V.V.VANNIAPERUMAL COLLEGE FOR WOMEN
(Belonging to Virudhunagar Hindu Nadars)
An Autonomous Institution Affiliated to Madurai Kamaraj University, Madurai
Reaccredited with 'A++' Grade (4th Cycle) by NAAC
VIRUDHUNAGAR
Quality Education with Wisdom and Values

OUTCOME BASED EDUCATION WITH CHOICE BASED CREDIT SYSTEM REGULATIONS AND SYLLABUS
(with effect from Academic Year 2023 - 2024)

V.V.Vanniaperumal College for Women, Virudhunagar, established in 1962, offers 13 UG Programmes (Aided), 15 UG Programmes (SF), 15 PG Programmes and 6 Ph.D. Programmes. The curricula for all these Programmes, except Ph.D. Programmes, have been framed as per the guidelines given by the and University Grants Commission (UGC) & Tamil Nadu State Council for Higher Education (TANSCHE) under Choice Based Credit System (CBCS) and the guidelines for Outcome Based Education (OBE).

The Departments of Commerce, English, History, Mathematics, Biochemistry and Tamil upgraded as Research Centres offer Ph.D. Programmes as per the norms and regulations of Madurai Kamaraj University, Madurai and do not come under the purview of CBCS.

A. CHOICE BASED CREDIT SYSTEM (CBCS)

The CBCS provides an opportunity for the students to choose courses from the prescribed Courses. The CBCS is followed as per the guidelines formulated by the UGC. The performance of students is evaluated based on the uniform grading system. Computation of the Cumulative Grade Point Average (CGPA) is made to ensure uniformity in evaluation system.

List of Programmes in which CBCS/Elective Course System is implemented

UG PROGRAMMES

Arts & Humanities	:	History (E.M. & T.M.), English, Tamil
Physical & Life Sciences	:	Mathematics, Zoology, Chemistry, Physics, Biochemistry, Home Science - Nutrition and Dietetics, Costume Design and Fashion, Microbiology, Biotechnology, Computer Science, Information Technology, Data Science, Computer Applications and Computer Applications - Graphic Design

Commerce & Management	:	Commerce, Commerce (Computer Applications), Commerce (Professional Accounting), Business Administration

PG PROGRAMMES

Arts & Humanities	:	History, English, Tamil
Physical & Life Sciences	:	Mathematics, Physics, Chemistry, Zoology, Biochemistry, Home Science - Nutrition and Dietetics, Biotechnology, Computer Science, Computer Science (Data Science) Computer Applications (MCA) *
Commerce & Management	:	Commerce, Business Administration (MBA) *
		* AICTE approved Programmes

OUTLINE OF CHOICE BASED CREDIT SYSTEM- PG

1. Core Courses
2. Elective Courses
   - Discipline Specific Elective Courses (DSEC)
   - Generic Elective Courses
   - Non-Major Elective Course (NMEC)
3. Skill Enhancement Courses
4. Self Study Course (Online)
5. Extension Activity
6. Extra Credit Courses (Optional)

List of Non Major Elective Courses (NME)
(2023-2024 onwards)

PG PROGRAMMES

Name of the Course	Course Code	Department
Tourism in Tamilnadu	23PHIN31	History
Functional English	23PENN31	English
தமிழும் பிற துறைகளும்	23PTAN31	Tamil
Taxation Concepts and Assessment	23PCON31	Commerce
Entrepreneurship	23PBAN31	Business Administration
Statistics for Life and Social Sciences	23PMTN31	Mathematics
Advanced Chemistry for Competitive Examinations	23PCHN31	Chemistry
Nutrition and Health	23PHSN31	Home Science - Nutrition and Dietetics
Molecular Basis of Diseases and Therapeutic Strategies	23PBCN31	Biochemistry
Web Programming	23PCSN31	Computer Science
Fundamentals of Web Design	23PCAN31	Computer Applications

B.OUTCOME BASED EDUCATION (OBE) FRAMEWORK

The core philosophy of Outcome Based Education rests in employing a student - centric learning approach to measure the performance of students based on a set of pre-determined outcomes. The significant advantage of OBE is that it enables a revamp of the curriculum based on the learning outcomes, upgrade of academic resources, quality enhancement in research and integration of technology in the teaching-learning process. It also helps in bringing clarity among students as to what is expected of them after completion of the Programme in general and the Course in particular. The OBE directs the teachers to channelise their teaching methodologies and evaluation strategies to attain the Programme Educational Objectives (PEOs) and fulfill the Vision and Mission of the Institution.

Vision of the Institution

The founding vision of the Institution is to impart Quality Education to the rural womenfolk and to empower them with knowledge and leadership quality.

Mission of the Institution

The mission of the Institution is to impart liberal education committed to quality and excellence. Its quest is to mould learners into globally competent individuals instilling in them life-oriented skills, personal integrity, leadership qualities and service mindedness.

B.1 Programme Educational Objectives, Programme Outcomes and Programme Specific Outcomes

It is imperative for the Institution to set the Programme Educational Objectives (PEOs), Programme Outcomes (POs) and Course Outcomes (COs), consistent with its Vision and Mission statements. The PEOs and the POs should be driven by the Mission of the Institution and should provide distinctive paths to achieve the stated goals. The PEOs for each Programme have to fulfill the Vision and Mission of the Department offering the Programme.

Vision of the Department of M.Sc. BIOCHEMISTRY

To empower our students with scientific knowledge and skills and to mold them with pioneering spirit, forward thinking, leadership and collaborative approach.

Mission of the Department of M.Sc. BIOCHEMISTRY

- To handle scientific and research faculty of students through deep learning of Biochemistry for employability in research, academia and pharmaceutical fields,
- To advance traditional boundaries, to motivate for research and entrepreneurship
- Committed to improving the scientific world today.

B.1.1 Programme Educational Objectives (PEOs)

PEOs are broad statements that describe the career and professional achievements that the Programme is preparing the graduates to achieve within the first few years after graduation. PEOs are framed for each Programme and should be consistent with the Mission of the Institution.

Programme Educational Objectives (PEOs) of M.Sc. BIOCHEMISTRY Programme

The Students will be able to

- provide in-depth knowledge in the core areas of life sciences for industries, clinical, research , pharmaceutical labs, and academia.
- instill the ability of entrepreneurship in research and diagnostics
- equip skillful attitude promoting lifelong learning to meet the ever evolving professional demands by developing ethical , interpersonal and team skills

Key Components of Mission Statement	PEO1	PEO2	PEO3
Employability in research, academia and pharmaceutical fields	✓	✓	✓
Motivation for research and entrepreneurship	✓	✓	✓
Committed to improving the scientific world today	✓	✓	✓

B.1.2 Programme Outcomes (POs)

POs shall be based on Graduate Attributes (GAs) of the Programme. The GAs are the attributes expected of a graduate from a Programme in terms of knowledge, skills, attitude and values. The Graduate Attributes include Disciplinary Knowledge,

Communication Skills, Critical Thinking, Problem Solving, Analytical Reasoning, Research Related Skills, Co-operation/Team Work, Scientific Reasoning, Reflective Thinking, Information/Digital Literacy, Multicultural Competence, Moral and Ethical Awareness/Reasoning, Leadership Qualities and Lifelong Learning.

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

1 apply their in-depth domain knowledge and practical skills in interdisciplinary fields for research-based endeavours, employment and entrepreneurship development. (*Disciplinary Knowledge)*

2 communicate proficiently and confidently with the ability to present complex ideas both in spoken and written forms in a concise manner to assorted groups. (*Communication Skills*)

3 identify, formulate and solve problems in a consistent and systematic way with updated skills using modern tools and techniques. (*Scientific Reasoning and Problem Solving*)

4 analyze the data, synthesis the findings and provide valid conclusion by critical evaluation of theories, policies and practices for the fulfillment of the local, national, regional and global developmental needs. (*Critical Thinking and Analytical Reasoning*)

5 explore and evaluate globally competent research methodologies to apply appropriately in interdisciplinary research; Develop and sustain the research capabilities to meet the emerging needs for the welfare of the society. (*Research Related Skills*)

6 use ICT to mould themselves for lifelong learning activities to face career challenges in the changing environment. (*Digital Literacy, Self - directed and Lifelong Learning*)

7 self-manage and function efficiently as a member or a leader in diverse teams in a multicultural society for nation building. (*Co-operation/Team Work and Multicultural Competence*)

8 uphold the imbibed ethical and moral values in personal, professional and social life for sustainable environment. (*Moral and Ethical Awareness*)

B.1.3 Programme Specific Outcomes (PSOs)

Based on the Programme Outcomes, Programme Specific Outcomes are framed for each PG Programme**.** Programme Specific Outcomes denote what the students would be able to do at the time of graduation. They are Programme-specific and it is mandatory that each PO should be mapped to the respective PSO.

On Successful completion of M.Sc.Biochemistry Programme, the students will be able to

PO 1: *Disciplinary Knowledge*

PSO 1.a: Apply the knowledge of theoretical and experimental approaches of Biochemistry in research oriented Endeavour to unravel problems in health care with a scientific basis of life process and will have an ability to provide solution to new problems.

PSO 1.b: Recognize the importance of bioethics, entrepreneurship and career oriented skills, thus providing a strong foundation for both academic / industrial placements across the country and globe as well as setting up entrepreneurial ventures.

PO2: *Communication Skills*

PSO 2: Communicate the knowledge of Biochemistry to address environmental, intellectual, societal and ethical issues through case studies .

PO3: *Scientific Reasoning and Problem Solving*

PSO 3.a: Enrich their analytical and problem solving skills regarding biochemical principles of life processes and technologies for combating human diseases.

PSO 3.b: build up the capacity of decision making with regard to scientific progress, personal development and career choice.

PO4: *Critical thinking and Analytical Reasoning*

PSO 4: Apply the knowledge of experimental approaches on designing experiments, analysis, interpretation of data and synthesis of information to provide valid conclusions for life situations and entrepreneurial situations.

PO5: *Research Related Skills*

PSO 5: An ability to properly understand the technical aspects with research aptitude of existing technologies that help in addressing the biological and medical challenges faced by human kind by adhering the code of conduct of Biochemistry

PO6: *Digital Literacy, Self - directed and Lifelong learning*

PSO 6: Analyze and interpret the data using state-of the-art techniques with ICT and modern tools in planning and executing projects in Biochemistry for health care area, research area and entrepreneurial area.

PO7: *Cooperation/Team Work and Multicultural Competence*

PSO 7: Develop leadership qualities, team spirit and good interpersonal skills to work effectively in diverse fields like agriculture, health care, research and entrepreneurial fields individually or as a team.

PO8: *Moral and Ethical awareness*

PSO 8: Follow the global standards of codes of conduct in Life science community and practice the imbibed moral values in their profession to maintain sustainable environment and society.

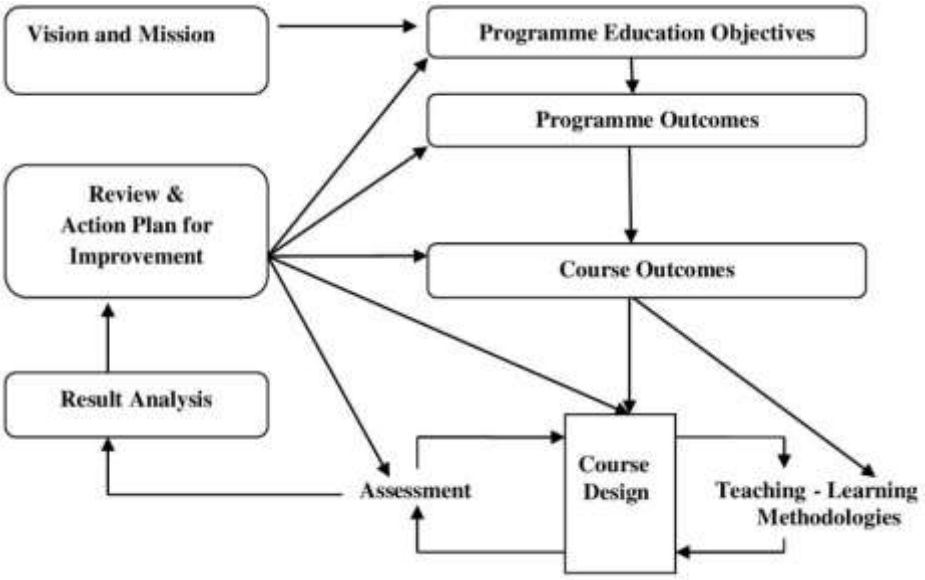
PO-PEO Mapping Matrix

Attainment of PEOs can be measured by a PO-PEO matrix. PEOs should evolve through constant feedback from alumnae, students, industry, management, *etc*. It is mandatory that each PEO should be mapped to at least one of the Pos.

PEOs / POs/PSOs	PEO1	PEO2	PEO3
PO1/PSO1	✓	✓	✓
PO2/PSO2	✓	✓	✓
PO3/PSO3	✓	✓	✓
PO4/PSO4	✓	✓	-
PO5/PSO5	-	✓	✓
PO6/PSO6	✓	✓	✓
PO7/PSO7	✓	✓	✓
PO8/PSO8	✓	✓	-

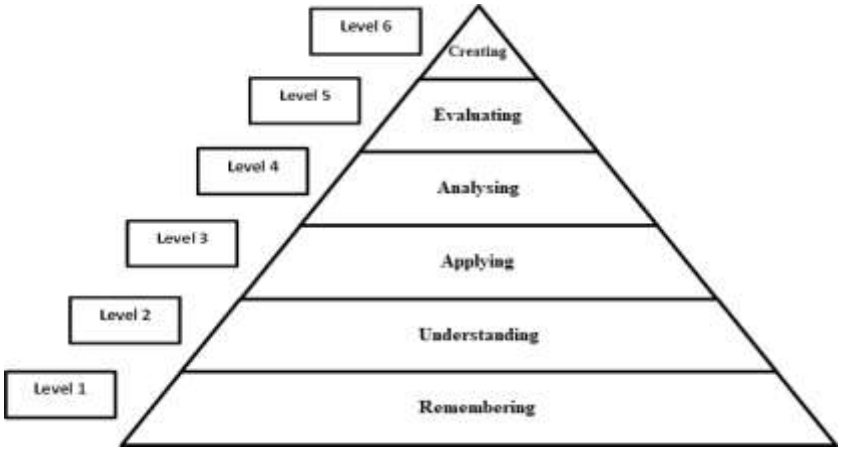
B.1.4 Course Outcomes (COs)

Course Outcomes are narrow statements restricted to the course contents given in five units. Course Outcomes describe what students would be capable of, after learning the contents of the Course. They reflect the level of knowledge gained, skills acquired and attributes developed by the students after learning of Course contents. COs are measurable, attainable and manageable in number. COs contribute to attain POs in such a way that each CO addresses at least one of the POs and also each PO is reasonably addressed by adequate number of COs.



It is important to determine the methods of assessment. A comprehensive assessment strategy may be outlined using the revised Bloom's Taxonomy levels.

BLOOM'S TAXONOMY



CO - PO Mapping of Courses

After framing the CO statements, the COs framed for each course is mapped with POs based on the relationship that exists between them. The COs which are not related to any of the POs is indicated with (-), signifying Nil. Measurement Mapping is based on Four Points Scale [High (H), Medium (M), Low (L) and Nil (-)]. For calculating weighted percentage of contribution of each Course in the attainment of the respective POs, the weights assigned for H, M and L are 3, 2 and 1 respectively.

CO-PO/PSO Mapping Table (Course Articulation Matrix)

PO/PSOs / COs	PO1/ PSO1	PO2/ PSO2	PO3/ PSO3	PO4/ PSO4	PO5/ PSO5	PO6/ PSO6	PO7/ PSO7	PO8/ PSO8
CO1								
CO2								
CO3								
CO4								
CO5								

ELIGIBILITY FOR ADMISSION

The candidate should have passed in B.Sc. Biochemistry, Zoology, Botany, Microbiology, Biotechnology (General or any Specialization) Degree from any recognized University.

DURATION OF THE PROGRAMME

The candidates shall undergo the prescribed Programme of study for a period of two academic years (four semesters).

MEDIUM OF INSTRUCTION

English

B.2 EVALUATION SCHEME

Components	Internal Assessment Marks	External Examination Marks	Total Marks
Theory/Project	25	75	**100**

B.2.1 Core Courses, Elective Courses (Discipline Specific Elective Courses, Generic Elective Courses & Non Major Elective Courses

INTERNAL ASSESSMENT

Distribution of Marks

Theory

Mode of Evaluation		Marks
Periodic Test	:	20
Assignment	: 5	
Total	**:**	**25**

Three Periodic Tests - Average of the best two will be considered

Two Assignments - Better of the two will be considered

Practical

Mode of Evaluation		Marks
Practical Test	:	30
Record Performance	:	10
Total	**:**	**40**

Practical Test - Average of the two Practical Tests will be considered

Performance - Attendance and Record

Question Pattern for Periodic Test **Duration: 2 Hours**

Section	Q. No.	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A	1 - 5	Multiple Choice Questions	5	5	1	5
B	6-9	Internal Choice – Either… or Type	4	4	5	20
C	10 - 11	Internal Choice – Either…. or Type	2	2	10	20
					Total	**45***

*The total marks obtained in the Periodic Test will be calculated for 20 mark

SUMMATIVE EXAMINATION

External Assessment
Distribution of Marks

Mode of Evaluation		Marks
Summative Examination	:	60
Seminar Presentation	:	15
Total	:	**75**

SUMMATIVE EXAMINATION

Question Pattern **Duration: 3 Hours**

Section	Q. No.	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A	1 - 5	Multiple Choice Questions	5	5	1	5
B	6 - 10	Internal Choice – Either ….or Type	5	5	5	25
C	11 - 13	Internal Choice -Either …or Type	3	3	10	30
					Total	**60**

B.2.2 Project

Individual Project is compulsory for II PG Students in IV Semester.

Distribution of Marks

Mode of Evaluation		Marks
Internal Assessment	:	40
External Examination	:	60
Total	:	**100**

Internal Assessment: Pre-submission Presentation - 10 Marks

Review Report - 20 Marks

One Open Online Course related to the Project - 10 Marks

External Examination: Project Report - 40 Marks

Viva Voce - 20 Marks

B. 2.3 SKILL ENHANCEMENT COURSES
INTERNAL ASSESSMENT
Distribution of Marks

Theory

Mode of Evaluation		Marks
Periodic Test	:	20
Assignment	:	5
Total	:	**25**

Three Periodic Tests - Average of the best two will be considered

Two Assignments - Better of the two will be considered

Practical

Mode of Evaluation		Marks
Practical Test	:	30
Record Performance	:	10
Total	**:**	**40**

Practical Test - Average of the two Practical Tests will be considered

Performance - Attendance and Record

Question Pattern for Periodic Test **Duration: 2 Hours**

Section	Q. No.	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A	1 - 4	Internal Choice – Either… or Type	4	4	5	20
B	5	Internal Choice – Either… or Type	1	1	10	10
					Total	**30***

*The total marks obtained in the Periodic Test will be calculated for 20 marks

SUMMATIVE EXAMINATION

External Assessment

Distribution of Marks

Mode of Evaluation		Marks
Seminar Paper		10
Seminar Presentation	**:**	15
Summative Examination	**:**	50
Total	**:**	**75**

SUMMATIVE EXAMINATION

Question Pattern **Duration: 3 Hours**

Section	Q. No.	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A	1 - 5	Multiple Choice Questions	5	5	1	5
B	6 - 10	Internal Choice - Either ….or Type	5	5	5	25
C	11 - 12	Internal Choice - Either …or Type	2	2	10	20
					Total	**50**

B. 2.3.1 Skill Enhancement Course - Professional Competency Skill

Types of Question – Multiple Choice Questions Only

INTERNAL ASSESSMENT

Distribution of Marks

Theory

Mode of Evaluation		Marks
Periodic Test	:	20
Assignment	:	5
Total	**:**	**25**

Three Periodic Tests - Average of the best two will be considered

Two Assignments - Better of the two will be considered

Question Pattern for Periodic Test **Duration: 2 Hours**

Section	Q. No.	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A	1 - 5	Multiple Choice Questions	5	5	1	5
B	6-9	Internal Choice – Either… or Type	4	4	5	20
C	10 - 11	Internal Choice – Either…. or Type	2	2	10	20
	Total					**45***

*The total marks obtained in the Periodic Test will be calculated for 20 marks

SUMMATIVE EXAMINATION

External Assessment

Distribution of Marks

Mode of Evaluation		Marks
Summative Examination	**:**	60
Seminar Presentation	**:**	15
Total	**:**	**75**

SUMMATIVE EXAMINATION

Question Pattern **Duration: 3 Hours**

Section	Q. No.	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A	1 - 5	Multiple Choice Questions	5	5	1	5
B	6 - 10	Internal Choice - Either ….or Type	5	5	5	25
C	11 - 13	Internal Choice - Either …or Type	3	3	10	30
					Total	**60**

B.2.4. Self Study - Online Course

Practice for CSIR NET-General Paper –Online
Internal Examination only

- Two Periodic Tests (Online) with Multiple Choice Questions will be conducted in III Semester.
- Model Examination will be conducted after two periodic tests.

Distribution of Marks

Mode of Evaluation		Marks
Periodic Test	:	25
Model Examination	:	75
Total	**:**	**100**

Two Periodic Tests - Better of the two will be considered

B.2.5. Extension Activities

Assessment by Internal Examiner only

Distribution of Marks

Mode of Evaluation		Marks
Attendance	:	5
Performance	:	10
Report	:	10
Total	**:**	**25***

*The marks obtained will be calculated for 100 marks

B.2.6. EXTRA CREDIT COURSES (OPTIONAL)

2.6.1 Extra Credit Course offered by the Department.

Assessment by Internal Examiner Only (To be conducted along with the III Periodic Test)

Distribution of Marks

Mode of Evaluation		Marks
Quiz (Multiple Choice Questions)	:	25
Model Examination	:	75
Total	**:**	**100**

Question Pattern for Model Examination

Section	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A Q.No.(1-5)	Internal Choice-Either or Type	5	5	7	35
B Q.No.(6-9)	Internal Choice-Either or Type	4	4	10	40
				Total	**75**

2.6.2 Extra credit Course offered by MOOC (Massive Open Online Course)

- The Courses shall be completed within the first III Semesters of the Programme.
- The allotment of credits is as follows **(Maximum of 15 credits)**

4weeks Course - 1 credit
8 weeks Course - 2 credits
12 weeks Course - 3 credits

ELIGIBILITY FOR THE DEGREE

- The candidate will not be eligible for the Degree without completing the prescribed Courses of study and a minimum of 50% Pass marks in all the Courses.
  - No Pass minimum for Internal Assessment for other Courses.
  - Pass minimum for External Examination is 27 marks out of 60 marks for Core Courses, Discipline Specific Elective Courses and Non-Major Elective Course.
  - Pass minimum for Practice for SET/NET - General Paper is 50 Marks.
- Attendance
  - The students who have attended the classes for 76 days (85%) and above are permitted to appear for the Summative Examinations without any condition.
  - The students who have only 60-75days (66% -84%) of attendance are permitted to appear for the Summative Examinations after paying the required fine amountand fulfilling other conditions according to the respective cases.
  - The students who have attended the classes for 59 days and less – upto 45 days (50% - 65%) can appear for the Summative Examinations only after getting special permission from the Principal.
  - The students who have attended the classes for 44 days or less (<50%) cannot appear for the Summative Examinations and have to repeat the whole semester.
  - These rules are applicable to UG, PG and M.Phil. Programmes and come into effect from 2020-2021 onwards.
  - For Certificate, Diploma, Advanced Diploma and Post Graduate Diploma Programmes, the students require 75% of attendance to appear for the Theory/Practical Examinations.

B.3 ASSESSMENT MANAGEMENT PLAN

An Assessment Management Plan that details the assessment strategy both at the Programme and the Course levels is prepared. The continuous assessment is implemented using an assessment rubric to interpret and grade students.

B.3.1 Assessment Process for CO Attainment

Assessment is one or more processes carried out by the institution that identify, collect and prepare data to evaluate the achievement of Course Outcomes and Programme Outcomes. Course Outcome is evaluated based on the performance of students in the Continuous Internal Assessments and in End Semester Examination of a course. Target levels of attainment shall be fixed by the Course teacher and Heads of the respective departments.

Direct Assessment (Rubric based) - Conventional assessment tools such as Term Test, Assignment, Quiz and End Semester Summative Examination are used.

Indirect Assessment - Done through Course Exit Survey.

CO Assessment Rubrics

For the evaluation and assessment of COs and POs, rubrics are used. Internal assessment contributes 40% and End Semester assessment contributes 60% to the total attainment of a CO for the theory courses. For the practical courses, internal assessment contributes 50% and Semester assessment contributes 50% to the total attainment of a CO. Once the Course Outcome is measured, the PO can be measured using a CO-PO matrix.

CO Attainment

Direct CO Attainment

Course Outcomes of all courses are assessed and the CO - wise marks obtained by all the students are recorded for all the assessment tools. The respective CO attainment level is evaluated based on set attainment rubrics.

Target Setting for Assessment Method

For setting up the target of internal assessment tools, 55% of the maximum mark is fixed as target. For setting up the target of End Semester Examination, the average mark of the class shall be set as target.

Formula for Attainment for each CO

Attainment = Percentage of students who have scored more than the target marks

$$\text{Percentage of Attainment} = \frac{\text{Number of Students who Scored more than the Target}}{\text{Total Number of Students}} \times 100$$

Attainment Levels of COs

Assessment Methods	Attainment Levels	
Internal Assessment	Level 1	50% of students scoring more than set target marks in Internal Assessment tools
	Level 2	55% of students scoring more than set target marks in Internal Assessment tools
	Level 3	60% of students scoring more than set target marks in internal Assessment tools
End Semester Summative Examination	Level 1	50% of students scoring more than average marks in End Semester Summative Examination
	Level 2	55% of students scoring more than average marks in End Semester Summative Examination
	Level 3	60% of students scoring more than average marks in End Semester Summative Examination

Indirect CO Attainment

At the end of each Course, an exit survey is conducted to collect the opinion of the students on attainment of Course Outcomes. A questionnaire is designed to reflect the views of the students about the Course Outcomes.

Overall CO Attainment=75% of Direct CO Attainment + 25 % of Indirect CO Attainment

In each Course, the level of attainment of each CO is compared with the predefined targets. If the target is not reached, the Course teacher takes necessary steps for the improvement to reach the target.

For continuous improvement, if the target is reached, the Course teacher can set the target as a value greater than the CO attainment of the previous year.

B.3.2 Assessment Process for Overall PO Attainment

With the help of CO - PO mapping, the PO attainment is calculated. PO assessment is done by giving 75% weightage to direct assessment and 25% weightage to indirect assessment. Direct assessment is based on CO attainment, where 75% weightage is given to attainment through End Semester Examination and 25 % weightage is given to attainment through Internal assessments. Indirect assessment is done through Graduate Exit Survey and participation of students in Co-curricular/Extra-curricular activities.

PO Assessment Tools

Mode of Assessment	Assessment Tool	Description
Direct Attainment (Weightage -75%)	CO Assessment	This is computed from the calculated CO Attainment value for each Course.
Indirect Attainment (Weightage - 25%)	Graduate Exit Survey 10%	At the end of the Programme, Graduate Exit Survey is collected from the graduates and it gives the opinion of the graduates on attainment of Programme Outcomes.
	Co-curricular / Extra-curricular activities 15%	For participation in Co-curricular/Extra-curricular activities during the period of their study.

Programme Articulation Matrix (PAM)

Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Average Direct PO Attainment									
Direct PO Attainment in percentage									

Indirect Attainment of POs for all Courses

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Graduate Exit Survey								
Indirect PO Attainment								

Attainments of POs for all Courses

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Direct Attainment(Weightage - 75%)								
Indirect Attainment(Weightage - 25%)								
Overall PO Attainment								

Overall PO Attainment= 75% of Direct PO Attainment +
25% of Indirect PO Attainment (Graduate Exit Survey & Participation in Co- curricular and Extra-curricular Activities)

Expected Level of Attainment for each of the Programme Outcomes

POs	Level of Attainment
Attainment Value ≥70%	Excellent
60% ≤ Attainment Value < 70%	Very Good
50% ≤ Attainment Value < 60%	Good
40% ≤ Attainment Value < 50%	Satisfactory
Attainment Value <40%	Not Satisfactory

Level of PO Attainment

Graduation Batch	Overall PO Attainment (in percentage)	Whether Expected Level of PO is Achieved? (Yes/No)

B.3.3 Assessment Process for PEOs

The curriculum is designed so that all the courses contribute to the achievement of PEOs. The attainment of PEOs is measured after 3 years of completion of the Programme only through Indirect methods.

Target for PEO Attainment

Assessment Criteria	Target (UG)	Target (PG)
Record of Employment	15% of the class strength	30 % of the class strength
Progression to Higher Education	50% of the class strength	5 % of the class strength
Record of Entrepreneurship	2 % of the class strength	5 % of the class strength

Attainment of PEOs

Assessment Criteria & Tool	Weightage
Record of Employment	10
Progression to Higher Education	20
Record of Entrepreneurship	10
Feedback from Alumnae	30
Feedback from Parents	10
Feedback from Employers	20
Total Attainment	**100**

$$\text{Percentage of PEO Attainment from Employment} = \frac{\text{Number of Students who have got Employment}}{\text{Target}} \times 100$$

$$\text{Percentage of PEO Attainment from Higher Education} = \frac{\text{Number of Students who pursue Higher Education}}{\text{Target}} \times 100$$

$$\text{Percentage of PEO Attainment from Entrepreneurship} = \frac{\text{Number of Students who have become Entrepreneurs}}{\text{Target}} \times 100$$

Expected Level of Attainment for each of the Programme Educational Objectives

POs	Level of Attainment
Attainment Value ≥70%	Excellent
60% ≤ Attainment Value < 70%	Very Good
50% ≤ Attainment Value < 60%	Good
40% ≤ Attainment Value < 50%	Satisfactory
Attainment Value <40%	Not Satisfactory

Level of PEO Attainment

Graduation Batch	Overall PEO Attainment (in percentage)	Whether Expected Level of PEO is Achieved? (Yes/No)

C. PROCESS OF REDEFINING THE PROGRMME EDUCATIONAL OBJECTIVES

The college has always been involving the key stakeholders in collecting information and suggestions with regard to curriculum development and curriculum revision. Based on the information collected, the objectives of the Programme are defined, refined and are inscribed in the form of PEOs. The level of attainment of PEOs defined earlier will be analysed and will identify the need for redefining PEOs. Based on identified changes in terms of curriculum, regulations and PEOs, the administrative system like Board of Studies, Academic Council and Governing Body may recommend appropriate actions. As per the Outcome Based Education Framework implemented from the Academic Year 2020 - 2021, the following are the Programme Structure, the Programme Contents and the Course Contents of M.Sc. Biochemistry Programme

V.V.VANNIAPERUMAL COLLEGE FOR WOMEN
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An Autonomous Institution Affiliated to Madurai Kamaraj University, Madurai
Reaccredited with 'A++' Grade (4th Cycle) by NAAC
VIRUDHUNAGAR
Quality Education with Wisdom and Values

MASTER OF BIOCHEMISTRY (7015)

Outcome Based Education with Choice Base Credit System
Programme Structure - Allotment of Hours and Credits
For those who join in the Academic Year 2023-2024

Components	Semester				Total Number of Hours (Credits)
	I	II	III	IV	
Core Course	6 (5)	6 (5)	6 (5)	6 (5)	24 (20)
Core Course	6 (5)	6 (5)	6 (5)	6 (5)	24 (20)
Core Course	6 (5)	6 (5)	6 (4)	-	18 (14)
Core Course Practical	6 (3)	6 (3)	5 (3)	-	17 (9)
Project	-	-	-	6 (5)	6(5)
Elective Course (DSEC)	6 (4)	6 (4)	-	6 (5)	18 (13)
Elective Course(NME)	-	-	5 (3)	-	5 (3)
Skill Enhancement Course/ Professional Competency Skill	-	-	2 (2)	6 (3)	8 (5)
Self Study Course	-	-	0 (1)	-	0 (1)
Total	**30 (22)**	**30 (22)**	**30 (23)**	**30 (23)**	**120 (90)**
Extra Credit Course(Optional) - Offered by the Department	-	-	0(2)	-	0(2)
Extra Credit Course(Optional) - MOOC	-	-	-	-	Limited to a maximum of 15 credits

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MASTER OF BIOCHEMISTRY

Programme Code - 7015

PROGRAMME CONTENT

M.Sc. Biochemistry -SEMESTER I

S.No.	Components	Title of the Course	Course Code	Hours Per Week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
1.	Core Course -1	Basics of Biochemistry	23PBCC11	6	5	3	25	75	100
2	Core Course -2	Biochemical and Molecular Biology Techniques	23PBCC12	6	5	3	25	75	100
3.	Core Course -3	Physiology and Cell Biology	23PBCC13	6	5	3	25	75	100
4.	Core Course Practical -1	Biomolecules and Biochemical Techniques Practical	23PBCC11P	6	3	6	40	60	100
5.	Discipline Specific Elective Course - 1	Microbiology and Immunology/ Biochemical and Environmental Toxicology/ Dairy Biochemistry	23PBCE11/ 23PBCE12/ 23PBCE13	6	4	3	25	75	100
Total				**30**	**22**				**500**

M.Sc. Biochemistry -SEMESTER II

S. No.	Components	Title of the Course	Course Code	Hours Per Week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
1.	Core Course -4	Enzymology	23PBCC21	6	5	3	25	75	100
2	Core Course -5	Cellular Metabolism	23PBCC22	6	5	3	25	75	100
3.	Core Course -6	Clinical Biochemistry	23PBCC23	6	5	3	25	75	100
4.	Core Course Practical -2	Enzymology, Microbiology and Cell Biology Practical	23PBCC21P	6	3	6	40	60	100
5.	Discipline Specific Elective Course - 2	1. Energy and Drug Metabolism/ 2. Plant Biochemistry/ 3. Bioinformatics and Nanotechnology	23PBCE21/ 23PBCE22/ 23PBCE23	6	4	3	25	75	100
Total				**30**	**22**				**500**

M.Sc. Biochemistry -SEMESTER III

S.No.	Components	Title of the Course	Course Code	Hours Per Week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
1	Core Course -7	Industrial Microbiology	23PBCC31	6	5	3	25	75	100
2	Core Course -8	Molecular Biology	23PBCC32	6	5	3	25	75	100
3	Core Course -9	Biostatistics and Data Science	23PBCC33	6	4	3	25	75	100
4	Core Course Practical -3	Clinical Biochemistry Practical	23PBCC31P	5	3	6	40	60	100
5	Skill Enhancement Course / Professional Competency Skill -1	Bioinformatics Practical	23PBCS31P	2	2	3	40	60	100
6	Non Major Elective Course -1	Molecular Basis of Diseases And Therapeutic Strategies	23PBCN31	5	3	3	25	75	100
7	Self Study Course	Practice for CSIR NET-General Paper-Online	23PGOL32	-	1	2	100	-	100
			Total	**30**	**23**				**700**
8	Extra Credit Course	Gene Editing, Cell and Gene therapy	23PBCO31	-	2	3	100	-	100

M.Sc. Biochemistry -SEMESTER IV

S. No.	Components	Title of the Course	Course Code	Hours Per Week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
1.	Core Course -10	Pharmaceutical Biochemistry	23PBCC41	6	5	3	25	75	100
2	Core Course -11	Developmental Biology	23PBCC42	6	5	3	25	75	100
3.	Core Course -12	Project	23PBCC41PR	6	5	-	40	60	100
4.	Discipline Specific Elective Course - 3	Biosafety, Lab Safety And IPR	23PBCE41	6	5	3	25	75	100
5.	Skill Enhancement Course/ Professional Competency Skill-2	Preparation for Competitive Examination -Life Sciences	23PBCS41	6	3	3	25	75	100
Total				**30**	**23**				**500**

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VIRUDHUNAGAR - 626 001

M.Sc. BIOCHEMISTRY

(2023 -2024 onwards)

Semester I	**BASICS OF BIOCHEMISTRY**	Hours/Week: 6	
Core Course-1		Credits: 5	
23PBCC11		Internal 25	External 75

COURSES OUTCOMES

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

CO1: Illustrate the chemical structure and explain the properties of biomolecules. [K2]

CO2: classification and general functions of biomolecules [K3]

CO3: Describe the biological role of biomolecules in biological system (K3)

CO4: Analyze the various levels of structural organization of proteins and nucleic acids .(K4)

CO5. Applying the knowledge of biomolecules in research and diagnosis (K4)

UNIT-I

Carbohydrates- Classification, structure (configurations and conformations, anomeric forms), function and properties of monosaccharides, mutarotation, Disaccharides and oligosaccharides with suitable examples . Polysaccharides - Homopolysaccharides (starch, glycogen, cellulose, inulin, dextrin, agar, pectin, dextran). Heteropolysaccharides - Glycosaminoglycans– source, structure, functions of hyaluronic acid, chondroitin sulphates, heparin, keratan sulphate,. Glycoproteins - proteoglycans. O- Linked and N-linked glycoproteins. Biological significance of glycan. Blood group polysaccharides. Bacterial cell wall (peptidoglycans, teichoic acid) and plant cell wall carbohydrates.

(18 hours)

UNIT-II

Lipids – Classification of lipids, structure, properties and functions of fatty acids, triacylglycerols, phospholipids, glycolipids, sphingolipids and steroids – Biological importance. Eicosanoids- classification, structure and functions of prostaglandins, thromboxanes,
leukotrienes. Lipoproteins – Classification, structure, transport (endogenous and exogenous Pathway) and their biological significance. **(18 hours)**

UNIT-III

Overview of Amino acids - classification, structure and properties of amino acids, Biological role. Non- Protein amino acids and their biological significance .Proteins – classification based on composition, structure and functions. Primary, secondary, super secondary (motifs) (Helix-turn –helix, helix-loop-helix, Beta-alpha-beta motif, Rosemann Rossmann fold, Greek key),tertiary and quaternary structure of proteins. Structural characteristics of collagen and hemoglobin- Determination of amino acid sequence. Chemical synthesis of a peptide, Forces involved in stabilization of protein structure, Ramachandran plot. Folding of proteins- Molecular chaperons – Hsp 70 and Hsp 90 - biological role.

(**18 hours)**

UNIT-IV

Membrane Proteins - Types and their significance. Cytoskeleton proteins - actin , tubulin , intermediate filaments . Biological role of cytoskeletal proteins. Membrane structure-fluid mosaic model. (**18 hours)**

UNIT-V

Nucleic acids – types and forms (A, B, C and Z) of DNA. Watson-Crick model-Primary, secondary and tertiary structures of DNA. Triple helix and quadruplex DNA. Mitochondrial and chloroplast DNA. DNA supercoiling (calculation of Writhe, linking and twist number). Determination of nucleic acid sequences by Maxam Gilbert and Sanger's methods. Forces stabilizing nucleic acid structure. Properties of DNA and RNA. C-value, C-value paradox,

Cot curve. Structure and role of nucleotides in cellular communications. Major and minor classes of RNA, their structure and biological functions . (**18 hours)**

TEXT BOOKS:

1. Satyanarayan,U (2014) Biochemistry (4th ed), ArunabhaSen Books & Allied (P) Ltd, Kolkata.
2. Voet.D & Voet. J.G (2010) Biochemistry , (4th ed), JohnWiley & Sons, Inc.

REFERENCE BOOKS:

1. David L.Nelson and Michael M.Cox (2012) LehningerPrinciples of Biochemistry (6th ed) W.H. Freeman.
2. Metzler D.E (2003). The chemical reactions of livingcells (2nd ed), Academic Press.
3. Zubay G.L (1999) Biochemistry , (4th ed), Mc Grew-Hill.
4. Lubert Stryer (2010) Biochemistry,(7th ed), W.H.Freeman

Course Code 23PBCC11	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO3 3.a	PSO3 3.b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	2	2	2	2	1	2	3	2	2	1
CO 2	2	2	2	3	2	3	2	3	2	1
CO 3	3	3	2	3	2	3	2	3	2	2
CO 4	2	2	2	3	1	2	2	2	1	1
CO 5	2	3	3	3	2	3	3	3	2	1

Strong (3) Medium (2) Low (1)

Dr.P.Annapoorani **Dr.R.Renuka**

Head of the Department **Course Designer**

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VIRUDHUNAGAR - 626 001

M.Sc. BIOCHEMISTRY

(2023-2024 onwards)

Semester: I	**BIOCHEMICAL AND MOLECULAR BIOLOGY TECHNIQUES**	Hours/Week: 6	
Core Course-2		Credits: 5	
Course Code **23PBCC12**		Internal 25	External 75

After completion of the course, the students should be able to:

CO1: Understand the Biophysical, Biochemical and Molecular Biological techniques. [K2]

CO2: Apply the knowledge on different types of Identification and separation techniques in biological investigations. [K3]

CO3: Determine the Biochemical and Biophysical characterization of macromolecules and their complexes for structural biology experiments. [K3]

CO4 : Analyze the practical and data handling skills required to undertake the Bio Technical research. [K4]

CO5: Examine the principles and techniques of Biochemistry that motivates the students for higher education and acquiring skills in separation techniques to identify different biomolecules in scientific research. [K4]

UNIT-I

General approaches to biochemical investigation, cell culture techniques and microscopic techniques. Organ and tissue slice technique, cell distribution and homogenization techniques, cell sorting, and cell counting, tissue Culture techniques. Cryopreservation, Biosensors- principle and applications. Principle, working and applications of light microscope, dark field, phase contrast and fluorescent microscope. Electron microscope- Principle, instrumentation of TEM and SEM, Specimen preparation and applications-shadow casting, negative staining and freeze fracturing.

(18 hours)

UNIT-II

Chromatographic Techniques:Basic principles of chromatography- adsorption and partition techniques. Chiral Chromatography and counter current Chromatography. Adsorption Chromatography – Hydroxy apatite chromatography and hydrophobic interaction Chromatography. Affinity chromatography.Gas liquid chromatography- principle, instrumentation, column development, detectors and applications. Low pressure column chromatography – principle, instrumentation, column packing, detection, quantitation and column efficiency, High pressure liquid chromatography- principle, instrumentation, delivery pump, sample injection unit, column packing, development, detection and application. Reverse HPLC, capillary electro chromatography and perfusion chromatography. (**18 hours)**

UNIT-III

Electrophoretic Techniques: General principles of electrophoresis, supporting medium, factors affecting electrophoresis, Isoelectric focusing-principle, ampholyte, development of pH gradient and application. PAGE-gel casting-horizontal, vertical, slab gels, sample application, detection-staining using CBB, silver, fluorescent stains. SDS PAGE-principle and application in molecular weight determination principle of disc gel electrophoresis ,2D PAGE. Electrophoresis of nucleic acids-agarose gel electrophoresis of DNA, pulsed field gel electrophoresis- principle, apparatus, application. Electrophoresis of RNA, curve. Microchip electrophoresis and 2D electrophoresis, Capillary electrophoresis. (**18 hours)**

UNIT-IV

Spectroscopic techniques: Basic laws of light absorption- principle, instrumentation and applications of UV-Visible, IR, ESR, NMR, Mass spectroscopy, Turbidimetry and Nephelometry. Luminometry (Luciferase system, chemiluminescence). X – ray diffraction. Atomic absorption spectroscopy – principle and applications – Determination of trace elements. (**18 hours)**

UNIT-V

Radiolabeling Techniques and Centrifugation: Nature of radioactivity-detection and measurement of radioactivity, methods based upon ionisation (GM counter) and excitation (scintillation

counter), autoradiography and applications of radioactive isotopes, Biological hazards of radiation and safety measures in handling radioactive isotopes.

Basic principles of Centrifugation. Preparative ultracentrifugation - Differential centrifugation, Density gradient centrifugation. Analytical ultracentrifugation - Molecular weight determination.

(18 hours)

Text Books:

1. Keith Wilson, John Walker (2010) Principles and T2echniques of Biochemistry and Molecular Biology (7th ed) Cambridge University Press.

Reference Books:

1. David Sheehan (2009), Physical Biochemistry: Principles and Applications (2nd ed), Wiley-Blackwell
2. David M. Freifelder (1982) Physical Biochemistry: Applications to Biochemistry and Molecular Biology,W.H.Freeman
3. Rodney F.Boyer (2012), Biochemistry Laboratory: Modern Theory and techniques,(2nd ed),Prentice Hall
4. Kaloch Rajan (2011), Analytical techniques in Biochemistry and Molecular Biology, Springer
5. Segel I.H (1976) Biochemical Calculations (2nd ed),John Wiley and Sons
6. Robyt JF (2015) Biochemical techniques: Theory and Practice (1st ed), CBS Publishers & Distributors.

Course Code 23PBCC12	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	PSO 1a	PSO 1b	PSO 2	PSO 3a	PSO 3b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	3	2	2	3	3	3	2	3	3	2
CO2	2	2	2	2	2	3	2	3	2	2
CO3	2	2	1	2	2	3	2	3	1	1
CO4	3	2	2	3	3	2	3	3	2	2
CO5	3	3	2	3	1	3	3	3	2	2

Strong (3) Medium (2) Low (1)

Dr.P.Annapoorani **Mrs.M.Rajakumari**

Head of the Department **Course Designer**

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M.Sc Biochemistry

(2023-2024 onwards)

Semester I	**PHYSIOLOGY AND CELL BIOLOGY**	Hours/Week: 6	
Core Course - 3		Credits: 5	
Course Code **23PBCC13**		Internal 25	External 75

COURSE OUTCOMES

On completion of the course the students will be able to

CO1. comprehend the biological and chemical processes within a human cell [K2]

CO2. identify and prevent diseases andexamining the problems from a different perspective. [K3]

CO3. identify general characteristics in individuals with imbalances of acid- base, fluid and electrolytes. [K3]

CO4. Analyse the defects in digestion, nutritional deficiencies and intolerances, and gastrointestinal pathologies [K4]

CO5. interpret the mechanism: the transmission of biochemical information between cell membrane and nucleus. [K4]

Unit I

Major classes of cell junctions- anchoring, tight and gap junctions. Major families of cell adhesion molecules (CAMs)- cadherins, integrins. Types of tissues. Epithelium- organisation and types. The basement membrane. Cell cycle- mitosis and meiosis, Cell cycle-phases and regulation. Cell death mechanisms- an overview-apoptosis, necrosis. **(18 Hours)**

Unit II

Reproductive system & Hormones- sexual differentiation and development; sperm transport, sperm capacitation, semen analyses and Acrosome reaction. Clinical relevance of female reproductive physiology- menstrual cycle, pregnancy and menopause. Fertilisation and infertility issues. Hormones – Classification, Biosynthesis, circulation in blood, modification and degradation. Mechanism of hormone action, Target cell concept. Hormones of Hypothalamus, pituitary, Pancreatic, thyroid & parathyroid, adrenal and gonadal hormones. Synthesis, secretion, physiological actions and feedback regulation of synthesis. (**18 hours)**

Unit III

Digestive system- structure and functions of different components of digestive system, digestion and absorption of carbohydrates, lipids and proteins, role of bile salts in digestion and absorption, mechanism of HCl formation in stomach, role of various enzymes and hormones involved in digestive system. Composition of blood, lymph and CSF. Blood cells - WBC, RBC and energy metabolism of RBC, Blood clotting mechanism and blood groups- ABO and Rhesus system. (**18 hours)**

Unit IV

Respiratory system-Gaseous transport and acid-base homeostasis. Mechanism of the movement of O2 and CO2 through lungs, arterial and venous circulation. Bohr effect, oxygen and carbon dioxide binding haemoglobin. pH maintenance by cellular and intracellular proteins. Phosphate and bicarbonate buffers, Metabolic acidosis and alkalosis. Respiratory acidosis and alkalosis. Regulation of fluid and electrolyte balance. (**18 hours)**

Unit V

Sensory transduction, Nerve impulse transmission- nerve cells, synapses, reflex arc structure, resting membrane potential, Nernst equation, action potential, voltage gated ion-channels, impulse transmission, neurotransmission, neurotransmitter receptors, synaptosomes, synaptotagmin, rod and cone cells in the retina, changes in the visual cycle, photochemical reaction and regulation of rhodopsin, odour receptors, learning and memory.

Chemistry of muscle contraction – actin and myosin filaments, theories involved in muscle contraction, mechanism of muscle contraction, energy sources for muscle contraction.

(**18 hours)**

TEXT BOOKS

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments (6th ed). John Wiley & Sons. Inc.
2. Bruce Alberts and Dennis Bray (2013),Essential Cell Biology,(4th ed),Garland Science.
3. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. (5th ed). Sunderland, Mass. Sinauer Associates, Inc.
4. Wayne M. Baker (2008) the World of the Cell. (7th ed). Pearson Benjamin Cummings Publishing, San Francisco. Cell Biology
5. John E. Hall (2010). Guyton and Hall Textbook of Medical Physiology (12th ed), Saunders
6. Harrison's Endocrinology by J. Larry Jameson Series: Harrison's Specialty, 19th Edition Publisher: McGraw-Hill, Year: 2016.

REFERENCE BOOKS

1. Ronald Voet & Judith G.Voet (2006), *Biochemistry*, 2nd Edition, John Wiley & Sons, U.S.A.
2. Benjamin Lewin (2004), *Genes* VIII, Oxford University Press, New York.
3. S.C.Rastogi (1986), *Cell and Molecular biology*, 3rd edition, New Age International Pvt Ltd, NewDelhi.
4. Becker, Kleinsmith, Hardin (2002). *The world of the cell*, 4th Edition, Benjamin Cummings.

Course Code 23PBCC13	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	PSO 1a	PSO 1b	PSO 2	PSO 3a	PSO 3b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	2	2	2	1	1	2	3	2	2	2
CO 2	2	1	3	2	2	2	2	2	2	2
CO 3	3	1	3	2	2	2	2	2	2	2
CO 4	3	1	3	3	3	2	2	2	1	1
CO 5	1	3	1	1	1	2	2	2	2	1

Strong (3) Medium (2) Low (1)

Dr.P.Annapoorani
Head of the Department

Dr. R.Gloria Jemmi Christobel
Course Designer

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M.Sc Biochemistry

(2023-2024 onwards)

Semester I	**BIOMOLECULES AND BIOCHEMICAL TECHNIQUES PRACTICAL**	Hours/Week: 6	
Core Course Practical- 1		Credits: 3	
Course Code **23PBCC11P**		Internal 40	External 60

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

CO1: understand the techniques used in the isolation, purification and estimation of different biomolecules that are widely employed in research (K2)

CO2**:** explain the Principle, Instrumentation and method of estimating the biomolecules and chromatographic techniques (K2).

CO3: sketch the flowchart for the estimation of various biomolecules (K3)

CO4. observe and calculate the results for the estimation and chromatographic separation of various macro and biomolecules and complete the record work. (K3)

CO5. analyze the outcomes of the sample analysis using biochemical techniques (K4)

Unit I

Biochemical studies and estimation of macromolecules

1. Isolation and estimation of glycogen from liver.
2. Isolation and estimation of DNA from animal tissue.
3. Isolation and estimation of RNA from yeast.
4. Purification of Polysaccharides –Starch and assessment of its purity

Unit II

UV absorption

1. Denaturation of DNA and absorption studies at 260nm.
2. Denaturation of Protein and absorption studies at 280nm.

Unit III

Colorimetric estimations

1. Estimation of Pyruvate
2. Estimation of tryptophan.

Unit IV

Estimation of minerals

1. Estimation of calcium
2. Estimation of iron

Unit V

Plant Biochemistry

1. Qualitative analysis Phytochemical screening
2. Estimation of Flavonoids -Quantitative analysis

Group Experiments

1. Fractionation of sub-cellular organelles by differential centrifugation-Mitochondria and nucleus
2. Identification of the separated sub-cellular fractions using marker enzymes (any one)
3. Separation of identification of lipids by thin layer chromatography.
4. Separation of plant pigments from leaves by column chromatography
5. Identification of Sugars by Paper Chromatography
6. Identification of Amino acids by Paper Chromatography

Text Books

1. David Plummer (2001) An Introduction to Practical Biochemistry (3rd ed) McGraw Hill Education (India) Private Ltd
2. Jayaraman, J (2011),laboratory Manual in Biochemistry, New age publishers
3. Varley H (2006) Practical Clinical Biochemistry (6th ed) , CBS Publishers
4. O. Debiyi and F. A. Sofowora, (1978)"Phytochemical screening of medical plants," Iloyidia, vol. 3, pp. 234–246,
5. Prof. Sarin A. Chavhan, Prof. Sushilkumar A. Shinde (2019) A Guide to Chromatography Techniques Edition:1
6. Analytical techniques in Biochemistry and Molecular Biology; Katoch, Rajan. Springer (2011)

Course Code 23PBCC11P	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	PSO 1a	PSO 1b	PSO 2	PSO 3a	PSO 3b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	3	3	2	3	3	3	2	1	2	2
CO 2	3	3	2	2	2	3	2	1	2	2
CO 3	3	3	2	3	3	3	2	1	2	2
CO 4	3	3	2	3	3	3	2	1	2	2
CO 5	3	3	2	3	3	3	2	1	2	2

Strong (3) Medium (2) Low (1)

Dr.P.Annapoorani
Head of the Department

Dr.R.Salini
Course Designer

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M.Sc BIOCHEMISTRY

(2023-2024 onwards)

Semester: I	**MICROBIOLOGY & IMMUNOLOGY**	Hours/Week: 6	
DSEC-1		Credits: 4	
Course Code **23PBCE11**		Internal 25	External 75

COURSE OUTCOMES

After completion of the course, the students should be able to:

CO1: Illustrate the different types of microorganisms and explain their life cycle along with beneficial, harmful and immunological effects in humans (K2)

CO2: Apply the microbial classification system to identify the microorganisms involved in food microbiology, antibiotic resistance and illness of living beings. (K3)

CO3: Select the types of culture media, food preservation approaches, microbial screening methods, immune cells and immunological reactions, mode of action of antimicrobials in various fields of microbiology. (K3)

CO4: analyze the variety of antimicrobial agents along with their mode of action, classification of microbes, food spoilage, immune system and organs of the immune system . (K4)

CO5: Infer the life cycle of microbes, culture media, methods of food preservation and antigen antibody interaction. (K4)

UNIT-I

Taxonomical classification - bacteria, viruses (DNA, RNA), algae, fungi and protozoa. Distribution and role of microorganisms in soil, water and air. Charaka's classification of microbes, lytic cycle and lysogeny. Types of culture media, isolation of pure culture, growth curve and the measurement of microbial growth. **(18 hours)**

UNIT-II

Contamination and spoilage of foods – cereals, cereal products, fruits, vegetables, meat, fish, poultry, eggs, milk and milk products. General principles of traditional and modern methods of food preservation - Removal or inactivation of microorganisms, boiling, steaming, curing, pasteurization, cold processing, freeze drying, irradiation, vacuum packing, control of oxygen and enzymes. Microbes involved in preparation of fermented foods - cheese, yoghurt, curd, pickles, rice pan cake, appam, ragi porridge (கேழ்வரகு கூழ்) and bread **(18 hours)**

UNIT-III

Food poisoning- bacterial food poisoning, *Salmonella*, *Clostridium blotulinum* (botulism), *Staphylococcus aureus*, fungal food poisoning – aflatoxin, food infection – *Clostridium*, *Staphylococcus* and *Salmonella*. Pathogenic microorganisms, *E. coli, Pseudomonas, Klebsilla, Streptococcus, Haemophilus, & Mycobacterium*, causes, control, prevention, cure and safety. Food microbiological screening- Real time PCR, ELISA, Aerobic and anaerobic Plate Count, dye reduction method, anaerobic lactic acid bacteria, anaerobic sporeformers, Hazard analysis critical control point (HACCP) **(18 hours)**

UNIT-IV

Antimicrobial chemotherapy, General characteristics of antimicrobial agents. Mechanism of action – sulfonamides, sulphones and PAS. Penicillin, streptomycin- spectra of activity, mode of administration, mode of action, adverse effects and sensitivity test., Antiviral and antiretroviral agents, Antiviral RNA interference, natural intervention (Natural immunomodulators routinely used in Indian medical philosophy). **(18 hours)**

UNIT-V

Immune system- definition and properties. Cells of the immune system – neutrophils, eosinophils, basophils, mast cells, monocytes, macrophages, dendritic cells, natural killer cells, and lymphocytes (B cells and T cells). Lymphoid organs- Primary and Secondary; structure and functions. Antigens and Complement System: definition, properties- antigenicity and immunogenicity, antigenic determinants and haptens. Antigen - antibody interactions - molecular mechanism of binding. Affinity, avidity, valency, cross reactivity and multivalent binding. Immunoglobulins & Immune Response: Structure, classes and distribution of antibodies.

Antibody diversity. Immune system in health & disease, Transplantation immunology- graft rejection and HLA antigens. Immunological techniques, Flow cytometry and its application

(18 hours)

Text Books

1. Michael J.Pelczar Jr.(2001) Microbiology (5th ed), McGraw Hill Education (India) Private Limited
2. Frazier WC , Westhoff DC, Vanitha NM (2010) Food Microbiology (5th ed), McGraw Hill Education (India) Private Limited
3. Willey J and Sherwood L (2011) ,Prescott's Microbiology (8th ed) McGraw Hill Education (India)

Reference Books

1. Ananthanarayanan , Paniker and Arti Kapil (2013) Textbook of Microbiology (9th ed) Orient BlackSwan
2. Judy Owen , Jenni Punt Kuby (2013) ,Immunology (Kindt, Kuby Immunology) (7th ed) W. H. Freeman & Co
3. Brooks GF and Carroll KC (2013) Jawetz Melnick & Adelbergs Medical Microbiology,(26th ed) McGraw Hill Education
4. Greenwood D (2012), Medical Microbiology, Elsevier Health

Course Code 23PBCE11	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	PSO 1a	PSO 1b	PSO 2	PSO 3a	PSO 3b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	3	2	3	3	3	2	3	1	1	2
CO2	3	2	3	2	2	3	3	2	1	2
CO3	3	2	3	2	2	3	3	1	1	2
CO4	3	2	3	3	3	2	3	2	1	2
CO5	3	2	3	3	3	2	3	2	1	2

Strong (3) Medium (2) Low (1)

Dr.P.Annapoorani
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Dr.R.Salini
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V.V.VANNIAPERUMAL COLLEGE FOR WOMEN
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VIRUDHUNAGAR - 626 001

M.Sc. BIOCHEMISTRY

(2023 -2024 onwards)

Semester I	**BIOCHEMICAL AND ENVIRONMENTAL TOXICOLOGY**	Hours/Week: 6	
DSEC-1		Credits: 4	
Course Code **23PBCE12**		Internal 25	External 75

COURSE OUTCOMES

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

CO1: describe the terms and basic principles of toxicology, mechanism of toxic effects of toxicants and factors affecting disposition of toxicants. [K2]

CO2: identify health conditions linked to selected toxic exposures from food, lifestyle, environment, workplace and home. [K3]

CO3: apply pharmacokinetic and pharmacodynamic principles that impact administration, ADME, efficacy, potency, effectiveness and biological activity of drugs and toxins. [K3]

CO4: analyze the types of toxicology, toxicants, metals and its disposition, responses in target organ, non-organ directed toxicity. [K4]

CO5: examine the techniques and methods of toxicity and fate of toxicants in humans. [K4]

UNIT I

General principles of Toxicology -Definition, Toxicologic terms and definitions- Toxin, Toxicant, Toxicity, Hazard, Risk, Acute exposure, Chronic exposure, Synergism, Additive effect, Potentiation effect, Antagonism. classification of toxicology, Classification of toxic agents. Desired and undesired effects. Dose response relationship, Measurement of Dose-Response. Principles of selective toxicity: cooperative morphology, comparative biochemistry, comparative cytology. Factors affecting disposition of toxicants- absorption, distribution, biotransformation, elimination. Toxication vs. Detoxication, Antidotal therapy. **(18 Hours)**

UNIT II

Toxicity assessment: acute, subchronic, chronic exposure, determination of ED50 and LD50 values. Toxicity testing: Test protocol, Genetic toxicity testing & Mutagenesis assay-In vitro test systems: bacterial mutation tests-Reversion test, Ames test, Fluctuation test, and Eukaryotic mutation test. In vivo test system Mammalian mutation test-Host mediated assay and Dominant Lethal test. Mechanism of toxicity: Disturbance of excitable membrane function, Altered Calcium homeostasis, Covalent binding to cellular macromolecules. **(18 Hours)**

UNIT III

Non- organ directed toxicity: Chemical carcinogenesis: definition, mechanisms. Genetic toxicology: definition, health impacts and mechanism. New approaches for genetic toxicology, advances in cytogenetics. **(18 Hours)**

UNIT IV

Target organ toxicity: Skin: skin as a barrier, dermatitis, acne, urticaria. Toxic responses of the blood: blood as a target organ, toxicology of erythron, leucon and platelets. Toxic responses of the liver: physiology and pathophysiology, factors in liver injury, mechanism of liver injury. Toxic responses of the respiratory systems: lungs structure and functions, pulmonotoxic agents, pathogenesis of chemical induced damage, acute and chronic responses of lungs to injury.

(18 Hours)

UNIT V

Applications of Toxicology: Food toxicology: Role of diet in cardiovascular diseases and cancer. Metal toxicity: Toxicology of arsenic, mercury, lead, and cadmium. Environmental factors affecting metal toxicity – effect of light, temperature and pH. Occupational toxicology, Industrial effluent toxicology & environmental health. Forensic toxicology. Effects of toxicology on individual and entire population. **(18 Hours)**

TEXT BOOKS

1. Casarette, Doull and Klaassen (1992), *Toxicology*,8th edition**,** McGraw-Hill,New York.
2. Ernest Hodgson (2004) *A Textbook Of Modern Toxicology*.3rd edition, A John Wiley & sons, inc., Publication, USA.

REFERENCE BOOKS

1. Marrs and Turner (1995), *General and applied toxicology*, Macmillan Press Ltd.
2. Williams RT (1947), *Detoxification mechanisms*, J.Wiley & Sons, New York.
3. Albert A.(1979), *Selective Toxicity* ,Springer Link.

Course code (23PBCE12)	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
	1a	**1b**	**2**	**3a**	**3b**	**4**	**5**	**6**	**7**	**8**
CO 1	3	3	3	2	2	2	2	2	1	2
CO 2	3	2	3	3	2	2	3	2	2	2
CO 3	3	3	2	3	2	3	3	2	3	3
CO 4	3	3	3	3	2	2	3	2	2	3
CO 5	3	3	3	3	2	2	3	2	2	3

Strong (3) Medium (2) Low (1)

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M.Sc. BIOCHEMISTRY

(2023 -2024 onwards)

Semester I	**DAIRY BIOCHEMISTRY**	Hours/Week: 6	
DSEC-1		Credits: 4	
Course Code **23PBCE13**		Internal 25	External 75

COURSE OUTCOMES

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

CO1: understand the composition and physicochemical characteristics of the main components of milk. [K2]

CO2: apply the knowledge of chemistry of dairy components and find the impacts of processing conditions on milk and dairy products. [K3]

CO3: identify the dairy products manufacturing and key functions of the processing steps involved. [K3]

CO4: analyze the food adulteration and contamination of food, food laws and standards. [K4]

CO5: examine the basic concepts of dairy needs, method of production, and refrigeration. [K4]

UNIT-I

Composition of Milk, Food and Nutritive Value of Milk, Classification, Colostrums and its properties and difference from normal milk, Correlations amongst Compositional parameters, Legal standards of milk, Chemical test **.** **(18 Hours)**

UNIT –II

Reception & Treatment of Milk at the Dairy Plant: Reception, Chilling, Clarification and Storage Coagulation and heat stabilizing milk. **(18 Hours)**

UNIT-III

Homogenization – Definition, Effect of Homogenization on Physical properties of Milk. Elementary knowledge about indigenous and modern dairy products. **(18 Hours)**

UNIT –IV

Thermal Processing of Milk; Definition & Description of Processes – Pasteurization, Thermization, Sterilization and UHT Processing. Collection and Transportation of Milk, Preservation at Farm, Refrigeration. **(18 Hours)**

UNIT-V

Adulteration in milk & their detection, Defects in Market Milk, Standardized Milk, Manufacturing of Special Milk – Toned, Doubled Toned, Reconstituted, Recombined, Flavored Milk **(18 Hours)**

TEXT BOOKS

1. Dubey R.C, (2000). Text book on Microbiology,1st edition. S.Chand & Co., New Delhi.
2.John Wiley and sons , Dairy Chemistry and Physics. New York,

REFERENCE BOOKS

1. S.K.DEY, *Outlines of Dairy Technology*, Oxford IBH Pub. NDRI Market milk.
2. Pelczar, M.J., Chan,E.C.S and Kreig,N.R (1993).*Microbiology*,5th Edition, Tata Publishing Co., Ltd., New Delhi.

Course Code 23PBCE13	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	1a	1b	2	3a	3b	4	5	6	7	8
CO 1	3	3	3	3	3	3	3	3	3	3
CO 2	3	3	2	3	3	2	3	2	3	3
CO 3	3	3	3	2	2	3	2	3	3	2
CO 4	3	3	2	3	3	2	3	2	2	3
CO 5	3	3	3	3	3	3	3	3	3	3

Strong (3) Medium (2) Low (1)

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M.Sc. Biochemistry

(2023-2024 onwards)

Semester II	**ENZYMOLOGY**	Hours/Week: 6	
Core Course - 4		Credits: 5	
Course Code **23PBCC21**		Internal 25	External 75

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

CO1: Describe the classification, kinetics, catalytic mechanisms and techniques involved in enzymology (K2)

CO2: apply the appropriate methods for the isolation, purification, immobilization and the study of enzymes (K3)

CO3: sketch the enzyme classification, kinetics, catalysis and technology in enzymology (K3)

CO4: Analyze the enzyme classification and nomenclature, catalysis, kinetics and technology. (K4)

CO5: Compare the kinetics, methods of inhibition, isolation, purification and identification techniques of enzymes (K4)

Unit I

Introduction to enzymes and features of catalysis: A short history of the discovery of enzymes and how they became powerful biochemical tools. Holoenzyme, apoenzyme, cofactors, coenzyme, prosthetic groups, Classification and Nomenclature, Specificity of enzyme action-group specificity, absolute specificity, substrate specificity, stereochemical specificity. Active site, Identification of amino acids at the active site-trapping of ES complex, identification using chemical modification of amino acid side chains and by site-directed mutagenesis.

Mechanisms of enzyme catalysis: acid-base catalysis, covalent catalysis, electrostatic catalysis, metal ion catalysis, proximity and orientation effects, Low barrier H-bonds, Structural flexibility Mechanism of action of chymotrypsin **(18 Hours)**

Unit II

Enzyme techniques: Isolation and purification of enzymes - Importance of enzyme purification, methods of purification- choice of source , extraction, fractionation methods- based on size or mass (centrifugation, gel filtration); based on polarity (ion-exchange chromatography, electrophoresis, isoelectric focusing, hydrophobic interaction chromatography); based on solubility (change in pH, change in ionic strength); based on specific binding sites (affinity chromatography) ,choice of methods, Criteria of purity of enzymes. Enzyme units - Katal, IU. Measurement of enzyme activity - discontinuous, continuous, coupled assays; stopped flow method and its applications. Isoenzymes and their separation by electrophoresis with special reference to LDH **(18 Hours)**

Unit III

Enzyme kinetics I: Thermodynamics of enzyme action, Activation energy, transition-state theory, steady-state kinetics & pre-steady-state kinetics.Single substrate enzyme catalyzed reactions -assumptions, Michaelis-Menten and Briggs-Haldane kinetics, derivation of Michaelis-Menten equation . Double reciprocal (Lineweaver-Burk) and single reciprocal (Eadie -Hofstee) linear plots, their advantages and limitations. Analysis of kinetic data- determination of Km, Vmax, kcat, and their physiological significance, Importance of kcat/Km. Enzyme inhibition: Irreversible inhibition. Reversible inhibition-Competitive, uncompetitive ,noncompetitive, mixed and substrate inhibition. Michaelis -Menten equation in the presence of competitive, uncompetitive and non-competitive inhibitors. Graphical analysis - Diagnostic plots for the determination of inhibition type. Therapeutic use of enzyme inhibitors-Aspirin, statins (irreversible inhibitors), Methotrexate (competitive inhibitor), Etoposide (non-competitive inhibitor), camptothecin (uncompetitive inhibitor).

Demonstration :Using Microsoft Excel to Plot and Analyze Kinetic Data **(18 Hours)**

Unit IV

Enzyme kinetics II: Allosteric enzymes: Cooperativity, MWC and KNF models of allosteric enzymes, Sigmoidal kinetics taking ATCase as an example. Regulation of amount and catalytic activity by - extracellular signal, transcription, stability of mRNA, rate of translation and degradation, compartmentation, pH, temperature, substrate concentration, allosteric effectors, covalent modification. Regulation of glycogen synthase and glycogen phosphorylase. Feedback inhibition-sequential, concerted, cumulative, enzyme-multiplicity with examples.

Bi - Substrate reactions: Single Displacement reactions (SDR) (Ordered and Random bi bi mechanisms), Double Displacement reactions (DDR) (Ping pong mechanism), Examples, Cleland's representation of bisubstrate reactions, Graphical analysis (diagnostic plots) to differentiate SDR from DDR**.** **(18 Hours)**

Unit V

Enzyme technology: Immobilization of enzymes – methods - Reversible immobilization (Adsorption, Affinity binding), Irreversible immobilization (Covalent coupling, Entrapment and Microencapsulation, Crosslinking, Advantages and Disadvantages of each method, Properties of immobilized enzymes,. Designer enzymes- ribozymes and deoxyribozymes, abzymes, synzymes. Enzymes as therapeutic agents-therapeutic use of asparaginase and streptokinase. Application of enzymes in industry- Industrial application of rennin, lipases, lactases, invertase, pectinases, papain. **(18 Hours)**

Text Books

1. Enzymes: Biochemistry, Biotechnology and Clinical chemistry, 2nd edition, 2007, Palmer T and Bonner P; Affiliated- East West press private Ltd, New Delhi
2. Fundamentals of Enzymology, 3rd edition, 2003, Price NC and Stevens L; Oxford University Press, New York

Reference Books

1. Voet's Biochemistry, Adapted ed, 2011,Voet,D and Voet JG; Wiley, India
2. Lehninger Principles of Biochemistry, 8th edition, 2021, .Nelson DL and Cox MM; WH Freeman & Co, New York
3. Biochemistry, Berg JM, Stryer L, Gatto,G, 8th ed, 2015;WH Freeman & Co., New York.
4. Enzyme Kinetics and Mechanism; Cook PF, Cleland W, ;2007; Garland Science, London

Course Code **23PBCC21**	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1a	**PSO 1b**	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO1	3	3	1	2	2	1	3	1	1	1
CO2	3	3	1	2	2	1	3	1	1	1
CO3	3	2	1	2	2	1	3	1	1	1
CO4	3	3	2	2	2	1	3	2	1	1
CO5	3	3	2	2	2	1	2	2	2	1

Strong (3) Medium (2) Low (1)

Dr.P.Annapoorani
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Dr,R.Salini
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M.Sc. Biochemistry

(2023-2024 onwards)

Semester II	**CELLULAR METABOLISM**	Hours/Week: 6	
Core Course - 5		Credits: 5	
Course Code **23PBCC22**		Internal 25	External 75

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

After completion of the course, the students should be able to:

CO1. Appreciate the modes of synthesis and degradation of glucose , lipids, proteins , nucleic acids and will be able to justify the pros and cons of maintaining their normal levels [K2]

CO2. find the integrated approach of anabolic and catabolic pathways of various biomolecules [K3]

CO3. apply the crucial role of enzymes with regard to the integration of metabolic Pathways. [K3]

CO4. analyze the role of key enzymes that regulate various metabolicPathways. [K4]

CO5.Correlate the disturbance of metabolic reactions to clinical manifestations [K4]

Unit I

Glycolysis – aerobic and anaerobic, inhibitors, and regulation. Feeder pathway- entry of hexoses into glycolysis, Galactosemia, fructosuria, Pyruvate dehydrogenase complex- mechanism and regulation. Glyoxalate cycle and its regulation. Gluconeogenesis- source, key enzymes, reaction sequence and its regulation. Blood glucose homeostasis and the role of hormones. Pentose phosphate pathway- significance and its regulation. Metabolism of glycogen and its regulation. Biosynthesis of N-linked and O-linked glycoproteins, mucopolysaccharides, Chondroitin sulphate. **(18 Hours)**

Unit II

Oxidation of fatty acids-oxidation of saturated and unsaturated fatty acids (α, β & ω oxidation) Oxidation of fatty acids with odd and even numbered carbon atoms. Regulation of β oxidation. Ketogenesis and its regulation. Biosynthesis of fatty acid–saturated and unsaturated, chain elongation, regulation. Biosynthesis of prostaglandins, thromboxanes and leukotrienes and hydroxyl eicosanoic acids. Biosynthesis and degradation of triacylglycerol, phosphoglycero lipids-lecithin, cephalin, plasmalogens and phosphatidyl inositol, Sphingolipid-sphingomyelin, cerebrosides, sulfatides, and gangliosides. Cholesterol biosynthesis and its regulation. Lipoprotein metabolism-chylomicrons, VLDL, HDL and LDL. **(18 Hours)**

Unit III

Metabolism of nucleotides- *De novo* synthesis and salvage pathways of purine and pyrimidine nucleotides. Regulation and inhibitors of nucleotide biosynthesis. Role of ribonucleotide reductase and its regulation. Degradation of purine and pyrimidine nucleotides

(18 Hours)

Unit IV

Biosynthesis of non- essential amino acids.- Role and biological significance of glutamate dehydrogenase, glutamine and asparagine synthetase, lysine, proline and phenylalanine hydroxylase. Interconversion of amino acids - proline to glutamate, methionine to cysteine, serine to glycine. Biosynthesis of spermine and spermidine. Degradation of amino acids – glucogenic and ketogenic amino acids. Formation of acetate from leucine and aromatic amino acid, pyruvate from cysteine, threonine and hydroxy proline, α-keto glutarate from histidine and proline, succinate from methionine, threonine, valine and isoleucine, Oxaloacetate from aspartate, glycine and serine. **(18 Hours)**

Unit V

Biosynthesis and degradation of heme. Jaundice-classification, pathology and Differential diagnosis Oxidation and reduction of inorganic sulphur compounds by microbes and plants. Sulpho transferases and their biological role-rhodanases, sulphatases , 3-mercapto pyruvate sulphur transferases. Mucopolysaccharidoses - Hunter syndrome, Sanfilippo syndrome and

Maroteaux-Lamy syndrome. Oxidation of cysteine to sulphate and inter conversion of sulphur compounds**.** **(18 Hours)**

Books Recommended

1. David L.Nelson and Michael M.Cox (2012) Lehninger Principles of Biochemistry (6th ed), W.H.Freeman
2. Voet.D and Voet. J.G (2010) Biochemistry , (4th ed), John Wiley & Sons, Inc.
3. Metzler D.E (2003). The chemical reactions of living cells (2nd ed), Academic Press.
4. Zubay G.L (1999) Biochemistry , (4th ed), Mc Grew-Hill.
5. Textbook of Biochemistry with Clinical Correlations, 7th Edition,Thomas M. Devlin (Editor), Wiley
6. Human Biochemistry – James M.Orten & Otto.W.Neuhan- 10th edn- The C.V.Mosby Company

Course Code 23PBCC22	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	PSO 1a	PSO 1b	PSO 2	PSO 3a	PSO 3b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	3	3	3	3	2	2	2	2	2	2
CO 2	3	2	3	2	2	2	2	2	2	2
CO 3	3	3	3	3	2	2	2	2	2	2
CO 4	3	2	2	3	2	2	2	1	2	1
CO 5	3	3	3	3	2	2	2	2	2	2

Strong (3) Medium (2) Low (1)

Dr.P.Annapoorani
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M.Sc. Biochemistry

(2023-2024 onwards)

Semester II	**CLINICAL BIOCHEMISTRY**	Hours/Week: 6	
Core Course -6		Credits: 5	
Course Code **23PBCC23**		Internal 25	External 75

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

CO1. explain the biological significance of sample collection and awareness of the diagnostic/screening tests to detect common non- communicable diseases so as to understand role of laboratory investigations for biochemical parameters and understand the disorders associated with blood cells. [K2]

CO2. describe the etiology of metabolic diseases like diabetes and atherosclerosis and avoid such lifestyle disorders by healthy eating and correlate the symptoms with underlying pathology based on diagnostic and prognostic markers. [K3]

CO3. identify the diagnostic application of serum/plasma enzymes to correlate their levels with the organ pathologies associated with specific diseases. [K3]

CO4. analyse the role of pre and post-natal diagnosis leading to healthy progeny. [K4]

CO5. evaluate the serum hormone levels and clinical symptoms with underlying hormonal disturbances and review the onward transmission of signal by different pathways by comparing and contrasting them and critically evaluate the network between them resulting in the biological outcome. [K4]

Unit I

Biochemical investigations in diagnosis, prognosis, monitoring, screening: Specimen collection – blood, (primary /Secondary specimen)., urine and CSF. Preservation of biological specimens -blood, urine, CSF and amniotic fluid. ; . Biological reference ranges;

Disorders of blood cells: Hemolytic, iron deficiency and aplasticanemia and diagnosis, sickle cell anaemia, thalassemia HBA1C variants. Porphyrias, Thrombocytopenia, Causes of leucopenia, leukemia and leucocytosis. Disorders of blood clotting mechanism - Von willebrand's disease, Hemophilia A, B and C, diagnostic test for clotting disorders,
D-dimer and its clinical significance **(18 Hours)**

Unit II

Diabetes mellitus: pathology and complications: Acute changes; Chronic complications: Diabetic nephropathy, neuropathy, retinopathy and Diabetic foot ulcers, Random/Fasting/PP glucose testing, Impaired glucose tolerance (IGT), Impaired fasting glucose (IFT), Diagnosis-by GTT, Pre-diabetes, Gestational DM ,Glycosylated Haemoglobin (HBA1c) ; Glycated albumin., Hypoglycaemia and critical alert value for glucose. Markers of complications of Diabetes mellitus: Metabolic syndrome, Lipid profile &lipoproteinemia, Atherosclerosis, Diabetic nephropathy, Micralbuminuira, eGFR.

Point of care testing for glucose (Glucometers) and continuous glucose monitoring (CGM): principle and its use. Major groups of anti-diabetic drugs. Diet and life style modifications **(18 Hours)**

Unit III

Diagnostic Enzymology: Clinically Important Enzymes and Isoezyme as diagnostic markers: Clinical significance of AST, ALT, ALP, ACP, CK, γ-GT, amylase, pseudocholinesterase and their pattern in .Myocardial infarction; Liver disease, Bone disease, Muscle disease, Cancer (tumor markers), GI tract pancreatitis); Enzymes as therapeutic agents.
Pre- and post-natal testing: Amniocentesis, prenatal detection of inborn errors of metabolism in developing fetus- Autosomal recessive mode of inheritance- cystic fibrosis, X linked recessive inheritance-Duchenne muscular dystrophy. New born screening (NBS) for In born errors of metabolism, Tandem mass spectrometry application in NBS**.** **(18 Hours)**

Unit IV

Liver function tests: Liver function test panel, Fatty liver . Plasma protein changes in liver diseases. Hepatitis A, B and C. Cirrhosis and fibrosis. Portal hypertension and hepatic coma. Acute phase proteins -CRP, Haptoglobins, α-fetoprotein, ferritin and transferrin and their clinical significance, Interpreting serum protein electrophoresis. Inflammatory markers (cytokines such as TNF-alpha IL6 and others. **(18 Hours)**

Unit V

Renal function tests - tests for glomerular and tubular function-Acute and chronic renal failure-Glomerulonephritis, Nephrotic syndrome, uraemia-urinary calculi-Nephrocalcinosis and Nephrolithiasis-causes, pathology and symptoms. Chronic kidney disease. Dialysis-Hemodialysis and peritoneal dialysis.

Electrolyte disorder**:** calcium: hypercalcemia and hypocalcemia; Calcium homoestasis in Blood; phosphate: hyperphosphatemia or hypophosphatemia; Clinical significance: Potassium: hyperkalaemia and hypokalaemia, Sodium: hypernatremia and hyponatremia; Chloride: hyperchloremia, hyporchloremia

Hormonal disorders and diagnostics: T3, T4 and TSH in the diagnosis of thyroid disorders; Diagnostic methods for disorders associated with adrenal, pituitary and sex hormones - Addison's disease, Cushing's syndrome, pituitary tumour, Hypopituitarism, Hypogonadism

(18 Hours)

Text Books

1. ThomasM.Devlin (2014) Textbook of Biochemistry with Clinical Correlations (7th ed). John Wiley & Sons
2. Montgomery R, Conway TW, Spector AA (1996),Biochemistry: A Case-Oriented Approach (6th ed), Mosby Publishers, USA.
3. Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics (2018) (8th ed),Saunders
4. Dinesh Puri, (2020) Text book of Biochemistry: A clinically oriented approach – 4th Edition, Elsevier.
5. M.N.Chatterjee and Rana Shinde (2012).Textbook of Medical Biochemistry (8th ed), Jaypee Brothers Medical Publishers.

6. Clinical Case Discussion In Biochemistry A Book On Early Clinical Exposure (ECE), Poonam Agrawal, 2021, CBS Publishers & distributors pvt. Ltd

Course Code 23PBCC23	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1a	**PSO 1b**	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO 1	2	2	2	3	1	2	3	2	1	1
CO 2	2	2	1	3	2	2	2	2	1	1
CO 3	3	2	1	3	2	2	2	2	1	1
CO 4	3	3	1	2	3	2	2	1	1	1
CO 5	3	3	3	2	1	2	2	2	1	1

Strong (3) Medium (2) Low (1)

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M.Sc. Biochemistry

(2023-2024 onwards)

Semester II	**ENZYMOLOGY, MICROBIOLOGY AND CELL BIOLOGY PRACTICAL**	Hours/Week: 6	
Core Course Practical -2		Credits: 3	
Course Code **23PBCC21P**		Internal 40	External 60

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

CO1. describe the relevant techniques for the isolation and purification of enzymes and gain skill in kinetic studies which is essential for research activity (K2)

CO2. explain the methods for the isolation and staining of bacteria, blood smear preparation and separation of proteins and nucleic acids. (K2)

CO3. apply the basic concepts in microbiology and cell biology which will be helpful for interdisciplinary research work and mankind. (K3)

CO4. sketch the separation techniques used in molecular Biology and enzymology. (K3)

CO5. Illustrate about the methods involved in the isolation and purification of enzymes and industrial standard and current work practices (K4)

Unit-I:

Enzymology

Alkaline Phosphatase

a. Isolation of Alkaline Phosphatase from goat kidney.
b. Purification of alkaline phosphatase
c. Checking the purity using SDS-PAGE
d. Determination of optimum pH and temperature of alkaline phosphatase.
e. Determination of specific activity and Km of alkaline phosphatase.
f. Effect of activators and inhibitors on the activity of alkaline phosphatase.

Assay of enzymes

a. Salivary Amylase
b. Acid Phosphatase

Unit-II:

Microbiology

a. Safety measures and Good Laboratory Practices in microbiology laboratory

b. Sterilization,Culture and inoculum preparation

c. Staining of bacteria – Gram Staining

Unit-III:

Physiology & Cell Biology

a. Test for blood grouping (Haemagglutination).

b. Peripheral Blood smear –Staining and Interpretation

Unit-IV:

Group Experiments

a. Separation of proteins based on molecular weight by SDS PAGE

b. Agarose gel electrophoresis of genomic DNA

Unit-V:

Industrial visit can be organized to students through Academia –Industry collaborative Program

Reading List
(Print and Online)

1.https://www.researchgate.net/publication/337146254_Kinetic_studies_with_alkaline_phosphatase

2.https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4846332/

3.https://www.ijsr.net/archive/v3i8/MDIwMTU0MDk=.pdf

4.https://www.researchgate.net/publication/349318898_ABC_of_Periheral_smear

5.https://ncdc.gov.in/WriteReadData/l892s/File608.pdf

6.https://www.ncbi.nlm.nih.gov/books/NBK562156/

Self-Study

1. Preparation of Buffers and pH measurement
2. Michaelis-Menten equation and Lineweaver Burk plot

Books Recommended

1. David Plummer (2001) An Introduction to Practical Biochemistry (3rd ed) McGraw Hill Education (India) Private Ltd
2. Jayaraman, J (2011), laboratory Manual in Biochemistry, New age publishers
3. Fundamentals of Enzymology; 3rd Edn. Nicholas C. Price and Lewis Stevens, Oxford University Press (2012).

4. Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis; Robert A. Copeland , Wiley-VCH Publishers (2000).
5. Cappuccino JG & Sherman N (2005). Microbiology-A Laboratory Manual, Pearson Education Inc
6. Practical Enzymology, Second Revised Edtion: Hans Bisswanger, Wiley – Blackwell; 2 Edition (2011)

Course Code 23PBCC21P	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1a	**PSO 1b**	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO1	3	3	2	3	3	3	2	1	2	2
CO2	3	3	2	2	2	3	2	1	2	2
CO3	3	3	2	3	3	3	2	1	2	2
CO4	3	3	2	3	3	3	2	1	2	2
CO5	3	3	2	3	3	3	2	1	2	2

Strong (3) Medium (2) Low (1)

Dr.P.Annapoorani
Head of the Department

Dr. R. Salini
Course Designer

V.V.VANNIAPERUMAL COLLEGE FOR WOMEN
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Re-accredited with 'A' Grade (3rd Cycle) by NAAC
VIRUDHUNAGAR - 626 001

M.Sc. Biochemistry

(2023-2024 onwards)

Semester II	**ENERGY AND DRUG METABOLISM**	Hours/Week: 6	
Discipline Specific Elective Course - 2		Credits: 4	
Course Code **23PBCE21**		Internal 25	External 75

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

After completion of the course, the students should be able to:

CO1. Appreciate the relationship between free energy and redox potential and will be able to justify the role of biological oxidation and energy rich compounds in maintaining the energy level of the system with an entrepreneurial outlook (K2)

CO2. Gain knowledge on role of mitochondria in the production of energy currency of the cell, P/O ratio and light and dark reactions (K3)

CO3. Acquaint with the thermodynamic laws, ATPase, cyclic and noncyclic, Xenobiotic reactions, inhibitors and process of photosynthesis (K3)

CO4. Comprehend on the diverse role of ETC, inhibitors, different pathways, transport and phase II reactions of Xenobiotics for entrepreneurial situations (K4)

CO5. Correlate the avenues available to metabolize the xenobiotics and infer Redox Potential oxidative phosphorylation, synthesis and breakdown of starch, energetics of metabolic pathways and mode of action of Xenobiotics for health care and entrepreneurial area. (K4)

Unit I

Thermodynamic- principles in biology- Concept of entropy, enthalpy and free energy change. Redox systems. Redox potential and calculation of free energy. Biological oxidation – Oxidases, dehydrogenases, hydroperoxidases, oxygenases. Energy rich compounds – phosphorylated and non-phosphorylated. High energy linkages **(18 Hours)**

Unit II

Electron transport chain-various complexes of ETC, Q-cycle. Inhibitors of ETC. Oxidative phosphorylation-P/O ratio, chemiosmotic theory. Mechanism of ATP synthesis - role of F0-F1 ATPase, ATP-ADP cycle. Inhibitors of oxidative phosphorylation ionophores, protonophores .Regulation of oxidative phosphorylation **(18 Hours)**

Unit III

Light reaction-Hills reaction, absorption of light, photochemical event. Photo ETC-cyclic and non-cyclic electron flow. Photophosphorylation-role of CF0-CF1 ATPase. Dark reaction- Calvin cycle, control of C3 pathway, and Hatch-Slack pathway (C4 pathway), Photorespiration. Synthesis and degradation of starch **(18 Hours)**

Unit IV

Interconversion of major food stuffs. Energy sources of brain, muscle, liver, kidney and adipose tissue. Amphibolic nature of Citric acid cycle. Anaplerotic reaction. Krebs cycle, Inhibitors and regulation of TCA cycle. Transport of extra mitochondrial NADH – Glycerophosphate shuttle, malate aspartate shuttle. Energetics of metabolic pathways – glycolysis, (aerobic and anaerobic) ,citric acid cycle, beta oxidation **(18 Hours)**

Unit V

Activation of sulphate ions – PAPS, APS, SAM and their biological role. Metabolism of xenobiotics – Phase I reactions – hydroxylation, oxidation and reduction. Phase II reactions – glucuronidation, sulphation, glutathione conjugation, acetylation and methylation. Mode of action and factors affecting the activities of xenobiotic enzymes.

(18 Hours)

Text Books:

1.David L.Nelson and Michael M.Cox (2012) Lehninger Principles of Biochemistry (6th ed), W.H.Freeman

2. Robert K. Murray, Darryl K. Granner, Peter A. Mayes, and Victor W. Rodwell (2012), Harper's Illustrated Biochemistry, (29th ed), McGraw-Hill Medical

Reference Books

1. Metzler D.E (2003). The chemical reactions of living cells (2nd ed), Academic Press.

2. Zubay G.L (1999) Biochemistry , (4th ed), Mc Grew-Hill.

3. Devlin RM (1983) Plant Physiology (4th ed), PWS publishers

4. Taiz L , Zeiger E (2010), Plant Physiology (5th ed), Sinauer Associates, Inc

Course Code 23PBCE21	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	PSO 1a	PSO 1b	PSO 2	PSO 3a	PSO 3b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	3	3	2	3	3	3	3	1	1	1
CO2	3	3	2	3	3	3	3	1	2	2
CO3	3	2	2	3	3	3	3	1	2	2
CO4	3	3	2	3	3	3	3	2	2	2
CO5	3	3	2	3	3	3	2	2	2	2

Strong (3) Medium (2) Low (1)

Dr.P.Annapoorani
Head of the Department

Dr.P.Annapoorani
Course Designer

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M.Sc. BIOCHEMISTRY

(2023 -2024 onwards)

Semester II	**PLANT BIOCHEMISTRY**	Hours/Week: 6	
Discipline Specific Elective Course - 2		Credits: 4	
Course Code **23PBCE22**		Internal 25	External 75

COURSE OUTCOMES

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

CO1: summarize plant tissue culture, organelles of plant cell and also biochemistry of photosynthetic process and its relation to man and its environment. [K2]

CO2: interpret the role of nutrients and secondary metabolites in plants. [K3]

CO3: sketch the effect of environmental factors, growth regulators and pathogens in plant physiology. [K3]

CO4: analyze the biochemical pathways involved in the synthesis, transport, growth, maturation and disease resistant mechanisms in plants. [K4]

CO5: examine the transport mechanism, tissue culture technique and industrial applications of secondary metabolites in plants. [K4]

UNIT I

Plant Cell & Transport Mechanism: Structure. Composition and functions of plant cell organelles, including cell wall and cell membranes. Biosynthesis of cell wall. Plant tissue culture. Transport Mechanisms-Water management, ascent of sap, mechanisms for movement of solutes. Translocation in xylem and phloem. **(18 Hours)**

UNIT II

Plant Nutrition: Essential nutrients – inorganic nutrients, their functions, deficient and toxicity symptoms. Nitrogen fixation- Biochemistry of Nitrate assimilation, Sulphur metabolism, Sulphur Activation and Assimilation. **(18Hours)**

UNIT III

Photosynthesis: Structure and composition of photosynthetic apparatus, light and dark reactions- Photophosphorylation; Carbon-di-oxide fixation C3, C4 and CAM pathways. Biosynthesis of sucrose and starch, Factors affecting the rate of photosynthesis. Photorespiration-Photosynthesis and plant productivity. **(18 Hours)**

UNIT IV

Growth Regulators & Phytochemistry: Auxins, Gibberellins, Cytokinins, ABA, Ethylene Metabolism, functions and mechanism of action. Plant growth inhibitors. Plant chemicals and their significance storage carbohydrates, proteins and fats. Secondary plant products and their economic importance- waxes; essential oils, phenolic glycosides, flavones, anthocyanins and alkaloids. Biosynthesis of alkaloids, terpenoids, phenolics and pigments (general treatment only). Algal secondary metabolites. **(18 Hours)**

UNIT V

Biochemistry of plant diseases: Plant pathogenesis initial stages of pathogenesis, mechanisms of pathogenesis- Mechanism of attack. Responses of plants to pathogens-pathological effects of respiration, photosynthesis, cell wall enzymes and –water uptake. Disease-resistance mechanism; phytoalexins. Photomorphogenesis: Photoperiodism – phytochrome, Physiology of flowering, Physiology and biochemistry of fruit ripening, Physiology and biochemistry of senescence Biochemistry of seed germination. Plant Stress, Plant responses to abiotic and biotic stress. **(18 Hours)**

TEXT BOOKS

1. Lincoln Taiz and Eduardo Zeiger, (2002). *Plant Physiology*, Sinauer Associates; 3rd Edition

2. Pandey & Sinha. (2012), *Modern Plant Physiology*, 4th Edition. Vikas Publication House Pvt Ltd.

REFERENCE BOOKS

1.Thomas Moore. (2010). *Biochemistry and physiology of plant hormones*, II Edition, Springer-Verlag Berlin and Heidelberg GmbH & Co.

2. Devlin. (2009). *Plant Biochemistry*, Fourth Edition, Vikas Publication House Pvt Ltd.

3. R.K. Sinha. (2012). *Modern Plant Physiology*, 4th Edition, Alpha Science International Ltd

Course Code (23PBCE22)	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	PSO 1a	PSO 1b	PSO 2	PSO 3a	PSO 3b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	3	3	2	2	2	3	2	2	2	1
CO 2	3	2	2	2	2	3	2	2	1	1
CO 3	3	3	2	2	2	2	2	2	1	1
CO 4	3	3	2	3	2	2	2	2	2	1
CO 5	3	3	2	3	3	3	3	2	3	2

Strong (3) Medium (2) Low (1)

Dr.R.Renuka

Dr.P.Annapoorani — Dr.R.Salini

Head of the Department — Course Designer

V.V.VANNIAPERUMAL COLLEGE FOR WOMEN

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M.Sc. BIOCHEMISTRY

(2023 -2024 onwards)

Semester II	**BIOINFORMATICS AND NANOTECHNOLOGY**	Hours/Week: 6	
Discipline Specific Elective Course - 2		Credits: 4	
Course Code **23PBCE23**		Internal 25	External 75

COURSE OUTCOMES

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

CO1: understand the basic bioinformatics techniques and synthesis, applications of nanomaterials used in biological research. [K2]

CO2: apply sequence alignment methods for sequence similarity search, visualization tools in biological data and different types of nanomaterials, applications of Nanotechnology in Biomedical and Pharmaceutical Industries. [K3]

CO3: analyze the different types of nano materials and application of Nanotechnology in Biomedical and Pharmaceutical Industries and different databases, tools used in biological analysis. [K3]

CO4: examine the development, ELSI of Genome projects, challenges, scope and application of bioinformatics, importance of scoring matrix, gap penalty in sequence alignment, properties of nanomaterials, different types of nanoparticle synthesis methods and its advantage, disadvantage. [K4]

CO5: analyse sequence analysis using tools in biological systems, important contributions in bioinformatics, goals, strategics of human genome project, role of nanotechnology in biological research and industries. [K4]

UNIT I

History, Scope and Importance: Important contributions - Aims and tasks of Bioinformatics - applications of Bioinformatics - challenges and opportunities - internet basics – HTML – introduction to NCBI data model - Various file formats for biological sequences. Databases - Tools and their uses Primary sequence databases - Composite sequence databases - Secondary databases- Nucleic acid sequence databases - Protein sequence data bases – Structural databases- Protein structure visualization tools (RasMol, Swiss PDB Viewer) **(18 Hours)**

UNIT II

Sequence Alignment Methods: Sequence analysis of Biological data - Significance of Sequence alignment – Pairwise sequence alignment methods - Use of Scoring matrices and Gap penalties in sequence alignments - Multiple sequence alignment methods – Tools and application of multiple sequence alignment. Definition of genome and genomics. Types of gene - map genetic, cytogenetic and physical. Molecular markers for mapping - RFLPs, microsatellites and SNPs. Assembling a physical map of the genome – chromosome walking and jumping**.** **(18 Hours)**

UNIT III

Proteomics and Genomics: Genome projects: *E.coli*, *D.melanogaster*, *A. thaliana* and mouse. The human genome project: goals, mapping strategies, markers, sequencing technologies, results of final sequence, potential benefits and risks, ethical, legal and social issues (ELSI). **(18 Hours)**

UNIT IV

Introduction to Nanotechnology: Introduction, Definition, and Nanoscale, Classification of Nanomaterials: Quantum Dots, Wells and Wires. Carbon-based Nanomaterials - Nanotubes, Metal based Nanomaterials (Nanogold, Nanosilver and metal oxides). Properties of nanostructured materials**.** **(18 Hours)**

UNIT V

Synthesis and applications of Nanomaterials: Top-down (Nanolithography, CVD), Bottom-up (Sol-gel processing, chemical synthesis). Biological methods of Synthesis: Use of Plant extracts, bacteria, fungi, yeast and other biological particles. Applications of Nanotechnology in Biomedical and Pharmaceutical Industries**.** **(18 Hours)**

TEXT BOOKS

1. S.C. Rastogi & others (2003), *Bioinformatics - Concepts, Skills, and Applications*, CBS Publishing.
2. T K Attwood, D J parry – Smith (2005), "*Introduction to Bio*informatics", Pearson Education, 1st Edition, 11th Reprint.
3. Pradeep.T (2007). *Nano: The Essentials Understanding Nanoscience and Nanotechnology*, 1st Edition, Tata McGraw – Hill Publishing Company Limited, New Delhi.

REFERENCES BOOKS

1. Andreas D Baxevanis& B F Francis (2000), *"Bioinformatics - A practical guide to analysis of Genes & Proteins "*, John Wiley.
2. LakshmanDesai (2007), *Nanotechnology*, 1st Edition, Paragon International Publishers.
3. C S V Murthy, (2003,) "*Bioinformatic*s", Himalaya Publishing House, 1st Edition.
4. S. Ignacimuthu, S.J., (1995). "*Basic Bioinformatics"*, Narosa Publishing House,
5. C.S. Tsai, (2002), *An Introduction to Computational Biochemistry*, Wiley Liss, New York.

Course Code (23PBCE23)	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	PSO 1a	PSO 1b	PSO 2	PSO 3a	PSO 3b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	3	3	2	3	3	2	2	2	2	2
CO 2	3	2	2	3	3	2	2	2	2	2
CO 3	3	3	2	3	3	2	2	2	2	2
CO 4	3	3	2	3	3	2	2	2	2	2
CO 5	3	3	2	3	3	2	2	2	2	2

Strong (3) Medium (2) Low (1)

Dr.P.Annapoorani
Head of the Department

Dr.R.Salini
Course Designer

V.V.VANNIAPERUMAL COLLEGE FOR WOMEN
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VIRUDHUNAGAR
Quality Education with Wisdom and Values

M.Sc. BIOCHEMISTRY
(for those who join in 2023-2024)

Semester III	**INDUSTRIAL MICROBIOLOGY**	Hours/Week: 6	
Core Course-7		Credits: 5	
23PBCC31		Internal 25	External 75

COURSES OUTCOMES

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

CO1: Understand the knowledge of various kinds of microorganisms, significance and role of microorganisms in various industries[K2]

CO2: Illustrate the central roles of microorganisms in nature, and the importance of microorganisms in industries and in food preservation [K3]

CO3: Apply the Knowledge regarding basic, advanced and applicable concepts in emerging areas of Industrial Microbiology (K3)

CO4: Analyze the microbial strains and methods used in fermentation technology and food microbiology (K4)

CO5: Examine the theoretical and practical understanding of industrial microbiology (K4)

UNIT-I

Structure of bacteria, fungi and viruses and their classification. Types and characteristics of microorganisms used in Industry (a) Food Industry (b) Chemical Industry (c) Pharmaceutical Industry. (**18 hours)**

UNIT-II

Fundamentals and principles of microbial fermentation techniques – application in industry and pharmaceutical Biochemistry. Fermentation – types, techniques, design and operation of fermenters including addition of medium. Types and characteristics of microorganisms,

environmental conditions required for the growth and metabolism of industrially and pharmaceutically important microbes. Sterilization methods in fermentation techniques, air, gas, culture medium sterilization. Steam-filtration and chemicals. Types and constituents of fermentative culture medium and conditions of fermentations, Antifoaming devices.

(**18 hours)**

UNIT-III

Recovery and estimation of products of fermentation- Production of ethanol, acetic acid, glycerol, acetone, butanol and citric acid by fermentation. Production of Enzymes- amylase, protease, lipase,Production of pharmaceuticals by fermentation– penicillin, streptomycin, tetracycline, riboflavin, vitamin B12.Beverages-wine, beer and malt beverages.

(**18 hours)**

UNIT-IV

Food Microbiology: Production of dairy products-bread, cheese and yoghurt (preparation and their types). Food borne diseases- Bacterial and Non- Bacterial. Food preservation - Principles–Physical methods: temperature (low, high, canning, drying), irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging, Chemical methods - salt, sugar, organic acids, SO2, nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins. (**18 hours)**

UNIT-V

Agricultural Microbiology: General Properties of soil, microorganisms in soil – decomposition of organic matter in soil. Biogeochemical cycles, nitrogen fixation, Production of bio fertilizers and its field applications – Rhizobium, azotobacter, blue green algae, mycorrhizae, azospirilium, Production of biofuels (biogas- methane), soil inoculants. .

(**18 hours)**

TEXT BOOKS:

1. Food Microbiology: An Introduction: 4th edition,Matthews KR, Kniel KE, Montville TJ; American Society for Microbiology
2. Food, Fermentation and Micro-Organisms,2nd edition, Charles, BW; Blackwell Science Ltd

3. Microbiology. 5th edition , Pelczar MJ, Chan ECS and Krieg NR; McGraw Hill Book Company.
4. Text book of Microbiology:11th edition, Ananthanarayanan R and Paniker CKJ; Universities Press (India) Pvt. Ltd.
5. Food Microbiology, 3rd edition,Frazier WC and Westhoff DC;Tata McGrawHill Publishing Company Ltd, New Delhi
6. New Methods of Food Preservation:1st edition, Gould GW; Springer Manual of Industrial Microbiology and Biotechnology: 3rd edition.

REFERENCE BOOKS:

1. Industrial Microbiology, Casida LE. (1991),1st edition. Wiley Eastern Limited.
2. Biotechnology: A textbook of Industrial Microbiology. Crueger W and Crueger A. (2000), 2nd edition. Panima Publishing Co. New Delhi.
3. Principles of Fermentation Technology.Stanbury PF, Whitaker A and Hall SJ. (2006), 2nd edition, Wiley-Eastern
4. Prescott's Microbiology 10th Editionby Joanne Willey (Author), Linda Sherwood (Author), Christopher J. Woolverton (Author), Publisher : McGraw-Hill Education; 10th edition (January 4, 2016).
5. Microbiology - Pelczar - 5th Edition - 2023-24/Ed. by Michale J. Pelczar Jr. | 12 April 2023

Course Code 23PBCC31	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO3 3.a	PSO3 3.b	PSO4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	3	3	2	2	3	2	2	2	3	2
CO 2	3	2	2		3	2	2		2	3
CO 3	2	2	3	3	2	2	2	2	2	2
CO 4	2	3	2	2		2		2	2	2
CO 5	2	3	2		2		2	2	2	2

Strong (3) Medium (2) Low (1)

Dr.P.Annapoorani
Head of the Department

Mrs.M.Rajakumari
Course Designer

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M.Sc. BIOCHEMISTRY
(for those who join in 2023-2024)

Semester: III	**MOLECULAR BIOLOGY**	Hours/Week: 6	
Core Course-8		Credits: 5	
Course Code **23PBCC32**		Internal 25	External 75

After completion of the course, the students should be able to:

CO1: Understand the organization of genomes, the molecular basis of DNA replication, recombination and transposition, the significance of these processes, DNA damage and repair, and molecularmechanisms in gene expression and regulation [K2]

CO2: Apply the knowledge on genome organization , gene expression, regulation, DNA mutation and repair [K3]

CO3: make use of the perceived knowledge about gene and protein expression for various molecular biology experimental approaches [K3]

CO4 : Analyze the expression of genes and proteins during the molecular events . [K4]

CO5: Examine the genome organization, replication, transcription, translation and regulation process in depth and develop an interest to pursue high quality research. [K4]

UNIT-I

Mendel's laws of inheritance-dominance-complete, incomplete and co- dominance, multiple alleles-gene mapping in haploids and diploids, recombination mapping- restriction mapping- modes of gene information transfer in bacterial- conjugation, transformation and transduction. The bacterial chromosome, the eukaryotic genome- chromosome structure – Histones, Nucleosome, chromatin- heterochromatin, euchromatin, chromatin remodeling, DNAase hypersensitive sites, genome organization – the C-value paradox, reassociation kinetics, repetitive sequences, gene amplification, telomeres, pseudogenes, split genes, organelle genomes – mitochondrial and chloroplast genome. **(18 hours)**

UNIT-II

DNA replication and repair: Enzymes of replication, prokaryotic replication mechanisms, primosome & replisomes, eukaryotic DNA replication, the role of topoisomerases and telomerase, regulation of replication, difference between prokaryotic and eukaryotic replication. Mutations - Types of mutations, mechanisms of mutations, mutagenic agents. DNA repair mechanisms – Direct repair, excision repair, mismatch repair, recombination repair, SOS response, eukaryotic repair systems. Recombination and mobile genetic elements- the Holliday model, the general recombination in E.coli, site specific recombination, transposons and retroposons.

(18 hours)

UNIT-III

Transcription – Prokaryotic transcription-subunits of RNA polymerase, E. coli promoters, sigma factor and promoter recognition, alternative sigma factors, initiation, elongation, Rho-dependent and independent termination of transcription. Eukaryotic transcription- Initiation, promoter elements, RNA polymerases, transcription factors, regulatory sequences in eukaryotic protein – coding genes, CpG islands, enhancers.

Translation – organization of the ribosome, the genetic code, evidence for a triplet code, deciphering the genetic code, wobble hypothesis, deviation in the genetic code, unusual codons. activation, initiation, elongation and termination of translation in E. coli. The role of tRNA and rRNA, suppressor tRNAs and inhibitors of protein synthesis., Comparison of prokaryotic translation with eukaryotic translation. **(18 hours)**

UNIT-IV

Regulation of gene expression in prokaryotes-– Positive and negative control, the lac operon, identification of operator and regulator sequences by mutations, induction and repression, Foot-printing and gel-shift assays for identification of protein-DNA interactions. Catabolite repression. Trp operon – Attenuation, alternative secondary structures of trp mRNA.

Regulation of gene expression in eukaryotes- Response elements, DNA-binding motifs, steroid receptors, association of methylation and histone acetylation with gene expression. **(18 hours)**

UNIT-V

Post transcriptional modifications in eukaryotes- RNA processing- mRNA 5' capping and 3'poly-adenylation, introns and exons, RNA splicing,- spliceosome assembly, alternative splicing, processing of tRNA and rRNA, self-splicing, ribozymes, RNA editing- substitution and insertion/deletion editing, Genome editing-CRISPR- Cas technology

Post translational modification of proteins- Proteolytic cleavage, covalent modifications, glycosylation of proteins, disulfide bond formation, Protein sorting – signal peptides, transport of secretory proteins, Golgi and post-golgi sorting, coated vesicles, targeting of mitochondrial, lysosomal and nuclear proteins, Protein degradation-Ubiquitination of proteins, Protein folding-chaperones.

(18 hours)

Text Books:

1. Lewin's Genes XII : 12th edition, Krebs JE, Goldstein ES, Kilpatrick ST ;Prentice Hall, Delhi
2. Molecular Biology of the Gene : 6th edition, Watson JD , Baker TA, Bell S, Gann A, Levine M, Losick R; Cold Spring Harbor Laboratory Press, New York
3. Essential Cell Biology :3rd edition, Alberts B, Bray D, Hopkin K, Johnson A, Lewis J, Raff M, Roberts K, Walter P ; Garland Science, New York
4. Molecular Cell Biology : 8th edition , Lodish H, Arnold Berk; W.H.Freeman & Co, New York

Reference Books:

1. Stephen.L.Wolfe (1993). *Molecular and Cellular Biology,* USA: Cengage learning Inc. 1st Edition.
2. Darnell, Lodish, Baltimore (1986). *Molecular Cell Biology,* United States: WH Freeman &Company, 1st Edition.
3. Brown. T.A. (2006). *Genomes,* Garland Science Inc. United States, 3rd Edition.
4. Becker, Kleinsmith, Harden (2000). *The World of the Cell,* United States: Addison WesleyLongman Inc. 4th Edition.

Course Code 23PBCC32	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1a	**PSO 1b**	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO1	3	2	2	3	3	3	2	3	3	2
CO2	3	3	2	2	2	3	2	3	2	2
CO3	2	2		2	2	3	2	3		2
CO4	3	2	2	3	3	2	3	3	2	2
CO5	3	3	2	3	2	3	3	3	2	2

Strong (3) Medium (2) Low (1)

Dr.P.Annapoorani
Head of the Department

Dr. R.Gloria Jemmi Christobel
Course Designer

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M.Sc. Biochemistry
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Semester III	**BIOSTATISTICS AND DATA SCIENCE**	Hours/Week: 6	
Core Course – 9		Credits: 4	
Course Code **23PBCC33**		Internal 25	External 75

COURSE OUTCOMES

On completion of the course the students will be able to

CO1. demonstrate the necessary skill sets to interpret statistical data and data science. [K2]

CO2: utilize effective statistical methods for data analysis and interpretation. [K3]

CO3: discover the statistical methodology for the evaluation of results during health and disease conditions. [K3]

CO4: assess the general theory of data science and data analysis as they apply to confidence intervals, effect sizes and hypothesis testing. [K4]

CO5. Make use of statistical and data science concepts for biological studies [K4]

Unit I

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. **(18 Hours)**

Unit II

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. **(18 Hours)**

Unit III

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. Survey : Types and Procedures. (**18 hours)**

Unit IV

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. (**18 hours)**

Unit V

Introduction to Data Science, Definition of data science, importance, and basic applications, Machine Learning Algorithms, Deep Learning, Artificial Neural Networks and their Application, Reinforcement Learning, Natural Language Processing Artificial Intelligence (AI), Data Visualization, Data Analysis, Optimization Techniques, Big Data, Predictive Analysis. Application of AI in medical, health and pharma industries. **(18 hours)**

TEXT BOOKS

1.Palanichamy.S and Manoharan.M (2008). *Statistical Methods for Biologists(Biostatistics),* Palani: Palani Paramount Publications, 3rd Edition.

2. Gupta.S.P. (2008). *Statistical Methods,* New Delhi: Sultan Chand & Sons, 36th Edition.

3. Kothari, R.C. (1993). *Research Methodology,* New Delhi: Wiley Eastern Limited, 5th Edition.

REFERENCE BOOKS

1. Zar, J.H. (1984) "Bio Statistical Methods", Prentice Hall, International Edition

2. Sundar Rao P. S.S., Jesudian G. & Richard J. (1987), "An Introduction to Biostatistics", 2nd edition,. Prestographik, Vellore, India,.

3. Warren,J; Gregory,E; Grant,R (2004), "Statistical Methods in Bioinformatics",1st edition,Springer

4. Milton,J.S.(1992),. “Statistical methods in the Biological and Health Sciences”, 2nd edition ,Mc Graw Hill,
5. Rosner,B (2005), “Fundamentals of Biostatistics”, Duxbury Press.
6. Introducing Data Science, Davy Cielen, Anro DB Meysman, Mohamed Ali.

Course Code 23PBCC33	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1a	**PSO 1b**	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO 1	2	2	2	2	1	2	3	2	2	2
CO 2	2	2	3	2	2	2	2	2	2	2
CO 3	3	1	3	2	2	2	2	2	2	2
CO 4	3	2	3	3	3	2	2	2	3	3
CO 5	1	3	2	2	1	2	2	2	2	1

Strong (3) Medium (2) Low (1)

Dr.P.Annapoorani
Head of the Department

Dr. R.Gloria Jemmi Christobel
Course Designer

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Quality Education with Wisdom and Values

M.Sc. Biochemistry
(for those who join in 2023-2024)

Semester III	**CLINICAL BIOCHEMISTRY PRACTICAL**	Hours/Week: 5	
Core Course Practical- 3		Credits: 3	
Course Code **23PBCC31P**		Internal 40	External 60

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

CO1: understand the techniques and principles behind the clinical parameter analysis (K2)

CO2**:** explain the principle and method of estimating the biomolecules(K2).

CO3: Identify the normal and abnormal parameters of biological samples using colorimetry and other basic biochemical methods (K3)

CO4. observe and calculate the results for the estimation and assays of various macro and biomolecules (K3)

CO5. Infer the normal and abnormal parameters of biological samples analyzed by colorimetry and other basic biochemical methods for enzyme assay , hematology and serology (K4)

Unit I

Haematology: RBC count, WBC count – total and differential count, ESR, PCV, MCV. Bleeding Time, Clotting Time and Estimation of hemoglobin.Determination of Electrolytes :Sodium, Potasium and Calcium **(15 Hours)**

Unit II

Liver function test: Estimation of bilirubin – direct and indirect. Estimation of plasma protein, A/G ratio, Thymol turbidity test, Prothrombin Time (PT),Assay of serum glutamate oxaloacetate transaminase, alkaline phosphatase, Gamma-glutamyltransferase (GGT), isoenzyme separation of LDH by electrophoresis. **(15 Hours)**

Unit III

Renal function test: Collection and Preservation of Urine sample .Qualitative tests for normal and pathological components of urine.BUN: Estimation of blood Urea, creatinine, and uric acid. Urea Clearance test **(15Hours)**

Unit IV

Serology : Estimation of blood glucose by orthotoluidine and glucose oxidase method. Determination of glycosylated Hb. Glucose tolerance test. Kit method .Lipid profile: Estimation of cholesterol by Zak's method, lipoprotein profile, estimation of ketone bodies, estimation of triglycerides, free fatty acids and phospholipids. **(15 Hours)**

Unit V

Group Experiments

a. Collection of blood ,Serum or Plasma separation and Storage
b. Antigen – Antibody Reaction - HCG kit method , RA kit method
c. Phlebotomy –Venipuncture , Different techniques of venipuncture
d. Automation in Clinical Biochemistry -Autoanalyser ,Semiautoanalyser **(15 Hours)**

Reading List (Print and Online)

1. https://www.researchgate.net/publication/260182512_ Practical_Manual_in_Biochemistry_and_Clinical_Biochemistry
2. https://main.icmr.nic.in/sites/default/files/upload_documents/ GCLP_Guidelines _2020_ Final.pdfhttps://www.westgard.com/clia.html
3. https://www.researchgate.net/publication/263929434_Biochemistry
4. https://ucms.ac.in/Lectures-C-2020/Renal%20function%20Tests%20-%20PPT.pdf
5. https://youtu.be/i2PfjEks4GQ
6. https://www.euro.who.int/__data/assets/pdf_file/0005/268790/WHO-guidelines-on-drawing-blood-best-practices-in-phlebotomy-Eng.pdf

Self-Study

1. Laboratory handling of human biological specimen
2. Automation in Clinical Biochemistry

Recommended Texts

1 Practical Clinical Biochemistry- Varley's by Alan H Gowenlock, published by CBS Publishers and distributors, India Sixth Edition ,1988.

2. Manipal Manual of Clinical Biochemistry (For Med.Lab.And Msc Stud.) 2013 (4 Edition)

3. Case Oriented Approach in Biochemistry-Dr. Rajesh Kawaduji Jambhulkar, Dr. Abhijit D. Ninghot: 2019 First Edition

4. Medical Lab Technology Vol I& II, Kanai L Mukerjee New Delhi: Tata Mcgraw Hill Publishing Company, 1996.

5. Practical Biochemistry – Plummer, New Delhi: Tata Mcgraw Hill Publishing Company, 2000.

6.Introductory practical Biochemistry – S.K. Sawhney, Randhir Singh, 2nd ed, 2005.

Course Code 23PBCC31P	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1a	**PSO 1b**	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO1	3	3	2	3	3	3	2	1	2	2
CO2	3	3	2	2	2	3	2	1	2	2
CO3	3	3	2	3	3	3	2	1	2	2
CO4	3	3	2	3	3	3	2	1	2	2
CO5	3	3	2	3	3	3	2	1	2	2

Strong (3) Medium (2) Low (1)

Dr. R. Gloria Jemmi Christobel
Mrs.M.Rajakumari
Course Designer

Dr.P.Annapoorani
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M.Sc. BIOCHEMISTRY
(for those who join in 2023-2024)

Semester: III	**BIOINFORMATICS PRACTICAL**	Hours/Week: 2	
Skill Enhancement Course-1		Credits: 2	
Course Code **23PBCS31P**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: recall the protocols for sequence retrieval from different Biological databases [K1]

CO2: explain the methodologies for accessing proteomic tools and DNA or protein sequence similarity search using BLAST and visualizing protein structure [K2]

CO3: write the results of retrieved and aligned sequences from different primary databases, structural databases, multiple sequence alignment, proteomic tools. [K2]

CO4: identify the basic informatics tools to extract or retrieve information from Biological databases, molecular visualization tools and its applications. [K3]

CO5:build homology model for unknown protein sequence and predict the structure [K4]

Experiments

- Access NCBI : EBI query website for Downloading a files.
- Accessing of Genbank website and downloading of files
- Accessing DDBJ website for Downloading a files.
- Accessing SWISS-Prot database and Downloading a protein sequence
- BLAST similarity search for Nucleotide sequences
- BLAST similarity search for protein sequences

- Searching and retrieving from KEGG
- Working with EnsembleMultiple Sequence Alignment – ClustaLw
- Expasy-proteomic tools.
- Visualize protein structure – Rasmol and spdbv
  - Ø Load the raw sequence, Bond angle and bond length
  - Ø Homology modeling for protein structure prediction
- CHEM Sketch: Small molecules build
  - Ø Draw the structure of any chemical compound
  - Ø Find its properties

REFERENCES BOOKS

1. Mani.K(2000), *Bioinformatics – a practical approach*, 3rd edition, published by Saras Publication, Nagercoil.
2. Sundaralingam.R , Kumaresan.V(2001), *Bioinformatics* , 3rd edition, published by Saras Publication, Nagercoil.

Course Code 23PBCS31P	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1a	**PSO 1b**	**PSO 2**	**PSO 3a**	**PSO 3b**	PSO 4	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO1	2	2	1	3	3	3	3	3	2	2
CO2	3	2	2	3	2	3	3	2	2	1
CO3	3	3	2	3	3	3	3	3	2	2
CO4	2	2	2	3	3	2	3	3	2	1
CO5	2	2	1	2	3	3	3	3	2	2

Strong (3) Medium (2) Low (1)

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M.Sc. BIOCHEMISTRY
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Semester III	**MOLECULAR BASIS OF DISEASES AND THERAPEUTIC STRATEGIES**	Hours/Week: 5	
Non Major Elective-1		Credits: 3	
Course Code **23PBCN31**		Internal 25	External 75

COURSE OUTCOMES

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

CO1: List the diagnostic importance of blood sugar, gastric function, renal function, cancer, neurogenerative disorders and cardiovascular diseases. [K1]

CO2: Explain the methodologies of blood, urine and body fluids tests for diagnostic purpose. [K2]

CO3: Understand the abnormalities of digestive, reproductive, kidney , cardiac system and blood sugar level [K2]

CO4: make use of the laboratory results with respect to the biological reference ranges and relate them critically in light of the clinical picture. [K3]

CO5: analyse the consistent and inconsistent elements in biological fluids and explain its pathophysiology, signs, treatment. [K4]

UNIT I

Mechanism of blood sugar regulation in human body: Pathophysiology of Type I and II diabetes, Diabetes – investigation methods for the diagnosis of diabetes. Nutritional care. Complications related to diabetes – Diabetic cardiovascular disease, retinopathy, neuropathy and nephropathy. Cellular and molecular mechanism of development of diabetes- Management of Type I and Type II diabetes, drugs for the treatment of diabetes. **(15 Hours)**

UNIT II

Biology of cancer: Overview of hallmarks of cancer. Tumorigenesis, Tumor progression and mechanism of Metastasis. Proto-oncogene to oncogene. Oncogene- myc and src family. Tumor suppressor gene-Rb and p53 pathway in cancer. Molecular techniques in cancer diagnosis. Treatment of cancer- surgery, radiotherapy, chemotherapy, hormonal treatment, and biological therapy. Introduction to personalized medicine. **(15 Hours)**

UNIT III

Brain- neuronal network- memory- Neurogenerative diseases- Parkinson and Alzheimer Disease- molecular understanding of the neurodegenerative diseases- treatment modalities. **(15 Hours)**

UNIT IV

Acute and chronic renal failure, glomerular diseases–glomerulonephritis, nephritic syndrome, diabetes insipidus, diagnosis of kidney disease.

(15 Hours)

UNIT V

Introduction to cardiovascular diseases, Lipids and lipoproteins in coronary heart disease-cardiac enzymes, Molecular changes during cardiac remodeling – hypertrophy of hearts – heart failure-treatment modalities. **(15 Hours)**

Reading List (Print and Online)

1.The Biochemical basis of disease:2018, Barr AJ; Portland Press

2.Biochemical Basis of Diseases

3.https://www.biologydiscussion.com/diseases-2/biochemical-basis-of-diseases/44276

TEXT BOOKS

1.Wills' Biochemical Basis of Medicine: 2nd edition, Thomas H, Gillham B;Elsevier

2.Molecular Biochemistry of Human Diseases,2021, Feuer G ,de la Iglesia F; CRC Press

REFERENCE BOOKS

1. Harrison (1994). *Principles of Internal Medicine,*McGraw-Hill Companies, United States: 13th Edition.
2. Sonntag & Oswald (2002). *Tietz Fundamentals of Clinical Chemistry*, WB Saunders Philadelphia. 5th Edition.

Course code (23PBCN31)	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	1a	1b	2	3a	3b	4	5	6	7	8
CO 1	2	2	2	2	2	2	2	2	1	2
CO 2	2	2	2	2	2	2	3	2	2	2
CO 3	2	2	2	2	2	3	2	2	3	2
CO 4	2	2	2	2	2	2	2	2	2	2
CO 5	2	2	2	2	2	2	2	2	2	2

Strong (3) Medium (2) Low (1)

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Semester III	**GENE EDITING ,CELL AND GENE THERAPY**	Hours/Week:
Extra Credit Course -1		Credits: 2
Course Code **23PBCO31**		Internal 100

COURSE OUTCOMES

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

CO1: understand the composition and physicochemical characteristics of the main components of milk. [K2]

CO2: apply the knowledge of chemistry of dairy components and find the impacts of processing conditions on milk and dairy products. [K3]

CO3: identify the dairy products manufacturing and key functions of the processing steps involved. [K3]

CO4: analyze the food adulteration and contamination of food, food laws and standards. [K4]

CO5: examine the basic concepts of dairy needs, method of production, and refrigeration. [K4]

UNIT-I

Gene Editing: Basis of gene editing, DNA repair mechanisms, Double strand DNA breaks, Nonhomologous End-Joining (NHEJ), Homology directed repair, Programmable nucleases for gene editing, Meganucleases, Zinc-Finger nucleases, Transcription Activator-Like Effector Nucleases (TALEN), CRISPR-Cas systems, gene editing using CRISPR-Cas, drawbacks and major challenges to present gene editing techniques, gene editing for human disease therapy**.**

UNIT –II

Gene and cell therapy: Basics of Gene and cell therapy, types of gene therapy, gene therapy strategies, therapeutic targets for gene therapy, choice of the therapeutic target, administration routes, delivery systems, expression of transgene, persistence of the gene therapy, cell targeting, immunological response to the therapy, ethical and legal issues, concerns about gene and cell therapy.

UNIT-III

Vectors for Gene therapy: Non-viral and viral vectors for gene therapy, Physical methods of gene delivery, Polymer, Lipid and inorganic material based chemical systems for gene delivery, Viral vectors, Lentiviral, Adenoviral, Adeno-associated virus, Herpes Simplex virus, vaccinia, baculoviral vectors for gene delivery, choice of viral vector and oncolytic virus. Gene therapy applications, Gene therapy for cancer, suicide and oncolytic gene therapy.

UNIT –IV

Stem cells and tissue regeneration: Adult and fetal stem cells, embryonic stem cells, cell reprogramming, induced pluripotent stem cells (iPSC), Chemically induced pluripotent stem cells (CiPSC), reprogramming factors, iPSC derived progenitors 'cells, Organoids, three dimensional (3D) bioprinting.

UNIT-V

Regulatory and Ethical Considerations of stem cell and Gene Therapy, pluripotent stem cell-based cell replacement therapies. Assessing Human Stem Cell Safety, Use of Genetically Modified Stem Cells in Experimental Gene Therapies. Technological challenges towards development of pluripotent stem cell-based cell replacement therapies.

TEXT BOOKS

1.Stem Cell Biology, Daniel Marshak, Richard L. Gardener and David Gottlieb, Cold Spring Harbour Laboratory Press

2.Stem cell biology and gene therapy, Booth C., Cell Biology International, Academic Press

3.Stem Cell and Gene-Based Therapy: Frontiers in Regenerative Medicine, Alexander Battler,

REFERENCE BOOKS

1.An Introduction to Human Molecular Genetics (2nd Edition), J.J. Pasternak, 2005

2.An Introduction to Molecular Medicine and Gene Therapy 1st Edition by Thomas F. Kresina Upadhyay, S. K. (Ed.). (2021).

3.Human Molecular Genetics (4th Edition), Tom Strachan & Andrew Read, 2010.

4.Stem Cells Handbook: Stewart Sell, Humana Press; Totowa NJ, USA; Oct. 2003.

Course Code 23PBCO31	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	1a	1b	2	3a	3b	4	5	6	7	8
CO 1	2	3	3	3	3	3	3	3	3	3
CO 2	3	2	2	2	2	2	2	2	2	2
CO 3	2	2	2	2	2	3	2	3	3	2
CO 4	2	2	2	2	2	2	2	2	2	2
CO 5	2	2	2	1	1	1	1	2	3	3

Strong (3) Medium (2) Low (1)

Dr.P.Annapoorani
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Semester III	**PRACTICE FOR CSIR NET – GENERAL PAPER**	Hours/Week:-	
Course Code		Credits: 1	
23PGOL32		Internal 100	External -

COURSE OUTCOMES

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

CO1 : explain various concepts related to numbers, quantitative comparison, monetary problems and logical reasoning. [K2]

CO2 : apply the analytical skills and logical reasoning in solving problems related to competitive examinations. [K3]

CO3 : solve typical problems, geometrical type problems, daily life problems in a effective manner. [K3]

CO4 : analyze the techniques used in solving complicated real life problems. [K4]

CO5 : examine the data using logical reasoning and observational ability. [K4]

UNIT I

Typical Problems- Series formation

Numerical Ability- Numbers

UNIT II

Geometrical Type Problems

Mensuration and quantitative comparison

UNIT III

Typical Problems- Moving locomotive problem

Numerical Ability- Distance and Directions

UNIT IV

Daily Life Problems

Finding the X – Average - Monetary problems

UNIT V

Logical Reasoning
Data interpretation – Observational ability – Logical puzzles

BOOKS FOR STUDY:

Christy Varghese (2016).,*CSR – NET, General aptitude –A new outlook,* Lilly publishing house, Changanacherry, Kerala

REFERENCE BOOKS

1. Pradip Kumar Ray, General Aptitude Theory ,CSIR NET, Previous question and answer with explanation and hint to solve, Notion Press, India
2. Ram Mohan Pandey (2021)., *CSIR-UGC-NET General Aptitude Theory and Practice*, Pathfinder Publication, a unit of Pathfinder Academy Pvt. Ltd., India.

Unit	Chapter	Section/Page Number
1	4	142-162
	5	163-192
2	12	272-294
3	3	132-141
	7	206-220
4	8	221-230
	9	231-239
	10	240-249
5	13	295-309
	14	310-323
	15	324-332

Course code 23PGOL32	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	3	3	2	2	-	2	-	-
CO2	3	3	3	3	-	2	-	-
CO3	3	3	3	3	-	3	-	-
CO4	3	2	3	3	-	3	-	-
CO5	3	2	3	3	-	3	-	-

Strong (3) Medium (2) Low (1)

Dr. M. C. Maheshwari
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M.Sc. Biochemistry
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Semester IV	**PHARMACEUTICAL BIOCHEMISTRY**	Hours/Week: 6	
Core Course - 10		Credits: 5	
Course Code **23PBCC41**		Internal 25	External 75

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

CO1: Describe the classification, kinetics, catalytic mechanisms and techniques involved in enzymology (K2)

CO2: apply the appropriate methods for the isolation, purification, immobilization and the study of enzymes (K3)

CO3: sketch the enzyme classification, kinetics, catalysis and technology in enzymology (K3)

CO4: Analyze the enzyme classification and nomenclature, catalysis, kinetics and technology. (K4)

CO5: Compare the kinetics, methods of inhibition, isolation, purification and identification techniques of enzymes (K4)

Unit I

Drug discovery and development, drug target identification and validation, Hit identification, General principles of screening, correlations between various animal models and human situations, Correlation between in-vitro and in-vivo screens; Special emphasis on cell-based assay, biochemical assay, radiological binding assay, Pharmacological assay, In vitro, In vivo & Ex-vivo experiments, lead optimization, preclinical studies. **(18 Hours)**

Unit II

Bioinformatics approaches for drug development:Identification of potential molecules, chemical compound library preparation, Identification of target in pathogen, Ligand & protein preparation, Molecular docking, Binding free energy estimation, High throughput

virtual screening, Docking protocol validation and enrichment analysis, Single point energy calculation, Pharmacokinetics and Pharmacodynamics, ADME & toxicity prediction, Molecular dynamic simulation, Rule of three and five, Lipinsky rule, Pharmacophore development, Quantitative structure activity relationship, 3D-QSAR, Techniques of developing a pharmacophore map covering both ligand based and receptor based approaches.

(18 Hours)

Unit III

Drug metabolism & interactions:Drug-receptor interactions, receptor theories and drug action, Xenobiotics, xenobiotics phases (Phase-I, Phase-II and Phase-III), role of cytochrome P450 oxidases and glutathione S-transferases in drug metabolism, factors affecting drug metabolism, Enzymes as a drug target, Kinase inhibitors, ATPase inhibitors, drug protein interaction, DrugDNA interaction. Basic ligand concepts-agonist, antagonist, partial agonist, inverse agonist, efficiency and potency. Forces involved in drug-receptor complexes. Receptor classification – the four super families. Receptor binding assays- measurement of Kd, Bmax and IC50. Drug intolerance and drug allergy. **(18 Hours)**

Unit IV

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. General principles of chemotherapy: chemotherapy of parasitic infections, fungal infections, viral diseases. Introduction to immunomodulators and chemotherapy of cancer. **(18 Hours)**

Unit V

Clinical trials (Phase-I, Phase-II, Phase-III and Phase-IV clinical trial). Main features of clinical trials, including methodological and organizational considerations and the principles of trial conduct and reporting. Key designs surrounding design, sample size, delivery and assessment of clinical trials. **(18 Hours)**

Text Books

1.Textbook of Drug Design. Krogsgaard-Larsen, Liljefors and Madsen (Editors), Taylor and Francis, London UK, 2002.

2.Drug Discovery Handbook S.C. Gad (Editor) Wiley-Interscience Hoboken USA, 2005

Reference Books

1.Practical Application of Computer-Aided Drug Design, Ed. Charifson P., Marcel Dekker Inc.

2.3D QSAR in Drug Design: Theory, Methods and Applications, Ed. Kubinyi H., Ledien .

3.Pharmaceutical Profiling in Drug Discovery for Lead Selection, Borchardt RT, Kerns, EH, Lipinski CA, Thakker DR and Wang B, AAPS Press, 2004

4.Drug Discovery and Development; Technology in Transition. HP Rang. Elsevier Ltd 1st edition 2006.

5.Pharmacology in Drug Discovery. T. P. Kenakin. Elsevier, 1st Edition 2012.

Course Code **23PBCC41**	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1a	**PSO 1b**	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO1	3	3	1	2	2	1	3	1	1	1
CO2	3	3	1	2	2	1	3	1	1	1
CO3	3	2	1	2	2	1	3	1	1	1
CO4	3	3	2	2	2	1	3	2	1	1
CO5	3	3	2	2	2	1	2	2	2	1

Strong (3) Medium (2) Low (1)

Dr.P.Annapoorani
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Dr, Sinthia Ganeshan
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Semester IV	**DEVELOPMENTAL BIOLOGY**	Hours/Week: 6	
Core Course - 11		Credits: 5	
Course Code **23PBCC42**		Internal 25	External 75

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

After completion of the course, the students should be able to:

CO1. Appreciate the principles of developmental biology and new terms involved[K2]

CO2. Apply the knowledge to study gametogenesis in model organisms like plants and animals like Drosophila [K3]

CO3. Analyze the crucial role of stem cells in regeneration and their application in tissue engineering [K3]

CO4. Compare various processes like morphogenesis, organogenesis and metamorphosis[K4]

CO5. Analyze the correlation between cell fate and senescence. [K4]

Unit I

Overview of Developmental biology: Background of Developmental biology - Principles of developmental biology –Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development. **(18 Hours)**

Unit II

Model organisms:Gametogenesis – production of gametes, Formation of zygote, fertilization and early development: molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants;cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination. Drosophila Developmental biology- Axis formation, Genes & mutation. C.elegans – Vulva formation, Axis formation. **(18 Hours)**

Unit III

Regeneration Developmental Biology:Stem cells – Definition, Classification, Embryonic and adult stem cells, properties, identification, Culture of stem cells, Differentiation and dedifferentiation, Stem cellmarkers, techniques and their applications in modern clinical sciences. Three- dimensional culture and transplantation of engineered cells. Tissue engineering - skin, bone and neuronal tissues. **(18 Hours)**

Unit IV

Morphogenesis & Organogenesis:Cell aggregation and differentiation in Dictyostelium; axes and pattern formation in Drosophila, amphibia and chick; organogenesis – vulva formation in Caenorhabditis elegans, eye lens formation, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development- larval formation, metamorphosis; environmental regulation of normal development; sex determination. **(18 Hours)**

Unit V

Cellular senescence and Cell fate decision :Cellular senescence – concepts &

Frizzled receptor in Development and disease. Diabetes and developmental biology,

Apoptosis: Cell death pathways in developments. Markers of important diseases.

(18 Hours)

Text Books

1. Arumugam.N. (2003). *A Text Book of Embryology*, Nagercoil, TamilNadu: Saras Publication, 1st Edition.
2. Subramanian.M.A. (2012). *Developmental Biology*, Chennai: MJP Publishers, Ist Edition.

Reference Books

1. Balinsky (1981). *An Introduction to Embryology*, Philadelphia: W.B. Saunders Company, 5th Edition.
2. Berill, N.J.(1971). *Developmental Biology*, London: MC Graw Hill, 1st Edition.
3. Saunder.J.W. (1982). *Developmental Biology – Pattern and Principles*, Newyork: Macmillan.

Course Code 23PBCC42	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	PSO 1a	PSO 1b	PSO 2	PSO 3a	PSO 3b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	3	3	3	3	2	2	2	2	2	2
CO 2	3	2	3	2	2	2	2	2	2	2
CO 3	3	3	3	3	2	2	2	2	2	2
CO 4	3	2	2	3	2	2	2	1	2	1
CO 5	3	3	3	3	2	2	2	2	2	2

Strong (3) Medium (2) Low (1)

Dr.P.Annapoorani — **Head of the Department**

Dr. R. Salini — **Course Designer**

V.V.VANNIAPERUMAL COLLEGE FOR WOMEN
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VIRUDHUNAGAR
Quality Education with Wisdom and Values

M.Sc. Biochemistry

(for those who join in 2023-2024)

Semester IV	**PROJECT**	Hours/Week: 6	
Core Course - 12		Credits: 5	
Course Code **23PBCC41PR**		Internal 40	External 60

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

CO1: discover the inter disciplinary knowledge to carry out project the work for the welfare of the society [K2]

CO2: Make use of literature review through existing digital platform to formulate the project work.[K3]

CO3: demonstrate proficiency in conducting literature reviews, gathering relevant data, and synthesizing information from multiple sources to inform their project. [K3]

CO4 : Develop an insight into the experiments carried out during the project work and conclude the findings with the existing results. [K4]

CO5 : analyse their own work and the work of others, identifying strengths, limitations, and areas for improvement [K4]

Project Specialisation Areas

- ✓ Clinical Biochemistry
- ✓ Molecular Biology
- ✓ Pharmacology
- ✓ Nanotechnology
- ✓ Microbiology
- ✓ Plant Biochemistry

- ✓ Marine Biology
- ✓ Environmental Biochemistry
- ✓ Nutritional Biochemistry
- ✓ **Bioinformatics and Computational Biology**
- ✓ **Immunology**
- ✓ **Structural Biology**
- ✓ **Chemical Biology**

Project Guidelines

- Project will be done by the final year students in the fourth semester under the guidance of respective guides.
- For projects internal marks will be awarded by the respective guide and external marks will be awarded in the external examinations held at the end of the semester.
- Only individual projects should be allotted.
- The report of the project must be in the prescribed form. It should be typed neatly in MS word (12 pt, Times New Roman, 1.5 spacing)
- The format of the project report should have the following components.
    - ❖ First page should contain:
      Title of the project report
      Name of the candidate
      Register number
      Name of the supervisor
      Address of the institution
      Month & year of submission
    - ❖ Contents
    - ❖ Certificate by supervisor
    - ❖ Declaration by candidate
    - ❖ Acknowledgement
    - ❖ Chapters
    - ❖ References

- The project report should be written in 30 - 40 pages.
- Three copies of the project report with binding should be submitted.

Evaluation Pattern (100 marks)				
Internal Assessment (40marks)			External Assessment (60 marks)	
Project Report (20)	Pre-Submission Presentation (10)	One Open online Course related to the Project (10)	Project Presentation (40)	Viva Voce (20)

Course Code 23PBCC41PR	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1a	**PSO 1b**	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO 1	3	3	3	3	2	2	2	3	3	3
CO 2	3	2	3	2	3	3	3	2	2	2
CO 3	3	3	3	3	3	3	3	2	2	2
CO 4	3	2	2	3	3	3	3	3	3	3
CO 5	3	3	3	3	2	2	3	3	3	3

Strong (3) Medium (2) Low (1)

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Head of the Department

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Semester IV	**BIOSAFETY, LAB SAFETY AND IPR**	Hours/Week: 6	
Discipline Specific Elective Course -3		Credits: 5	
Course Code **23PBCE41**		Internal 25	External 75

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

CO1: understand the biosafety, bioethics and Intellectual Property Rights concepts[K2]

CO2: illustrate about biosafety, laboratory safety and bioethics related to molecular technologies, GMOs IPR and patent filing [K3]

CO3: apply the concept of biosafety guidelines, bioethics, patenting and process of filing for a patent for the welfare of the environment and beneficial to the human beings [K3]

CO4: analyze biosafety, laboratory safety guidelines, regulatory compliances, patent and bioethics for the benefit of humankind [K4]

CO5: assess the importance of biosafety practices and guidelines, IPR, bioethics in research and development [K4]

Unit I

Biosafety: Historical background; introduction to biological safety cabinets; primary containment for biohazards; biosafety levels; recommended biosafety levels for infectious agents and infected animals; biosafety guidelines - government of India, roles of IBSC, RCGM, GEAC etc. for GMO applications in food and agriculture; environmental release of GMOs; risk assessment; risk management and communication; national regulations and international agreements. **(18 Hours)**

Unit II

Laboratory safety - Chemical, electrical and fire hazards; handling and manipulating human or animal cells and tissues, toxic, corrosive or mutagenic solvents and reagents; mouth pipetting, and inhalation exposures to infectious aerosols, Safe handling of syringe needles or other contaminated sharps, spills and splashes onto skin and mucous membranes. Health aspects; toxicology, allergenicity, antibiotic resistance.

History of biosafety microbiology and molecular biology, Risk assessment, Personal protective equipment, Laboratory facilities and safety equipment, Disinfection, decontamination, and sterilization, Regulatory compliance, Laboratory security and emergency response and administrative controls. **(18 Hours)**

Unit III

Intellectual Property Rights (IPR): Introduction to patents, types of patents, process involved in patenting in India, trademarks, copyright, industrial design, trade secrets, traditional knowledge, geographical indications, history of national and international treaties and conventions on patents, WTO, GATT, WIPO, Budapest Treaty, Patent Cooperation Treaty (PCT) and TRIPS. Patent databases: Searching international databases; analysis and report formation. Indian Patent Act 1970; recent amendments; filing of a patent application; precautions before patenting disclosure/non-disclosure; procedure for filing a PCT application. The patentability of microorganisms-claims, Characterization and repeatability disposition in the culture collections, legal protection for plants and other higher organisms, new plant varieties by rights, tissue culture protocols. **(18 Hours)**

Unit IV

Patent filing and infringement: Patent application- forms and guidelines, fee structure, time frames; types of patent applications: provisional and complete specifications; PCT and convention patent applications, International patenting-requirement, financial assistance for patenting-introduction to existing schemes; Publication of patents-gazette of India, status in Europe and US. Research Patenting: Patenting by researchers and scientists-University/organizational rules in India and abroad. Detailed information on patenting biological products, Case studies on patents (basmati rice, turmeric, neem etc.), and patent infringement. **(18 Hours)**

Unit V

Bioethics:Introduction to bioethics, human genome project and its ethical issues, genetic manipulations and their ethical issues, ethical issues in GMOs, foods and crops in developed and developing countries, environmental release of GMOs, ethical issues involved in stem cell research and use, use of animals in research experiments, animal cloning, human cloning and their ethical aspects, testing of drugs on human volunteers. (18 Hours)

Text Books

1.V. Shree Krishna, (2007). Bioethics and Biosafety in Biotechnology, New Age International Pvt. Ltd. Publishers.

2.Deepa Goel, Shomini Parashar, (2013). IPR, Biosafety and Bioethics, Pearson. (Unit II)

3.R. Ian Freshney, 2016. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 6th Ed, John Wiley & Blackwell.

4.BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007. (Unit I)

Reference Books

1.Biosafety in Microbiological and Biomedical Laboratories, (2020) 6th Ed. (https://www.cdc.gov/labs/pdf/SF__19_308133-A_BMBL6_00-BOOK-WEB-final3.pdf)

2.Kankanala C., (2007), Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd.

Course Code 23PBCE41	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	PSO 1a	PSO 1b	PSO 2	PSO 3a	PSO 3b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	3	3	2	2	1	1	1	1	1	2
CO 2	3	3	2	2	1	1	1	1	2	2
CO 3	3	3	3	3	2	3	3	2	2	3
CO 4	3	3	3	3	2	3	3	2	1	3
CO 5	3	3	3	3	2	3	3	2	1	3

Strong (3) Medium (2) Low (1)

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Semester IV	**PREPARATION FOR COMPETITIVE EXAMINATION - LIFE SCIENCES**	Hours/Week: 6	
SEC – 2 Professional Competency Skill		Credits: 3	
Course Code **23PBCS41**		Internal 25	External 75

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

CO1 : Recall the Basic Biological Concepts including biochemistry, inheritance biology, plant physiology,genetics, ecology, evolution and diversity life forms.[K1]

CO2: summarise the advanced topics such as biochemistry, inheritance biology, plant physiology genetics, ecology, evolution and diversity life forms. [K2]

CO3: Explain the concepts from multiple life sciences disciplines and interdisciplinary approaches to address complex biological questions and challenges.[K2]

CO4 : Discover the research Skills in literature review, experimental design, data interpretation, and scientific writing. [K3]

CO5 : Categorize life science concepts and develop expertise in a specific area of life sciences [K4]

Unit-I:

Microscopic techniques: Visualization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze- fracture methods for EM, image processing methods in microscopy. Electrophysiological methods: Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, fMRI, CAT . Methods in field biology: Methods of

estimating population density of animals and plants, ranging patterns through direct, indirect and remote observations, sampling methods in the study of behavior, habitat characterization: ground and remote sensing methods.

Immunology - Innate and adaptive immune system- Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity. B and T cell epitopes, structure and function of antibody molecules. generation of antibody diversity, monoclonal antibodies, antibody engineering, antigen-antibody interactions, MHC molecules, antigen processing and presentation, activationand differentiation of B and T cells, B and T cell receptors, humoral and cell- mediated immune responses, primary and secondary immune modulation, the complement system, Toll-like receptors, cell-mediated effector functions, inflammation, hypersensitivity and autoimmunity, immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, congenital and acquired immunodeficiencies, vaccines. (18 Hours)

Unit-II:

Inheritance biology : Mendelian principles : Dominance, segregation, independent assortment.Concept of gene : Allele, multiple alleles, pseudoallele, complementation tests. Extensions of Mendelian principles : Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.Gene mapping methods : Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants. Extra chromosomal inheritance : Inheritance of Mitochondrial and chloroplast genes, maternal inheritance. Microbial genetics : Methods of genetic transfers – transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes. Human genetics : Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders. Quantitative genetics : Polygenic inheritance, heritability and its measurements, QTL mapping. Mutation : Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis. Structural and numerical alterations of chromosomes : Deletion, duplication, inversion, translocation, ploidy and

their genetic implications. Recombination : Homologous and non-homologous recombination including transposition. (18 Hours)

Unit-III:

Ecological principles: The Environment: Physical environment; biotic environment; biotic and abiotic interactions. Habitat and Niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement. **Population** Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (*r* and *K* selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations. Species Interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis. Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones. Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax. Ecosystem Ecology: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine). Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India. Applied Ecology: Environmental pollution; global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches. Conservation Biology: Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves). (**18 Hours)**

Unit-IV:

Evolution and behaviour : Emergence of evolutionary thoughts-Lamarck; Darwin– concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis. Origin of cells and unicellular evolution: Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiement of Miller (1953); The first

cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism. Paleontology and Evolutionary History: The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionarytime scale; Origins of unicellular and multi cellular organisms; Major groups of plants and animals; Stages in primate evolution including Homo.Molecular Evolution:Concepts of neutral evolution, molecular divergence and molecular clocks; Molecular tools in phylogeny, classification and identification; Protein and nucleotide sequence analysis; origin of new genes and proteins; Gene duplicationand divergence. The Mechanisms: Population genetics – Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution. Brain, Behavior and Evolution: Approaches and methods in study of behavior; Proximate and ultimate causation; Altruism and evolution-Group selection, Kin selection, Reciprocal altruism; Neural basis of learning, memory, cognition, sleep and arousal; Biological clocks; Development of behavior; Social communication; Social dominance; Use of space and territoriality; Mating systems, Parental investment and Reproductive success; Parental care; Aggressive behavior; Habitat selection and optimality in foraging; Migration, orientation and navigation; Domestication and behavioral changes. **(18 Hours)**

Unit-V:

Diversity of life forms: Principles & methods of taxonomy- Concepts of species and hierarchical taxa, biological nomenclature, classical &quantititative methods of taxonomy of plants, animals and microorganisms.Levels of structural organization:Unicellular, colonial and multicellular forms. Levels of organization of tissues, organs & systems. Comparative anatomy, adaptive radiation, adaptive modifications.Outline classification of plants, animals & microorganisms:Important criteria used for classification in each taxon. Classification of plants, animals and microorganisms. Evolutionary relationships among taxa.Natural history of Indian subcontinent:Major habitat types of the subcontinent, geographic origins and migrations of species. Comman Indian mammals, birds.

Seasonality and phenology of the subcontinent.Organisms of health & agricultural importance:Common parasites and pathogens of humans, domestic animals and crops. Organisms of conservation concern:Rare, endangered species. Conservation strategies.

System physiology – plant : Photosynthesis - Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO2 fixation-C3, C4 and CAM pathways. Respiration and photorespiration – Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway. Nitrogen metabolism - Nitrate and ammonium assimilation; amino acid biosynthesis. Plant hormones – Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action. Sensory photobiology - Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks. Solute transport and photoassimilate translocation – uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates. Secondary metabolites - Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles. Stress physiology – Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses**.** **(18 Hours)**

Text Books

1. Nelson, L.Cox, M.M, Lehninger Principles of Biochemistry(2017),7th Edition W.H. Freeman and Sapling Learning: 978-1-4641-2611-6.
2. Prescott, LM, Prescott's Microbiology (2011) ,8th Edition,Mc Graw Hill Education: ISBN-13: 978-0071313674Jayaraman, J (2011), laboratory Manual in Biochemistry, New age publishers.
3. An Introduction to Genetic Analysis 12th edition, Griffith A. F, Doebley J, Peichel C, David A, Wassarman DA; Albion Press.W.H.Freeman & Co ,New York.
4. Devlin RM (1983) Plant Physiology (4th ed), PWS publishers
5. Jenni Punt, Sharon Stranford, Patricia Jones, and Judy Owen (2018) Kuby Immunology, 8th Edition, W.H. Freeman.

6. Prateek Sharma and N.P. Bali (2018) "Trueman's UGC CSIR-NET Life Sciences,1st Edition,Danika Publishing Company.

Reference Books

1. Taiz L , Zeiger E (2010), Plant Physiology (5th ed), Sinauer Associates, Inc.
2. Developmental biology: VIII edition, Gilbert, SF; Sinauer Associates, Inc.
3. Voet.D & Voet. J.G (2010) Biochemistry , (4th ed), John Wiley & Sons, Inc.
4. Metzler D.E (2003). The chemical reactions of living cells (2nd ed), Academic Press.
5. Zubay G.L (1999) Biochemistry , (4th ed), Mc Grew-Hill.
6. Lubert Stryer (2010) Biochemistry,(7th ed), W.H.Freeman.
7. Futuyma D, (2022) Evolution , (5th Ed.) , Oxford University Press.
8. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, and Ivan M. Roitt (2017),Roitt's Essential Immunology,13th Edition,Wiley-Blackwelx

Course Code 23PBCS41	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	PSO 1a	PSO 1b	PSO 2	PSO 3a	PSO 3b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	3	3	3	3	3	3	3	2	2	2
CO2	3	3	3	3	3	3	3	2	2	2
CO3	3	3	3	3	3	3	3	2	2	2
CO4	3	3	3	3	3	3	3	2	2	2
CO5	3	3	3	3	3	3	3	2	2	2

Strong (3) Medium (2) Low (1)

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