBK278937/>
2. <https://www.endocrine.org>

MAPPING


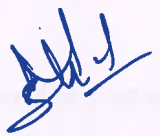
PSO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO					
CO1	H	S	S	M	H
CO2	M	H	H	S	M
CO3	S	M	S	H	H
CO4	S	H	S	M	H
CO5	S	M	S	H	M

S-Strong

H-High

M-Medium

L-Low

<p>Content prepared by (Based on Inputs)</p> <p></p> <p>Signature of the course in-charge Dr. S. Kavitha</p>	<p></p> <p>Signature of the HOD Head (1/e)</p>
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Department of Biochemistry
(PG & Research)
Kongunadu Arts and Science College
(Autonomous)
Coimbatore - 641 029

Sub.Code:26PBC413

Programme Code: 07		M.Sc Biochemistry		
Title of the paper: Core paper 13- rDNA technology				
Batch	Hours/week	Total Hours	Credits	Employability/skill development/Entrepreneurship
2026-2028	5	75	5	

Course Objectives

1. To enable the students to learn the principle and application of genetic engineering
2. To implement and transmission of a genetic material at molecular and cellular levels.

Course Outcomes (CO)

TO	K1	CO1	Enshrine the principles of genetic engineering and the vectors used in cloning and expression
		CO2	Grasp the different cloning strategies and their expression
		CO3	Demonstrate about implementation of genetic engineering for different purposes
		CO4	Investigate the different strategies of rDNA technology and resolve the problems encountered
K5	CO5	Analyse the various techniques of gene therapy.	

Syllabus

Unit I (15 hours)

Scope of Genetic Engineering: Milestones in Genetic Engineering, Cloning and patenting of life forms. Genetic engineering guidelines, Molecular tools (Restriction enzymes, modification enzymes, DNA and RNA markers, Linker, adaptors, and homopolymers), Gene isolation, purification and yield analysis.

Unit II (15 hours)

Cloning vectors: Plasmids (pBR322 and pUC18), Phages (λ phage and M13 vectors), Phagemids (pBluescript, pGEM), Cosmids (pJB8) and Artificial Chromosomes (BAC and YAC). Plant and Animal viruses as vector, binary and shuttle vectors, expression vectors for prokaryotes and eukaryotes, expression cassettes

Unit III (15 hours)

Gene transfer methods: preparation of competent cells and selection. calcium phosphate

Sub.Code:26PBC413

co-precipitation, electroporation, lipofection, viruses, biolistics, microinjection. Screening of recombinants: marker inactivation (antibiotic resistance, blue-white selection), colony hybridization, immunological screening.

Sequencing techniques: High throughput sequencing and shotgun sequencing. PCR and RT-PCR. Complementary DNA (cDNA). Human Genome Project (HGP) - features. Positional cloning. Identifying disease genes and Gene therapy

Unit IV (15 hours)

Cloning strategies: Cloning and expression of cloned genes Construction of genomic and cDNA libraries. Differences between genomic and cDNA libraries. Chromosome walking, chromosome Jumping, HRT and HART. Reporter genes – CAT, GFP, luciferase.

Basic principle and application of PCR – DNA Polymorphism –*RFLP, RAPD, VNTR, SSR, AFLP, STS, SCAR, SNP. DNA sequencing and fingerprinting. DNA microarrays. OMICS and Next Gen sequencing.

Unit V (15 hours)

Application: Transgenic animals as models in the prevention of human diseases like muscular dystrophy and anticancer therapy. Production of recombinant insulin, vaccines and growth hormone. Gene therapy: Stem cell gene therapy, Somatic cell gene therapy, Antisense RNA therapy, genetherapy for inherited diseases; familial hypercholesterolemia, hemophilia, ADA deficiency (SCID), SCP and *Cystic fibrosis.

* denotes Self study

Text Books

1. Primrose, S. B., Twyman, R. M., & Old, R. W. (2001). *Principles of Gene Manipulation: An Introduction to Genetic Engineering* (6th ed.). Blackwell Science Ltd., Oxford, UK.
2. Primrose, S. B., Twyman, R. M., & Old, R. W. (2001). *Principles of Gene Manipulation* (6th ed.). Blackwell Science Ltd., Oxford, UK.

Reference Books

1. Brown, T. A. (2010). *Gene Cloning and DNA Analysis: An Introduction* (6th ed.). Wiley-Blackwell, Oxford, UK.
2. Lucia, L. A., & Rojas, O. J. (Eds.). (2009). *The Nanoscience and Technology of Renewable Biomaterials*. Wiley-Blackwell, New York.
3. Primrose, S. B., Twyman, R. M., & Old, R. W. (2006). *Principles of Gene Manipulation and Genomics* (7th ed.). Blackwell Publishing Ltd., Oxford, UK.

4. Glick, B. R., Pasternak, J. J., & Patten, C. L. (2010). *Molecular Biotechnology: Principles and Applications of Recombinant DNA* (4th ed.). ASM Press, Washington, D.C.
5. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R. (2014). *Molecular Biology of the Gene* (7th ed.). Pearson Education, Boston.

E-Resources

1. <https://www.addgene.org/education/>
2. <https://www.ncbi.nlm.nih.gov/gene>

MAPPING



PSO CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	S	H	S	M
CO2	H	S	H	M	M
CO3	M	H	H	H	H
CO4	M	S	M	S	M
CO5	M	S	M	S	H

S-Strong

H-High

M-Medium

L-Low

Content prepared by (Based on Inputs)  Signature of the course in-charge Dr. S. Karilka	 Signature of the HOD Head (I/c)
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Department of Biochemistry
(PG & Research)

Kongunadu Arts and Science College
(Autonomous)
Coimbatore - 641 029

Programme Code: 07		M.Sc Biochemistry	
Title of the paper : Project and Viva-voce			
Batch 2026-2028	Semester IV	Credits 3	Employability/skill development/Entrepreneurship

Course Objectives

1. The student will be able to choose an appropriate topic for study and will be able to clearly formulate and state the research problem. For a selected research topic, student will be able to compile the relevant literature and frame hypotheses for research as applicable.
2. Based on the analysis and interpretation of the data collected, student will be able to arrive and propose suitable recommendations on the research problem
3. Student will be able to create a logically coherent project report and will be able to defend his / her work in front of a panel of examiner.

Course Outcomes (CO)

K1	CO1	Choose an appropriate research topic
	CO2	Summarize the findings through the literature survey
TO	CO3	State exactly the problem of the experimental study/ research undertaken
	CO4	Interpret the results of the research using the statistical tools.
K5	CO5	Evaluate the research outcomes and present them in oral presentation



Individual/Group Project Work shall be assigned to students at the beginning of the IV Semester under the supervision and guidance of faculty members. The Project Report shall be submitted at the end of the IV Semester, followed by a Viva-Voce Examination. The Project Work shall be related to the field of Biochemistry in healthcare, industry, environmental studies, and scientific research. The Internal and External Examiners shall jointly evaluate the Project Report and Viva-Voce Examination. Marks shall be awarded on the basis as mentioned below.

COMPONENTS	MARKS	TOTAL
CIA		
Project review	15	20
Regularity	2	
ESE Project Viva Voce		
Project Report	60	80
Viva-Voce (Internal & External jointly)	20	
TOTAL		100

Project mark breakup

Knowledge Level	Section
K3 ↑ ↓ K5	Project Report: <ul style="list-style-type: none"> ● Content – 20 ● Presentation – 20 ● R&D – 10 ● Review – 10
	Viva Voce: <ul style="list-style-type: none"> ● Layout of presentation – 5 ● Clarity – 5 ● Defense – 10

Note: The project dissertation evaluation and Viva-voce examination will be conducted by the Internal and External Examiners.

Content prepared by (Based on Inputs)	
	
Signature of the course in-charge <u>Dr. S. Monisha</u>	Signature of the HOD

Head
 Department of Biochemistry
 (PG & Research)
 Kongunadu Arts and Science College
 (Autonomous)
 Coimbatore - 641 029

MAJOR ELECTIVE

Major Elective Papers (2 papers are to be chosen from the following 6 papers)

S.No	Major Elective Papers
1	Nanobiotechnology
2	Microbial Technology
3	Bioinformatics
4	Bioethics, Biosafety and IPR
5	Environmental management
6	Biopharmaceuticals

Programme Code: 07	M.Sc Biochemistry			
Title of the paper:	Major Elective: Nanobiotechnology			
Batch 2026-2028	Hours / Week	Total Hours	Credits	Skill development
	5	75	5	

Course Objectives

1. To get an idea about the application of nanotechnology in biological research
2. To learn the properties and functions of nanomaterials in biological systems
3. To learn the applications of nanomaterials in drug delivery and treatment

Course Outcomes (CO)

K1	CO1	Insight about the nanotechnology concepts
	CO2	Explain the methods of nanoparticle synthesis
	CO3	Use properties of nanoparticles
TO	CO4	Apply the knowledge of nanotechnology in biological research
	K5	CO5

Syllabus

Unit I

(15 Hours)

Introduction to Nanotechnology: Introduction to nanoparticles. Nanoscience and its importance. Definition: Nanotechnology - Nanobiotechnology- Nanomaterial - Nanocomposites- Classification of nanostructures – Top down and Bottom Up approach - Quantum dots -Bio-inspired nanomaterials.

Unit II

(15 Hours)

Herbonanotechnology: Physical synthesis - Ball Milling - Thermal evaporation - Chemical synthesis – Solgel Process - Hydro thermal Synthesis-Biological Synthesis – Plant, Microbial compound based synthesis

Unit III

(15 Hours)

Properties of Nanomaterials: Preparation of nanoparticles Physical properties - Optical, Magnetic, Surface Plasmon resonance - Electrochemical Properties of Nanoscale Materials, Intramolecular bonding, Inter-molecular bonding,

***Nanocatalysis**, Self-assembly – DNA, Protein.

Unit IV

(15 Hours)

Characterization methods: UV - Visible Spectrophotometer, X-ray diffraction (XRD), Scanning Electron Microscope (SEM) Transmission, Electron Microscope (TEM), Fourier Transform InfraRed Spectrometer (FTIR), EDAX, Dynamic Light Scattering(DLS).

Unit V

(15 Hours)

Applications of Nanoparticles: Nanoparticles in waste water treatment, cancer therapy, Biosensors- DNA Microarrays - CellBiochips - Nanoparticles for Bioimaging- Textile and pharma industries. Application in environment, agriculture and pesticide diagnosis. Nanorobotics. Military applications of Nanotechnology - Nanomaterials for food Applications. Diagnosis and *nanoToxicity of Nanoparticles - Future Perspectives.

* denotes Self study

Text Books

1. Pradeep, T. (2008). *Nano: The Essentials – Understanding Nanoscience and Nanotechnology*. Tata McGraw-Hill Publishing Company Limited, New Delhi.
2. Kelsall, R. W., Hamley, I. W., & Geoghegan, M. (2005). *Nanoscale Science and Technology*. John Wiley & Sons Ltd., Chichester, UK.

Reference Books

1. Gao, G. (2004). *Nanostructures and Nanomaterials: Synthesis, Properties and Applications*. Imperial College Press, London.
2. Wilson, M., Kannangara, K., Smith, G., Simmons, M., & Raguse, B. (2005). *Nanotechnology: Basic Science and Emerging Technologies*. Chapman & Hall/CRC Press, Boca Raton, Florida.
3. Torchilin, V. P. (2006). *Nanoparticles as Drug Carriers*. Imperial College Press, London.
4. Niemeyer, C. M., & Mirkin, C. A. (Eds.). (2004). *Nanobiotechnology: Concepts, Applications and Perspectives*. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany.

E-Resources

1. <https://nptel.ac.in>
2. <https://www.nano.gov>
3. <https://jnanobiotechnology.biomedcentral.com>
4. <https://www.nanowerk.com>
5. <https://pubmed.ncbi.nlm.nih.gov>

MAPPING



PSO CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	L	M	M	M
CO2	S	M	H	S	H
CO3	H	S	M	M	S
CO4	S	M	S	S	M
CO5	S	M	S	M	H

S-Strong

H-High

M-Medium

L-Low

<p>Content prepared by (Based on Inputs)</p>  <p>Signature of the course in-charge</p> <p>Dr. S. Kavitha</p>	 <p>Signature of the HOD</p> <p>Head</p>
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Department of Biochemistry
 (PG & Research)
 Kongunadu Arts and Science College
 (Autonomous)
 Coimbatore - 641 029

Programme Code: 07	M.Sc Biochemistry			
Title of the paper	Major Elective: Microbial Technology			
Batch 2026-2028	Hours / Week	Total Hours	Credits	Employability/skill development/Entrepreneurship
	5	75	5	

Course Objectives

1. To learn about the microbiological techniques for microbial studies
2. To learn the energy process taking place in microbes
3. To learn about the food poisoning and pathogenicity of microbes

Course Outcomes (CO)

K1 TO	CO1	Commemorate the general bacteriology and microbial techniques.
	CO2	Understand the basic microbial structure and function
	CO3	Implement the handling techniques and staining procedures in laboratory
	CO4	Resolve the microbial techniques and its applications
K5	CO5	Employ the role of microbes in pathogenesis.

Syllabus

Unit I

(15 Hours)

Morphology and Ultrastructure: History of microbiology. Classification of microbes. Ultra structure and characteristics of fungi, algae and protozoa. Bacterial morphology and fine structure; cell wall, cell membrane, intra cytoplasmic structures and external structures-bacterial growth curve, synchronous growth, continuous culture. Factors affecting bacterial growth. Staining techniques-simple Differential Special staining techniques and negative staining.

Unit II

(15 Hours)

Microbiological techniques: Culture techniques: Isolation of microbes from various sources, serial dilution techniques, pure culture techniques, Anaerobic culture methods-chemical and physical methods. Culture preservation techniques.

Nutritional requirements: different kinds of media, composition of media -carbon sources, nitrogen sources, vitamin and growth factors, mineral, inducers, precursors and inhibitors.

Sterilization methods. Anaerobic fermentation- Alcoholic fermentation, propionic acid fermentation, formic acid fermentation.

Unit III (15 Hours)

Food Microbiology: Food poisoning – Food borne diseases- Bacterial and Non- Bacterial. Microbial quality and safety – Determining microorganisms in foodculture, Microscopy and sampling methods-Chemical and immunological methods. Principles of food preservations: Asepsis, Preservation by use of High temperature, Low temperature, Canning, Drying, Radiation and Food additives.

Unit IV (15 Hours)

Medical Microbiology: Infectious Diseases process-Diagnosis-Process of sample collection, transport and examinations of the specimens. Antibioqram. Bacteriology: Morphology, cultural characteristics, pathogenicity and laboratory diagnosis of Grampositive organisms- *Staphylococcus aureus*, Mycoplasma; Gram negative organisms: *E.coli*.

Unit V (15 Hours)

Pathogenicity and Laboratory Diagnosis: *Virology-Basic concepts of virology. General properties of Human viruses, Approaches to viral diagnosis-Serological and Molecular techniques of viral infections-Hepatitis.Mycology: General properties and approaches tolaboratory diagnosis. Mycosis-Superficial, Subcutaneous and Systemic infections-*Candida albicans*. Parasitology: Pathogenicity and *laboratory diagnosis of *Plasmodiumvivax*.

* denotes Self study

Text Books

1. Prescott, L. M., Harley, J. P., & Klein, D. A. (2003). *Microbiology* (5th ed.). McGraw-Hill Higher Education, Boston.
2. Pelczar, M. J., Chan, E. C. S., & Krieg, N. R. (2000). *Microbiology: Concepts and Applications* (5th ed.). McGraw-Hill Education, New York.

Reference Books

1. Ananthanarayan, R., & Paniker, C. K. J. (2005). *Textbook of Microbiology* (7th ed.). Universities Press (India) Pvt. Ltd., Hyderabad.
2. Stanbury, P. F., Whitaker, A., & Hall, S. J. (2008). *Principles of Fermentation Technology* (3rd ed.). Butterworth-Heinemann, Elsevier, Oxford, UK.

3. Davis, B. D., Dulbecco, R., Eisen, H. N., Ginsberg, H. S., & Wood, W. B. (1990). *Microbiology* (4th ed.). J. B. Lippincott Company, Philadelphia.

E-Resources

1. <https://microbiologysociety.org><https://www.nano.gov>
2. <https://asm.org><https://www.nanowerk.com>
3. <https://www.ncbi.nlm.nih.gov>
4. <https://vlab.co.in>
5. <https://pubmed.ncbi.nlm.nih.gov>

MAPPING

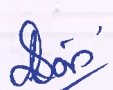

PSO CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	S	S	H
CO2	S	H	S	H	H
CO3	M	S	M	H	S
CO4	H	M	H	S	M
CO5	S	M	S	H	M

S–Strong

H–High

M–Medium

L –Low

Content prepared by (Based on Inputs)	
 Signature of the course in-charge Dr. S. Kavilka	 Signature of the HOD Head (i/c) Department of Biochemistry

(PG & Research)
Kongunadu Arts and Science College
(Autonomous)
Coimbatore - 641 029

Programme Code: 07		M.Sc Biochemistry		
Title of the paper		Major Elective: Bioinformatics		
Batch 2026-2028	Hours / week 5	Total Hours 75	Credits 5	Employability/skill development/Entrepreneurship

Course Objectives

1. To learn the role of computer programmes in studying the biological processes
2. To know about the different software's for data analysis
3. To learn about the methods of data retrieval from various databases

Course Outcomes (CO)

K1	CO1	Learn about the basics and beginning developments in computer usage
	CO2	Employ the basics of bioinformatics
TO	CO3	Differentiate various bioinformatics softwares
	CO4	Apply the role bioinformatics in biological science research
K5	CO5	Apply bio informatics in proteomics and human genome project.

Syllabus

Unit I

(15 Hours)

Bioinformatics: Introduction, fields related to bioinformatics, objectives, scope, genome mapping as a source of bioinformatics. Applications of bioinformatics in various fields*.Chronological history of events in bioinformatics.Role of computers in bioinformatics.Major categories of bioinformatics tools.Applications of programmes inbioinformatics.

Unit II

(15 Hours)

Biological databases: database, database management system and its advantages. Biological databases and information resources. Classification of biological databases: general databases, protein families & sequence motif database, signal sequence databases, protein – protein interaction databases, pathways databases, structural databases, SNPs database, histology database, standards, PUBMED, ENTREZ. Searching and retrieving data from databases- FASTA and BLAST. Linking databases with sequence retrieval systems (SRS).Advantages of SRS.OMIM, ExPASy, EMBL-Bank, ENSEMBL and its advantages.

Unit III

(15 Hours)

Genomics: gene, genome, genomics: genome mapping & genome projects, methods of gene sequence analysis: Genbank, Genbank assembly, genome annotation, genome

similarity. Types of genomics: comparative, structural and functional genomics. Gene functions: analysis of gene expression, DNA microarray or DNA chip, serial analysis of gene expression.

Unit IV

(15 Hours)

Proteomics: Introduction, methods of studying proteins: determining the post translationally modified proteins, determining the existence of proteins in complex mixtures, establishing protein-protein interactions. Protein structure classification: CATH, SCOP, DALI, FSSP, SSAP, protein structure bioinformatics resource. Protein structure prediction: ROSETTA, protein folding, protein folding disorders. Protein function prediction: automated protein function prediction, diversity in protein function.

Unit V

(15 Hours)

Human Genome Project: Milestones, types of sequences in Human Genome Project, impact, potential benefits, ethical, legal and social issues. **Gene therapy:** Principles, current status of gene therapy research. Factors affecting gene therapy. Recent developments in gene therapy. **Drug designing:** Objectives, *rational drug design, computer assisted drug design, drug development. **Pharmacogenomics:** prospects, uses, barriers to progress.

* denotes Self study

Text Books

1. Lohar, P. S. (2009). *Bioinformatics*. MJP Publishers, Chennai.
2. Claverie, J.-M., & Notredame, C. (2012). *Bioinformatics: A Beginner's Guide* (1st ed.). Wiley India Pvt. Ltd., New Delhi.

Reference Books

1. Mount, D. W. (2004). *Bioinformatics: Sequence and Genome Analysis* (2nd ed.). CBS Publishers & Distributors, New Delhi.
2. Westhead, D. R., Parish, J. H., & Twyman, R. M. (2002). *Instant Notes in Bioinformatics*. BIOS Scientific Publishers, Oxford, UK.
3. Lesk, A. M. (2019). *Introduction to Bioinformatics* (5th ed.). Oxford University Press, Oxford.
4. Baxevanis, A. D., & Ouellette, B. F. F. (Eds.). (2005). *Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins* (3rd ed.). Wiley-Interscience, New York.
5. Pevsner, J. (2015). *Bioinformatics and Functional Genomics* (3rd ed.). Wiley-Blackwell, Hoboken, New Jersey.

E-Resources

1. <https://www.ncbi.nlm.nih.gov>
2. <https://www.ebi.ac.uk>
3. <https://www.expasy.org>
4. <https://www.rcsb.org>
5. <https://pubmed.ncbi.nlm.nih.gov>

MAPPING



PSO CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	S	M	S
CO2	S	M	S	M	S
CO3	S	H	M	S	H
CO4	H	M	H	M	M
CO5	S	M	M	S	H

S-Strong

H-High

M-Medium

L-Low

Content prepared by (Based on Inputs)  Signature of the course in-charge Dr. S. Kavitha	 Signature of the HOD Head (i/c)
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Department of Biochemistry
(PG & Research)
Kongunadu Arts and Science College
(Autonomous)
Coimbatore - 641 029

Programme Code: 07		M.Sc Biochemistry		
Title of the paper		Major Elective: Bioethics, Biosafety and IPR		
Batch 2026-2028	Hours / Week 5	Total Hours 75	Credits 5	Employability/skill development/Entrepreneurship

Course Objectives

1. To learn about the demerits of biotechnological applications in recent research
2. To know the ethical issues to be concerned in the course of biological research
3. To know about the intellectual property rights of individual researchers

Course Outcomes (CO)

K1 TO	CO1	Remember the ethical issues of scientific research
	CO2	Employ the various regulations in biosafety and bioethics
	CO3	Decipher the awareness of the intellectual property rights
	CO4	Experiment the secured and ethical way of research
K5	CO5	Contribute the knowledge in filing the patents.

Syllabus

Unit I

(15Hours)

Bio-ethics-Nature, concept and relevance of bioethics; historical development of bioethics; basic principles of bioethics (autonomy, beneficence, non-maleficence, justice).

Ethical issues in modern biotechnology – plant, animal and microbial genetic engineering; ethical issues in genome editing technologies, ethical concerns in healthcare and biomedical research. Legal, social and economic implications of biotechnology products.

Biopiracy - concept of biopiracy with case studies such as Neem, Turmeric, and Basmati Rice; application of IPR to biological resources; access to biological resources; prior informed consent and benefit sharing.

Unit II

(15Hours)

Intellectual Property Rights.

Classification of intellectual property- patents, copyright, trademarks, industrial designs, geographical indications, and sui generis systems including protection of plant varieties and traditional knowledge.

Patent filing and infringement-Patent application procedures, forms and guidelines, fee structure and time frames; provisional and complete specifications; types of patent applications. International patent filing system under Patent Cooperation Treaty.

Unit III (15Hours)

International IP Law and Indian IPR Legislations - International Conventions related to Intellectual Property; Role of WIPO, General Agreement on Trade and Tariff (GATT); Trade Related Aspects of Intellectual Property Rights (TRIPS), Indian Position on WTO Regime, Indian IPR legislations – National Intellectual Property Policy and Unfair Competition

Unit IV (15Hours)

Patents and Patentability of Biotechnological Invention - Nature, Origin and Scope of Patents; Essentials of Patents- Patentability Criteria- novelty, inventive step and industrial applicability. Ethical and regulatory issues related to GMO in agriculture and food systems, environmental release and biosafety concerns, Patentability of Biotechnology Inventions, Patent Laws in Indian and International Perspective, Type of patents - Indian patent act and foreign patents

Unit V (15Hours)

Bio-safety: Concept and importance of biosafety; biosafety in relation to human health, environment and transgenic research, International Legal Instruments on Bio-safety-Cartagena Protocol on Bio-safety, Nagoya Protocol. Laws relating to Bio-safety in India, Bio- safety procedures, rules and guidelines under Environment (Protection) Act*.

Bio-safety Regulation: Principles and Practices in Microbial and Biomedical Labs; guidelines for research involving recombinant DNA molecule; Regulatory bodies at national and international level

* denotes Self study

Text Books

1. Cibelli, J., Lanza, R. P., Campbell, K. H. S., & West, M. D. (2002). *Principles of Cloning*. Academic Press, San Diego, California.
2. Sasson, A. (2000). *Biotechnologies in Developing Countries: Present and Future*. UNESCO Publishing, Paris.

Reference Books

1. Singh, K. (2000). *Intellectual Property Rights in Biotechnology*. BCIL (Biotech Consortium India Limited), New Delhi.
2. Government of India. (1970). *The Patents Act, 1970 (as amended) and Patent Rules*. Universal Law Publishing Co. Pvt. Ltd., New Delhi.
3. Kankanala, C. (2007). *Genetic Patent Law and Strategy* (1st ed.). Manupatra Information Solutions Pvt. Ltd., New Delhi.

4. Gurumani, N. (2006). *Research Methodology for Biological Sciences*. MJ Publishers, Chennai.
5. Sateesh, M. K. (2008). *Bioethics and Biosafety*. I. K. International Publishing House Pvt. Ltd., New Delhi.
6. Dubey, R. C. (2014). *A Textbook of Biotechnology* (5th ed.). S. Chand & Company Ltd., New Delhi. (Chapters on biosafety and bioethics).
7. WTO Secretariat. (2017). *Understanding the WTO: Intellectual Property Rights and TRIPS Agreement*. World Trade Organization, Geneva.

E-Resources

1. <https://www.unesco.org/en/ethics-science-technology>
2. <https://www.wipo.int>
3. <https://ipindia.gov.in>
4. <https://www.who.int/teams/health-ethics-governance>
5. <https://bch.cbd.int>

MAPPING

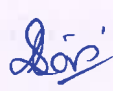

PSO \ CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	M	M	M	S
CO2	S	S	H	M	H
CO3	H	M	S	H	M
CO4	S	M	S	H	S
CO5	S	M	H	S	M

S–Strong

H–High

M–Medium

L –Low

Content prepared by (Based on Inputs)  Signature of the course in-charge Dr. S. Kavitha	 Signature of the HOD Head (i/c) Department of Biochemistry
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Unit III

(15 Hours)

The role of Risk Assessment in Environmental Management decisions : Evaluation of Human Health Risks Associated with airborne exposures to asbestos, a diagnostic human health risk assessment for a contaminated site problem and a risk based strategy for developing a corrective action, Response plan for petroleum – contaminated sites, Risk Management and Risk Communication.

Unit IV

(15 Hours)

Basic concepts of Environmental Economics: International Trade and its Environmental Integrity, Ecolabelling, responsible care, design for the Environment and full-cost accounting for municipal solid waste management, Waste lands and their reclamation, Desertification and its control. Soil erosion, Formation and reclamation of user, alkaline and saline soil, Terra Preta [black carbon] soil in Amazon forests for sustainability in soil; Biochars for energy production and as mitigation measures for global warming and ***soil rejuvenation.**

Unit V

(15 Hours)

Environmental Education and Communication: Environmental Conflict Management, Sustainable development-concept, and growth of the idea, indicators of sustainability, Sustainability of Water Resources, Sustainable Management of Forests, Sustainability in Industry, Ecosystem Management: Coastal Environments, River and Inland Water Environments, Wetlands, Desert margins, Rural and Urban Environments. Current environmental issues in India – Case studies: Narmada Dam, There Dam, Almetti Dam.

*** denotes Self study**

Text Books

1. Benjamin, S. L., & Bullock, D. A. (2001). *Practical Guide to Understanding, Managing and Reviewing Environmental Risk Assessment Reports*. Lewis Publishers, Boca Raton, Florida.
2. Theodore, M. K., & Theodore, L. (2009). *Introduction to Environmental Management* (1st ed.). CRC Press, Boca Raton, Florida.

Programme Code: 07		M.Sc Biochemistry		
Title of the paper		Major Elective: Environmental management		
Batch	Hours / week	Total Hours	Credits	Employability/skill development/Entrepreneurship
2026-2028	5	75	5	

Course Objectives

1. To learn the various issues pertaining to the environment
2. To combat the environmental issues with efficient strategies
3. To assess the various existing environmental risk issues

Course Outcomes (CO)

K1 TO	CO1	Remember the environmental related issues
	CO2	Employ the various human risk assessment
	CO3	Decipher the awareness of the environmental risk assessments
	CO4	Experiment the secured and environmental economics
K5	CO5	Contribute the knowledge about the environmental education and communication.

Syllabus

Unit I

(15 Hours)

Concept and scope of Environmental Management: Environmental Management of Resources - Water, forest, biological, mineral and agricultural; Environmental management of chemical, mining and manufacturing industries –petroleum, coal, cement, paper, fertilizer. Environmental Planning, Establishment of Health and Environmental standards, measuring Sustainable Development, Life Cycle Assessment, Material Flow Analysis, Environmental Auditing and Environmental Management Systems and Accounting for Eco-efficiency.

Unit II

(15 Hours)

Principles of Risk Assessment: Human Health Risk Assessments, Ecological Risk Assessment, Probabilistic Risk Assessments, Determination of acceptable risk based limits for Environmental chemicals and development of risk based remediation goals.

Reference Books

1. Dash, M. C. (2019). *Concepts of Environmental Management for Sustainable Development*. Dreamtech Press, New Delhi.
2. Frantzen, K. A. (2001). *Risk-Based Analysis for Environmental Managers*. Lewis Publishers, Boca Raton, Florida.
3. Cunningham, W. P., & Cunningham, M. A. (2018). *Environmental Science: A Global Concern* (14th ed.). McGraw-Hill Education, New York.



E-Resources

1. <https://www.unep.org>
2. <https://www.epa.gov>
3. <https://www.cseindia.org>
4. <https://moef.gov.in>
5. <https://envis.nic.in>

MAPPING

PSO CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	S	M	S
CO2	S	M	S	M	S
CO3	H	S	M	S	M
CO4	S	H	M	M	H

S – Strong H – High M – Medium L – Low

<p>Content prepared by (Based on Inputs)</p>  <p>Signature of the course in-charge</p>	 <p>Signature of the HOD</p>
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Dr. S. MONISHA

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Programme Code: 07		M.Sc Biochemistry		
Title of the paper		Major Elective: Biopharmaceuticals		
Batch 2026-2028	Hours / week 5	Total Hours 75	Credits 5	Employability/skill development/Entrepreneurship

Course Objectives

1. To demonstrate the basics of biopharmaceutical to the under graduate students.
2. To motivate the undergraduate students in analyzing the drug metabolism and mode of action.
3. To elaborate basic of formulations of drugs and to apply them in clinical trials.

Course Outcomes (CO)

K1 to K5	CO1	Acquire knowledge on drug development, principles, mechanism of actions of drugs
	CO2	Outline on preparation of biotechnology oriented pharmaceutical products.
	CO3	Quality control tests and manufacturing, packaging of drugs
	CO4	Help them to analyze the pharmaceutical products available in the market and Evaluate the recent advances in drug manufacturing
	CO5	Relate the regulations in clinical trial and management.

Syllabus

Total Hours: 75

Unit I

(15 Hours)

Drugs: Introduction - Development of Drugs and Pharmaceutical Industry. Drug Metabolism and Pharmacokinetics - ADME – Physico-Chemical Principles – Pharmacodynamics – Routes of drug administration – enteral, parenteral and topical. Action of drugs in humans.

Unit II

(15 Hours)

Manufacturing Principles: Compressed tablets – wet granulation, – Dry granulation – Direct compression – Tablet presses formulation – Coating – Pills – Capsules sustained, action dosage forms.

Quality control tests for tablets and capsules. Packaging of solid dosage forms.

Unit III

(15 Hours)

Formulations: Manufacturing Principles – Parental, solutions – Oral liquids – injections – Ointments. Quality control tests for semisolid and liquid dosage forms. Packaging of semisolid and liquid dosage forms.

Unit IV

(15 Hours)

Pharmaceutical Products – Vitamins and Antiseptics - Pharmaceutical Vitamins, Cold remedies, Laxatives, Analgesics, External Antiseptics, Antacids and Antibiotics, Biological hormones, recent advances in the manufacture of drugs using r-DNA Technology and monoclonal antibodies

Unit V

(15 Hours)

Trials & Regulations: Clinical Trials & Regulations - Clinical Trials – Design, double blind studies, placebo effects. FDA regulations (General) and Indian Drug regulations- highlight. Good Laboratory Practice, Good manufacturing practice.

* denotes Self study

Text Books

1. Brahmkar, D. M., & Jaiswal, S. B. (2005). *Biopharmaceutics and Pharmacokinetics: A Treatise* (2nd ed.). Vallabh Prakashan, New Delhi.
2. Ansel, H. C., Allen, L. V., & Popovich, N. G. (1999). *Pharmaceutical Dosage Forms and Drug Delivery Systems* (7th ed.). Lippincott Williams & Wilkins, Philadelphia.

Reference Books

1. Gennaro, A. R. (Ed.). (2005). *Remington: The Science and Practice of Pharmacy* (21st ed.). Lippincott Williams & Wilkins, Philadelphia.
2. Brunton, L. L., Lazo, J. S., & Parker, K. L. (Eds.). (2005). *Goodman & Gilman's The Pharmacological Basis of Therapeutics* (11th ed.). McGraw-Hill Medical Publishing Division, New York.
3. Tripathi, K. D. (2003). *Essentials of Medical Pharmacology* (5th ed.). Jaypee Brothers Medical Publishers (P) Ltd., New Delhi.
4. Shargel, L., Wu-Pong, S., & Yu, A. B. C. (2012). *Applied Biopharmaceutics and Pharmacokinetics* (6th ed.). McGraw-Hill Education, New York.

5. Crommelin, D. J. A., Sindelar, R. D., & Meibohm, B. (Eds.). (2013). *Pharmaceutical Biotechnology: Fundamentals and Applications* (4th ed.). Springer, New York.
6. Walsh, G. (2018). *Biopharmaceuticals: Biochemistry and Biotechnology* (3rd ed.). John Wiley & Sons, Chichester, UK.

E-Resources

1. <https://go.drugbank.com>
2. <https://pubchem.ncbi.nlm.nih.gov>
3. <https://www.fda.gov>
4. <https://www.who.int>

MAPPING




PSO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO					
CO1	S	S	H	S	H
CO2	H	S	M	S	S
CO3	S	H	H	S	H
CO4	H	H	S	S	H
CO5	H	S	H	H	S

S– Strong

H – High

M– Medium

L –Low

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NON MAJOR ELECTIVE

Non Major Elective Papers (2 papers are to be chosen from the following 4 papers)

S.No	Major Elective Papers
1	# Fundamentals of Information Security
2	Competitive Sciences
3	Bioprocess Technology
4	Cancer Biology

#to be offered by the respective departments

Programme Code: 07	M.Sc Biochemistry			
Course Code: 26PGI4N2	Non-Major Elective Paper : Fundamentals of Information Security			
Batch 2026-2027	Hours / Week 4	Total Hours 60	Credits 4	Employability / Skill Development

Course Objectives

1. To introduce the fundamentals of Information Security systems.
2. To appraise on the concepts of Cryptography and security systems.
3. To explore the nuances of vulnerable systems and their preventive methods.
4. To sensitize the students on the current Cyber laws.

Course Outcomes(CO)

K1	CO1	Comprehend the issues pertaining to Security at workplace.
	CO2	Establish methods of protecting data and data sets from attacks.
To	CO3	Introduce a robust data compliance model.
	CO4	Adopt novel methods of data/information protection through policies.
K5	CO5	Implement and appraise the existing Cyber Laws to appropriate Stakeholders.

UNIT I

(12 Hours)

Information Security basics: Definition of Information Security - History of Information Security - Characteristics of Information Security - Components of Information Security -Types of Security - Security System Development Life Cycle (SDLC) - Threats, Vulnerabilities, and Risks - Types of Cyber Attacks. Information Security for technical administrators: Types of Servers (Web, Database, Application) - Server Hardening Techniques- Server Security – Network security- Social Media Security -Secure Software Development Practices- Security Testing and Evaluation

UNIT II

(12 Hours)

Cryptography: Basic concepts - plain text - Cipher text -Types of Cryptography - Substitution and Transposition Techniques - Classical Ciphers- Encryption Principles – CRYPT Analysis - Cryptographic Algorithms - Cryptographic Tools – Authentication -Biometrics* -passwords - Access Control Devices - Physical Security - Security and Personnel- Cryptanalysis. Language-based Security: Analysis of code for security errors, Safe language and sandboxing techniques- Language-Based Access Control - Modern Cryptography Trends- Secure Communication- Privacy & Data

Protection.

UNIT III

(12 Hours)

Firewalls, Viruses , Worms Digital Rights Management: Viruses and Worms- Worms - Digital Rights Management – Firewalls - Application and Circuit Proxies - Stateful Inspection - Design Principles of Firewalls - Malware Concepts- Ransomware Attacks- Intrusion Detection and Prevention Systems (IDS/IPS)- Virtual Private Networks (VPNs)- Security Policies and Standards. Logical Design: Access Control Devices- Physical Security- Security and Personnel - NIST Models-VISA International Security Model- Design of Security Architecture-Planning for Continuity- Identity and Access Management (IAM) - Risk Management in Security Design- Security Monitoring and Logging- Compliance and Governance

UNIT IV

(12 Hours)

Hacking: Introduction – Hacker Hierarchy – Password cracking – Phishing - Network Hacking - Wireless Hacking - Windows Hacking - Web Hacking*- Ethical Hacking - Foot printing and Reconnaissance - Vulnerability Assessment- Exploitation Techniques - Malware Analysis- Social Engineering. Security Investigation: Need for Security- Business Needs-Threats- Attacks- IP Addressing and Routing – Social Media - Digital Forensics- Log Analysis and Monitoring- Vulnerability Assessment and Penetration Testing- Cyber Laws and Ethics- Email and Communication Security- Mobile and Endpoint Security.

UNIT V

(12 Hours)

Cyber Laws: What is Cyber Law? - Need for Cyber laws - Common Cyber Crimes and Applicable Legal Provisions: A Snapshot - Cyber Law (IT Law) in India – The Information Technology Act of India 2000 - Cyber Law and Punishments in India -Cyber Crime Prevention guide to users – Regulatory Authorities.- Data Protection and Privacy Laws- Intellectual Property Rights (IPR) in Cyberspace- Electronic Contracts (E-Contracts)- International Cyber Laws- E-Commerce and Legal Issues- Emerging Trends in Cyber Law.

*** Self-study and questions for examinations may be taken from the self-study portions also.**

Teaching Methods

Smart classroom/Power point presentation/Seminar/Quiz/Discussion/ Assignment/flipped class
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TEXT BOOK:

1. Fundamentals of Information Security – prepared by Kongunadu Arts and Science College, Coimbatore -29.

REFERENCE BOOKS:

- 1 Charles P Pfleeger and Shai Lawrence Pfleeger, “**Security in Computing**”, Fourth & Third Edition, Prentice Hall, 2007 & 2011.
- 2 Ross J. Anderson and Ross Anderson, “**Security Engineering: A guide to building Dependable Distributed System**”, Wiley,2009.

- 3 Thomas R. Peltier, Justin Peltier and John Bleckley, "Information Security Fundamentals", 2nd Edition, Prentice Hall 1996.
- 4 Gettier, Urs E. Information Security: Strategies for Understanding and Reducing Risks John Wiley & Sons, 2011.
- 5 "Principles of information security". Michael Whiteman and Herbert J. Mattord, 2012.
- 6 Information security -Marie wright and John kakalik, 2007.
- 7 Information security Fundamentals- Thomas R. Peltier, Justin Peltier and John Blackley-2005.
- 8 Information Security theory and practical PHI publication, Dhiren R. Patel-2008.
- 9 Debby Russell and Sr.G.T. Gangemi," computer Security Basics, 2nd edition, O'Reilly Media ., 2006
- 10 Mark Stamp's Information Security Principles and practice , deven N.shah ,Wiley , India 2013.
- 11 Information Security, A Practical Approach, S.M. Bhaskar, S.I. Ahson, Narosa Publications, 2008

E-Resources

1. <https://nptel.ac.in/course.html>
2. <https://www.netacad.com>
3. <https://owasp.org>
4. <https://www.nist.gov/cyberframework>

MAPPING



PSO CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	H	S	S
CO2	M	H	H	S	H
CO3	H	S	S	M	S
CO4	H	M	H	S	H
CO5	H	S	H	S	H

S–Strong

H–High

M–Medium

L –Low

Content prepared by (Based on Inputs)	
	
Signature of the course in-charge	Signature of the HOD

Dr. S. Kavitha

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(Autonomous)
Coimbatore - 641 029

Programme Code: 07		M.Sc Biochemistry		
Title of the paper		Non Major Elective – Competitive Science		
Batch	Hours / Week	Total Hours	Credits	skill development
2026-2028	4	60	4	

Course Objectives

1. To insist the various facts of life sciences in detail
2. To learn the various information regarding the biological processes
3. To expose the students to the online examination

Course Outcomes (CO)

TO	K1	CO1	Recall all concepts of biochemistry in detail
		CO2	Explain the consolidated view of life science subjects
		CO3	Develop the analytical capability by learning the objective type questions
		CO4	Undertake competitive examinations will necessary preparation
K5		CO5	Apply the knowledge of various fields of biochemistry.

Syllabus

Unit I

(12Hours)

Molecules and their Interaction relevant to Biology: Structure of atoms, molecules and chemical bonds - Composition, structure and function of biomolecules - Stabilizing interactions - Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties) - Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers - Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes- Conformation of proteins - Conformation of nucleic acids – Stability of proteins and nucleic acids - Metabolism of carbohydrates, lipids, amino acids nucleotides and*vitamins.

Unit II

(12Hours)

Cellular Organization: Membrane structure and function - Structural organization and function of intracellular organelles - Organization of genes and chromosomes - Cell division and cell cycle - Microbial Physiology. Fundamental Processes: DNA replication, repair and recombination - RNA synthesis and processing – Protein synthesis and processing - Control of gene expression at transcription and translation level.

Unit III

(12Hours)

System Physiology –Plant: Photosynthesis -Respiration and photorespiration – Nitrogen metabolism - Plant hormones – Sensory photobiology- Solute transport and photo assimilate translocation – Secondary metabolites - Stressphysiology.

System Physiology –Animal: Blood and circulation - Cardiovascular System - Respiratory system - Nervous system - Sense organs - Excretory system - Thermoregulation -Stress and adaptation - Digestive system - Endocrinology and reproduction.

Unit IV

(12Hours)

Cell Communication and Cell Signalling: Host parasite interaction - Cell signalling- Cellular communication - Cancer - Innate and adaptive immune system. Methods in Biology: Molecular Biology and Recombinant DNA methods - Histochemical and Immunotechniques- Biophysical Methods - Statistical Methods - Radiolabelling techniques - Microscopic techniques - Electrophysiological methods - Methods in field biology.

Unit V

(12Hours)

Applied Biology: Microbial fermentation and production of small and macro molecules - Application of immunological principles, vaccines, diagnostics - Tissue and cell culture methods for plants and animals - Transgenic animals and plants, molecular approaches to diagnosis and strain identification - Genomics and its application to health and agriculture, including gene therapy – Bioresource and uses of biodiversity - Breeding in plants and animals, including marker – assisted selection - Bioremediation and ***phytoremediation- Biosensors.**

*** denotes Self study**

Textbooks:

1. Kumar. (2016). Arihant Publications. 3rd edition.
2. Nithin Sharma (2020). Ace The Race: CSIR-UGC NET Life Sciences (JRF & LS) 2nd Edition.

E-Resources

1. <https://www.indiabix.com>
2. <https://testbook.com>
3. <https://byjus.com>
4. <https://ncert.nic.in/textbook.php>

MAPPING



PSO CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	M	H	S	M	S
CO2	S	S	M	H	M
CO3	M	M	S	S	H
CO4	S	S	M	S	M
CO5	S	S	M	M	S

S-Strong

H-High

M-Medium

L-Low

Content prepared by (Based on Inputs)	
	
Signature of the course in-charge Dr. S. Monisha	Signature of the HOD Head (i/c)

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Kongunadu Arts and Science College
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Coimbatore - 641 029

Programme Code: 07		M.Sc Biochemistry		
Title of the paper		Non Major Elective – Bioprocess Technology		
Batch 2026-2028	Hours / Week 4	Total Hours 60	Credits 4	Employability/skill development/Entrepreneurship

Course Objectives

1. To understand the basics of fermentation techniques
2. To learn the concepts of screening, optimization and maintenance of cultures
3. To provide the basics of bioprocess technology

Course Outcomes (CO)

K1 TO K4	CO1	Remember the basics of bioreactors
	CO2	Understanding of the various aspects of bioprocess techniques
	CO3	Employ in biotechnological industries
	CO4	Distinguish the fermentation process and its kinetics
	CO5	Appraise the role of bioreactors in various industries.

Syllabus

Unit I

(12Hours)

Introduction: Basic principles*, Historical development in fermentation, strain improvement and inoculum development. Types of fermentation: batch, fed batch and continuous. Isolation, screening, and maintenance of microbes for industrial process. Strain selection and improvement methods.

UNIT II

(12 Hours)

Bioreactor: Components design, parts and its functions. Types of bioreactors: CSTR, packed bed, batch, Air lift bioreactor, Bioreactors for immobilized cells, animal cells, waste water and effluent treatment. Specialized bioreactors: pulsed, fluidized and photobioreactors.

UNIT III

(12 Hours)

Upstream processing: Introduction, principles of microbial nutrition, Media formulation and optimization. Sterilization: Methods of sterilization- Batch and continuous sterilization. Air sterilization, design and air filters, aseptic operation of fermentor. Inoculadevelopment for Industrial fermentations. Scale up and scale down.

UNIT IV**(12 Hours)**

Transport phenomena: Mass and heat transfer mechanism. Mass, heat and oxygen transfer coefficients. Rheological properties of a fermentation broth. Bioprocess monitoring and control: On-line and Off-line analysis. Monitoring variables: pH, temperature, DO₂, agitation and foam level. PID control and computer aided control.

UNIT V**(12 Hours)**

Downstream processing: Overview. Primary separation- cells, solid matter and foam precipitation, filtration, centrifugation, cell disruptions (mechanical, enzymatic and chemical). Product isolation - solvent extraction, adsorption, aqueous two-phase system and precipitations. Purification techniques: Chromatography (ion - exchange, gel-permeation and affinity), membrane separation (microfiltration, Ultrafiltration and reverse osmosis). Product recovery; ***product polishing (drying and crystallization).**

*** denotes Self study**

Textbooks

1. El-Mansi, E. M. T., & Bryce, C. F. A. (2002). *Fermentation Microbiology and Biotechnology*. Taylor & Francis Group.
2. Stanbury, P. F., Whitaker, A., & Hall, S. J. (2003). *Principles of Fermentation Technology* (2nd ed.). Pergamon Press, Oxford.

Reference Books

1. Shuler, M. L., & Kargi, F. (2003). *Bioprocess Engineering: Basic Concepts* (2nd ed.). Prentice Hall, Englewood Cliffs.
2. Crueger, W., & Crueger, A. (2003). *A Textbook of Industrial Microbiology*. Panima Publishing Corporation, New Delhi.
3. Rajput, R. K. (2003). *Heat and Mass Transfer in SI Units*. S. Chand & Company Ltd., New Delhi.

E-Resources

1. <https://nptel.ac.in>
2. <https://ocw.mit.edu>
3. <https://bio.libretexts.org>
4. <https://pubmed.ncbi.nlm.nih.gov>

Page 83
MAPPING



PSO CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	M	S	S
CO2	H	S	S	H	M
CO3	S	H	S	M	S
CO4	M	S	H	S	S
CO5	S	M	S	H	M

S-Strong

H-High

M-Medium

L-Low

Content prepared by (Based on Inputs)  Signature of the course in-charge Dr. S. Monisha	 Signature of the HOD Head (i/c) Department of Biochemistry
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Programme Code: 07		M.Sc Biochemistry		
Title of the paper		Non Major Elective – Cancer Biology		
Batch 2026-2028	Hours / Week 4	Total Hours 60	Credits 4	Employability/skill development/Entrepreneurship

Course Objectives

1. To know the biology of cancer development
2. To know the features of various cancer types
3. To know about the mechanism of cancer cell cycle

Course Outcomes (CO)

K1	CO1	Remember the basic knowledge on cancer development
	CO2	Understand the molecular mechanisms of cancer cell cycle
TO	CO3	Apply the techniques for diagnosis of various cancers
	CO4	Contribute the role of different treatment strategies and its application
K5	CO5	Employ various strategies in the treatment of cancer

Syllabus

Unit I

(12 Hours)

Cancer: Introduction, Normal cells and tissues, Control of growth in normal Tissues, Tumour growth, the process of carcinogenesis*, Genes involved in carcinogenesis, Factors influencing the development of cancers. **Risk factors for cancer:** Tobacco, infections, dietary-related factors, reproductive and hormonal factors, radiation, occupational carcinogens, medical carcinogens (non-radiation), environmental pollution, genetic predisposition, mutagens and mutational spectra in relation to cancer types.

Unit II

(12 Hours)

Epidemiology, Etiology, pathology, Clinical Features, Diagnosis and Evaluation, Management of breast, oral, cervical, gastric, lung and skin cancer. Role of tumour suppressor genes (Rb, p53, NF1, BRCA 1 & 2) in cancer prevention and the mechanism leading to loss of function.

Unit III

(12 Hours)

Cancer cell cycle: Introduction, cell cycle events in normal and neoplastic cells, restriction point control and its loss, initiation of DNA replication, completion of DNA replication, checkpoint responses to DNA damage in G1 and S phase, from G2 to mitotic metaphase, checkpoints

controlling mitotic entry, centrosome duplication and the maintenance of ploidy, the metaphase–anaphase transition and exit from mitosis, cell cycle proteins as prognostic markers and drug targets.

Unit IV

(12 Hours)

Screening of cancer: Introduction, Types of screening tests, Safety and acceptability, Evaluation of screening (Evaluating the test, Potential biases, Randomized trials, Screening programmes), Types of screening test (Visual inspection, Palpation, Analysis of exfoliated cells, Imaging, Serum and urine markers, screening for and treatment of infections), Screening for specific cancers (Cervix cancer, Breast cancer, Colorectal cancer, Prostate cancer).

Unit V

(12 Hours)

Causes of Cancer: Introduction, Skin cancers, Breast cancer, Lung cancer, Prostate cancer, Colo rectal cancer. **Chemotherapy:** Mechanisms of action and resistance to traditional cytotoxic drugs, Therapeutic principles of traditional cytotoxic chemotherapy. **Radiotherapy. Immunotherapy of cancer:** Introduction, Specific Immunotherapy (Human tumour antigens & genetically enhanced T cells), ***Non-specific immunotherapy (Immunotherapy with cytokines).**

* denotes Self study

Textbook

1. Knowles, M. A., & Selby, P. J. (2005). *Introduction to the Cellular and Molecular Biology of Cancer* (4th ed.). Oxford University Press.

Reference Books

1. Cavalli, F., Kaye, S. B., Hansen, H. H., Armitage, J. O., & Piccart-Gebhart, M. J. (2009). *Textbook of Medical Oncology* (4th ed.). Informa Healthcare.
2. Ruddon, R. W. (2007). *Cancer Biology* (4th ed.). Oxford University Press.
3. Pardee, A. B., & Stein, G. S. (2009). *The Biology and Treatment of Cancer: Understanding Cancer*. John Wiley & Sons, Inc.
4. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Scott, M. P., Bretscher, A., Ploegh, H., & Matsudaira, P. (2007). *Molecular Cell Biology* (6th ed.). W. H. Freeman and Company, New York.

E-Resources

1. <https://www.cancer.gov>
2. <https://www.cancer.org>
3. <https://pubmed.ncbi.nlm.nih.gov>
4. <https://www.ncbi.nlm.nih.gov/books>

MAPPING



PSO CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	S	S	M	S
CO2	M	H	M	H	M
CO3	S	M	S	M	H
CO4	S	H	M	H	M
CO5	S	M	S	M	H

S-Strong

H-High

M-Medium

L-Low

Content prepared by (Based on Inputs)	
	
Signature of the course in-charge Dr. S. Monisha	Signature of the HOD Head (i/c)

Department of Biochemistry
(PG & Research)
Kongunadu Arts and Science College
(Autonomous)
Coimbatore 041119

**EXTRA DEPARTMENTAL COURSE
(EDC)**

**KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)
COIMBATORE – 641029**

**MODALITIES FOR THE CONDUCT OF OPEN BOOK EXAMINATION
SYSTEM FOR THE COURSES BASICS OF CYBER SECURITY AND
FUNDAMENTALS OF INFORMATION SECURITY FOR ALL UG AND
PG PROGRAMMES RESPECTIVELY**

PREAMBLE

The Curriculum Development Cell (CDC) meeting was convened on 16.10.2025 and recommended to implement an open book examination system for the courses, Basics of Cyber Security and Fundamentals Information Security for all UG and PG programmes to improve conceptual understanding skills, promote deep learning, enhance assessment quality and strengthen comprehensive skills, for the students to be admitted from the academic year 2026-2027 and onwards.

1.Purpose

To provide guidelines for conducting open book examinations that encourage critical thinking, application of knowledge, and analytical skills.

2.Scope

Applicable to Basics of Cyber Security and Fundamentals of Information Security courses for the undergraduate and postgraduate programmes respectively.

3. Examination Guidelines

Question Paper Design

- ❖ Questions should be Focused on higher-order thinking (analysis & evaluation)
- ❖ Avoid direct recall questions

Communication to Students and Staff Members

- ❖ Inform students in advance about the format, rules, and allowed resources.

Sub.Code :26PBC3XI

- ❖ Provide sample questions to familiarize them with the OBE style.
- ❖ All the Staff members should be familiar about the prescribed Books of the Basics of Cyber Security and Fundamentals of Information Security.
- ❖ Students are permitted to carry the prescribed Books (in original or xerox copy) duly signed by the respective staff in charge of courses to the examination Hall.
- ❖ Invigilators of the respective examination halls should permit the students with the prescribed book (in original or xerox copy) and not to allow the students with other than the prescribed Books.




PRINCIPAL

PRINCIPAL
Kongunadu Arts & Science Colleg
Coimbatore - 641 029

Programme Code: 07		M.Sc Biochemistry		
Title of the paper		EDC – Nutritional Biochemistry		
Batch	Hours / Week	Total Hours	Credits	Employability/skill development/Entrepreneurship
2026-2028	2	30	2	

Course Objectives

1. To impart the knowledge on historical overview of nutrition, essential nutrients for metabolism
2. To provide an overview of the major macro and micronutrients relevant to human health
3. To discuss the scientific rationale for defining nutritional requirements in healthy individuals and populations, with reference to specific conditions such as pregnancy, lactation, and older age

Course Outcomes (CO)

K1	CO1	Assess the nutritional status of community in order to determine the type magnitude and distribution of malnutrition
	CO2	Describe the biochemical and physiological functions of the nutrients and their integrated role.
	CO3	Evaluate the therapeutic role of key nutrients in maintaining health.
K5	CO4	Discriminate the diseases caused due to protein deficiency
	CO5	Employ the role of diet in various diseases.

Syllabus

Unit-I

(6 Hours)

Introduction: Nutrition – concepts - role of nutrition in maintaining health, basic food groups - energy yielding, body building and protective foods. Basic concepts of energy expenditure, unit of energy – Kcal - energy requirements of different categories of people - RQ of foods - Body Mass Index (BMI) - Basal Metabolic Rate (BMR) – determination and factors influencing

Unit-II

(6 Hours)

Nutritional significance of dietary components: Physiological role and nutritional significance of carbohydrates, lipids, proteins, vitamins (water soluble and fat soluble) minerals and fiber, Dietary sources, Functions, Digestion, absorption and storage, metabolism of carbohydrates – lipids – proteins.

Unit-III

(6 Hours)

Nutritive value of proteins: Essential amino acids, Biological values of Proteins (animal and plant proteins). Evaluation of proteins by nitrogen balance method-DC, BV, NPU and NAP of animal and

plant proteins, single cell proteins, factors influencing protein requirements, Effect of excess protein intake

Unit-IV (6 Hours)

Protein calorie malnutrition: Protein malnutrition (Kwashiorkor) and under nutrition (marasmus) their preventive and curative measures – composition of balanced diet and RDA for infants, children, adolescent, adult male and female, pregnant, lactating women and geriatrics

Unit-V (6 Hours)

Nutrition and body defenses: Effect of drugs on food and nutrients, drug - nutrient interaction - nutritional therapy food preparation and management. Role of diet and nutrition in the prevention and treatment of diseases – Diabetes mellitus, hypertension, infections, CVD, * **liver and kidney disorders.**

* denotes Self study

Text Books

1. Srilakshmi, B. (2013). *Nutrition Science* (Revised 4th ed.). New Age International (P) Ltd., New Delhi.
2. Paul, S. (2005). *A Textbook of Bio-Nutrition: Curing Diseases Through Diet* (1st ed.). CBS Publishers & Distributors Pvt. Ltd., New Delhi.
3. Swaminathan, M. (2004). *Advanced Textbook of Food and Nutrition* (Vol. II, 2nd ed.). Bangalore Printing and Publishing Co. Ltd., Bangalore, India.

Reference Books

1. Geissler, C., & Powers, H. (2010). *Human Nutrition* (12th ed.). Churchill Livingstone Elsevier, Edinburgh, UK.
2. Brody, T. (2006). *Nutritional Biochemistry* (2nd ed.). Academic Press, San Diego, CA, USA.
3. Eastwood, M. (2003). *Principles of Human Nutrition* (2nd ed.). Blackwell Science Ltd., Oxford, UK.

E-Resources

1. <https://www.khanacademy.org/science/biology>
2. <https://ocw.mit.edu>

MAPPING



PSO \ CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	S	H	S	M
CO2	H	S	H	M	M
CO3	M	H	H	H	H
CO4	M	S	M	S	M
CO5	M	S	M	S	H

S-Strong

H-High

M-Medium

L-Low

Content prepared by (Based on Inputs)	
	
Signature of the course in-charge Dr. S. Monisha	Signature of the HOD Head (file)

Department of Biochemistry
 (PG & Research)
 Kongunadu Arts and Science College
 (Autonomous)
 Coimbatore - 641 029

DATE	DESCRIPTION	AMOUNT	CHECK NO.	INITIALS	BALANCE

JOB ORIENTED COURSE (JOC)

[Faint, illegible text and signatures]

Programme Code: 07		Programme Title: M.Sc Biochemistry		
Title of the paper JOC –Bio-Entrepreneurship				
Batch	Hours / Week	Total Hours	Credits	Employability
2026-2028	4	60	2	

Course Objectives

1. To learn about the concepts of entrepreneurship
2. To study the various opportunities in launching and running a business
3. To know the various strategies of effective entrepreneurship

Course Outcomes (CO)

K1 TO K5	CO1	List the concepts of entrepreneurship
	CO2	Report the different strategies adopted for a better entrepreneurship
	CO3	Discriminate the various biological entrepreneurship programmes
	CO4	Apply the quipped enough to become an entrepreneur
	CO5	Employ in understanding about the marketing of products.

Unit I

(12 Hours)

Basics of Bioentrepreneurship Introduction to bioentrepreneurship– Biotechnology in a global scale, Scope in Bioentrepreneurship, Importance of entrepreneurship. Meaning of entrepreneur, function of an entrepreneur, types of entrepreneur, advantages of being entrepreneur. Innovation – types, out of box thinking, opportunities for Bioentrepreneurship. Entrepreneurship development programs of public and private protection and commercialization strategies. Make in India). Patent landscape, IP

Unit II

(12 Hours)

Management, Accounting and Finance Management principles of Henry Fayol. Business plan preparation: business feasibility analysis by SWOT, socio-economic costs benefit analysis, Sources of financial assistance – making a business proposal, approaching loan from bank and other financial institutions, budget planning and cash flow management, basics in accounting practices - balance sheet, P&L account, double entry book keeping, estimation of income, expenditure and Income tax. Collaborations and partnerships, information technology for business administration and expansion.

Unit III

(12 Hours)

Knowledge Centre and R&D Knowledge centers - Universities, innovation centre, research institutions and business incubators. R&D - technology development and upgradation, assessment of technology development, managing technology transfer, industry visits to successful bio-enterprises, regulations for transfer of foreign technologies, quality control, technology transfer agencies, Understanding of regulatory compliances and procedures (CDSCO, NBA, GLP, GCP & GMP)

Unit IV

(12Hours)

Medium & Small Scale Industry Definition, characteristics, need and rationale, objectives, scope and advantages of small scale industries. Types of bioindustries– Pharma, Agri and Industry. Biofertilizers production - *Azospirillum, Azolla, Cyanobacteria and its applications. Biopesticides production- Bacterial, fungal, viral and plant insecticides. Sericulture. Apiculture. Dairy farming. Single Cell Protein Production and applications. Vermicomposting and its applications. Mushroom cultivation and its application. Ancillary and tiny industries

Unit V

(12Hours)

Marketing and Human Resource Development Assessment of market demand for potential product(s) of interest, Market conditions, segments, prediction of market changes, identifying needs of customers including gaps in the market. Branding issues, developing distribution channels – franchising policies, promotion, advertising, branding and market linkages. Marketing of agro products. Recruitment and selection process, leadership skills, managerial skills, organization structure; training, ***team building and teamwork.**

*** denotes Self study**

Text Book

1. Jogdand, S. N. (2007). *Entrepreneurship and Business of Biotechnology*. Himalaya Publishing House, Mumbai.

Reference Book

1. Robbins, S. P., & Coulter, M. (2003). *Management* (7th ed.). Pearson Education, New Delhi.

E-Resources

1. <https://nptel.ac.in>
2. <https://swayam.gov.in>
3. <https://birac.nic.in>
4. <https://dbtindia.gov.in>

MAPPING



PSO CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	M	S	M	M
CO2	H	S	M	S	H
CO3	S	M	S	H	S
CO4	H	M	M	M	S
CO5	H	M	S	H	M

S-Strong

H-High

M-Medium

L-Low

<p>Content prepared by (Based on Inputs)</p>  <p>Signature of the course in-charge Dr. S. KAVITHA</p>	 <p>Signature of the HOD Head</p>
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Department of Biochemistry
(PG & Research)
Kongunadu Arts and Science College
(Autonomous)
Coimbatore 641 029

Programme Code: 07		Programme Title: M.Sc Biochemistry		
Title of the paper JOC - Food Safety and Quality Control				
Batch 2026-2028	Hours / Week 4	Total Hours 60	Credits 2	Employability

Course Objectives

1. To learn the principles of food quality control
2. To learn the methodologies to standardize and ensuring food safety
3. To gain knowledge on the framed food safety regulations

Course Outcomes (CO)

TO	K1	CO1	Repeat the various steps in the quality control of food items
		CO2	Classify the various food standards
		CO3	Illustrate the various methods to determine the quality of foods
		CO4	Examine the various regulations concerned with the food quality issues
K5		CO5	Evaluate the methods in standardization of quality control of foods.

Syllabus

Unit I (12Hours)

Principles of Quality control of food: Raw material control, processed control and finished product inspection. Leavening agents, classification, uses and optimum levels. Food additives - Preservatives, colouring, flavouring, sequestering agents, emulsifiers, antioxidants.

Unit II (12Hours)

Standardisation systems for quality control of foods: National and International standardization system, Food grades, Food laws-compulsory and voluntary standards. Food adulteration - Common adulterants in foods and tests to detect common adulterants.

Unit III (12Hours)

Standards for foods: Cereals and pulses, sago and starch, milk and milk products, Coffee, tea, sugar and sugar products.

Unit IV (12Hours)

Methods for determining quality: Subjective and objective methods. Sensory assessment of food quality-appearance, color, flavour, texture and taste, different methods of sensory analysis,

preparation of score card, panel criteria, sensory evaluation room.

Unit V

(12Hours)

Food safety, Risks and hazards: Food related hazards, Microbial consideration in food safety, HACCP-principles and structured approach. Chemical hazards associated with foods. *FSSAI.

* denotes Self study

Text Books

1. Food Science-Srilakshmi (2001). 2nd edition, New age international publishers- (2001)

Reference Books

1. Swaminathan M. (2014). Essentials of Food and Nutrition. 2nd edition. Bappco.

E-Resources

1. <https://www.fao.org/food-safety>
2. <https://nptel.ac.in>
3. <https://swayam.gov.in>

MAPPING



PSO CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	M	S	S	M	M
CO2	H	S	S	M	S
CO3	M	M	M	S	H
CO4	S	S	M	M	M
CO5	S	M	S	M	H

S–Strong

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L –Low

<p>Content prepared by (Based on Inputs)</p>  <p>Signature of the course in-charge</p> <p><u>Dr. S. Monica</u></p>	 <p>Signature of the HOD</p> <p>Head</p>
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Department of Biochemistry
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(Autonomous)
Coimbatore - 641 029

Programme Code: 07		Programme Title: M.Sc Biochemistry		
Title of the paper JOC –Clinical and Therapeutic Nutrition				
Batch	Hours / Week	Total Hours	Credits	Employability
2026-2028	4	60	2	

Course Objectives

1. To enable the basic principles of clinical nutrition
2. To understand the clinical significance of biochemical findings
3. To develop skills in planning and preparation of therapeutic diets for various diseases

Course Outcomes (CO)

K1	CO1	Commemorate the basics of nutritional care
	CO2	Explain the relation between nutrition and health
TO	CO3	Interpret the lifestyle and nutritional assessment techniques
	CO4	Analyze the main nutrients and its functions in the body
K5	CO5	Appraise the role of probiotics in diet.

UnitI

(12Hours)

Guidelines for dietary planning: ***Weights and Measures**. Nutritional Assessment .Nutritional care process. Nutritional intervention: Objectives of diet therapy, Therapeutic modification of the normal diet : diet prescription. Routine Hospital diet
- regular diets, clear fluid diet, full fluid diet, soft diet, modifications of food and nutrient intake, Enteral nutrition, parenteral nutrition, Refeeding syndrome, Transitional feeding. Medical and nutritional care record types and uses, Format for medical and nutrition charting and documentation record.

UnitII

(12Hours)

Dietician and Nutrition counselling: Role of dietician on hospitalized and outdoor patients and development of nutritional careplan. Specific functions of atherapeutic, administrative and consultant dietician. Team approach in patient care.

Psychological considerations in feeding the patients. Inter personal relationship with patients. Nutrition counseling- concept, components, activities for behavior changes ,intervention counseling models, types of counselling session in patient

UnitIII (12Hours)

Weight imbalances, anorexia nervosa and Bulimia nervosa, cardio vascular disorders, Diabetes mellitus-Type I, II, GI Tract Disorders, Liver and gall bladder, Pancreatic disorders, renal disorder, gout, cancer, Musculo-skeletal disorders (Rheumatoid Arthritis, Osteoarthritis, Osteoporosis), Respiratory problems, hyper metabolic conditions- Burns, Sepsis, Surgery.

UnitIV (12Hours)

Pro and prebiotics: Probiotics: Taxonomy and important features of probiotic microorganisms. Health effects of probiotics with mechanism of action. Probiotics in various foods: fermented milk products, non-milk products etc. **Prebiotics:** Definition, chemistry, sources, metabolism and bioavailability, effect of processing, physiological effects, effects on human health and potential applications in risk reduction of diseases. perspective for food applications for the-Non-digestible carbohydrates/oligosaccharides, Dietary fibre, Resistant starch, Gums. Palliative diet and nutritional care.

UnitV (12Hours)

Food- Drug Interaction: Effect of Food on Drug Therapy. Effect of Drug on Food and Nutrition. Modification of Drug Action by Food and Nutrition. Effect of Drug on Nutritional Status.Excipients and Food-Drug Interaction.***Medical nutritional therapy.**

* denotes Self study

Text Books

1. Mahan, L. K., & Escott-Stump, S. (2008). *Krause's Food, Nutrition and Diet Therapy* (12th ed.). Saunders Elsevier, Canada.
2. Garrow, J. S., James, W. P. T., & Ralph, A. (2000). *Human Nutrition and Dietetics* (10th ed.). Churchill Livingstone, London.
- 3.

Reference Books

1. Antia, F. P., & Abraham, P. (2001). *Clinical Nutrition and Dietetics* (4th ed.). Oxford University Press, New Delhi.
2. Williams, S. R. (2003). *Nutrition and Diet Therapy* (7th ed.). Mosby College Publishing, St. Louis, Missouri, USA.
3. Winterfeldt, E. A., Bogle, M. L., & Ebro, L. L. (2011). *Dietetics: Practice and Future Trends* (3rd ed.). Jones & Bartlett Learning Publishers, Massachusetts, USA.

E-Resources

1. <https://www.who.int/health-topics/nutrition>
2. <https://www.fao.org/nutrition>
3. <https://www.eatright.org>
4. <https://nutrition.org>

MAPPING



PSO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO					
CO1	S	M	H	S	S
CO2	M	S	S	M	M
CO3	S	H	M	S	H
CO4	M	S	H	H	S
CO5	S	M	H	S	M

S-Strong

H-High

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L-Low

Content prepared by (Based on Inputs)	
	
Signature of the course in-charge Dr. S. Monisha	Signature of the HOD Head

Department of Biochemistry
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Kongunadu Arts and Science College
(Autonomous)
Coimbatore - 641 029

Question paper pattern (External only)

1. THEORY

Max Marks = 75

Time = 3.00 hrs

SECTION - A (1 x 10=10 marks)

SECTION - B (5 x 5=25 marks)

Short answer questions

Q.No. 11-15: Either (a) or (b) short note type (One question 'a' or 'b' from each unit)

SECTION - C (8 x 5=40 marks)

Essay type of questions:

Q.No. 16-20: Either (a) or (b) essay type (One question 'a' or 'b' from each unit)

2. PRACTICALS – Question Pattern & Break-up of marks

END OF SEMESTER PRACTICAL EXAMINATION

Max. Marks: 60

Duration: 3 hrs

I. Major (One question) (1 x 20 = 20)

II. Minor (One question) (1 x 10 = 15)

III. Spotters (3 x 5 = 15)

Examine, identify and critically comment on the spotters A, B, C, D and E.

V. Record / Observation* (10)

**Record for ESE; Observation for CIA exam.*

ADVANCED LEARNERS COURSE (ALC)

Programme Code: 07		Programme Title: M.Sc Biochemistry	
Title of the paper: ALC – Forensic Science			
Batch	Credits	Employability	
2026-2028	2		

Course Objectives

1. To deals with the forensic aspects like legal procedures and types of trauma.
2. To prop up and develops regulation in forensic science
3. To give students with a sound basis in forensic science

Course Outcomes (CO)

K1	CO1	Define the basic concepts of forensic science	
	TO	CO2	Understand the identification procedures employed under forensics Science
		CO3	Apply the fingerprint analysis and interpretations in research fields
K5	CO4	Examine and analyze the results involved in fingerprinting technique	
	CO5	Evaluate the physical analysis and injuries.	

Unit I

Crime scene management and investigation: Collection, preservation, packing and forwarding of physical and trace evidences for analysis. Legal and court procedure related to expert testimony. Consumer Protection Act: rights and liabilities of doctors, medical indemnity insurance; human rights and violation; duties of medical practitioners to victims of torture; Human organ transplantation Act.

Unit II

Identification of the living and the dead: Forensic hematology; death; causes of death; mechanism and manner of death; changes after death; artifacts; medico legal Death in vestigation; exhumation. Examination and identification of hair, semen, saliva, urine, faecal matter and milk. DNA fingerprinting and HLA typing.

Unit III

Physical analysis: Soil, glass, paints, lacquers, cement, inks, paper, tool and tyre marks shoeprints. Forensic examination of vehicles in cases of accident. Identification of

individualization from foot prints and teeth.

Unit IV

Injuries: Mechanical injuries; injuries due to electricity, lightning and radiation; train and road traffic accidents; firearm and explosion injuries; medico legal aspects of wounds. General aspects; patho-physiology and classification; mechanical asphyxia; hanging; strangulation; drowning; smothering, choking, garroting, burking, yoking.

Unit V

Medico legal aspects: Medico legal aspects of wounds. Post mortem examination and changes, asphyxia death, sexual offences, infanticide, forensic psychiatry and lye detection. History, classification, search, lifting and examination of finger prints. Various methods for the development of latent fingerprints, ***Crime records and computerization.**

* denotes Self study

Text Books

1. Narayanareddy K. S. (2007). The Essentials of Forensic Medicine & Toxicology. 26th edition, K. Sugana Devi publishers, Hyderabad.
2. Basu, R. (2009). Fundamentals of forensic medicine and toxicology. 2nd Edition, Books and Allied (P) Ltd. Kolkata.

Reference Books

1. Pillay V.V. (2009). Text book of Forensic Medicine, Paras Publication. Hyderabad.
2. JB Mukherjee's. (2007). Forensic Medicine and Toxicology-Volume I and II (combined)- edited by Karmakar, 3rd edition.
3. R. Saferstein. (2004). Criminalistics. 8th edition, Prentice Hall, New Jersey.

E-Resources

1. <https://www.nfsu.ac.in>
2. <https://dfs.nic.in>
3. <https://www.aafs.org>
4. <https://www.theiai.org>
5. <https://www.fbi.gov/services/laboratory>
6. <https://www.interpol.int>

MAPPING



PSO \ CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	S	M	M	S
CO2	S	H	M	S	H
CO3	H	S	S	M	H
CO4	M	S	H	M	M
CO5	S	M	S	H	M

S-Strong

H-High

M-Medium

L-Low

<p>Content prepared by (Based on Inputs)</p> <p></p> <p>Signature of the course in-charge Dr. S. Karilka</p>	<p></p> <p>Signature of the HOD Head (I/c) Department of Biochemistry (PG & Research)</p>
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Kongunadu Arts and Science College
(Autonomous)
Coimbatore - 641 029

Programme Code: 07	Programme Title: M.Sc Biochemistry	
Title of the paper ALC – Nutraceuticals and Functional Foods		
Batch	Credits	Employability
2026-2028	2	

Course Objectives

1. To learn the concept of nutraceuticals and functional foods
2. To know the available biochemical compounds in our system
3. To prepare functional foods from nutraceutical compounds

Course Outcomes (CO)

K1	CO1	Remember the complete history of nutraceuticals
	CO2	Classify the different nutraceuticals
TO	CO3	Illustrate the formulation methods of functional foods
	CO4	Distinguish the role of functional foods in disease prevention and management
K5	CO5	Employ the role of nutraceuticals in various disorders.

Syllabus

Unit I

Introduction to Nutraceuticals as Science: Nutraceutical- Definition, Classification - Dietary supplements, Functional foods, Historical perspective, scope & future prospects. Applied aspects of the Nutraceutical Science. Sources of Nutraceuticals. Relation of Nutraceutical Science with other Sciences: Medicine, Human physiology, genetics, food technology, ***chemistry and nutrition (brief description).**

Unit II

Classification, Properties and structure of various Nutraceuticals: Alkaloids, Terpenoids, Glycosides, Natural phenols, Isoprenoid derivatives, Glucosamine, Octacosanol, flavonoids, carotenoids, polyunsaturated fatty acids, lecithin, choline and sphingolipids, Lycopene, Carnitine, Melatonin and Ornithine alpha-ketoglutarate as nutraceuticals. Use of proanthocyanidins, grape products, flaxseed oil as

Nutraceuticals.

Unit III

Nutraceuticals of plant and animal origin: Plant metabolites - Functions, sources - Alkaloids, phenols, Terpenoids. Applications with specific examples with reference to skin, hair, eye, bone, muscle, heart, brain, liver, kidney, general health and stimulants. Concept of cosmoceuticals and aquaceuticals. Animal metabolites – Functions, Sources - chitin, chitosan, glucosamine, chondroitin sulphate and other polysaccharides of animal origin. Uses and applications in preventive medicine and treatment.

Unit IV

Functional Foods: Definition. Applications of herbs to functional foods. Concept of free radicals and antioxidants; Nutritive and Non-nutritive food components with potential health effects. Soy proteins and soy isoflavones in human health; Role of nuts in cardiovascular disease prevention. Functional foods from wheat and rice and their health effects. Role of Dietary fibers in disease prevention. Vegetables, Cereals, milk and dairy products as Functional foods. Health effects of common beans, Capsicum annuum, mustards, Ginseng, garlic, citrus fruits, fish oils, and seafoods.

Unit V

Food as remedies: Nutraceuticals bridging the gap between food and drug, Nutraceuticals in treatment for cognitive decline, Nutraceutical remedies for common disorders like Arthritis, Bronchitis, circulatory problems, hypoglycemia, Nephrological disorders, Liver disorders, Osteoporosis, Psoriasis and Ulcers etc. Brief idea about some Nutraceutical rich supplements e.g. Bee pollen, Caffeine, Green tea, Lecithin, Mushroom extract, Chlorophyll, *Kelp and Spirulina etc.

* denotes Self study

Text Books

1. Swaminathan, M. (2014). *Essentials of Food and Nutrition* (2nd ed.). Bangalore Printing and Publishing Co. (BAPPCO), Bangalore, India.
2. Gopalan, C., Rama Sastri, B. V., & Balasubramanian, S. C. (Reprinted 2011). *Nutritive Value of Indian Foods (NVIF)*. National Institute of Nutrition (NIN), ICMR, Hyderabad.

Reference Books

1. Todd, V. R., Sanford, A. H., & Davidson, M. M. (2001). *Clinical Diagnosis and Management by Laboratory Methods* (17th ed.). W. B. Saunders Company, Philadelphia.
2. Antia, F. P., & Abraham, P. (2004). *Clinical Dietetics and Nutrition* (4th ed.). Oxford University Press, New Delhi.

E-Resources

1. <https://www.fssai.gov.in>
2. <https://www.nin.res.in>
3. <https://ods.od.nih.gov>
4. <https://www.nutrition.gov/topics/dietary-supplements>

MAPPING



PSO CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	M	H	S	S
CO2	M	S	S	M	M
CO3	S	H	M	S	H
CO4	M	S	H	H	S
CO5	M	S	M	H	S

S-Strong

H-High

M-Medium

L-Low

content prepared by (Based on Inputs)	
	
Signature of the course in-charge	Signature of the HOD

Dr. S. Monisha

Head Life

Department of Biochemistry
(PG & Research)
Kongunadu Arts and Science College
(Autonomous)
Coimbatore - 641 029

Programme Code: 07		Programme Title: M.Sc Biochemistry	
Title of the paper ALC –Stem Cell Biology			
Batch	Credits	Employability	
2026-2028	2		

Course Objectives

1. To learn about the technology of stem cells preparation
2. To learn the properties of stem cells
3. To prepare stem cells for gene therapy

Course Outcomes (CO)

K1	CO1	Recall the different types of stem cells and its applications
	TO	CO2 Explain the importance of gene therapy in various diseases
K5	CO3	Interpret implement the stem cell in therapies
	CO4	Examine the molecular concepts of stem cell
	CO5	Appraise the role of stem cells in various disorders.

Unit I

Introduction and Scope of stem cells: Definitions, Concepts of stem cells, differentiation, maturation, proliferation, pluripotency, self maintenance and selfrenewal, significations in measuring stemcells, preservation and storage protocols

Unit II

Types of stem cells: Intestinal stem cells, Mammary stem cells, Skeletal muscle stem cell,keratinocytstem cells of cornea, skin and hair follicles, tumor stem cells. Factors influencing proliferation and differentiation of stem cells. Role of hormone in differentiation.

Unit III

Embryonic stem cells: Blastocyst, inner cell mass, Culturing of ES cells in lab, laboratory tests to identify ES cells, stimulation ES cells for differentiation, properties of ES cells, human ES cells, Monkey and Mouse ES cells.

Unit IV

Application of stem cell: Identification, Manipulating differentiation pathways, stem cell therapy

vs cell protection, stem cell in cellular assays for screening, stem cellbased drug discovery platforms, drug screening and toxicology, stemcell banking.

Unit V

Gene therapy: Genetically engineered stem cells, stem cells and animal cloning, transgenic animals and stem cells, Therapeutic applications, Parkinson's disease, Neurological disorder, limb amputation, heart disease, spinal cord injuries, diabetes, burns. Matching the stem cell with transplant recipient, HLA typing Alzheimer's disease, spinal cord injuries tissue engineering application, production of complete organ, kidney, eyes, heart, and brain. ***Stem cell case study.**

*** denotes Self study**

Text Book

1. Turksen, K. (2002). *Embryonic Stem Cells: Methods and Protocols*. Humana Press, Totowa, New Jersey, USA.

Reference Book

1. Committee on the Biological and Biomedical Applications of Stem Cell Research. (2002). *Stem Cells and the Future of Regenerative Medicine*. National Academies Press, Washington, D.C., USA.
2. Lanza, R., Gearhart, J., Hogan, B., Melton, D., Pedersen, R., Thomas, E. D., Thomson, J., & West, M. (2009). *Essentials of Stem Cell Biology* (2nd ed.). Academic Press, USA.
3. Sell, S. (2013). *Stem Cells Handbook* (2nd ed.). Humana Press, USA.

E-Resources

1. <https://www.isscr.org>
2. <https://stemcells.nih.gov>
3. <https://www.eurostemcell.org>
4. <https://hsci.harvard.edu>
5. <https://www.nccs.res.in>

MAPPING



PSO \ CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	S	H	S
CO2	S	S	M	H	S
CO3	M	H	S	M	H
CO4	H	S	S	M	M
CO5	H	S	H	M	S

S-Strong

H-High

M-Medium

L-Low

Content prepared by (Based on Inputs)  Signature of the course in-charge Dr. S. Kavitha	 Signature of the HOD Head (ic)
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Department of Biochemistry
 (PG & Research)
 Kongunadu Arts and Science College
 (Autonomous)
 Coimbatore - 641 029

Question paper pattern

(External only)

1. THEORY

Max Marks = 75

Time = 3.00 hrs

SECTION - A (1 x 10=10 marks)

SECTION - B (5 x 5=25 marks)

Short answer questions

Q.No. 11-15: Either (a) or (b) short note type (One question 'a' or 'b' from each unit)

SECTION - C (8 x 5=40 marks)

Essay type of questions:

Q.No. 16-20: Either (a) or (b) essay type (One question 'a' or 'b' from each unit)

2. PRACTICALS – Question Pattern & Break-up of marks

END OF SEMESTER PRACTICAL EXAMINATION

Max. Marks: 60

Duration: 3hrs

I. Major (One question) (1 x 20 = 20)

II. Minor (One question) (1 x 10 = 15)

III. Spotters (3 x 5 = 15)

Examine, identify and critically comment on the spotters A, B, C, D and E.

V. Record / Observation* (10)

**Record for ESE; Observation for CIA exam.*

**CERTIFICATE COURSE ON
MEDICAL LABORATORY TECHNOLOGY**

**KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)
COIMBATORE – 641029.**

**COURSE NAME: CERTIFICATE COURSE ON MEDICAL LABORATORY TECHNOLOGY
Curriculum and Scheme of Examination under CBCS
(Applicable to the students admitted during the Academic Year 2026-2027)**

Subject code/ Question paper code	Title of the paper	Instructions hours/cycle	Exam Marks			Duration of Exam (Hrs)	Credits
			CIA	ESE	Total		
26CCL101	Paper I: Biochemistry	2	25	75	100	3	2
26CCL102	Paper II: Clinical Pathology and Microbiology	2	25	75	100	3	2
26CCL1CL	Clinical Biochemistry Practical- I	2	40	60	100	3	2
26CCL1Z1	Internship training and Viva voce	2	20	80	100	3	6

Sub code: 26CCL101

Programme Code: 07		Programme Title: Certificate course on medical laboratory technology	
Course Code: 26CCL101		Title: Paper I-Biochemistry	
Batch	Hours / Week	Total Hours	Credits
2026-28	2	30	2

Course Objectives

1. To acquire the knowledge on laboratory safety and measures
2. To know the techniques of biochemistry and clinical chemistry
3. To obtain information about various enzymes analysis and analytical techniques

Syllabus

Unit I

(6 Hours)

Laboratory safety and Specimen processing: General approach to medical laboratory sciences. Safety in laboratory. General laboratory instruments and equipments. Basic chemistry and laboratory chemicals. Specimen processing for biochemical analysis: blood, urine, CSF.

Unit II

(6 Hours)

Biochemical techniques: Principles of analytical techniques. Basic concepts of colorimetry, spectrophotometry, chromatography, electrophoresis, PCR

Unit III

(6 Hours)

Clinical biochemistry: Biochemical tests: glucose, protein, albumin, urea, creatinine, uric acid, bilirubin and cholesterol. Enzymes: *SGOT, SGPT, ALP, ACP, LDH, creatinine kinase, lipase, amylase, choline esterase. Hormones: Insulin, T3, T4, TSH, cortisol, FSH, progesterone and estrogen. Electrolytes and blood gases.

Unit IV

(6 Hours)

Automation in clinical laboratory: Basic concepts, automation of the analytical processes, steps of automation in biochemical analysis, computers in the clinical laboratory, types of automated analysers, commonly used analysers of biochemical laboratories.

Sub code: 26CCL101

Unit V

(6 Hours)

Laboratory management: Laboratory management: Basic concepts, financial management, quality management-fundamentals, total quality management of clinical laboratory.

Reference Books

1. Mukherjee KL. (1988). Medical Laboratory Technology-A procedure manual for routine diagnostic tests, Vol I, II, III. Tata McGraw Hill Publishing Company Limited.
2. Ochei Jand Klothkar A. (2000). Medical Laboratory Science-Theory and Practice. Tata McGraw Hill Publishing Company Limited.
3. Henry JB. (1988). Clinical Diagnosis and Management by Laboratory methods. 7th edition, WB Saunders Company.
4. Chatterjee MNand Shinde R. (2002). Text book of Medical Biochemistry. 5th edition. Jaypee Brothers Medical Publishers.
5. Burtis CA, Ashwood ER. (1999). Teitz Textbook of Clinical Chemistry. 3rd edition, WB Saunders Company.
6. Varley S. (1988). Practical Clinical Biochemistry. 6th edition, CBS Publishers and Distributors.

E-Reseources

1. <https://scholar.google.com>
2. <https://bio.libretexts.org/Bookshelves/Biochemistry>

MAPPING



PSO \ CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	S	H	S
CO2	S	S	M	H	S
CO3	M	H	S	M	H
CO4	H	S	S	M	M
CO5	H	S	H	M	S

S-Strong

H-High

M-Medium

L-Low

<p>Content prepared by (Based on Inputs)</p>  <p>Signature of the course in-charge Dr. S. Kavitha</p> <p>Dr. S. Monikha</p>	 <p>Signature of the HOD Head (i/c)</p> <p>Department of Biochemistry (PG & Research) Kongunadu Arts and Science College (Autonomous) Coimbatore - 641 029</p>
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Sub code: 26CCL102

Programme Code: 07		Programme Title: Certificate Course on Medical Laboratory Technology	
Course Code: 26CCL102		Title: Paper II-Clinical Pathology and Microbiology	
Batch	Hours / Week	Total Hours	Credits
2026-28	2	30	2

Course Objectives

1. To acquire the knowledge on microbial techniques
2. To know the techniques of serological procedures
3. To obtain information on hematological processing

Syllabus**Unit I****(6 Hours)**

Microbiology: Introduction to diagnostic microbiology. Role of microbiology in laboratory, specimen handling, laboratory records maintenance, safety regulations, basic procedures of diagnostic microbiology, culture environment of microbes and quality control in microbiology.

Unit II**(6 Hours)**

Diagnostic Bacteriology: Systemic grouping of pathogenic bacteria and their laboratory identification. Basic diagnostic methods for bacterial infections Anti microbial susceptibility test. Diagnostic of mycotic infection: Introduction to fungi, parasitic fungi, specimen collection, laboratory diagnosis of mycotic infection/

Unit III**(6 Hours)**

Serology: Serology and serodiagnostic procedures: Principles of immunological reactions, serodiagnosis. Laboratory procedures in serology: Collection and preparation of s e r u m s a m p l e s . CRP test, RA test, ASO test, HIV, pregnancy test.

Unit IV**(6 Hours)****Clinical Pathology:**

Routine urine examination and chemical tests. Laboratory examination of body fluids: CSF, Serous fluids
Stool examination: collection and laboratory investigation.

Semen analysis and its clinical significance.

Sub code: 26CCL102

Unit V

(6 Hours)

Hematology: Components of blood and their function, specimen collection. Routine haematological test: RBC, WBC, DC, platelet, *Hb, ESR, PCV. Basic coagulation tests: Bleeding time, Clotting time. Blood grouping and basic principles of blood transfusion.

Reference Books

1. Mukherjee KL. (1988). Medical Laboratory Technology-A procedure manual for routine diagnostic tests, Vol I, II, III. Tata McGraw Hill Publishing Company Limited.
2. Ochei Jand Klohakar A. (2000). Medical Laboratory Science-Theory and Practice. Tata McGraw Hill Publishing Company Limited.
3. Henry JB. (1988). Clinical Diagnosis and Management by Laboratory methods. 7th edition, WB Saunders Company.
4. Chatterjee MNand Shinde R. (2002). Text book of Medical Biochemistry. 5th edition. Jaypee Brothers Medical Publishers.
5. Burtis CA, Ashwood ER. (1999). Teitz Textbook of Clinical Chemistry. 3rd edition, WB Saunders Company.
6. Varley S. (1988). Practical Clinical Biochemistry. 6th edition, CBS Publishers and Distributors.

E-Resources

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MAPPING



PSO \ CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	S	H	S
CO2	S	S	M	H	S
CO3	M	H	S	M	H
CO4	H	S	S	M	M
CO5	H	S	H	M	S

S-Strong

H-High

M-Medium

L-Low

Content prepared by (Based on Inputs)	
 Signature of the course in-charge Dr. S. Monisha	 Signature of the HOD Head (ic) Department of Biochemistry (PG & Research) Kongunadu Arts and Science College (Autonomous) Coimbatore - 641 029

Programme Code: 07		Programme Title: Certificate Course on Medical Laboratory Technology	
Course Code:26CCL1CL		Title: Clinical Biochemistry Practical- I	
Batch	Hours / Week	Total Hours	Credits
2026-28	2	30	2

Course Objectives

1. To attain the knowledge on serum and urine analysis
2. To know the principles and techniques of microbiology
3. To acquire knowledge on pathological techniques

Biochemistry:

1. Analysis in serum:
Glucose, creatinine, cholesterol, urea, bilirubin, total protein.
2. Analysis in urine:
Glucose, creatinine, urea
3. Routine complete urine analysis (physical, chemical and microscopic)(dip stick method)

Microbiology:

4. Sterilization and media preparation
5. Staining procedures: Simple, Gram and acid fast staining
6. Processing of clinical specimens: Urine, pus, blood and other body fluids(demo)

Clinical Pathology:

7. CRP
8. ASO
9. RA
10. HIV
11. WIDAL
12. Blood banking: Sample collection and storage



Reference Books

1. Mukherjee KL. (1988). Medical Laboratory Technology-A procedure manual for routine diagnostic tests, Vol I, II, III. Tata McGraw Hill Publishing Company Limited.
2. Burtis CA, Ashwood ER. (1999). Teitz Textbook of Clinical Chemistry. 3rd edition, WB Saunders Company.
3. Varley S. (1988). Practical Clinical Biochemistry. 6th edition, CBS Publishers and Distributors.

MAPPING

CO \ PSO	PSO				
	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	M	S	M	S
CO2	H	S	S	S	M
CO3	M	M	H	M	S
CO4	S	H	M	H	M
CO5	S	M	H	S	M

S-Strong H-High M-Medium L-Low

<p>Content prepared by (Based on Inputs)</p>  <p>Signature of the course in-charge Dr. S. KAVITHA Dr. S. MONISHA</p>	 <p>Signature of the HOD Head</p>
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Department of Biochemistry
(PG & Research)
Kongunadu Arts and Science College,
(Autonomous)
Coimbatore - 641 029

Question paper pattern

(External only)

1. THEORY

Max Marks = 75

Time = 3.00 hrs

SECTION - A (1 x 10=10 marks)

SECTION - B (5 x 5=25 marks)

Short answer questions

Q.No. 11-15: Either (a) or (b) short note type (One question 'a' or 'b' from each unit)

SECTION - C (8 x 5=40 marks)

Essay type of questions:

Q.No. 16-20: Either (a) or (b) essay type (One question 'a' or 'b' from each unit)

2. PRACTICALS – Question Pattern & Break-up of marks

END OF SEMESTER PRACTICAL EXAMINATION

Max. Marks: 60

Duration: 3hrs

I. Major (One question) (1 x 20 = 20)

II. Minor (One question) (1 x 10 = 15)

III. Spotters (3 x 5 = 15)

Examine, identify and critically comment on the spotters A, B, C, D and E.

V. Record / Observation* (10)

**Record for ESE; Observation for CIA exam.*

CERTIFICATE COURSE
ON
BAKING SCIENCE AND TECHNOLOGY

KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)

Re-accredited by NAAC with 'A' Grade Status

College of Excellence (UGC)

COIMBATORE – 641029, TAMIL NADU, INDIA.**Course Name: CERTIFICATE COURSE ON BAKING SCIENCE AND TECHNOLOGY****Curriculum and Scheme of Examination under CBCS****(Applicable for the Students Admitted during the Academic Year 2026-27 onwards)**

Subject code/ Question paper code	Title of the paper	Instructions hours/cycle	Exam Marks			Duration of Exam (Hrs)	Credits
			CIA	ESE	Total		
26CBS101	Paper I: FACTS OF BAKING SCIENCE	2	25	75	100	3	2
26CBS102	Paper II: HYGIENE AND BAKERY SETUP	2	25	75	100	3	2
26CBS103	Practical I: BAKERY TECHNOLOGY PRACTICALS	2	40	60	100	3	2

Sub code: 26CBS101

Programme Code: 07		Programme Title: Certificate course on Baking science and Technology	
Course Code: 26CBS101		Title: Paper I-FACTS OF BAKING SCIENCE	
Batch	Hours / Week	Total Hours	Credits
2026-28	2	30	2

Course Objectives

1. To acquire the knowledge on bakery science
2. To know the techniques of in baking and its products
3. To obtain information about various raw materials and its effects

Syllabus

Unit I

(6 Hours)

Introduction to bakery: Introduction ,Scope of Bakery & Confectionery, Bakery terms, types, nutrition, and its essentials. Instruments used in the bakery. Infrastructure for bakery setup. Organisation chart of Bakery. Bakery layout – The required approvals for setting up of a Bakery – Government procedure and Bye-laws. Selection of site, Selection of equipment, Layout design and Electricity.

Unit II

(6 Hours)

Eggs and dairy products: types importance in bakery and confectionery grading, quality and selection. Gelling agents and stabilizers, Their role in bakery and confectionery, Food additives and preservatives. Edible garnishes Canned food.

Unit III

(6 Hours)

Raw material: Required for bread making bread, cake, biscuits, puffs, beavverages, pasteries, chocolates etc., Role of flour, water, yeast, salt - Sugar, and fats. Wheat and Flour: Different types of flours available, Constituents of flours, pH Value of flour, Water absorption power of flour, Gluten, diastatic capacity of flour, Grade of flour. Temperature/ Weight conversions 1 unit; °F/ °C /gms / lb serving size.

Unit IV

(6 Hours)

Fermentation and preservation: Yeast □ An elementary knowledge of Baker's yeast, the part it plays in the fermentation of dough and conditions influencing it's working. □ Effect of over and under

Sub code: 26CBS101

fermentation and under proofing of dough and other fermented goods. Methods of food preservation in bakery. Role in raising bakery products and chemical leavening agents

Unit V

(6 Hours)

Quality control: Introduction to food laws, Storage and preservation of bakery and confectionery products, Organic and genetically modified foods. Packing methods for bakery products. Microbiological techniques use to check the quality of milk, flour, baked products. Raw-materials for the quality check.

Reference books:

1. Dubey, S.C. 2007, Basic Baking, 5th Edition, Chankya Mudrak Pvt Ltd.
2. Raina et al., 2010, Basic Food Preparation- A Complete Manual, 4th Edition, Orient Black Swan Ltd.
3. Khanna K, Gupta S, Seth R, Mahna R, Reki T, 2004, The Art and Science of Cooking: A Practical Manual , Revised Edition, Elite Publishing House Pvt Ltd.

E-Resources

1. <https://nptel.ac.in>
2. <https://swayam.gov.in>
3. <https://www.cerealsgrains.org>
4. <https://www.ift.org>
5. <https://www.cftri.res.in>
6. <https://www.fssai.gov.in>
7. <https://www.fao.org>

Sub code: 26CBS101

MAPPING



PSO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO					
CO1	H	M	S	H	S
CO2	S	S	M	H	S
CO3	M	H	S	M	H
CO4	H	S	S	M	M
CO5	H	S	H	M	S

S-Strong

H-High

M-Medium

L-Low

Content prepared by (Based on Inputs)	
 Signature of the course in-charge Dr. S. Manisha A Dr. S. Karilka	 Signature of the HOD Head (PG & Research) Department of Biochemistry Kongunadu Arts and Science College (Autonomous) Coimbatore - 641 029

Sub code: 26CBS102

Programme Code: 07		Programme Title: Certificate course on Baking science and Technology	
Course Code: 26CBS102		Title: Paper II-HYGIENE AND BAKERY SETUP	
Batch	Hours / Week	Total Hours	Credits
2026-28	2	30	2

Course Objectives

1. To acquire the knowledge on laws
2. To know the techniques of in maintaining hygiene and sanitary procedures
3. To obtain information about various safety authorities and costing

Syllabus

Unit I (6 Hours)

INTRODUCTION: Bakery layout – The required approvals for setting up of a Bakery – government procedure and Bye-laws. Selection of site, Selection of equipment, Layout design, Business model and Electricity.

Unit II (6 Hours)

HYGIENE FACTS: Introduction: Food microbiology, Microorganism, groups important in food microbiology. Viruses, Bacteria, Fungi (Yeast & Molds), Algae, Parasites, Factors affecting the growth of microbes, Beneficial role of Microorganisms

Unit III (6 Hours)

SANITARY PROCEDURE: Food handling, Receiving, Storage, Preparation, Cooking, Holding, and service of the food.

GARBAGE DISPOSAL: Different Methods, Advantages & Disadvantages, Municipal Laws and Swachh Abhiyan

Unit IV (6 Hours)

FOOD SAFETY AUTHORITY (FSSAI): Introduction to FSSAI, Role of FSSAI. FSSAI Compliance, GST.

Unit V (6 Hours)

Cost and yield: Raw materials cost, food cost, labour cost, overhead cost, miscellaneous cost. Yield: butchers yield, cooking yield, portion control

Reference Books:

1. James M jay: Modern food microbiology IV edition, CBS publishers, New Delhi (1996)
2. M.R. Adams and M.O. Moss, Food Microbiology, Second Edition, Panima Publishing corporation, New Delhi. Third reprint 2004.
3. Gustavo F Gutierrez-Lopez, Gustavo V Barbosa-Canovas Food Science and Food Biotechnology: CRCPress 2003
4. Bibek Ray: Fundamental Food Microbiology, (Third Edition) CRC Press December 2003

E-Resources

1. <https://nptel.ac.in>
2. <https://swayam.gov.in>
3. <https://www.cerealsgrains.org>
4. <https://www.ift.org>
5. <https://www.cftri.res.in>
6. <https://www.fssai.gov.in>
7. <https://www.fao.org>

MAPPING



PSO \ CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	S	H	S
CO2	S	S	M	H	S
CO3	M	H	S	M	H
CO4	H	S	S	M	M
CO5	H	S	H	M	S

S-Strong

H-High

M-Medium

L-Low

<p>Content prepared by (Based on Inputs)</p>  <p>Signature of the course in-charge Dr. S. Monisha</p>	 <p>Signature of the HOD Head</p>
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Coimbatore - 641 029

Sub code: 26CBS103

Programme Code: 07		Programme Title: Certificate course on Baking science and Technology	
Course Code: 26CBS103		Title: Practical I: BAKERY TECHNOLOGY PRACTICALS	
Batch	Hours / Week	Total Hours	Credits
2026-28	2	30	2

Course Objectives

1. To acquire the protocols of dough making
2. To know the techniques of baking
3. To obtain information about packaging

Baking and packing

1. Selection of flour and yeast for bread making
2. Dough making for bread
3. Making and packing of bread
4. Preparation and packaging of cake and cake icing
5. Preparation and packaging of cookies and pastry
6. Preparation and packaging of donuts
7. Milletes based baking
8. Selection of flour and sheet making
9. Samosa making

MAPPING



CO \ PSO	PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
	CO1	S	M	S	M	S
CO2	H	S	S	S	M	
CO3	M	M	H	M	S	
CO4	S	H	M	H	M	
CO5	S	M	H	S	M	

S–Strong

H–High

M–Medium

L –Low

<p>Content prepared by (Based on Inputs)</p> <p></p> <p>Signature of the course in-charge Dr. S. Karitha</p>	<p></p> <p>Signature of the HOD Head (i/c)</p>
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Department of Biochemistry
(PG & Research)
Kongunadu Arts and Science College
(Autonomous)
Coimbatore - 641 029

Question paper pattern

(External only)

THEORY

Max Marks = 75

Time = 3.00 hrs

SECTION - A (1 x 10=10 marks)

SECTION - B (5 x 5=25 marks)

Short answer questions

Q.No. 11-15: Either (a) or (b) short note type (One question 'a' or 'b' from each unit)

SECTION - C (8 x 5=40 marks)

Essay type of questions:

Q.No. 16-20: Either (a) or (b) essay type (One question 'a' or 'b' from each unit)

PRACTICALS – Question Pattern & Break-up of marks

END OF SEMESTER PRACTICAL EXAMINATION

Max. Marks: 60

Duration: 3 hrs

I. Major (One question) (1 x 20 = 20)

II. Minor (One question) (1 x 10 = 15)

III. Spotters (3 x 5 = 15)

Examine, identify and critically comment on the spotters A, B, C, D and E.

V. Record / Observation* (10)

**Record for ESE; Observation for CIA exam.*

