V.V.VANNIAPERUMAL COLLEGE FOR WOMEN
(Belonging to Virudhunagar Hindu Nadars)
An Autonomous Institution Affiliated to Madurai Kamaraj University, Madurai
Re-accredited with 'A' Grade (3rd Cycle) by NAAC
VIRUDHUNAGAR - 626 001

OUTCOME BASED EDUCATION WITH CHOICE BASED CREDIT SYSTEM REGULATIONS AND SYLLABUS
(with effect from Academic Year 2020 - 2021)

V.V.Vanniaperumal College for Women, Virudhunagar, established in 1962, offers 20 UG Programmes, 14 PG Programmes, 6 M.Phil. Programmes and 6 Ph.D. Programmes. The curriculua 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 the 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 and Computer Applications.

PG PROGRAMMES

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

* AICTE approved Programmes

PRE-DOCTORAL PROGRAMMES (M.Phil.)

Arts & Humanities	:	History, English, Tamil
Physical & Life Sciences	:	Mathematics, Biochemistry
Commerce & Management	:	Commerce

OUTLINE OF CHOICE BASED CREDIT SYSTEM - PG

1. Core Courses
2. Project
3. Elective Courses
   3.1 Discipline Specific Elective Courses (DSEC)
   3.2 Non Major Elective Course (NMEC)
4. Online Course – Practice for CSIR NET – General Paper
5. Extra Credit Courses (Optional)

List of Non Major Elective Courses (NMEC) Offered

PG PROGRAMMES

Name of the Course	Semester	Department
History of Freedom Movement in India (A.D. 1885 - 1947)	III	History
English for Job Aspirants	III	English
தமிழும பிறதுறைகளும	III	Tamil
Taxation Concepts and Assessment	III	Commerce
Entrepreneurship	III	Business Administration
Mathematics for Competitive Examinations	III	Mathematics
Digital Electronics	III	Physics
Chemistry for Competitive Examinations	III	Chemistry
Apiculture	III	Zoology
Nutrition and Health	III	Home Science - Nutrition and Dietetics
Clinical Biochemistry	III	Biochemistry
Web Programming	III	Computer Science
Fundamentals of Information Technology	III	Information Technology
Web Technology	III	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 channelize 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 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, synthesize the findings and provide valid conclusion by critical evaluation of theories, policies and practices for the betterment of society. (*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 in 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.

PO 2: *Communication Skills*

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

PO3: *Scientific Reasoning and Problem Solving*

PSO 3.a: Enrich their analytical and problem solving skills with regard to 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.

PO 4: *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

PO 5: *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 humankind by adhering the code of conduct of Biochemistry

PO 6: *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.

PO 7: *Co-operation/Team Work and Multicultural Competence*

PSO 7: Develop leadership qualities, team spirit and good interpersonal skills to work effectively in diverse fields individually or as a team

PO 8: *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 and society to maintain sustainable environment.

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.

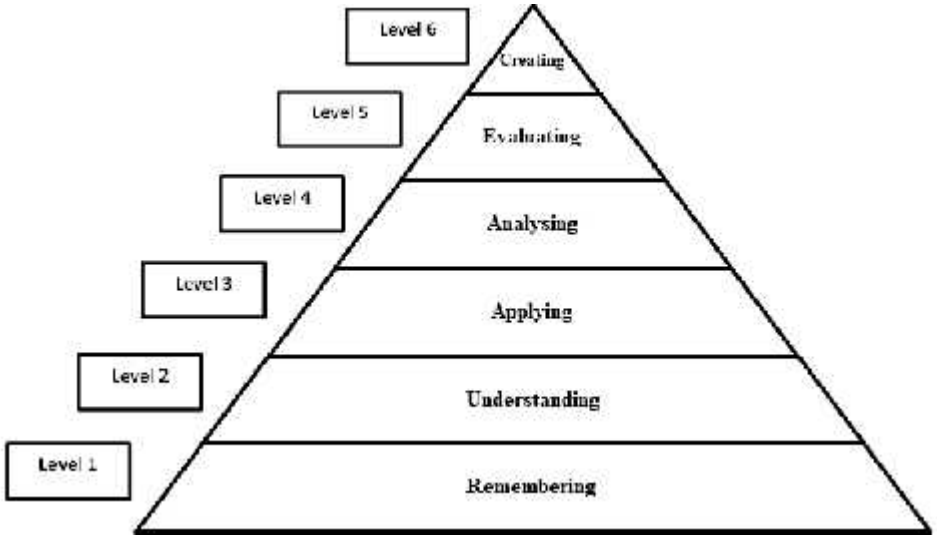
PEOs / POs/PSOs	PEO1	PEO2	PEO3
PO1/PSO1	✔	✔	✔
PO2/PSO2	✔	✔	✔
PO3/PSO3	✔	✔	✔
PO4/PSO4	✔	✔	✔
PO5/PSO5	✔	✔	✔
PO6/PSO6	-	✔	
PO7/PSO7	-	✔	✔
PO8/PSO8	✔	✔	✔

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 toany of the POs is indicated with (-), signifying Nil. Measurement Mapping is based on Four Points Scale [High (H), Medium (M), Low (L) and NilT(-)]. 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	40	60	**100**
Project	60	40	**100**

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

INTERNAL ASSESSMENT

Distribution of Marks Theory

Mode of Evaluation			Marks
Periodic Test		:	25
Assignment	K5 Level	:	5
Seminar		:	10
Total		**:**	**40**

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
Test	:	15
Model Examination		15
Performance	:	10
Total	**:**	**40**

Test - Better of two will be considered Model Examination - Better of two will be considered Performance
- Attendance and Record

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

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

*The total marks obtained in the Periodic Test will be calculated for 25 marks

Question Pattern **Duration: 3 Hours**

Section	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A Q.No.(1 - 5)	Multiple choice	5	5	1	5
B Q.No.(6-10)	Internal Choice- Either Or Type	5	5	5	25
C Q.No.(11-15)	Internal Choice- Either Or Type	5	3	10	30
Total					**60**

B.2.2 Project

Project is compulsory for II PG Students in IV Semester.

Distribution of Marks

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

Evaluation Pattern (100 marks)					
Internal Assessment (60marks)				External Assessment (40 marks)	
One Periodic Test (20)	Project Report (20)	Pre-Submission Presentation (10)	One Open online Course related to the Project (10)	Project Presentation (30)	Viva Voce (10)

B.2.3Online Course

Practice for CSIR NET - General Paper

Internal Examination only

- Online Test 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	:	40
Model Examination	:	60
Total	:	**100**

Two Periodic Tests - Better of the two will be considered

B.2.4 Extra Credit Courses

- Extra credits are allotted for the completion of Open Online Courses offered by MOOC to the maximum of 15 credits.
  - The Courses shall be completed within the first III Semesters of the Programme.
  - The allotment of credits is as follows

    4 weeks Course - 1 credit

    8 weeks Course - 2 credits

    12 weeks Course - 3 credits

EXTRA CREDIT COURSES (OPTIONAL) offered by the Department

Assessment by Internal Examiner only

Distribution of Marks
Question Pattern **Duration: 3 Hours**

Section	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A Q. No.(1- 9)	Multiple Choice	9	9	1	9
B Q. No.(10 -12)	Internal Choice – Either or Type	3	3	7	21
C Q. No.(13-15)	Open Choice	3	2	20	20
				Total	**50**

*The total marks obtained in the Test will be converted in to 100 Marks

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 60-75 days (66% - 84%) of attendance are permitted to appear for the Summative Examinations after paying the required fine amount and 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 in 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.

Attainment Levels of COs

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

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

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

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 attainment of 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 against 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
Extracurricular activities)]

Expected Level of Attainment for each of the Programme Outcomes

Pos	Level of Attainment
Value >= 70%	Excellent
Value > = 60 % and Value < 70%	Very Good
Value > = 50 % and Value < 60%	Good
Value > = 40% and Value < 50%	Satisfactory
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	25 % of the class strength	30 % of the class strength
Progression to Higher Education	40 % 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**

Expected Level of Attainment for each of the Programme Educational Objectives

POs	Level of Attainment
Value >= 70%	Excellent
Value > = 60 % and Value < 70%	Very Good
Value > = 50 % and Value < 60%	Good
Value > = 40% and Value < 50%	Satisfactory
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 stake holders 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 analyzed 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.

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MASTER OF SCIENCE- 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 2020-2021

Components	Semester				Total Number of Hours (Credits)
	I	II	III	IV	
Core Course	6 (5)	5 (4)	6 (5)	6 (5)	23 (19)
Core Course	6 (5)	5 (4)	6 (5)	6 (5)	23 (19)
Core Course	6 (5)	5 (4)	6 (5)	6 (5)	23 (19)
Core Course Practical	6 (3)	6 (3)	6 (3)	-	18 (9)
Core Course Practical	-	4(2)	-	-	4(2)
Project	-	-	-	12 (8)	12(8)
Discipline Specific Elective Course	6 (5)	5 (4)	-	-	11 (9)
Non Major Elective Course	-	-	5 (4)	-	5 (4)
Online Course	-	-	1 (1)	-	1 (1)
Total	**30 (23)**	**30 (21)**	**30 (23)**	**30 (23)**	**120 (90)**
Extra Credit Course (Optional) - MOOC	-	-	-	-	Limited to a maximum of 15 credits
Extra Credit Course (Optional)		**2**			2

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VIRUDHUNAGAR - 626 001

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	Chemistry of Biopolymers	20PBCC11	6	5	3	40	60	100
2	Core Course-2	Principles of Biochemical and Biophysical Techniques	20PBCC12	6	5	3	40	60	100
3	Core Course-3	Biochemical and Environmental Toxicology	20PBCC13	6	5	3	40	60	100
4	Core Practical-1	Biochemical Techniques and Analysis Lab	20PBCC11P	6	3	6	40	60	100
5	DSEC-1	DSCE-Cellular Biochemistry and Virology/ Enzymes and Enzyme Technology/ Dairy Biochemistry	20PBCE11/ 20PBCE12/ 20PBCE13	6	5	3	40	60	100
				30	**23**				**500**

DSEC- Discipline Specific Elective Course

M.Sc. BIOCHEMISTRY -SEMESTER II

S. No	Components	Title of the Cours	Course Code	Hours per Week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
1	Core Course -4	Endocrinology and Metabolic Regulation	20PBCC21	5	4	3	40	60	100
2	Core Course -5	Microbial Biochemistry and Fermentation	20PBCC22	5	4	3	40	60	100
3	Core Course -6	Molecular Biology and Genetic Engineering	20PBCC23	5	4	3	40	60	100
4	Core Practical -2	Microbiology and Molecular biology	20PBCC21P	6	3	6	40	60	100
5	Core Practical-3	Bioinformatics Lab	20PBCC22P	4	2	3	40	60	100
6	DSEC-2	DSEC- 1. Plant Biochemistry/ 2. Bioinformatics and Nanotechnology / Molecular Mechanism of	20PBCE21/ 20PBCE22/ 20PBCE23	5	4	3	40	60	100
				30	**21**				**600**

DSEC- Discipline Specific Elective Course

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	Immunochemistry	20PBCC31	6	5	3	40	60	100
2	Core Course-8	Biostatistics	20PBCC32	6	5	3	40	60	100
3	Core Course-9	Eukaryotic Gene Expression	20PBCC33	6	5	3	40	60	100
4	Core Practical-4	Immunology and Advanced Biochemistry lab	20PBCC31P	6	3	6	40	60	100
5	NMEC	NME - Clinical Biochemistry (Basics)	20PBCN31	5	4	3	40	60	100
6	Online Course	Practice for CSIR NET - General Paper	20PGOL32	1	1	-	100	-	100
			Total	**30**	**23**				**600**

NMEC: Non Major Elective Course

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	Environmental Biochemistry	20PBCC41	6	5	3	40	60	100
2	Core Course-11	Clinical Biochemistry	20PBCC42	6	5	3	40	60	100
3	Core Course-12	Developmental Biology and Genetics	20PBCC43	6	5	3	40	60	100
4	Project	Project Viva - Voce	20PBCC41PR	12	8	6	40	60	100
				30	**23**				**400**

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MASTER OF BIOCHEMISTRY
Programme Code - 7015
REVISED 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	Chemistry of Biopolymers	20PBCC11	6	5	3	40	60	100
2	Core Course-2	Principles of Biochemical and Biophysical Techniques	20PBCC12	6	5	3	40	60	100
3	Core Course-3	Biochemical and Environmental Toxicology	20PBCC13	6	5	3	40	60	100
4	Core Practical-1	Biochemical Techniques and Analysis Lab	20PBCC11P	6	3	6	40	60	100
5	DSEC-1	DSCE-Cellular Biochemistry and Virology/ Enzymes and Enzyme Technology/Dairy Biochemistry	20PBCE11/ 20PBCE12/ 20PBCE13	6	5	3	40	60	100
			Total	**30**	**2**				**500**

DSEC- Discipline Specific Elective Course

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	Endocrinology and Metabolic Regulation	20PBCC21N	5	4	3	40	60	100
2	Core Course -5	Microbial Biochemistry and Fermentation	20PBCC22N	5	4	3	40	60	100
3	Core Course -6	Molecular Biology and Genetic Engineering	20PBCC23N	5	4	3	40	60	100
4	Core Practical -2	Microbiology and Molecular biology Techniques Lab	20PBCC21P	6	3	6	40	60	100
5	Core Practical-3	Bioinformatics Lab	20PBCC22P	4	2	3	40	60	100
6	DSEC-2	DSEC- 1. Plant Biochemistry/ 2. Bioinformatics and Nanotechnology/ Molecular	20PBCE21N / 20PBCE22/ 20PBCE23	5	4	3	40	60	100
			Total	**30**	**21**				**600**
7	Extra Credit Course (Optional)	Biosafety, laboratory safety and IPR	22PBCO21		**2**				**100**

DSEC- Discipline Specific Elective Course

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	Immunochemistry	20PBCC31	6	5	3	40	60	100
2	Core Course-8	Biostatistics	20PBCC32N	6	5	3	40	60	100
3	Core Course-9	Eukaryotic Gene Expression	20PBCC33N	6	5	3	40	60	100
4	Core Practical-4	Immunology and Advanced Biochemistry lab	20PBCC31P	6	3	6	40	60	100
5	NMEC	NME - Clinical Biochemistry (Basics)	20PBCN31	5	4	3	40	60	100
6	Online Course	Practice for SET/NET Preparation -	20POLG31	1	1	-	100	-	100
General			**Total**	**30**	**23**				**600**

NMEC: Non Major Elective Course

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	Environmental Biochemistry	20PBCC41N	6	5	3	40	60	100
2	Core Course-11	Clinical Biochemistry	20PBCC42N	6	5	3	40	60	100
3	Core Course-12	Developmental Biology and Genetics	20PBCC43N	6	5	3	40	60	100
4	Project	Project - Research Methodology & Ethics	22PBCC41PR	12	8	6	40	60	100
			Total	**30**	**23**				**400**

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M.SC. BIOCHEMISTRY

(2020 -2021 onwards)

Semester I	**CHEMISTRY OF BIOPOLYMERS**	Hours/Week: 6	
Core Course-1		Credits: 5	
Course Code **20PBCC11**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: describe the composition, classification of biomolecules and its essential role in the biological system. [K2]

CO2: sketch the structure of biomolecules and its properties. [K3]

CO3: identify the mechanism of action of biomolecules along with their structural relationship. [K3]

CO4: evaluate the methods involved in the isolation and purification of macromolecules. [K4]

CO5: compile the structural difference in biomolecules and techniques involved in biomolecules structure identification. [K5]

UNIT I

Introduction to Biomolecules: Chemistry of monomeric units, polysaccharides, proteins and nucleic acids [structure and function only]. Isolation and purification of polysaccharides, proteins and nucleic acids. Determination of molecular weight and shape of polysaccharides, proteins and nucleic acids. Protein- nucleic acid interaction and protein- other biological polymers interaction.

(15 Hours)

UNIT II

Structural Investigation of Polysaccharides: General methods of investigating the structure- methylation, acetylation, degradation by acid hydrolysis, enzymatic hydrolysis and per- iodate oxidation methods. Occurrence, structure, isolation, properties, purification and biological functions of glycans. A brief account of chitin, fructans, mannans, xylans, arabinans, galactans and galacturonans. Occurrence, structure, isolation, purification, properties and biological functions of mucopolysaccharides, bacterial cell wall polysaccharides, sialic acids and blood group substances. A brief account of polysaccharides with a xylose backbone, polysaccharides with glucose and mannose backbone. (20 Hours)

UNIT III

Properties of Proteins: Terminology- peptide bond, peptide, polypeptide and protein, functions of protein. Structures- levels of structures of protein [primary structure, secondary, tertiary and quaternary] conformation of protein structure, their analysis and forces, molecular modeling. Properties of proteins in aqueous solutions: Isoelectric pH, acid base properties, electrophoretic mobility, influence of ionic concentration on the protein solubility, hydrolysis of proteins, denaturation and renaturation of proteins. (20 Hours)

UNIT IV

Metalloprotein: Metalloenzymes- Carboxypeptidase, Superoxide dismutase, Signal transduction protein: Calmodulin, Oxygen carriers: Cytochrome & Hemoglobin, Structural Protein-Occurrence & Structure of Keratin, Collagen. (15 Hours)

UNIT V

Nucleic acid Analysis: Structure of nucleic acid, chemical and enzymatic methods of sequence analysis, properties of DNA in aqueous solution- sedimentation behavior, viscosity, hyperchromic effect, melting point of DNA and hydrolysis of nucleic acids, Hybridization techniques and chemical synthesis of nucleic acids. (20 Hours)

TEXT BOOKS

1. West E. S. & Todd W. R. (1974), *Text book of Biochemistry*, 4th Edition. New York: MacMillan Publishing Company.
2. Lehninger. (2012), *Principles of Biochemistry*, 5thEdition, W H Freeman & Co.

REFERENCE BOOKS

1. Nathan Sharon. (1978). *Complex carbohydrates*, 2ndEdition.Kluwer Academic *Publishers*, Dordrecht.
2. Charles R. Cantor, Paul R. Schimmel. (1989) ,*Biophysical Chemistry*, San Francisco: W.H. Freeman and Company.
3. Geoffrey L.Zubay. (1998). *Biochemistry*, 4th edition, USA: Wm.C. Brown *Publishers*.
4. Ward Pigmann. (1977). *The carbohydrates*, 2nd Edition, Academic Press.
5. Ronald Voet& Judith G.Voet. (2006). *Biochemistry*, 2nd Edition. U.S.A: John Wiley & Sons.
6. Adams. (1986). *Biochemistry of the Nucleic acid–*, 10th Edition. Springer.

Course Code 20PBCC11	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	H	H	M	H	M	H	H	M	-	-
CO2	H	H	M	M	L	H	M	H	-	-
CO3	H	H	H	M	L	H	H	M	L	H
CO4	H	H	M	H	M	H	M	M	H	L
CO5	H	H	M	H	M	H	M	M	H	H

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M.SC. BIOCHEMISTRY

(2020 -2021 onwards)

Semester I	**PRINCIPLES OF BIOCHEMICAL AND BIOPHYSICAL TECHNIQUES**	Hours/Week: 6	
Core Course-2		Credits: 5	
Course Code **20PBCC12**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: understand the Biophysical, Biochemical and Molecular Biology techniques. [K2]

CO2: apply the separation procedures such as Centrifugation, Chromatography and Eletrophoretic 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: evaluate the principles and techniques of Biochemistry that motivates the students for higher education, acquiring skills in separation techniques to identify different biomolecules, undertaking research, and for becoming health professionals. [K5]

UNIT I

Stoichiometry: Normality, Molarity, Molality and Milliosmoles. Ionic strength. pH. pOH, Henderson-Hesselbach equation, Buffers, pH of body fluids. Measurement of pH by indicators, Zwitterions. pH dependent ionization of amino acids and proteins. Colloids and their applications, Viscosity, Surface tension and Donnan membrane equilibrium. Principles of electrochemical techniques-measurement of pH by glass electrode and hydrogen electrode Oxygen electrode-principles, operation of a Clarke electrode and its applications.

(20 Hours)

UNIT II

Electrophoresis: Electrophoresis – Principle, types- Agarose gel electrophoresis, SDS – Polyacrylamide Gel Electrophoresis, 2D-Polyacrylamide Gel Electrophoresis, Immunoeletrophoresis. Visualizing protein bands-CBB and Silver Staining. MS-MALDI-TOF. Introduction to proteomics.

(15 Hours)

UNIT III

Chromatography & Centrifugation: Chromatography-Principle, Procedure and Applications of GLC, HPLC, FPLC Cell Fractionation Techniques- Cell lysis, Differential and density gradient centrifugation. Ultracentrifugation-Preparative and Analytical Ultracentrifuge.

(15 Hours)

UNIT IV

Spectroscopy: Spectroscopy- X-ray crystallography, X-ray fiber diffraction, X-ray scattering. NMR, ESR, Spectro fluorimetry, Flame photometry, UV Spectroscopy, FTIR, Biochips (DNA chips, Protein chips, Sensor chips) Atomic Absorption Spectroscopy, and Raman Spectroscopy

(20 Hours)

UNIT V

Molecular Biology Techniques: Isolation of Nucleic acids, Restriction endonucleases, Restriction mapping, Nucleic acid probes, Oligonucleotide probes and labelling of nucleic acid probes. Nucleic acid hybridization- Southern, Northern, Western hybridization, Restriction fragment length polymorphism. DNA finger printing, Polymerase chain reaction. (20 Hours)

TEXT BOOK

1. V.Kumaresan (2012), *Biotechnology* , 6th edition, Saras Publication

REFERENCE BOOKS

1. Keith Wilson & John Walker (1995), *Practical Biochemistry, Principles & Techniques*, 4th Edition, Cambridge University Press.
2. VinashUpadhay, Kakoli Upadhyay and Nirmalendu Nath (2002), *BioPhysical Biochemistry, Principles & Techniques*, 3rd Edition, Himalaya Pub. House, Mumbai.
3. Boyer.R (2000), *Modern Experimental Biochemistry*.3rdedition. Addison-Wesley Pub. Co. University of Michigan.

Course Code 20PBCC12	PO1		PO2	PO3		PO4	PO 5	PO6	PO7	PO8
	PSO 1a	PSO 1b	PSO 2	PSO 3a	PSO 3b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	H	H	L	M	M	M	-	M	M	-
CO2	H	H	H	H	H	H	-	M	M	-
CO3	H	H	H	H	H	H	M	M	M	-
CO4	H	H	M	H	H	H	M	M	M	M
CO5	H	H	H	M	H	H	M	M	M	M

Dr.R.Mallika
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M.SC. BIOCHEMISTRY
(2020 -21 onwards)

Semester I	**BIOCHEMICAL AND ENVIRONMENTAL TOXICOLOGY**	Hours/Week: 6	
Core Course-3		Credits: 5	
Course Code **20PBCC13**		Internal 40	External 60

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: assess the techniques and methods of toxicity and fate of toxicants in humans. [K5]

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. Principles of selective toxicity: cooperative morphology, comparative biochemistry, comparative cytology. Toxicity assessment: acute, subchronic, chronic exposure, determination of ED50 and LD50 values, tests for mutagencity, carcinogenicity, genotoxicity, Ames test. (20 Hours)

UNIT II

Disposition of Toxicants: Factors affecting disposition of toxicants: absorption, distribution, biotransformation, elimination. Absorption through gastro-intestinal tract, lungs, skin. Distribution: Storage in tissues, blood-brain barrier, passage across placenta, redistribution. Biotransformation, Phase I and II reactions, metabolic interrelationship, antidotal therapy. Excretion: urinary, fecal, exhalation, other routes. Toxicokinetics: classical and physiological kinetics. (15 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. (15 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. (20 Hours)

UNIT V

Applications of Toxicology: Food toxicology: Role of diet in cardiovascular diseases and cancer. Toxicology of food additives. 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. (20 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 20PBCC13	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	H	M	H	M	M	H	M	L	-	-
CO2	H	H	H	H	M	H	H	L	M	H
CO3	H	H	M	H	M	H	H	M	M	H
CO4	H	H	H	H	M	H	H	M	M	H
CO5	H	H	H	H	M	H	H	m	H	H

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M.SC. BIOCHEMISTRY

(2020 -21onwards)

Semester: I	**BIOCHEMICAL TECHNIQUES AND ANALYSIS LAB**	Hours/Week: 6	
Core Practical-1		Credits: 3	
Course Code **20PBCC11P**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: apply the principles and methodologies of partial enzyme purification, spectrophotometry and chromatographic techniques in biomolecules analysis.[K3]

CO2: sketch flowcharts for the partial enzyme purification, spectrophotometry and Chromatographic techniques of various bioanalytes. [K3]

CO3: observe and calculate the results for the spectrophotometry, chromatographic techniques of biological samples and complete the record work. [K3]

CO4: infer the normal and abnormal parameters of biological samples analyzed by spectrophotometry, chromatographic techniques. [K4]

CO5: evaluate the outcomes of the modifications in sample analysis using spectrophotometry, chromatographic Techniques. [K5]

Experiments

1. Buffer preparation, pka value

2. Spectrometric estimation

(i) Estimation of Riboflavin

(ii) Estimation of Thiamine

(iii) Estimation of Calcium

(iv) Estimation of amino acid by formal titration

(v) Estimation of iron by Wong's method.

3. Secondary metabolites analysis
   (i) Phenol
   (ii) Flavonoids
4. Lipid separation by TLC
5. Serum aminoacids separation by paper chromatography
6. Partial purification of enzymes by column chromatography : Amylase /urease/alkaline Phosphatase. Enzyme kinetics: determination of Km and Vmax

REFERENCE BOOKS

1. Palanivelu P.(2004) *Analytical Biochemistry & Separation Techniques* ,Palkalai Nagar, Madurai:4/e, 21st Century Publication.
2. Harold Varley (1980), *Practical Clinical chemistry*-Vol.1&II ,5thedition.New York: Inter Science Publishers, Inc.
2. Sadasivam .S& A. Manickam (1996), *Biochemical Methods*, 2nd edition. New Delhi: India NewAge International Publishers.

Course Code 20PBCC11P	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	M	M	M	M	M	M	M	M	-	M
CO2	M	M	M	M	M	M	M	M	-	M
CO3	H	H	H	H	H	M	H	L	-	H
CO4	H	H	H	H	H	H	H	M	-	H
CO5	H	H	H	H	H	H	H	M	L	H

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M.SC. BIOCHEMISTRY

(2020 -2021 onwards)

Semester I	**CELLULAR BIOCHEMISTRY AND VIROLOGY**	Hours/Week: 6	
DSEC-1		Credits: 5	
Course Code **20PBCE11**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: comprehend the chemical composition of cell membrane, cellular processes on the plasma membrane, regulated and unregulated events inside and outside the cell. [K2]

CO2: identify the occurrence of cellular mechanisms at molecular level based on ionic transport, ATP synthesis, cell signaling and cell division process. [K3]

CO3: apply the knowledge about plasma membrane on various cellular events & infer the link between the life cycle of viruses and oncogenesis mechanism. [K3]

CO4: dissect a cellular problem into its key features by thinking in an integrated manner and examining the problems from a different perspective. [K4]

CO5: interpret the cell biological principles based on sound scientific principles and correlating them with the modern cell biology research. [K5]

UNIT I

Molecular organization: Freeze fracture and fluid mosaic model. Composition: membrane lipids, membrane protein, membrane fluidity and molecular mobility of lipids and proteins. Model membrane isolation: Techniques of making multilamellar vesicles, bilayer reconstitution of proteins into vesicles, liposomes. Isolation and characterization of plasma membrane. Membrane fusion in exocytosis and endocytosis. (20 Hours)

UNIT II

Electron Transport Chain: Structure of mitochondria, respiratory chain - Enzyme complexes, inhibitors and uncouplers of respiratory chain, energy transfer, oxidative phosphorylation, proton gradient and ATP synthesis- F1 ATPase. (13 Hours)

UNIT III

Membrane transport: Small molecules- simple diffusion, Facilitated diffusion- pores, channels, properties. Carriers- specific ionophores. Active transport- Na pump, Ca^{2+} pump. Secondary active transport-Na dependent active transport. (12 Hours)

UNIT IV

Cell junctions: Desmosomes, tight junction, gap junctions. Extracellular matrix- Collagen, chemistry and assembly. Organization and role in cell adhesion- proteoglycans and glycosaminoglycans, elastin. Molecular aspects of cell division- Cell cycle. Membrane receptors, communications: chemical signaling between cells- hormones and neurotransmitters. Signal transduction: cAMP, G protein, IP. Structure and organization of the nervous system.

(27 Hours)

UNIT V

Bacteriophages & Cancer Biology: Tumor viruses: DNA virus- SV40 replication, RNA viruses - RSV replication. Cancer Biology- cell cultures, cell lines, and cell transformation. Chemical differences between normal and cancer cells, surface changes in cancer cells. Agents that cause cancer in animals. Chemical carcinogens and radiation. Oncogenesis mechanism. MTT assay. Comet assay. (18 Hours)

TEXT BOOKS

1. Powar C.B. (1992), *General Microb*iology, Vol–II ,2nd Edition, Himalaya Pub. House, Mumbai.
2. Gerald Karp (1999), *Cell & Molecular Biology*, John Wiley &sons, Newyork.
3. Becker, Kleinsmith, Hardin (2002). *The world of the cell*, 4th Edition, Benjamin Cummings.

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. De Robertis (2005), *Cell and Molecular Biology*, 8th Edition, B.I.Waverly Pvt Ltd, New Delhi.

Course Code 20PBCE11	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	M	M	M	L	L	-	H	-	-	L
CO2	M	L	L	M	M	M	H	M	-	L
CO3	H	H	H	H	H	M	H	M	-	-
CO4	H	H	H	H	H	H	H	H	L	H
CO5	H	H	H	H	H	H	H	H	L	H

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M.SC. BIOCHEMISTRY

(2020 -2021 onwards)

Semester I	**ENZYMES AND ENZYME TECHNOLOGY**	Hours/Week: 6	
DSEC-1		Credits: 5	
Course Code **20PBCE12**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: describe the structure, functions, mechanism of action of enzymes, kinetics of enzyme catalyzed reactions, enzyme inhibitions, regulatory process and their application in commercial production. [K2]

CO2: apply their knowledge in the commercial synthesis of novel products using the enzyme kinetics in living systems. [K3]

CO3: compare and contrast the uses of enzyme technology with current applications in a diverse range of industries. [K3]

CO4: evaluate the function of cofactors in enzyme catalyzed reactions, immobilization of enzymes, exposure of wide applications of enzymes and future potential. [K4]

CO5: detect the immobilization of enzymes, commercial enzyme production and the presence of aminoacids in the active sites. [K5]

UNIT I

Introduction: Active site-definition, salient features, list of functional groups, Identification of amino acids present in the active site by chemical modification, affinity labeling and site directed mutagenesis. Specificity of enzymes. Cofactor as carriers: Redox carriers (NAD/NADP, flavoprotein, lipoate, glutathione, ascorbic acid, quinines, cytochromes). Carriers of one carbon group - (Tetrahydrofolate, Homocysteine, Biotin), Phosphate carrier (ATP), Glycosyl carrier (UTP). (15 Hours)

UNIT II

Enzyme Kinetics: Concept of ES complex, derivation of Michaelis-Menten equation for uni-substrate reactions. Different plots for the determination of Km &Vmax and their physiological significance. Importance of Kcat/Km. Enzyme inhibition: Irreversible inhibition and reversible- Competitive, non- competitive, uncompetitive. Reactions of two substrates. (20 Hours)

UNIT III

Enzyme Regulation: Allosteric enzyme –definition, classification and properties. Allosteric regulation - Concerted model of Monod *et al.,* and sequential model of Koshland *et al*., allosteric and feedback inhibition. NAD/NADH ratio, adenylate charge. (15 Hours)

UNIT IV

Mechanism Enzyme action: Activation energy, Fischer's Lock and Key hypothesis and Koshland's induced fit model. Proximity and orientation effect, Strain & distortion theory. Acid – base catalysis - Ribonuclease, Lysozyme. Covalent catalysis – Chymotrysin, Carboxy peptidase. Multienzyme complex.

(25 Hours)

UNIT V

Enzyme technology: Immobilized enzyme: Techniques of immobilization and its applications. Commercial production of enzymes – amylases, cellulases, pectinases, protease and applications of enzymes in industries. Enzyme as Biosensor - Calorimetric biosensor and Immunosensor. Enzyme engineering, artificial enzymes in organic solvents.

(15 Hours)

TEXT BOOKS

1. Ronald Voet & Judith G.Voet (2006), *Biochemistry*, 2nd Edition, John Wiley & Sons, U.S.A
2. J.L.Jain, Nitin Jain and Sunhay Jain (2013*), Fundamentals of Biochemistry*, 6th edition, S.Chand publishing.
3. Dr.P.Asokan (2003), *Enzyme*s, 1st edition, Chinnaa Publications.
4. R.C.Dubey and D.K.Maheswari (2013), *Text book of Micro*biology,4thedition,S Chand Publishing.

REFERENCE BOOKS

1. Pandey, A. Webb, C., Soccol C.R. and Larroche, C. (2004).*Enzyme Technology*, Published by Asia Tech Publishers INC. New Delhi.
2. Dixon and Web (1979), *Enzymes*, 3 rd Edition , Academic Press, New York
3. Geoffrey L.Zubay (1998), *Biochemistry*, 4th edition, Wm.C. Brown *Publishers*, USA
4. Trevor Palmer (2001), *Enzymes: Biochemistry*, *Biotechnology and Clinical Chemistry*, Horwood.
5. Martin Chaplin and Christopher Bucke (1990). *Enzyme Techn*ology, Cambridge University Press.

Course Code 20PBCE12	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	H	H	M	M	M	H	M	-	-	-
CO2	H	H	M	M	M	M	M	-	-	M
CO3	H	M	M	M	M	M	M	-	-	-
CO4	H	H	M	M	M	H	H	-	-	M
CO5	H	H	M	M	M	M	H	-	-	M

Dr.P.Annapoorani
Head of the Department

K.Sudha Rameshwari
Course Designer

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VIRUDHUNAGAR - 626 001

M.SC. BIOCHEMISTRY

(2020 -2021 onwards)

Semester I	**DAIRY BIOCHEMISTRY**	Hours/Week: 6	
DSEC-1		Credits: 5	
Course Code **20PBCE13**		Internal 40	External 60

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: design methods of dairy production, and refrigeration and storage techniques. [K5]

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.

(20 Hours)

UNIT II

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

(15 Hours)

UNIT III

Homogenization – Definition, Effect of Homogenization on Physical properties of Milk.

Elementary knowledge about indigenous and modern dairy products.

(15 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. (20 Hours)

UNITV

Adulteration in milk & their detection, Defects in Market Milk, Standardized Milk, Manufacturing of Special Milk – Toned, Doubled Toned, Reconstituted, Recombined, Flavored Milk (20 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 20PBCE13	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	H	H	M	M	M	M	M	M	M	M
CO2	H	H	M	H	H	M	M	M	-	-
CO3	H	M	H	M	M	H	M	-	-	M
CO4	H	H	M	H	H	M	H	M	M	-
CO5	H	H	H	H	H	H	H	-	-	-

Dr.P.Annapoorani
Head of the Department

M.Rajakumari
Course Designer

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M.SC. BIOCHEMISTRY

(2020 -2021 onwards)

Semester II	**ENDOCRINOLOGY & METABOLIC REGULATION**	Hours/Week: 5	
Core Course-4		Credits: 4	
Course Code **20PBCC21**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: demonstrate various metabolic pathways of various biomolecules, hormones of endocrine glands and their mechanism of action. [K2]

CO2: apply the crucial role of hormones with regard to the integration of metabolic Pathways. [K3]

CO3: find the integrated approach of anabolic and catabolic pathways of various biomolecules mediated by hormones. [K3]

CO4: analyze the role of hormones and key enzymes that regulate various metabolic Pathways. [K4]

CO5: assess the involvement of hormones and organs in the metabolic pathways of the living System. [K5]

UNIT I

Introduction to Hormones: Characteristics of hormone system, functions & mechanism of action of hormones. Growth factors: somatomedin & erythropoietin, Nerve growth factor, epidermal growth factor, fibroblast growth factor, GI tract hormones. Chemistry, biosynthesis, secretion, biochemical actions of pituitary, thyroid, parathyroid, adrenal & gonadal hormones. (15 Hours)

UNIT II

Hormonal regulation of carbohydrate metabolism: Glycolysis & gluconeogenesis: Phosphofructokinase as the key enzyme in glycolysis; role of fructose 2, 6 diphosphate in liver & muscle; hexokinase and pyruvate kinase as regulatory enzymes in glycolysis, pyruvate dehydrogenase complex & its regulation. Reciprocal of glycolysis & gluconeogenesis (15 Hours)

UNIT III

Glycogen metabolism: Glycogen as an efficient storage form of glucose, cAMP& coordinated control of Glycogenesis & Glycogenolysis. Phosphorylase activation & inactivation. Effect of phosphorylation of synthase. Action of phosphatases. HMP shunt - glucose – 6- phosphate dehydrogenase as a regulatory enzyme – role of NADPH in metabolism. TCA cycle, Citrate synthase, Isocitrate dehydrogenases & α- Ketoglutarate dehydrogenase as regulatory site in TCA cycle. Transport of NADH into mitochondria. (15 Hours)

UNIT IV

Fatty acid and Amino acid Metabolism: Control of Acetyl-coA carboxylase, role of hormones, effect of diet on fatty acid synthesis. Regulation of biosynthesis of Triacylglycerol, cholesterol, phosphatidyl ethanolamine sphingomyelin. Metabolism of triacylglycerol during stress. Fatty acid oxidation, role of carnitine control of oxidation, regulation of ketogenesis, Metabolism of aromatic amino acids, prostaglandins & thromboxanes. (15 Hours)

UNIT V

Urea Cycle & Nucleic Acid Metabolism: Regulation of glutamate dehydrogenase & Urea cycle. Regulation of purine & pyrimidine nucleotide biosynthesis. Integration of metabolism: Key junction in metabolism: Glucose- 6- PO_4, Pyruvate & Acetyl coA. Metabolic profiles of major organs – Brain, muscle, liver and adipose tissue. (15 Hours)

TEXT BOOKS

1. Stryer L (2003). *Biochemistr*y 2nd Edition, W.H. Freeman and Company, NY.
2. Chatterjee (2011), *Text book of Medical Biochemistry*, 8th edition, **Jaypee** Brothers *Medical* (P) Ltd. New Delhi.
3. Lehninger A.L. (2008). *Principles of Biochemistry* , 5th edition, Palgrave Macmillan UK.

REFERENCE BOOKS

1. Ronald Voet& Judith G.Voet (2006), *Biochemistry*, 2nd Edition, John Wiley & Sons, U.S.A
2. Geoffrey L.Zubay (1998), *Biochemistry*, 4th edition, Wm.C. Brown *Publishers*, USA.
3. Conn E.E., Stumpf P.K ,Bruening G (1987). *Outlines of Biochemistry* 5/e –R.H, John Wiley & Sons, USA.
4. Voet D & Voet J.G (1990). *Biochemistry*, John Wiley & Sons, NY.

Course Code 20PBCC21	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	M	M	M	L	L	L	M	-	-	-
CO2	H	H	L	M	M	M	M	-	-	H
CO3	H	H	M	H	H	M	H	M	-	H
CO4	H	H	H	H	H	H	H	M	L	H
CO5	H	H	H	H	H	H	H	H	L	H

Dr.P.Annapoorani
Head of the Department

Mrs. R.Gloria Jemmi Christobel
Course Designer

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M.Sc. BIOCHEMISTRY

(2022 -2023 onwards)

Semester II	**ENDOCRINOLOGY & METABOLIC REGULATION**	Hours/Week: 5	
Core Course-4		Credits: 4	
Course Code **20PBCC21N**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: demonstrate various metabolic pathways of various biomolecules, hormones of endocrine glands and their mechanism of action [K2]

CO2: apply the crucial role of hormones with regard to the integration of metabolic Pathways [K3]

CO3: find the integrated approach of anabolic and catabolic pathways of various biomolecules mediated by hormones. [K3]

CO4: analyze the role of hormones and key enzymes that regulate various metabolic pathways [K4]

CO5: assess the involvement of hormones and organs in the metabolic pathways of the living system [K5]

UNIT I

Introduction to Hormones: Characteristics of Hormone System, Functions & Mechanism of Action of Hormones. Growth Factors: Somatomedin & Erythropoietin, Nerve Growth Factor, Epidermal Growth Factor, Fibroblast Growth Factor, GI Tract Hormones. Chemistry, Biosynthesis, Secretion, Biochemical Actions of Pituitary, Thyroid, Parathyroid, Adrenal & Gonadal Hormones (15 Hours)

UNIT II

Hormonal Regulation of Carbohydrate Metabolism: Glycolysis & Gluconeogenesis: Phosphofructokinase As The Key Enzyme in Glycolysis; Role of Fructose 2, 6 Diphosphate in Liver & Muscle; Hexokinase and Pyruvate Kinase as Regulatory Enzymes in Glycolysis, Pyruvate Dehydrogenase Complex & its Regulation. Reciprocal of Glycolysis & Gluconeogenesis. (15 Hours)

UNIT III

Glycogen metabolism: Glycogen as an efficient storage form of glucose, cAMP& coordinated control of Glycogenesis & Glycogenolysis. Phosphorylase activation & inactivation. Effect of phosphorylation of synthase. Action of Phosphatases. HMP shunt-Glucose-6-phosphate dehydrogenase as a Regulatory enzyme, Role of NADPH in metabolism. TCA cycle, Citrate synthase, Isocitrate dehydrogenases & α-Ketoglutarate dehydrogenase as Regulatory site in TCA cycle. Transport of NADH into mitochondria. Heme metabolism : Biosynthesis, catabolism (porphyrins and bilirubin metabolism) (15 Hours)

UNIT IV

Fatty acid and Amino acid Metabolism: Control of Acetyl-Coa Carboxylase, Role of Hormones, Effect of Diet On Fatty Acid Synthesis. Biosynthesis of Triacyl Glycerol, Cholesterol, Phosphatidyl Ethanolamine & Sphingomyelin. Metabolism of Triacylglycerol during Stress. Fatty Acid Oxidation, Role of Carnitine Control of Oxidation, Regulation of Ketogenesis, Metabolism of Aromatic Amino Acids, Prostaglandins & Thrombaxanes. (15 Hours)

UNIT V

Urea Cycle & Nucleic Acid Metabolism: Regulation of Glutamate Dehydrogenase & Urea Cycle. Regulation of Purine & Pyrimidine Nucleotide Biosynthesis. Integration of Metabolism: Key Junction in Metabolism: Glucose- 6- PO_4, Pyruvate & Acetyl CoA. Metabolic Profiles of Major Organs - Brain, Muscle, Liver and Adipose Tissue. (15 Hours)

TEXT BOOKS

1. Stryer L (2003). *Biochemistr*y 2nd Edition, W.H. Freeman and Company, NY.
2. Chatterjee (2011), *Text book of Medical Biochemistry*, 8th edition, **Jaypee** Brothers. New Delhi.
3. Lehninger A.L. (2008). *Principles of Biochemistry* , 5th edition, Palgrave Macmillan UK.

REFERENCE BOOKS

1. Ronald Voet& Judith G.Voet (2006), *Biochemistry*, 2nd Edition, John Wiley & Sons, U.S.A
2. Geoffrey L.Zubay (1998), *Biochemistry*, 4th edition, Wm.C. Brown *Publishers*, USA.
3. Conn E.E., Stumpf P.K ,Bruening G (1987). *Outlines of Biochemistry* 5/e –R.H, John Wiley & Sons, USA.
4. Voet D &Voet J.G (1990). *Biochemistry*, John Wiley & Sons, NY.

Course Code (20PBCC21N)	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
	1a	**1b**	**2**	**3a**	**3b**	**4**	**5**	**6**	**7**	**8**
CO 1	H	M	M	M	M	M	H	M	M	M
CO 2	H	M	M	H	H	H	H	M	M	M
CO 3	M	M	H	H	M	H	H	M	M	M
CO 4	M	M	H	H	M	H	H	M	M	M
CO 5	M	M	H	H	M	H	H	M	M	M

Dr.P.Annapoorani
Head of the Department

Dr. R.Gloria Jemmi Christobel
Course Designer

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M.SC. BIOCHEMISTRY

(2020 -2021 onwards)

Semester II	**MICROBIAL BIOCHEMISTRY AND FERMENTATION TECHNOLOGY**	Hours/Week: 5	
Core Course-5		Credits: 4	
Course Code **20PBCC22**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: understand how microbes are relevant in technological developments for industries related to food and fermentation and their various, metabolic energy yielding pathways. [K2]

CO2: develop knowledge about microbial metabolism, growth, energy generation, various fermentation pathways, energetic its role in science and industry today. [K3]

CO3: apply the knowledge of microbial biochemistry and fermentation technology Including areas such as energy metabolism, microbial biosynthesis and industrial production, purification of compounds and their application to research, development and societal needs. [K3]

CO4: analyze different fermentation techniques, bioreactor design, inoculum development for industrial fermentation, the use of microorganisms for the value-added products through fermentation processes, the production of secondary metabolites. [K4]

CO5: assess fermentation technology and requirements; production of commercially important microbial products and various metabolic activities in microorganisms. [K5]

UNIT I

Metabolic and energy yielding reactions of sugars: Transport of sugars into the bacterial cell- The phosphotransferase system, Transport of non-PTS sugars. Membrane bound transport systems – E.coli lactose permease, ß-methyl galactoside system. Pathways of glucose degradation: EMP, HMP, ED pathways, and Phosphoketolase pathways. Aerobic pathways of pyruvate metabolism-TCA cycle, electron transport and glyoxylate cycle, anaplerosis. Utilization of one carbon and two carbon compounds-Glycerate pathway and serine pathway. Interrelationship of EMP, HMP and ED pathways.

(15 Hours)

UNIT II

Metabolism of lipids: Oxidation of fatty acids in microbes, Oxidation of fatty acids with odd number of carbon atoms, oxidation of branched chain fatty acids, Oxidation of aliphatic and aromatic hydrocarbons. Biosynthesis of straight chain , branched chain fatty acids, biosynthesis of superchain fatty acids, glycerol dissimilation, synthesis of triglycerides, phospholipids and glycolipids. Catabolism of phospholipids, poly isoprenoid biosynthesis.

(15 Hours)

UNIT III

Microbial Biosynthesis: Synthesis of storage polymers- Poly Beta hydroxybutyrate and poly phosphate. Secondary metabolites - Biosynthesis of patulin as an example. Extracellular enzymes. Photosynthesis: Photosynthetic structures, types of bacterial photosynthesis, photosynthetic pigments, photosynthetic electron transport, photophosphorylation. Co_2 fixation - Calvin cycle and reductive carboxylic acid cycle. Distinction between prokaryotic and eukaryotic photosynthesis.

(15 Hours)

UNIT IV

Fermentation technology: Fermentation - definition, Types of fermentation- Homolactic and hetero lactic fermentation, propionic fermentation and formic acid fermentation. Surface, submerged fermentation and solid state fermentation. Design and operation of Fermentor - Basic concepts for selection of a reactor, Packed bed reactor, Fluidized bed reactor, Trickle bed reactor, Bubble column reactor. Downstream processing-precipitation, Centrifugation, filtration, solvent extraction, chromatographic purification and affinity purification.

(15 Hours)

UNIT V

Industrial Biotechnology: General techniques of the inocula buildup for industrial fermentations. Scale up and scale down fermentation. Cheap raw materials as substrates. Industrial production- Streptomycin, Penicillin (antibiotic), Beer, Wine (alcohol), organic acid (Citric acid, Lactic acid), L-glutamic acid (amino acid), amylase, Protease (enzymes), Vitamins (B_{12}.Production of single cell proteins, production of fermented foods.

(15 Hours)

TEXT BOOKS

1. C.B.Power (1992), *General Microbiology*, Vol I, 8th Edition, Himalaya Publishing house, Mumbai.
2. R.C.Dubey and D.K.Maheswari (2013), *Text book of Micro*biology,4thedition, S Chand *Publishing*.
3. L.E.Casida, JR (1994). *Industrial Microbiology*, New Age International Publ.
4. Patel A.H.(1999), *Industrial microbiology* , Macillan India Ltd.

REFERENCE BOOKS

1. Caldwell D.R(2002.). *Microbial physiology and metabolism*, William C Brown Publishers, USA.
2. Stanbury O.F., Whitakar A., & Hall S.J.(1997), *Principles of Fermentation Technology*, Aditya Books (P) Ltd., New Delhi.
3. Schlegel H.G. (1995),*General Microbiology*, 7th edition, Cambridge University Press, Cambridge
4. Puvanakrishnan.R, Sivasubramanian.S, Hemalatha.T.(2012).*Microbial technology concepts and applications*.MJP publishers, New Delhi.

Course Code 20PBCC22	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	H	H	M	M	H	H	M	M	-	-
CO2	H	H	M	M	H	H	M	H	-	-
CO3	H	H	H	H	H	H	H	H	M	H
CO4	H	H	H	H	H	H	M	H	M	H
CO5	H	H	M	H	H	H	M	H	M	H

Dr.P.Annapoorani
Head of the Department

Mrs.K. Sudha Rameshwari
Course Designer

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M.Sc. BIOCHEMISTRY

(2022 -2023 onwards)

Semester II	**MICROBIAL BIOCHEMISTRY AND FERMENTATION TECHNOLOGY**	Hours/Week: 5	
Core Course-5		Credits: 4	
Course Code **20PBCC22N**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: understand how microbes are relevant in technological developments for industries related to food and fermentation and their various, metabolic energy yielding pathways. [K2]

CO2: develop knowledge about microbial metabolism, growth, energy generation, various fermentation pathways, energetic its role in science and industry today. [K3]

CO3: apply the knowledge of microbial biochemistry and fermentation technology including areas such as energy metabolism, microbial biosynthesis and industrial production, purification of compounds and their application to research, development and societal needs. [K3]

CO4: analyze different fermentation techniques, bioreactor design, inoculum development for industrial fermentation, the use of microorganisms for the value-added products through fermentation processes, the production of secondary metabolites. [K4]

CO5: assess fermentation technology and requirements; production of commercially important microbial products and various metabolic activities in microorganisms. [K5]

UNIT I

Metabolic and energy yielding reactions of sugars: Transport of sugars into the bacterial cell- The phosphotransferase system, Transport of non-PTS sugars. Membrane bound transport systems – E.coli lactose permease, ß-methyl galactoside system. Pathways of glucose degradation: EMP, HMP, ED pathways, and Phosphoketolase pathways. Aerobic pathways of pyruvate metabolism-TCA cycle, electron transport and glyoxylate cycle, anaplerosis. Utilization of one carbon and two carbon compounds-Glycerate pathway and serine pathway. Interrelationship of EMP, HMP and ED pathways. (15 Hours)

UNIT II

Metabolism of lipids: Oxidation of fatty acids in microbes, Oxidation of fatty acids with odd number of carbon atoms, oxidation of branched chain fatty acids, Oxidation of aliphatic and aromatic hydrocarbons. Biosynthesis of straight chain , branched chain fatty acids, biosynthesis of superchain fatty acids, glycerol dissimilation, synthesis of triglycerides, phospholipids and glycolipids. Catabolism of phospholipids, poly isoprenoid biosynthesis.

(15 Hours)

UNIT III

Microbial Biosynthesis: Synthesis of storage polymers- Poly Beta hydroxybutyrate and poly phosphate. Commercially important microbial polysaccharides and their applications. Secondary metabolites - Biosynthesis of patulin as an example. Extracellular enzymes. Photosynthesis: Photosynthetic structures, types of bacterial photosynthesis, photosynthetic pigments, photosynthetic electron transport, photophosphorylation. Co_2 fixation - Calvin cycle and reductive carboxylic acid cycle. Distinction between prokaryotic and eukaryotic photosynthesis. (15 Hours)

UNIT IV

Fermentation technology: Fermentation - definition, Types of fermentation- Homolactic and hetero lactic fermentation, propionic fermentation and formic acid fermentation. Surface, submerged fermentation and solid state fermentation. Design and operation of Fermentor - Basic concepts for selection of a reactor, Packed bed reactor, Fluidized bed reactor, Air lift bioreactor, Trickle bed reactor, Bubble column reactor. Downstream processing-precipitation, Centrifugation, filtration, solvent extraction, chromatographic purification and affinity purification. (15 Hours)

UNIT V

Industrial Biotechnology: General techniques of the inocula buildup for industrial fermentations. Scale up and scale down fermentation. Cheap raw materials as substrates. Industrial production-antibiotic (Streptomycin, Penicillin), alcohol (Beer, Wine), organic acid (Citric acid, Lactic acid), aminoacid (L- glutamic acid), enzymes (amylase, Protease), Vitamins (B_{12}). Production of single cell proteins from wastes and wood. Production of fermented foods.

(15 Hours)

TEXT BOOKS

1. Caldwell D.R (2002.). *Microbial physiology and metabolism*, William C Brown Publishers, USA.

2. Joanne Willey, Kathleen Sandman and Dorothy Wood (2019). Prescott's Microbiology

3. U.Satyanaayana (2015), Biotechnology, Arunabha sen Books and allied (p) Ltd., Kolkata.

4. Lehninger A.L. (2008). *Principles of Biochemistry* , 5th edition, Palgrave Macmillan UK.

REFERENCE BOOKS

1. Schlegel H.G. (1995), *General Microbiology*, 7th edition, Cambridge University Press, Cambridge

2. L.E.Casida, JR (1994). Industrial Microbiology, New Age International Publication

3. R.C.Dubey and D.K.Maheswari (2014*), A text book of Biotechnology*, 5th edition ,S Chand *Publishing*.

Course Code (20PBCC22N)	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	1a	1b	2	3a	3b	4	5	6	7	8
CO 1	H	H	M	M	H	M	M	M	M	M
CO 2	H	H	M	M	H	M	M	H	M	M
CO 3	H	H	H	M	H	H	H	H	M	H
CO 4	H	H	M	M	H	M	M	H	M	H
CO 5	H	H	M	M	H	M	M	H	M	H

Dr.P.Annapoorani — Head of the Department

Mrs.K. Sudha Rameshwari — Course Designer

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M.SC. BIOCHEMISTRY

(2020 -2021 onwards)

Semester II	**MOLECULAR BIOLOGY AND GENETIC ENGINEERING**	Hours/Week: 5	
Core Course- 6		Credits: 4	
Course Code **20PBCC23**		Internal 40	External 60

COURSE OUTCOMES

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

· CO1: understand the principles and techniques leads to comprehensive analysis and practices in Molecular Biotechnology. [K2]

CO2: apply the synthetic information from a wide variety of sources to understand the key principles of molecular biology and Genetic Engineering. [K3]

CO3: identify the various issues both independently and cooperatively for current and future research problems in molecular and advanced biotechnology. [K3]

CO4: analyze the various applications of rDNA technology in evolving plants for resistance to pest and disease, tolerance to herbicides and abiotic factors. [K4]

CO5: evaluate the steps of the synthesis of novel bio products, development of research aptitude and technical skills. [K5]

UNIT I

Structural aspects of DNA Duplex: DNA Replication – Various models. Enzymes involved in DNA replication, Events in replication fork, Mechanism of Bacterial and Plasmid DNA replication. Inhibitors of replication. Errors during replication, Mutation & its types.

(15 Hours)

UNIT II

Transcription & Translation: Enzymes involved in transcription – DNA dependent RNA polymerase – Mechanism involved in transcription. Inhibitors of transcription, Operon model – lac, Ara& trp. Translation- Enzymes, mechanism of translation. Inhibitors of translation. Transposons and their types. (15 Hours)

UNIT III

Introduction to restriction modification system: Types, Restriction, Ligation enzymes. Hemopolymer tailing. Cloning vectors: Gene transfer Vector, expression vectors, plasmid vector- PBR322, Phage vector – M13 filamentous phage, cosmid, yeast vector – YIP.

Intoduction of rDNA into host cells- *E-coli,* plant cells and Mammalian Cells. Techniques involved in transfer of genes. Blue white selection, phenotypic selection, selection based on hybridization technique, HRT & HART**.**

(15 Hours)

UNIT IV

Expression of cloned proteins: Maximizing the expression of cloned genes – vectors for maximizing the product – promoter expression system- T7 expression system and ara expression system, Constructing the optimal promoter, increasing the plasmid copy number.

Gene manipulation in plants: Gene transfer through *Agrobacterium tumefaciens*, Protoplast isolation and its applications, protoplast fusion , Bt Cotton, production of herbicide, virus & pest resistance plants. Transgenic plants; Experimental procedure for producing transgenic plants.

(15 Hours)

UNIT V

Production of novel proteins: Human insulin, somatostatin, Interferon, Vaccines, Blood proteins, Lymphokines. Transgenic animals: Methods of production, Expression of foreign DNA in transgenic mice. Gene therapy: Treating adenosine deaminase deficiency (combined immune deficiency)

(15 Hours)

TEXT BOOKS

1. R.C.Dubey and D.K.Maheswari (2014*), A text book of Biotechnology*, 5th edition ,S Chand *Publishing*.
2. V.Kumaresan (2012), *Biotechnology* ,6th edition, Saras Publication.

REFERENCE BOOKS

1. David Freifelder(2005), *Molecular biol*ogy, 2nd Edition, Narosa publishing house, New Delhi.
2. Watson, J. D., Hopkins, N. H., Roberts, J. W., Steitz, J. A., & Weiner, A. M.(1992). *Molecular biology of the Gene* , 4/e, The Benjamin/Cumming Publishing Company Inc.
3. Adams (1986), *Biochemistry of nucleic acids*, 10th Edition, Springer.
4. Old and primrose (2004), *Principles of Gene manipulation*, 6th edition, Blackwell science Ltd, USA.
5. T.A.Brown (2006*), Gene cloning*, 5th Edition, Wiley-Blackwell, USA.
6. S.N.Jogdand (2008), *Gene Biotechnology*, 2nd Edition, Himalaya publication.
7. Sandhya Mitra (1996), *Genetic Engineering-Principles and practice*, Macmillan India Ltd, New Delhi.

Course Code 20PBCC23	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	M	M	M	L	L	L	-	-	-	-
CO2	M	M	L	M	M	M	M	-	-	-
CO3	H	H	H	H	H	H	M	-	-	-
CO4	H	H	H	H	M	M	M	M	M	-
CO5	H	H	M	H	M	H	H	H	M	M

Dr.P.Annapoorani
Head of the Department

Dr.P.Annapoorani
Mrs.M.Rajakumari
Course Designer

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VIRUDHUNAGAR - 626 001

M.Sc. BIOCHEMISTRY

(2022 -2023 onwards)

Semester II	**MOLECULAR BIOLOGY AND GENETIC ENGINEERING**	Hours/Week: 5	
Core Course- 6		Credits: 4	
Course Code **20PBCC23N**		Internal 40	External 60

COURSE OUTCOMES

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

· CO1: understand the principles and techniques leads to comprehensive analysis and practices in Molecular Biotechnology. [K2]

CO2: apply the synthetic information from a wide variety of sources to understand the key principles of molecular biology and Genetic Engineering. [K3]

CO3: identify the various issues both independently and cooperatively for current and future research problems in molecular and advanced biotechnology. [K3]

CO4: analyze the various applications of rDNA technology in evolving plants for resistance to pest and disease, tolerance to herbicides and abiotic factors. [K4]

CO5: create and explain the steps involved in the synthesis of novel bio products, development of research aptitude and technical skills. [K5]

UNIT I

Structural aspects of DNA Duplex: DNA Replication – Various models. Enzymes involved in DNA replication, Events in replication fork, Mechanism of Bacterial and Plasmid DNA replication. Inhibitors of replication. Errors during replication, Mutation & its types. (15 Hours)

UNIT II

Transcription & Translation: Enzymes involved in transcription – DNA dependent RNA polymerase – Mechanism involved in transcription. Inhibitors of transcription, Fine structure of gene, Operon models – lac, ara & trp. Translation- Enzymes, mechanism of translation. Inhibitors of translation. Transposons and its types. (15 Hours)

UNIT III

Introduction to restriction modification system: Types, Restriction, Ligation enzymes. Hemopolymer tailing. Cloning vectors: Gene transfer Vector, expression vectors, plasmid vector- PBR322, PUC18, BAC, Phage vector – M13 filamentous phage, cosmid, yeast vector – YIP, YAC. Introduction of rDNA into host cells- *E-coli*, plant cell and Mammalian Cells. Techniques involved in transfer of genes. Blue white selection, phenotypic selection, selection based on hybridization technique, HRT & HART**.** (15 Hours)

UNIT IV

Expression of cloned proteins: Maximizing the expression of cloned genes – vectors for maximizing the product – promoter expression system- T7 expression system and ara expression system, Constructing the optimal promoter, increasing the plasmid copy number, Synthetic Biology (*E. coli* and Yeast).

Gene manipulation in plants: Gene transfer through *Agrobacterium tumefaciens*, Protoplast isolation and its applications, protoplast fusion , Bt Cotton, production of herbicide, virus & pest resistance plants. Transgenic plants; Experimental procedure for producing transgenic plants.

(15Hours)

UNIT V

Production of novel proteins: Human insulin, somatostatin, Interferon, Vaccines, Blood proteins, Lymphokines. Transgenic animals: Methods of production, Expression of foreign DNA in transgenic mice, Gene Knock out and Knock in (Humanized mice Antibody). Gene therapy: Treating adenosine deaminase deficiency (combined immune deficiency) .

(15 Hours)

TEXT BOOKS

1. R.C.Dubey and D.K.Maheswari (2014*), A text book of Biotechnology*, 5th edition ,S. Chand *Publishing*.

REEFERENCE BOOKS

1. David Freifelder(2005), *Molecular biol*ogy, 2nd Edition, Narosa publishing house, New Delhi.
2. Watson, J. D., Hopkins, N. H., Roberts, J. W., Steitz, J. A., & Weiner, A. M.(1992). *Molecular biology of the Gene* , 4/e, The Benjamin/Cumming Publishing Company Inc.
3. Adams (1986), *Biochemistry of nucleic acids*, 10th Edition, Springer.
4. T.A.Brown (2006*), Gene cloning*, 5th Edition, Wiley-Blackwell, USA.
5. S.N.Jogdand (2008), *Gene Biotechnology*, 2nd Edition, Himalaya publication.

6. Sandhya Mitra (1996), *Genetic Engineering-Principles and practice,* Macmillan India Ltd, New Delhi.

Course Code (20PBCC23N)	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
	1a	**1b**	2	3a	3b	4	5	6	7	8
CO 1	H	H	H	M	M	H	M	M	L	M
CO 2	H	M	M	H	M	H	M	H	M	M
CO 3	H	H	H	H	H	H	M	H	H	H
CO 4	H	H	H	H	M	M	M	H	H	M
CO 5	H	H	M	H	M	H	H	H	H	M

Dr.P.Annapoorani

Dr.P.Annapoorani — Mrs.M.Rajakumari

Head of the Department — Course Designer

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VIRUDHUNAGAR - 626 001

M.Sc. BIOCHEMISTRY

(2020 -21 onwards)

Semester: II	**MICROBIOLOGY AND MOLECULAR BIOLOGY TECHNIQUES LAB**	Hours/Week: 6	
Core Practical-2		Credits: 3	
Course Code **20PBCC21P**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: apply the principles and methodologies of microbial cell culture, characterization of microbes, electrophoresis , DNA isolation from various cells such as bacterial cells and animal tissues. [K3]

CO2: outline the flow charts for microbes characterization, electrophoresis, DNA isolation from various cells [K3]

CO3: observe and interpret the results of microbiology and molecular biology experiments using the standard methods and techniques and complete the record work. [K3]

CO4: Comment on the microbial cell culture, characterization of microbes, electrophoresis And DNA isolation from various cells. [K4]

CO5: assess the modifications in the use of reagents, in characterizing microbes, in electrophoresis and DNA isolation. [K5]

Experiments

1. Preparation and use of glassware, sterilization
2. Preparation of simple microbial culture media
3. Maintenance of microbial cultures
4. Metabolite study:

i) Hydrogen sulfide production
ii) Acid production

5. Electrophoresis i) SDS-PAGE

ii) Agarose gel electrophoresis

6. Isolation of genomic DNA animal tissue/ intact chloroplast /coconut endosperm i)DNA-Quantification
   ii) Hyperchromic effect and Tm

REFERENCE BOOKS

1. Gunasekaran.P (1995) ,*Laboratory manual in Microbiology-*, New age International(P) Ltd. Publishers, New Delhi.
2.Aneja, K.R. (1996).*Experiments in Microbiology, Plant pathology, Tissue culture and mushroom Cultivation*, I edition, New age International (P) Ltd. Publishers, New Delhi.
3. PalaniveluP.(2004) *Analytical Biochemistry & Separation Techniques* ,Palkalai Nagar, Madurai: 4/e, 21st Century Publication.

Course Code 20PBCC21P	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	M	M	M	M	M	M	M	-	M	M
CO2	H	H	M	M	M	M	M	-	M	H
CO3	H	H	H	H	H	H	H	L	M	H
CO4	H	H	H	H	H	H	H	L	M	H
CO5	H	H	H	H	H	H	H	M	M	H

Dr.P.Annapoorani — Head of the Department

Mrs. R.Gloria Jemmi Christobel — Course Designer

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M.Sc. BIOCHEMISTRY

(2020 - 2021 onwards)

Semester II	**BIOINFORMATICS LAB**	Hours/Week: 4	
Core practical-3		Credits: 2	
Course Code **20PBCC22P**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: write the protocols for sequence retrieval from different Biological databases. [K3]

CO2: construct the methodologies for accessing proteomic tools and DNA or protein sequence similarity search using BLAST and visualizing protein structure. [K3]

CO3: interpret the results of retrieved and aligned sequences from different primary databases, structural databases, multiple sequence alignment, proteomic tools and complete the record work notebook. [K3]

CO4: assess the basic informatics tools to extract or retrieve information from Biological databases, molecular visualization tools and its applications. [K4]

CO5: build homology model for unknown protein sequence and predict the structure. [K5]

Experiments

- Access EBI query website for Downloading a file
- Accessing of Genbank website and downloading of files
- Accessing EMBL website and cross link to Genbank
- Accessing DDBJ website for Downloading a file
- Accessing SWISS-Prot database and Downloading a protein sequence
- Accessing PDB website and Downloading a protein structure
- Search NCBI's MMDB

- USE THE Dali structure family Database
- BLAST similarity search for Nucleotide sequences
- BLAST similarity search for protein sequences
- Fasta similarity search for Nucleotide sequences
- Fasta similarity search for Protein sequences
  - Find difference between insulin sequence in pig and human Accessing EBI website for Downloading an Entry of Human Lysosomal alpha Glucosidase Gene
  - Show that sequence coding for C-peptide is less conserved than sequences coding for the A-chain and the B-chain
- Searching and retrieving from KEGG
- Working with Ensembl
  - Exploring features related to a gene
  - Examining the supporting evidence for a gene prediction.
- ENTREZ AND OMIM
- CHEM Sketch: Small molecules build
  - Draw the structure of any chemical compound using Chem Sketch
  - Find its properties
- Multiple Sequence Alignment – ClustaLw
- Expasy-proteomic tools
- Visualize a protein structure
  - Rasmol
  - Homology modeling
- NCBI's 1000 Genomes Browser-Introduction
  - Data viewer: Navigate exons and find CDS positions

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 20PBCC22P	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	H	M	M	M	M	M	M	-	-	L
CO2	H	H	M	M	M	M	M	-	-	L
CO3	H	H	M	H	H	H	H	H	H	H
CO4	H	H	M	H	H	H	H	H	H	H
CO5	H	H	M	H	H	H	H	H	H	H

Dr.P.Annapoorani
Head of the Department

Mrs. K.Sudha Rameshwari
Course Designer

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M.Sc. BIOCHEMISTRY

(2020 - 2021 onwards)

Semester II	**PLANT BIOCHEMISTRY**	Hours/Week: 5	
DSEC-2		Credits: 4	
Course Code **20PBCE21**		Internal 40	External 60

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: evaluate the transport mechanism, tissue culture technique and industrial applications of secondary metabolites in plants. [K5]

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 and tissue culture. Water management, ascent of sap, mechanisms for movement of solutes. Translocation in xylem and phloem. (15 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.

(15 Hours)

UNIT III

Photosynthesis: Structure and composition of photosynthetic apparatus light and dark reactions- Photophosphorylation; Carbondioxide fixation C3, C4 and CAM pathways. Biosynthesis of sucrose and starch, Factors affecting the rate of photosynthesis. Photorespiration.

(10 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. (15 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. (20 Hours)

TEXT BOOKS

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

Course Code 20PBCE21	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	H	H	H	M	M	H	M	M	M	H
CO2	H	M	M	M	M	H	M	M	-	-
CO3	H	H	M	M	M	M	M	M	-	L
CO4	H	H	M	H	M	M	M	M	-	-
CO5	H	H	M	H	H	H	H	M	H	M

Dr.R.Renuka

Dr.P.Annapoorani Dr.R.Salini

Head of the Department Course Designer

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M.Sc. BIOCHEMISTRY

(2022 -2023 onwards)

Semester II	**PLANT BIOCHEMISTRY**	Hours/Week: 5	
DSEC-2		Credits: 4	
Course Code **20PBCE21N**		Internal 40	External 60

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: evaluate the transport mechanism, tissue culture technique and industrial applications of secondary metabolites in plants. [K5]

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. (15 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. (15 Hours)

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.

(10 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. (15 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. (20 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 (20PBCE21N)	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
	1a	**1b**	2	3a	3b	4	5	6	7	8
CO 1	H	H	M	M	M	H	M	M	M	L
CO 2	H	M	M	M	M	H	M	M	L	L
CO 3	H	H	M	M	M	M	M	M	L	L
CO 4	H	H	M	H	M	M	M	M	M	L
CO 5	H	H	M	H	H	H	H	M	H	M

Dr.R.Renuka

Dr.P.Annapoorani Dr.R.Salini

Head of the Department Course Designer

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M.SC. BIOCHEMISTRY

(2020 - 2021 onwards)

Semester II	**BIOINFORMATICS AND NANOTECHNOLOGY**	Hours/Week: 5	
DSEC- 2		Credits: 4	
Course Code **20PBCE22**		Internal 40	External 60

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: evaluate 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. [K5]

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) (15 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. (15 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).

(15 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.

(15 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. (15 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 20PBCE22	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	H	H	M	L	L	L	M	M	-	-
CO2	H	M	M	L	L	L	M	M	-	-
CO3	H	H	M	H	M	M	M	M	-	M
CO4	H	H	M	H	M	M	M	M	-	M
CO5	H	H	M	H	M	M	M	M	-	M

Dr.P.Annapoorani — Head of the Department

Mrs.K.Sudha Rameshwari — Course Designer

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M.SC. BIOCHEMISTRY

(2020 -2021 onwards)

Semester II	**MOLECULAR MECHANISM OF INFECTIOUS DISEASES**	Hours/Week: 5	
DSEC- 2		Credits: 4	
Course Code **20PBCE23**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: demonstrate the mechanism of disease cause, transmission, detection, treatment and prevention. [K2]

CO2: apply the mechanism behind various diseases in diagnosis and research for treatment Interventions. [K3]

CO3: identify the reason behind the disease cause, transmission and the response towards Treatment. [K3]

CO4: analyze the existing or emerging infection, drug resistance mechanisms in order to develop new tools for their management. [K4]

CO5: interpret the research findings pertaining to transmission, detection, treatment and prevention of diseases. [K5]

UNIT I

Overview of infectious diseases : Infectious agents - Bacteria, Viruses, protozoa and fungi, pathogenicity and virulence; Facultative / obligate intracellular pathogens.

(15 Hours)

UNIT II

Bacterial disease : Epidemiology, signs and symptoms, causative agent, history, infection and pathogenicity, Diagnostics, Therapeutics and vaccines. Drug resistance, mechanisms, Multidrug efflux pumps, extended spectrum β-lactamases and implications on public health. Molecular mechanisms for Tuberculosis, Typhoid, Cholera. (15 Hours)

UNIT III

Viral diseases : Epidemiology, signs and symptoms, causative agent, history, infection and pathogenesis, Detection, Drugs and inhibitors, Vaccines. Molecular mechanisms for hepatitis, influenza, dengue, polio, herpes. (15 Hours)

UNIT IV

Parasitic diseases : Epidemiology, signs and symptoms, causative agents, history, Vectors, life cycle, Host parasite interactions, Diagnostics, Drugs and Inhibitors, Resistance, Vaccine development. Molecular mechanisms for Malaria. (15 Hours)

UNIT V

Emerging and re-emerging infectious diseases and pathogens: MRSA, SARS virus, Bird flu, prions, Hemorrhagic Fever and Chlamydiae, opportunistic fungal pathogens. (15 Hours) **TEXT BOOKS**

1. Principles and practices of Infectious diseases, 7th edition, Mandell, Douglas and

Bennett. S, Volume, 2. Churchill Livingstone Elsevier. ISBN: 978-0-443-06839-3

REFERENCE BOOKS

1. Klein's Microbiology (2008) 7th Ed., Prescott, Harley, Willey, J.M., Sherwood, L.M., Woolverton, C.J. Mc Graw Hill International Edition (New York) ISBN: 978-007-126727.

2. Sherris Medical Microbiology: An Introduction to Infectious Diseases. (2010).

3. Kenneth J.Ryan, C. George Ray, Publisher: McGraw-Hill. ISBN-13: 978-

0071604024 ISBN-10: 0071604022 Medical Microbiology. (2012).

4. Patrick R. Murray, Ken S. Rosenthal, Michael A.Pfaller, Elsevier Health Sciences.

ISBN: 978-0-323-08692-9.

5. Bacterial Pathogenesis: A molecular approach by Salyers AA and Whitt DD eds.

American Society for Microbiology Press, Washington, DC USA. 2002

Course Code 20PBCE23	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	M	M	H	M	M	M	H	-	-	-
CO2	H	H	H	H	H	M	H	-	L	H
CO3	H	H	H	H	H	M	H	M	L	H
CO4	H	H	H	H	H	H	H	M	M	H
CO5	H	H	H	H	H	H	H	M	M	H

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VIRUDHUNAGAR - 626 001

M.Sc. BIOCHEMISTRY

(2020 -2021onwards)

Semester III	**IMMUNO CHEMISTRY**	Hours/Week: 6	
Core Course-7		Credits: 5	
Course Code **20PBCC31**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: understand the structure and function of the major lymphoid systems, including the molecular, biochemical and cellular mechanisms for maintaining homeostasis and basic defense mechanism. [K2]

CO2: apply the immunoglobulin genes of the immune system, antigen antibody interaction and their applications in various immuno assays. [K3]

CO3: develop the knowledge of each lymphoid system 's contribution to the functioning of health and diseases. [K3]

CO4: analyze the mechanism of cellular and molecular basis of immune responsiveness and its therapeutic implications in human system. [K4]

CO5: evaluate the state-of-the-art experimental methods and Technologies in disease diagnosis and clinical research. [K5]

UNIT I

Principles of immunology: Types of immunity. Antigens – Factors influencing antigenicity. Specific group of antigens- self antigens, foreign antigens- tumor antigens, viral antigens, bacterial antigens, haptens. Organs of the immune system. Cells of the immune system, response of B cells to antigens, response of T cells to antigens, Interaction between T and B cells. Cytokines and Lymphokines (Briefly). Mononuclear phagocytic system.

(20 Hours)

UNIT II

Antibodies and Complement: properties of antibody, structure of IgG, Isotopes, allotypes, idiotype Igs as antigens. Monoclonal antibodies (hybridoma). Ag-Ab complex- chemical basis of Ag-Ab binding, affinity, valence, kinetics of Ag-Ab reactions. Theories of antibody formation; generation of antibody diversity and its genetics. Complement system-complement pathway and complement fixation. Disorders of immunoglobulin synthesis.

(20 Hours)

UNIT III

Vaccines and Hypersensitivity: Vaccination- Passive and active immunization schedule, antibacterial, antitoxic and antiviral vaccines - Corona viral Vaccine. **Allergy and hypersensitivity:** Type I, II, III, IV hypersensitivity**.** Autoimmunity: Rheumatoid arthritis, myasthenia gravis, Systemic lupus erythematosus and Type I Diabetes mellitus.

(15 Hours)

UNIT IV

Transplantation and Tumour immunology: Transplantation- Graft rejection, transplantation antigens, Graft vs Host disease. prevention of graft rejection, Immuno suppressive agents, Immune surveillance mechanism. Tumor immunology. Acquired Immuno Deficiency Syndrome.

(20 Hours)

UNIT V

Immuno histochemistry: Principles, Procedure and Applications-

Precipitation, Agglutination, Immuno-electrophoresis, Fluorescent antibody techniques, RIA , ELISA, ELISpot, FACS .

(15 Hours)

TEXT BOOK

1. Janis kuby,(2007). *Immunology,* New York.: W.H.Freeman and Company, 6th Edition.

REFERENCE BOOKS

1. Tizard (1995). *Immunology,* USA: Harcourt Brace College Publishers, 4th Edition.
2. Ivan M. Roitt and Peter J. Delves, (2005). *Essential Immunology,* USA: Blackwell Publication, 10th Edition.
3. James T.Barrett (1988). *Text Book of Immunology - An Introduction to Immunochemistry & Immunobiology,* Mosby: 5th Edition.
4. Donald Weir (1997). *Immunology,* Churchill Livingstone, United Kingdom,8th Edition.H

Course Code 20PBCC31	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	H	H	H	-	-	M	M	M	M	-
CO2	H	M	H	M	H	M	M	M	-	-
CO3	H	H	M	H	M	M	M	-	-	M
CO4	H	H	H	H	M	M	H	-	M	-
CO5	M	H	H	H	M	H	H	M	-	-

Dr.P.Annapoorani
Head of the Department

Mrs.M.Rajakumari
Course Designer

V.V.VANNIAPERUMAL COLLEGE FOR WOMEN
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M.SC. BIOCHEMISTRY

(2020-2021 onwards)

Semester III	**BIOSTATISTICS**	Hours/Week: 6	
Core Course-8		Credits: 5	
Course Code		Internal	External
20PBCC32		40	60

COURSE OUTCOMES

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

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

CO2: utilize effective statistical methods for data analysis and interpretation. [K3] CO3: discover the statistical methodology for the evaluation during health and disease conditions. [K3]

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

CO5: hypothesize study designs for analyzing data based on research problems. [K5]

UNIT I

Sampling and tests of significance: sampling distribution, standard error. Tests of significance for attributes-test for number of success, test for proportion of success and test for difference between proportions. Tests of significance of large samples: testing the significance of mean, testing the difference between means of two samples, testing the difference between two standard deviations. Students't' distribution: Testing the significance of the mean of a random sample, testing the difference between means of two samples and testing the significance of observed correlation coefficient. (Problems Only).Steps in hypothesis testing. (20 Hours)

UNIT II

Theoretical distributions-Binomial distribution –Types-Properties-Binomial distribution-Fitting of Binomial distribution, Poisson distribution-Fitting of Poisson distribution, Normal distribution Methods of constructing normal distribution-The Ordinate method, The Area method(Problems Only) (15 Hours)

UNIT III

Types of Correlation - positive & negative: Simple, partial & negative: Linear and non-linear correlation (Definition Only).Scatter diagram method, Graphic Method, Karl Pearson's coefficient of correlation, rank correlation coefficient .Regression equation and regression lines (problems only). Difference between Correlation and Regression. (20 Hours) **UNIT IV**

Analysis of frequencies and analysis of variance: Chi-square-Test for goodness of fit,
Test

for independence of attributes; yate's correction, analysis of variance (ANOVA)- Single factor ANOVA and Two-factor ANOVA with unequal and equal replication. (Problems Only).

(20 Hours)

UNIT V

Research methodology: Concepts of research, types of study design-case control study, nested case control study, Familial study. Layout of thesis-review of literature, Referencing-styles of Reference. Plagiarism (Short note). (15 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.

REFERENCE BOOK

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

Course Code 20PBCC32	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	H	H	M	H	L	H	M	-	-	-
CO2	H	H	H	H	M	H	M	L	-	M
CO3	H	H	H	H	M	H	M	M	M	M
CO4	H	H	H	H	M	H	H	M	M	H
CO5	H	H	H	M	H	H	H	H	M	H

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Head of the Department

Mrs.R.Gloria Jemmi Christobel
Course Designer

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M.Sc. BIOCHEMISTRY

(2023 -2024 onwards)

Semester III	**BIOSTATISTICS**	Hours/Week: 6	
Core Course-8		Credits: 5	
Course Code **20PBCC32N**		Internal 40	External 60

COURSE OUTCOMES

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

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

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

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

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

CO5:evaluate various statistical methods for data analysis . [K5]

UNIT I

Representation of Data: Diagrammatic- Simple bar diagram, Rectangles, squares, circles or Pie diagram, Graphic representation-Histogram, Frequency Polygon, Frequency Curve, Cumulative Frequency Curve or O Give Curve. Measures of central tendency (mean, median, mode) and dispersion (standard deviation and mean deviation). Sampling: Types of sampling, Advantages and disadvantages. R-Studio

(15Hours)

UNIT II

Sampling and tests of significance: standard error. Tests of significance for attributes-test for number of success test for proportion of success and test for difference between proportions. Tests of significance of large samples: testing the significance of mean, testing the difference between means of two samples, testing the difference between two standard deviations. Students't' distribution: Testing the significance of the mean of a random sample, testing the difference between means of two samples and testing the significance of observed correlation coefficient. (Problems Only). Steps in hypothesis testing. (20 Hours)

UNIT III

Theoretical distributions-Binomial distribution –Types-Properties-Binomial distribution-Fitting of Binomial distribution, Poisson distribution-Fitting of Poisson distribution, Normal distribution Methods of constructing normal distribution-The Ordinate method, The Area method (Problems Only) (15 Hours)

UNIT IV

Types of Correlation - positive & negative: Simple, partial & negative: Linear and non-linear correlation (Definition Only).Scatter diagram method, Graphic Method, Karl Pearson's coefficient of correlation, rank correlation coefficient. Regression equation and regression lines (problems only). Difference between Correlation and Regression. (20 Hours)

UNIT V

Analysis of frequencies and analysis of variance: Chi-square-Test for goodness of fit, Test for independence of attributes; yate's correction, analysis of variance (ANOVA)- Single factor ANOVA and Two-factor ANOVA with unequal and equal replication. (Problems Only).

(20 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.

REFERENCE BOOK

1.Kothari, R.C. (1993). *Research Methodology*, New Delhi: Wiley Eastern Limited, 5th Edition.
2. Babak Shahbaba. (2012) Biostatistics with R -An Introduction to Statistics Through Biological Data. ISBN: 978-1-4614-1302-8.

Course Code 20PBCC32N	PO1		PO 2	PO3		PO4	PO5	PO 6	PO7	PO8
	1a	1b	2	3a	3b	4	5	6	7	8
CO1	H	H	H	H	H	M	M	H	M	M
CO 2	H	H	M	H	H	H	H	H	M	M
CO 3	M	M	M	M	H	H	H	H	H	H
CO 4	H	H	M	H	H	H	H	H	M	M
CO 5	H	H	M	H	H	H	H	H	H	H

Dr.P.Annapoorani

Dr.R.Salini

Head of the Department Course Desi

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M.SC. BIOCHEMISTRY

(2020 -2021 onwards)

Semester III	**EUKARYOTIC GENE EXPRESSION**	Hours/Week: 6	
Core Course-9		Credits: 5	
Course Code **20PBCC33**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: outline the cell division process, stem cell types, genome organization and molecular mechanisms in gene expression and regulation in eukaryotes. [K2]

CO2: apply the properties of stem cells, gene function and their modulation in various aspects of normal and abnormal signaling pathways. [K3]

CO3: make use of the perceived knowledge about gene and protein expression on various signaling mechanism and its deregulation in the oncogenesis process. [K3]

CO4 : analyze the properties of stem cells , normal and abnormal gene regulation and protein expression during cell cycle ,cell signaling, and oncogenesis mechanism. [K4]

CO5 : assess the information related to eukaryotic gene expression , stem cells , cell division, cell signaling and cancer. [K5]

UNIT I

Genome Organization- Eukaryotic genome organization, Repeat sequences- Cot curve analysis, structural DNA sequences- Complexity, frequency of repetitions. Nucleosomes, chromatin - active chromatin, inactive chromatin, heterochromatin and euchromatin. (20 Hours)

UNIT II

Replication & Transcription- Eukaryotic gene replication, Transcription of RNAs, mRNA structure, processing of mRNA- capping, splicing and editing. Promoters, Cis-regulatory elements, Enhancers, trans – acting proteins. Difference between prokaryotic and eukaryotic transcription. DNA repair. Difference between prokaryotic and eukaryotic replication.

(20 Hours)

UNIT III

Epigenetics- Chromatin remodeling, Role of histones and its modifications, non-histone proteins. Introduction to Silencing mechanism- DNA methylation. Role of epigenetic mechanism in normal development and oncogenesis. Protein and gene microarray technology -Principles and applications.

(20 Hours)

UNIT IV

Translation-Genetic code, eukaryotic ribosomes, eukaryotic translational process, polysomes, post translational modification. Secretory proteins-signal hypothesis - Difference between prokaryotic and eukaryotic translation.

(15 Hours)

UNIT V

Signaling pathways, Cancer and Cell cycle- Signaling Pathways- Stat pathway, MAPK/ERK Pathway, JNK pathway, Wnt signaling pathway, Notch signaling pathway. Cell cycle, Oncogenes. Introduction to Stem cells- Properties , Embryonic and adult stem cells.CRISPR-Cas9 technology.

(15 Hours)

TEXT BOOKS

1. David Freifelder (2008). *Molecular Biology,* New Delhi: Narosa Publications, 2nd Edition.
2. James D.Watson et al., (2004). *Molecular Biology of Gene,* Pearson Education (Singapore) Indian Branch, New Delhi. 2nd Edition.
3. Becker, Kleinsmith, Harden (2000). *The World of the Cell,* United States: Addison Wesley Longman Inc. 4th Edition.

REFERENCE BOOKS

1. Stephen.L.Wolfe (1993). *Molecular and Cellular Biology*, USA: Cengage learning Inc. 1st Edition.
2. Benjamin Lewin (2004). *Genes VIII,* New Jersey: Pearson Prentice Hall, 8th Edition.
3. Darnell, Lodish, Baltimore (1986). *Molecular Cell Biology,* United States: WH Freeman & Company, 1st Edition.
4. Brown. T.A. (2006). *Genomes,* Garland Science Inc. United States, 3rd Edition.

5.Lodish et.al.(2004). *Molecular Cell Biology*, United States: WH Freeman & Company, 5th Edition.

6.De Robertis and De Robertis (2001). *Cell and Molecular Biology*,Wolters Kluwer India Pvt Ltd. 8th Edition.

7.Gerald Karp (2004). *Cell and Molecular Biology*, New York: John Wiley & Sons. 4thedition

Course Code 20PBCC33	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO 8
	PSO 1a	PSO 1b	PSO 2	PSO 3a	PSO 3b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	M	H	M	L	L	-	-	-	-	-
CO2	M	H	H	H	H	M	H	-	-	H
CO3	H	H	H	H	H	M	H	-	L	H
CO4	H	H	H	H	H	H	H	-	L	H
CO5	H	H	H	H	H	H	H	H	M	H

Dr.P.Annapoorani
Head of the Department

Dr.P.Annapoorani
Mrs.R.Gloria Jemmi Christobel
Course Designers

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M.Sc. BIOCHEMISTRY

(2023 -2024 onwards)

Semester III	**EUKARYOTIC GENE EXPRESSION**	Hours/Week: 6	
Core Course-9		Credits: 5	
Course Code **20PBCC33N**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: demonstrate the cell division process, stem cell types, genome organization and molecular mechanisms in gene expression and regulation in eukaryotes. [K2]

CO2: apply the properties of stem cells, gene function and their modulation in various aspects of normal and abnormal signaling pathways. [K3]

CO3: apply the perceived knowledge about gene and protein expression on various signaling mechanism and its deregulation in oncogenesis process. [K3]

CO4 : analyse and discuss research articles in the area of normal and abnormal gene regulation and protein expression, stem cells & cell cycle process. [K4]

CO5 : evaluate the information relating to eukaryotic gene expression, cell division , stem cells, cell signaling and cancer. [K5]

UNIT I

Genome Organization- Eukaryotic Genome Organization, Repeat Sequences- Cot Curve Analysis, C-Value Paradox, Structural DNA Sequences- Complexity, Frequency Of Repetitions. Nucleosomes, Chromatin - Active Chromatin, Inactive Chromatin, Heterochromatin and Euchromatin. (20 Hours)

UNIT II

Replication & Transcription- Eukaryotic Gene Replication, Transcription of RNAs. Structure of mRNA & tRNA .RNA Processing-Capping, Polyadenylation, Splicing- Types of Splicing, Snurps and RNA editing. Promoters, Enhancers, Cis-regulatory elements, Trans - acting proteins. Difference between Prokaryotic and Eukaryotic Replication and Transcription. DNA repair. (20 Hours)

UNIT III

Epigenetics- Chromatin remodeling, Role of Histones and its modifications, Non-histone proteins. Introduction to Silencing mechanism- DNA methylation. Role of Epigenetic mechanism in normal development and Oncogenesis. Protein and Gene Microarray Technology - Principles and Applications. (20 Hours)

UNIT IV

Translation-Genetic Code, Eukaryotic Ribosomes, Eukaryotic Translational process, Polysomes, Post Translational Modification. Secretory Proteins-Signal hypothesis . Difference between Prokaryotic and Eukaryotic translation. (15 Hours)

UNIT V

Signaling pathways, Cancer and Cell cycle- Signaling Pathways- Wnt signaling pathway, Notch signaling pathway, ROS pathway, Protein Kinase B, NF-kB and AMP-Activated Protein Kinase. Cell cycle- Phases and Check points. Oncogenesis Mechanism. Introduction to Stem cells- Properties, Embryonic and adult stem cells. CRISPR-Cas9 technology.

(15 Hours)

TEXT BOOKS

1. David Freifelder (2008). *Molecular Biology,* New Delhi: Narosa Publications, 2nd Edition.
2. James D.Watson et al., (2004). *Molecular Biology of Gene,* Pearson Education (Singapore) Indian Branch, New Delhi. 2nd Edition.
3. Becker, Kleinsmith, Harden (2000). *The World of the Cell,* United States: Addison Wesley Longman Inc. 4th Edition.

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1. Stephen.L.Wolfe (1993). *Molecular and Cellular Biology,* USA: Cengage learning Inc. 1st Edition.

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3. Darnell, Lodish, Baltimore (1986). *Molecular Cell Biology,* United States: WH Freeman & Company, 1st Edition.

4.Brown. T.A. (2006). *Genomes,* Garland Science Inc. United States, 3rd Edition.

5.Lodish et.al.(2004). *Molecular Cell Biology,* United States: WH Freeman & Company, 5th Edition.

6.De Robertis and De Robertis (2001). *Cell and Molecular Biology,*Wolters Kluwer India Pvt. Ltd. 8th Edition.

7.Gerald Karp (2004). *Cell and Molecular Biology,* New York: John Wiley & Sons. 4thedition

Course Code 20PBCC33N	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO 8**
	1a	1b	2	3a	3b	4	5	6	7	8
CO1	M	M	H	H	H	H	M	H	M	M
CO 2	H	H	M	H	H	H	H	H	M	M
CO 3	H	M	H	M	H	H	H	H	M	M
CO 4	H	H	M	H	H	H	H	H	M	M
CO 5	H	H	M	H	H	H	H	H	M	M

Dr.P.Annapoorani

Dr.P.Annapoorani

Head of the Department

Dr.R.Gloria Jemmi Christobel

Course Designers

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M.SC. BIOCHEMISTRY

(2020 -2021 onwards)

Semester III	**IMMUNOLOGY AND ADVANCED BIOCHEMISTRY LAB**	Hours/Week: 6	
Core Practical-4		Credits: 3	
Course Code **20PBCC31P**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: apply the principles of western blot, immunochemical techniques, cloning and restriction digestion. [K3]

CO2: sketch the schema chart for the techniques involved in immunology and advanced biochemistry. [K3]

CO3: observe and interpret the results of molecular biology and immunological techniques and complete the record work. [K3]

CO4: comment and compare the antigen-antibody interaction methods and gene cloning technique. [K4]

CO5: Assess gene cloning with and without restriction endonucleases, ligase, plasmid and judge the antigen-antibody interaction. [K5]

EXPERIMENTS

1. Aggultination and precipitiation
2. Immunoelectrophoresis
3. Immunodiffusion
4. ELISA [demonstration]
5. Western Blot analysis – commercial kit
6. Isolation of Plasmid DNA from *E.coli* Bacteria.
7. Single Restriction digestion of λ DNA and ligation
8. Double restriction digestion of λ DNA.
9. Cloning of DNA fragment by blue, white selection method
10. Determination of antibody titre

REFERENCE BOOKS

1. Adrian.J.Harwood (1996). *Basic DNA and RNA Protocols,* NewYork, USA: Humana Press, 1st Edition.
2. Stanley R.Maloy (1990). *Experimental Techniques in Bacterial Genetics,* Boston: Jones and Bartlett Publisher, 1st Edition.
3. Richard.L.Myers (1994). *Immunology: A Laboratory Manual,* United States: McGraw-Hill Science, 2nd Edition.
4. Frederick M. Ausubel, Roger Brent, Robert E. Kingston, David D. Moore, J.G. Seidman, John A. Smith & Kevin Struhl (2003). *Current Protocols in Molecular Biology,* United States: John Wiley & Sons Inc., 1st Edition.

Course Code 20PBCC31P	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	H	H	M	H	H	H	H	M	H	M
CO2	H	H	M	H	H	H	H	M	H	M
CO3	H	H	M	H	H	H	H	M	H	M
CO4	H	H	M	H	H	H	H	M	H	M
CO5	H	H	M	H	H	H	M	M	H	M

Dr.P.Annapoorani — Dr.R.Salini

Mrs.K.Sudha Rameshwari

Head of the Department — Course Designer

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M.Sc. Bio Chemistry
(2021 -22 onwards)

Semester III	**PRACTICE FOR CSIR NET – GENERAL PAPER**	Hours/Week:1	
Course Code		Credits: 1	
20PGOL32		Internal 100	External -

COURSE OUTCOMES

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

CO1 : explian 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 : interpret the data using logical reasoning and observational ability. [K5]

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 20PGOL32	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	H	M	M	-	M	-	-
CO2	H	H	H	H	-	M	-	-
CO3	H	H	H	H	-	H	-	-
CO4	H	M	H	H	-	H	-	-
CO5	H	M	H	H	-	H	-	-

Dr.A.Uma Devi

Head of the Department

Dr.A.Uma Devi
Tmty.T.Anitha
Course Designer

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M.SC. BIOCHEMISTRY

(2020-2021onwards)

Semester IV	**ENVIRONMENTAL BIOCHEMISTRY**	Hours/Week: 6	
Core Course-10		Credits: 5	
Course Code **20PBCC41**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: understand the key concepts and complex relationship between biotic and abiotic components of ecosystem. [K2]

CO2: apply the ecological knowledge and its consequences in basis of regional and global environmental issues.[K3]

CO3: identify the current environmental problems (Air, water and soil pollution), chemical pollutants and its impacts on Biosphere. [K3]

CO4: analyze the strategies, technologies and methods for assessment of environmental system and discuss some mitigation strategies like Biodegradation and Bioremediation. [K4]

CO5: evaluate basic chemical concepts to analyze the Bio chemical processes involved in different environmental problems. [K5]

UNIT I

Introduction to Ecosystem-Fundamentals of Ecology, Ecosystems: concept of ecosystems, energy flow in ecosystems, Food-chains. Interactions between environment and biota - concept of habitat and ecological niches, Organisms and stress factors - temperature: cold exposure, acclimatization, heat exposure and adaptation to heat. (15 Hours)

UNIT II

Air, Land and Noise pollution- Types of air pollutants, Sources, effects and control. Land pollutants & their biochemical effects. Solid Waste- Characteristics of municipal Waste, disposal of hazardous waste. Noise pollution and their biological effects. Fireworks and match industry: Pollutants and its abatement. (20 Hours)

UNIT III

Water Pollution & Industrial pollution: Water pollution - Sources, effect and control. Marine pollution – pollutants, sources, effects, oil pollution -control. Thermal pollution sources, effects & prevention. Removal of waste water from sugar industry, paper industry, pesticides & tannery industry. Bioplastics. Industrial & Laboratory hazards of plastics – biodegradation. Bioremediation and Bioleaching. (20 Hours)

UNIT IV

Pesticides and Herbicides: Systemic & Non systemic pesticides, structure, mode of action and applications (2, 4 D, DDT and Malathion only). Behaviour in soil, problems of pollution by pesticides. Environmental risks of direct & Indirect food additives, food colors & other contaminants. Occurrence of pesticides in foods .Removal of waste water from pesticide industry. Biodegradation of pesticides. (20 Hours)

UNIT V

Environmental Toxicology: Environmental carcinogens – chemical carcinogens, classification and mode of action (Azo dye-Tartrazine, Nitrosamine), Environmental teratogens, teratogenic effects, mechanism of action of teratogens. Environmental mutagens and their effects. Effects of radiation – sources of radiation, radioactive waste & management. (15 Hours)

TEXT BOOK

1.Sharma, P.D. (1994). *Environmental Biology,* Meerut, India: Rastogi & Company, 1st Edition.

REFERENCE BOOKS

1. Sharma, B.K. (1994). *Environmental Chemistry*, Meerut, India: Goel Publishing House, *1st*Edition.
2. Jogdand, S.N. (2008). *Environmental Biotechnology*, Bombay: Himalaya Publishing House, 4th Edition.
3. Sharma, B.K. (2001). *Water Pollution*, New Delhi: Goel Publishing, 3rd Edition.
4. Paliwal, K.V. (1994). *Pesticidal Pollution of Environment and Control*, Delhi, India:M.D. \ Publications Pvt. Ltd., 1st Edition.
5. Khopkar, S.M. (1994). *Environmental Pollution Analysis*, London: Heyden & Son Ltd, 1st Edition.
6. Trivedi, R.N. (1997). *A Text Book of Environmental Sciences*, New Delhi: Anmol
7. st Publications, 1 Edition.
8. Michael L. Cain, William D. Bowman, & Sally D. Hacker, (2014). *Ecology*, New Delhi: Sinauer Associates Inc, 3rd Edition.

Course Code 20PBCC41	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	M	H	M	M	-	M	M	-	-	M
CO2	H	H	M	H	H	M	M	-	M	-
CO3	H	H	H	H	M	H	M	-	M	M
CO4	H	H	H	H	H	M	H	-	-	-
CO5	H	H	M	H	M	H	H	-	M	M

Dr.P.Annapoorani — Mrs.M. Rajakumari

Head of the Department — Course Designer

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VIRUDHUNAGAR - 626 001

M.Sc. BIOCHEMISTRY

(2022-2023onwards)

Semester IV	**ENVIRONMENTAL BIOCHEMISTRY**	Hours/Week: 6	
Core Course-10		Credits: 5	
Course Code **20PBCC41N**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: understand the key concepts and complex relationship between biotic and abiotic components of ecosystem [K2]

CO2: apply the ecological knowledge and its consequences in basis of regional and global environmental issues. [K3]

CO3: analyze the current environmental problems (Air, water and soil pollution), chemical pollutants and its impacts on Biosphere.[K3]

CO4: evaluate the strategies, technologies and methods for assessment of environmental system and discuss some mitigation strategies like Biodegradation and Bioremediation.[K4]

CO5: create basic chemical concepts to analyze the Bio chemical processes involved in different environmental problems.[K5]

UNIT I

Introduction to Ecosystem-Fundamentals of Ecology, Ecosystems: concept of ecosystems, energy flow in ecosystems, Food-chains. Interactions between environment and biota - concept of habitat and ecological niches, Organisms and stress factors - temperature: cold exposure, acclimatization, heat exposure and adaptation to heat. (15 Hours)

UNIT II

Air, Land and Noise pollution- Types of air pollutants, Sources, effects and control. Land pollutants &their biochemical effects. Solid Waste- Characteristics of municipal Waste, Solid waste management, disposal of hazardous waste. Noise pollution and their biological effects. Fireworks and match industry: Pollutants and its abatement. Carbon sequestration.

(20 Hours)

UNIT III

Water Pollution & Industrial pollution: Water pollution - Sources, effect and control. Marine pollution – pollutants, sources, effects, oil pollution -control. Thermal pollution sources, effects & prevention. Treatment of waste water from sugar industry, paper industry, pesticides & tannery industry (Physical, Chemical and Biological methods). Effects of radiation – sources of radiation, radioactive waste & management. Industrial & Laboratory hazards of plastics, Biodegradation, Bioremediation and Bioleaching. Bioplastics.

(20 Hours)

UNIT IV

Pesticides and Herbicides: Systemic & Non systemic pesticides, structure, mode of action and applications (2, 4 D, DDT and Malathion only). Behaviour in soil, problems of pollution by pesticides. Environmental risks of direct & Indirect food additives, food colors & other contaminants. Occurrence of pesticides in foods. Treatment of waste water from pesticide industry. Biodegradation of pesticides.

(20 Hours)

Environmental Toxicology and convention : Environmental carcinogens – chemical carcinogens, classification and mode of action (Azo dye-Tartrazine, Nitrosamine), Environmental teratogens, teratogenic effects, mechanism of action of teratogens. Environmental mutagens and their effects. Chipko movement, Montreal Protocol, Kyoto Protocol, Ramsar Convention, Stockholm Convention, Rio summit.

(15 Hours)

TEXT BOOK

1.Sharma, P.D. (1994). *Environmental Biology*, Meerut, India: Rastogi & Company, 1st Edition

REFERENCE BOOKS

1. Sharma, B.K. (1994). *Environmental Chemistry,* Meerut, India: Goel Publishing House, *1st*Edition.
2. Jogdand, S.N. (2008). *Environmental Biotechnology,* Bombay: Himalaya Publishing House, 4 Edition.
3. Sharma, B.K. (2001). *Water Pollution*, New Delhi: Goel Publishing, 3rd Edition.
4. Paliwal, K.V. (1994). *Pesticidal Pollution of Environment and Control,* Delhi, India:M.D. Publications Pvt. Ltd., 1st Edition.
5. Khopkar, S.M. (1994). *Environmental Pollution Analysis,* London: Heyden & Son Ltd, 1st Edition. Trivedi, R.N. (1997). *A Text Book of Environmental Sciences,* New Delhi: Anmol Publications, 1st Edition.
6. Michael L. Cain, William D. Bowman, & Sally D. Hacker, (2014). *Ecology,* New Delhi: Sinauer Associates Inc, 3rd Edition.

Course Code (20PBCC41N)	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
	1a	1b	2	3a	3b	4	5	6	7	8
CO 1	M	H	M	H	H	H	M	L	L	M
CO 2	H	M	M	H	H	M	H	M	M	H
CO 3	H	M	H	H	M	H	M	M	M	M
CO 4	H	M	H	H	M	M	M	H	H	H
CO 5	M	M	M	M	M	M	M	M	M	M

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Mrs.M. Rajakumari
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M.SC. BIOCHEMISTRY

(2020 -2021 onwards)

Semester IV	**CLINICAL BIOCHEMISTRY**	Hours/Week: 6	
Core Course-11		Credits: 5	
Course Code **20PBCC42**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: discuss the diagnostic importance of gastric, renal function, immunological, prenatal test and metabolic functions. [K2]

CO2: perform clinical investigation on blood, urine and other body fluids for diagnostic purpose [K3]

CO3. determine the abnormalities of digestive, reproductive, kidney system and inborn errors of metabolism. [K3]

CO4: interpret the laboratory results with respect to the biological reference ranges and infer the results critically in light of the clinical picture. [K4]

CO5: assess the role of clinical biochemistry monitoring the biochemical basis of diseases and novel strategies to prevent the diseases [K5]

UNIT I

Disorders of carbohydrate and lipid metabolism: Diabetes mellitus, Hypoglycemia, Hyper lipoproteinemia and hypolipoproteinemia**.**

Disorders of inborn error of metabolism: Metabolic disorders of Carbhohydrate-galctosemia, glucogen storage disease (GSD). Metabolic disorders of aminoacids- Phenylketonuria, Alkaptonuria, Maple syrup urine disease. Metabolic disorders of lipids: Tay-sach's disease, Fabry's disease, Niemann-Pick disease, Gaucher's disease, Refsum's disease, Krabbe's disease. (20 Hours)

UNIT II

Disorders of digestive system: Typhoid, Cholera, Crohn disease, Appendicitis, Hernia –causes, symptoms, diagnosis, treatment and prevention.

Gastric function tests: collection of gastric contents, examination of gastric residium, Fractional Test Meal (FTM), stimulation tests, tubeless gastric analysis**.** Peptic Ulcer -definition, types, causes, diagnosis, prevention, treatment. Difference between stomach cancer and stomach ulcer. (20 Hours)

UNIT III

Kidney and urine- Collection of urine**,** Routine qualitative analysis of normal and abnormal constituents of urine and its diagnostic importance – reducing sugar, blood, bilirubin, ketone bodies, bile salts, porphyrin, uric acid and protein. Acute and chronic glomerulonephritis, acute and chronic renal failure. Renal function test, renal calculi. (20 Hours)

UNIT IV

Hematology – E.S.R, Screening test for sickle cell anemia, prothrombin time, Bleeding time. Immunological test:C- reactive protein test, rheumatoid arthritis test, immunologic test for pregnancy. Body fluid: Cerebrospinal fluid – site of withdrawal, blood brain barrier, collection of sample, function of CSF, composition of normal CSF and clinical investigation of CSF in various CNS diseases**.**

(15 Hours)

UNIT V

Disorders of reproductive system: Amnorrhea, cervical cancer, Poly cystic ovarian disease (PCOD), Endometriosis, Menopause, Breast cancer, Ectopic pregnancy- causes, symptoms, diagnosis, treatment and prevention.

Prenatal diagnosis of diseases- Amniotic fluid and fetal blood examination. Acetylcholinesterase and other tests on amniotic fluid. Chromosomal abnormalities by cytogenetics. Newborn screening: β-Thalassemia, PKU, cystic fibrosis and sweat tests. (20 Hours)

TEXT BOOKS

1. Chatterjea, M. N. & Rana Shinde (2011). *Text book of Medical Biochemistry*, New Delhi: Jaypee Brothers Medical Publishers (P) Ltd, 8th Edition.
2. Deb, A.C. (2001). *Fundamentals of Biochemistry*, Kolkata: New Central Book Agency, 7th Edition.
3. Kanai L Mukherjee &Swarajit Ghosh (2010). *Medical Laboratory Technology*,New Delhi: Vol I, Tata Mcgrawhill, 2nd Edition.

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 20PBCC42	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	H	H	H	M	M	M	M	M	M	-
CO2	H	H	M	M	M	M	M	M	M	-
CO3	H	H	H	M	H	M	-	M	M	M
CO4	H	H	M	M	H	M	M	M	M	H
CO5	H	H	H	M	H	M	H	M	M	H

Dr.R.Mallika

Dr.P.Annapoorani
Head of the Department

Mrs.K. Sudha Rameshwari
Course Designers

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M.Sc. BIOCHEMISTRY

(2022-2023onwards)

Semester IV	**CLINICAL BIOCHEMISTRY**	Hours/Week: 6	
Core Course-11		Credits: 5	
Course Code **20PBCC42N**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: discuss the diagnostic importance of gastric, renal function, immunological, prenatal test and metabolic functions. [K2]

CO2: perform clinical investigation on blood, urine and other body fluids for diagnostic purpose [K3]

CO3. determine the abnormalities of digestive, reproductive, kidney system and inborn errors of metabolism. [K3]

CO4: interpret the laboratory results with respect to the biological reference ranges and infer the results critically in light of the clinical picture. [K4]

CO5: assess the role of clinical biochemistry monitoring the biochemical basis of diseases and novel strategies to prevent the diseases [K5]

UNIT I

Disorders of carbohydrate and lipid metabolism: Diabetes mellitus, Hypoglycemia, Hyper lipoproteinemia and hypolipoproteinemia **.**

Disorders of inborn error of metabolism: Metabolic disorders of Carbhohydrate - galctosemia, glucogen storage disease (GSD). Metabolic disorders of aminoacids- Phenylketonuria, Alkaptonuria, Maple syrup urine disease. Metabolic disorders of lipids: Tay-sach's disease, Fabry's disease, Niemann-Pick disease, Gaucher's disease, Refsum's disease, Krabbe's disease. (20 Hours)

UNIT II

Disorders of digestive system: Typhoid, Cholera, Crohn disease, Appendicitis, Hernia –causes, symptoms, diagnosis, treatment and prevention. **Gastric function tests:** collection of gastric contents, examination of gastric residium, Fractional Test Meal (FTM), stimulation tests, tubeless gastric analysis**.** Peptic Ulcer-definition, types, causes, diagnosis, prevention, treatment. Difference between stomach cancer and stomach ulcer. (20 Hours)

UNIT III

Kidney and urine- Collection of urine**,** Routine qualitative analysis of normal and abnormal constituents of urine and its diagnostic importance – reducing sugar, blood, bilirubin, ketone bodies, bile salts, porphyrin, uric acid and protein. Acute and chronic glomerulonephritis, acute and chronic renal failure. Renal function test, renal calculi. (15 Hours)

UNIT IV

Hematology – E.S.R, Screening test for sickle cell anemia, prothrombin time, Bleeding time. Immunological test: C- reactive protein test, rheumatoid arthritis test, immunologic test for pregnancy. Body fluid: pericardial fluid, synovial fluid, pleural fluid, Cerebrospinal fluid –Collection, composition, clinical significances. (15 Hours)

UNIT V

Disorders of reproductive system: Amnorrhea, cervical cancer, Poly cystic ovarian disease (PCOD), Endometriosis, Menopause, Breast cancer, Ectopic pregnancy- causes, symptoms, diagnosis, treatment and prevention.

Prenatal diagnosis of diseases- Amniotic fluid and fetal blood examination. Acetylcholinesterase and other tests on amniotic fluid. Chromosomal abnormalities by cytogenetics. Newborn screening: β-Thalassemia, PKU, cystic fibrosis and sweat tests. (20 Hours)

TEXT BOOKS

1. Chatterjea, M. N. & Rana Shinde (2011). *Text book of Medical Biochemistry*, New Delhi: Jaypee Brothers Medical Publishers (P) Ltd, 8th Edition.
2. Deb, A.C. (2001). *Fundamentals of Biochemistry*, Kolkata: New Central Book Agency, 7th Edition.
3. Kanai L Mukherjee &Swarajit Ghosh (2010). *Medical Laboratory Technology*,New Delhi: Vol I, Tata Mcgrawhill, 2nd Edition.

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 20PBCC42N	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	H	H	H	M	M	M	M	M	M	-
CO2	H	H	M	M	M	M	M	M	M	-
CO3	H	H	H	M	H	M	-	M	M	M
CO4	H	H	M	M	H	M	M	M	M	H
CO5	H	H	H	M	H	M	H	M	M	H

Dr.R.Mallika
Mrs.K. Sudha Rameshwari
Course Designer

Dr.P.Annapoorani
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M.SC. BIOCHEMISTRY

(2020 -2021 onwards)

Semester IV	**DEVELOPMENTAL BIOLOGY AND GENETICS**	Hours/Week: 6	
Core Course-12		Credits: 5	
Course Code **20PBCC43**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: summarize the principles and experimental approaches of developmental biology and genetics. [K2]

CO2: compute the principles of genetics , molecular events of embryogenesis in understanding human embryo development and associated defects. [K3]

CO3: make use of molecular laboratory techniques used routinely in embryo development, forensic analysis including sex typing, DNA profiling, Single Nucleotide Polymorphism detection , DNA sequencing and genetic disorders. [K3]

CO4: analyse the findings of embryo development process, human genome project, genetic counseling and mendelian principles.[K4]

CO5: evaluate the early development process, principles of genetics to produce a family pedigree from a family history, and to distinguish patterns of inheritance for genetic disorders linked to autosomes or sex chromosomes. [K5]

UNIT I

Basic concepts of Developmental Biology: Theories of developmental biology. General concepts of organism development: Potency, commitment, specification, induction, competence, determination & differentiation; morphogenetic gradients; cell fate & cell lineages; genomic equivalence and cytoplasmic determinants. (15 Hours)

UNIT II

Gametogenesis, Fertilization, Cleavage & Gastrulation: Spermatogenesis and oogenesis process; types of sperms and eggs. Fertilization- approach of sperm to the egg- Activation of egg – Cortical reaction. Cleavage pattern in mammals. Blastulation and Gastrulation in mammals. Neural tube formation and cell migration in mammals.

(20 Hours)

UNIT III

Mendelian Genetics: Mendel's study of heredity, Phenotype, Genotype, Dominant and Recessive alleles, Principle of dominance, Principle of segregation, Principle of independent assortment. Monohybrid crosses, Dihybrid crosses, Trihybrid crosses, Test Cross, Back cross. Alleles, Co-dominant alleles, Multiple alleles . Linkage and crossing over in Drosophila.

(20 Hours)

UNIT IV

Human Genetics: Pedigree analysis, Linkage analysis, Chromosome mapping. Human disorders following Mendelian patterns of inheritance. Genome imprinting. Gene amplification. STRs and VNTRs, Paternity test. (20 Hours)

UNIT V

Inherited disorders: Polyploidy, aneuploidy , Allosomal (Kline felter's syndrome and Turner syndrome) Autosomal (Down syndrome). Genetic counseling. Human genome project.

(15 Hours)

TEXT BOOKS

1. Arumugam.N. (2003). *A Text Book of Embryology,* Nagercoil, TamilNadu: Saras Publication, 1st Edition.
2. Varma P.S. &Agarwal.V.K (2001). *Genetics,* New Delhi: S.chand Publications,5th Edition.
3. 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.
4. James D.Watson Et al., (2004). *Molecular Biology of Gene*, New Delhi: Pearson Education (Singapore) Indian Branch, 2nd Edition.
5. Eldon John Gardner (1991). *Principles of Genetics,* USA: John Wiley & Sons, 8th Edition.
6. Bhatnagar, S.M. (1995). *Essentials of Human Genetics,* Hyderabad: Sangam Books Pvt. Ltd. 1st Edition.
7. Robert H.Tamarin (2001). *Principles of Genetics,* Newyork: MCGraw Hill Companies, 7th Edition.

Course Code 20PBCC43	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	M	H	M	L	L	-	-	-	-	-
CO2	H	H	H	H	H	M	L	-	-	H
CO3	H	H	H	H	H	H	H	H	-	H
CO4	H	H	H	H	H	H	H	H	L	H
CO5	H	H	H	H	H	H	H	H	L	H

Dr.P.Annapoorani
Head of the Department

Mrs.R.Gloria Jemmi Christobel
Course Designer

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M.Sc. BIOCHEMISTRY

(2022 -2023 onwards)

Semester IV	**DEVELOPMENTAL BIOLOGY AND GENETICS**	Hours/Week: 6	
Core Course-12		Credits: 5	
Course Code **20PBCC43N**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: summarize the principles and experimental approaches of developmental biology and genetics. [K2]

CO2: apply the genetics principle, molecular events of embryogenesis in understanding human development and associated defects. [K3]

CO3 : apply molecular laboratory techniques used routinely in embryo development, forensic analysis including sex typing, DNA profiling, Single Nucleotide Polymorphism detection and in DNA sequencing. [K3]

CO4: examine the early development process, principles of genetics to produce a family pedigree from a family history, and to distinguish patterns of inheritance for genetic disorders linked to autosomes or sex chromosomes. [K4]

CO5 : evaluate the concept of genetics, human genome project, genetic counselling, fertilization process and embryo development, genetic markers . [K5]

UNIT I

Basic concepts of Developmental Biology: Theories of developmental biology. General concepts of organism development: Potency, commitment, specification, induction, competence, determination & differentiation; morphogenetic gradients; cell fate & cell lineages; genomic equivalence and cytoplasmic determinants. Transgenics in analysis of development, Programmed Cell Death (15 Hours)

UNIT II

Gametogenesis, Fertilization, Cleavage & Gastrulation: Spermatogenesis and oogenesis process; types of sperms and eggs. Fertilization- approach of sperm to the egg- Activation of egg – Cortical reaction. Cleavage pattern in mammals. Blastulation and Gastrulation in mammals. Neural tube formation and Cell migration in mammals. (20 Hours)

UNIT III

Mendelian Genetics: Mendel's study of heredity-Mendelian Laws. Pedigree analysis- Sex Linked Pedigree, Autosomal Pedigree, Importance of Pedigree Analysis. Linkage analysis, Chromosome mapping. Linkage and crossing over in Drosophila.

(20 Hours)

UNIT IV

Human Genetics: Human disorders following Mendelian patterns of inheritance. Gene Markers-STRs and VNTRs. Karyotype, Chromosome Banding. Genome Imprinting. Gene amplification. Paternity test. Next Generation Sequencing. (20 Hours)

UNIT V

Inherited disorders: Polyploidy, aneuploidy , Allosomal -Klinefelters' syndrome and Turners' syndrome. Autosomal -Down syndrome. Genetic counseling. Human genome project. Online Mendelian Inheritance in Man. (15 Hours)

TEXT BOOKS

1. Arumugam.N. (2003). *A Text Book of Embryology*, Nagercoil, TamilNadu: Saras Publication, 1st Edition.

2. Varma P.S. &Agarwal.V.K (2001). *Genetics,* New Delhi: S.chand Publications,5th Edition.

3. 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.

4.James D.Watson Et al., (2004). *Molecular Biology of Gene,* New Delhi: Pearson Education (Singapore) Indian Branch, 2nd Edition.

5.Eldon John Gardner (1991). *Principles of Genetics,* USA: John Wiley & Sons, 8th Edition.

6. Bhatnagar, S.M. (1995). *Essentials of Human Genetics,* Hyderabad: Sangam Books Pvt. Ltd. 1st Edition.

7. Robert H.Tamarin (2001). *Principles of Genetics,* Newyork: MC Graw Hill Companies, 7th Edition.

Course Code 20PBCC43N	PO1		PO2	PO 3		PO 4	PO 5	PO 6	PO 7	PO 8
	1a	1b	2	3a	3b	4	5	6	7	8
CO1	M	M	H	H	H	H	M	H	M	M
CO 2	H	H	M	H	H	H	H	H	M	M
CO 3	M	M	M	M	H	H	H	H	M	H
CO 4	H	H	H	H	H	H	H	H	H	H
CO 5	H	H	M	H	H	H	H	H	H	H

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M.Sc. BIOCHEMISTRY
(2020-2021 onwards)

Semester IV	**PROJECT VIVA-VOCE**	Hours/Week: 12	
Project		Credits: 8	
Course Code **20PBCC41PR**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : Make use of literature review through existing digital platform to formulate the project work. [K3]

CO2 : Discover the inter disciplinary knowledge to carry out project the work for the welfare of the society. [K3]

CO3 : Analyze the results of the project work that is being executed and to correlate them for improving the society. [K4]

CO4 : Develop an insight into the experiments carried out during the project work and conclude the findings with the existing results. [K5]

CO5 : assess the original findings and interpret the data.[K5]

- 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.
- Four copies of the project report with binding should be submitted.

Course code 20PBCC41PR	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	H	H	H	H	H	H	H	H	M	H
CO2	H	H	H	H	H	H	H	M	M	H
CO3	H	H	H	H	H	H	H	M	M	H
CO4	H	H	H	H	H	H	H	H	M	H
CO5	H	H	H	H	H	H	H	H	M	H

Dr.P.Annapoorani — Head of the Department

Dr.R.Mallika — Course Designer

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M.Sc. BIOCHEMISTRY

(2022 -2023 onwards)

Semester IV	**Project - Research Methodology & Ethics**	Hours/Week: 12	
Core Course-12		Credits: **8**	
Course Code **22PBCC41PR**		Internal 60	External 40

COURSE OUTCOMES

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

CO1 : apply the knowledge of research problems and hypothesis to carry out the experiments for Project with Research Ethics. [K3]

CO2 : relate different research papers with their own research problem and design protocols for their works. [K3]

CO3 : analyze the results of the project work that is being executed and to correlate them for improving the society. [K4]

CO4 : Develop an insight into the experiments carried out during the project work and conclude the findings with the existing results. [K5]

CO5 : Summarise the original findings of the project work for paper publication. [K5]

Unit-I: Art of Research planning

Objectives of research – Understanding research and its goals. Critical thinking. Research topic selection and justification. Techniques involved in designing a questionnaire – Methods of scientific enquiry – formulation of hypotheses and testing of the same – Development of a research proposal – Theoretical and Experimental Processes.

(6 hours)

Unit-II: Literature survey, Research sources

Sources of information- Literature search: Computers in literature search using Internet websites, Online data bases – search tools. Literature review – Case studies, review articles and Meta analysis – record of research review. Ethical and Moral Issues in Research, Plagiarism, tools to avoid plagiarism – Thesis writing, and Research report writing and preparation of dissertation. Publication in Journals - ACS-pubs, Royal Society, Springer link, science direct, Wiley – Interscience ,Pubmed, Elsevier. Submission of research articles for Publication to Reputed journals-h-index, i-index, ISSN, ISBN –Science Citation Index - Chemistry journal index. Intellectual Property Rights – Copy right laws – Patent rights. (6 hours)

- 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.
- Four copies of the project report with binding should be submitted.

References

1. Ganesan R, Research Methodology for Engineers , MJP Publishers, Chennai. 2011
2. Walpole R.A., Myers R.H., Myers S.L. and Ye, King: Probability & Statistics for Engineers and Scientists, Pearson Prentice Hall, Pearson Education, Inc. 2007.
3. Anderson B.H., Dursaton, and Poole M.: Thesis and assignment writing, Wiley Eastern 1997.
4. Bijorn Gustavii: How to write and illustrate scientific papers? Cambridge University Press.
5. Bordens K.S. and Abbott, B.b.: Research Design and Methods, Mc Graw Hill, 2008.
6. Graves N, Varma V: Working for a doctorate Toutledge 1997.
7. Graziano, A., M., and Raulin, M.,L.: Research Methods – A Process of Inquiry, Sixth Edition, Pearson, 2007.
8. Leedy., P., D.: Practical Research – Planning and Design, Eighth Edition, Pearson., 2005.
9. Kothari C.K., Research Methodology- Methods and Techniques (New Age International, New Delhi), 2004.

Course Code	PO1		PO2	PO 3		PO 4	PO 5	PO 6	PO 7	PO 8
22PBCC41PR	1a	1b	2	3a	3b	4	5	6	7	8
CO1	H	H	H	H	H	H	H	H	M	H
CO 2	H	H	H	H	H	H	H	M	M	H
CO 3	H	H	H	H	H	H	H	M	M	H
CO 4	H	H	H	H	H	H	H	H	M	H
CO 5	H	H	H	H	H	H	H	H	M	H

Evaluation Pattern (100 marks)					
Internal Assessment (60marks)				External Assessment (40 marks)	
One Periodic Test (20)	Project Report (20)	Pre-Submission Presentation (10)	One Open online Course related to the Project (10)	Project Presentation (30)	Viva Voce (10)

Dr.P.Annapoorani
Head of the Department

Dr.P.Annapoorani
Course Desiger

V.V.VANNIAPERUMAL COLLEGE FOR WOMEN
(Belonging to Virudhunagar Hindu Nadars)
An Autonomous Institution Affiliated to Madurai Kamaraj University, Madurai
Re-accredited with 'A' Grade (3rd Cycle) by NAAC
VIRUDHUNAGAR - 626 001

M.Sc. BIOCHEMISTRY

(2022 -2023 onwards)

EXTRA CREDIT COURSE

Semester II	BIOSAFETY, LABORATORY SAFETY AND IPR	Credits: 2
EXTRA CREDIT COURSE-1		
Course Code **22PBCO21**		Internal 100

COURSE OUTCOMES

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

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

CO2: Know-how of issues and bioethics related to molecular technologies and GMOs

CO3: Apply the concept of patenting and process of filing for a patent

CO4: Analyze the use of genetically modified organisms and its effect on human health

CO5: Evaluate the importance of biosafety practices and guidelines in research

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.

Unit-II

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.

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.

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.

Unit-V

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.

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.

Text books

1. Sateesh, M.K., Bioethics and Biosafety, IK International Publishers (2008)
2. Singh I. and Kaur, B., Patent law and Entrepreneurship, Kalyani Publishers (2006).
3. Srinivasan, K. and Awasthi, H.K., Law of Patents, Jain Book Agency (1997)

Reference Books

1. Narayan, P., Patent Law, Eastern Law House (1975).
2. Jonathan, Y.R., Anthology of Biosafety (Vols. 1-4), American Biological Safety Association (2005).
3. Encyclopedia of Ethical, Legal and Policy issues in Biotechnology, John Wiley & Sons Inc. (2005)