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

OUTCOME BASED EDUCATION WITH CHOICE BASED CREDIT SYSTEM REGULATIONS AND SYLLABUS
(with effect from Academic Year 2025 - 2026)

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

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

A. CHOICE BASED CREDIT SYSTEM (CBCS)

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

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

UG PROGRAMMES

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

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

PG PROGRAMMES

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

* AICTE approved Programmes

OUTLINE OF CHOICE BASED CREDIT SYSTEM- PG

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

List of Non Major Elective Courses (NME)
(2024-2025 onwards)

PG PROGRAMMES

Name of the Course	Semester	Course Code	Department
Introduction to Epigraphy	II	24PHIN21	History
Communication Strategies for Leadership Success	III	24PHIN31	
Functional English	II	24PENN21	English
English for Careers	III	24PENN31	
ஆளுமை மேம்பாடு	II	24PTAN21N	Tamil
தகவல் தொடர்பியல்	III	24PTAN31	
Accounting for Managers -1	II	24PCON21N	Commerce
Accounting for Managers -II	III	24PCON31	
Entrepreneurship Development	II	24PBAN21	Business Administration
Employability Skills	III	24PBAN31	
Mathematics for Life Sciences	II	24PMTN21	Mathematics
Statistics for Life and Social Sciences	III	24PMTN31	
Solid Waste Management	II	24PPHN21	Physics

Sewage and Waste Water Treatment and Reuse	III	24PPHN31	
Chemistry in Everyday Life	II	24PCHN21	Chemistry
Industrial Chemistry	III	24PCHN31	
Food Preservation	II	24PHSN21	Home Science - Nutrition and Dietetics
Nutrition and Health	III	24PHSN31	
Nutritional Biochemistry	II	24PBCN21	Biochemistry
Molecular Basis of Diseases and Therapeutic Strategies	III	24PBCN31	
Tissue engineering	II	24PBON21	Biotechnology
Gene manipulation Technology	III	24PBON31	
Web Programming	II	24PCSN21	Computer Science
Python Programming	III	24PCSN31	
Fundamentals of Web Design	II	24PCAN21N	Computer Applications
Fundamentals of Cyber Security	III	24PCAN31	

B. OUTCOME BASED EDUCATION (OBE) FRAMEWORK

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

Vision of the Institution

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

Mission of the Institution

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

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

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

Vision of the Department of M.Sc. BIOTECHNOLOGY

To educate rural women students in the field of research and academics with excellent state-of-art Biotechnological skills to serve for the benefit of mankind

Mission of the Department of M.Sc. BIOTECHNOLOGY

1. To impart quality education in Biotechnology to the students with sound disciplinary knowledge
2. To become competent Biotechnologists who will be able to apply the basic principles and techniques of life sciences to solve a wide array of problems to facilitate human welfare in various fields such as health, agriculture and industry with socio-ethical consideration

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. BIOTECHNOLOGY Programme The Students will be able to

- To acquire knowledge and sound understanding of concepts in various branches of Biotechnology and exhibit their abilities and skills leading to become competent professionals
- To employ their knowledge and technical skills in their profession for problem solving
- To sustain the standards of the profession concerned with ethical consideration

Key Components of Mission Statement	PEO1	PEO2	PEO3
conceptual knowledge	✓	✓	✓
Problem solving	✓	✓	✓
socio-ethical consideration	✓	✓	✓

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.Biotechnology Programme, the students will be able to

PO 1: *Disciplinary Knowledge*

PSO 1.a : Demonstrate and apply their knowledge of cell biology, biochemistry, microbiology and molecular biology to solve the problems related to the field of biotechnology.

PSO 1.b : Understand the principles and handling of various instruments used in Biochemistry, Microbiology and molecular biology laboratory and to equip the practical skills in various areas of Biotechnology providing a strong foundation for both academic / industrial placements across the country and globe as well as setting up entrepreneurial ventures.

PO2: *Communication Skills*

PSO 2 : Explain various concepts and processes of Biological sciences both in verbal and written form and illustrate the techniques related to Biotechnology in an effective manner

PO3: *Scientific Reasoning and Problem Solving*

PSO 3.a: apply their acquired theoretical knowledge and analytical and problem solving skills skills to identify and solve problems in day today life.

PSO 3.b: Employ interdisciplinary knowledge to provide better solutions and new ideas in various branches of Biotechnology in a sustainable manner

PO 4: Critical Thinking and Analytical Reasoning

PSO 4: critically think and apply the concepts in life sciences in identifying the problems which can be addressed only through Biotechnology

PSO 4b: Analyse the organization of plant, animal and microbes from cellular level upto genome level and their inter relationship to exploit them for various research and development activities in the field of Agriculture, health and environment.

PO 5: Research Related Skills

PSO 5: develop research related solutions to combat the challenges such as pandemic, famine and environmental deterioration arising globally in day today life with scientific temperament and acquired skills

PO 6: Digital Literacy, Self - Directed and Lifelong Learning

PSO 6 : utilize the ICT tools for their research process in analysing the data quickly and accurately in various fields of Biotechnology

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

PSO 7: Work effectively as a member with cooperation in an institution, industry or society through the acquired skills from paper presentation, Industrial visit and Internship programme.

PO 8: Moral and Ethical Awareness

PSO 8 : Understand the IPR, ethics in life science and adapting ecofriendly techniques for sustainable development to meet the global standards and to follow moral values in both professional and personal life

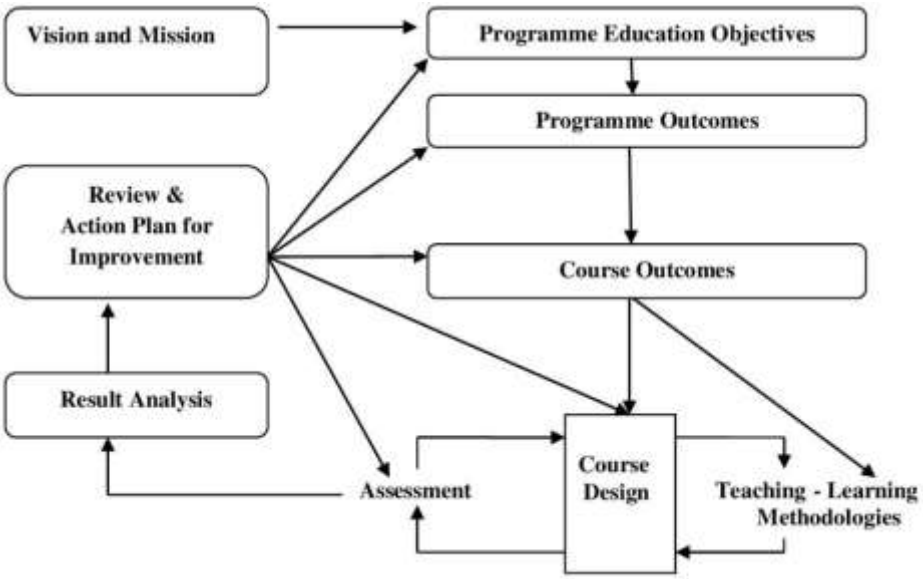
PO-PEO Mapping Matrix

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	✓	✓	-

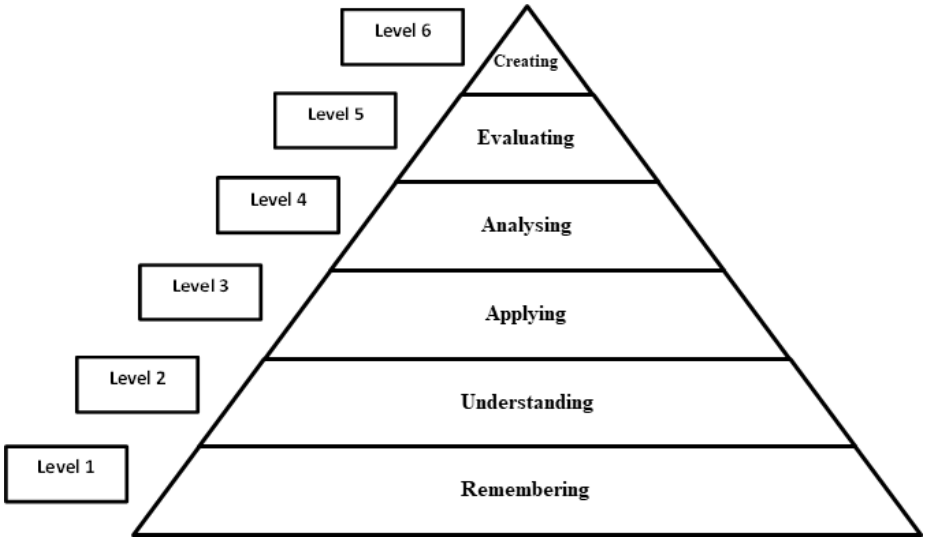
B.1.4 Course Outcomes (COs)

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



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

BLOOM'S TAXONOMY



CO - PO Mapping of Courses

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

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

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

ELIGIBILITY FOR ADMISSION

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

DURATION OF THE PROGRAMME

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

MEDIUM OF INSTRUCTION

English

B.2 EVALUATION SCHEME

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

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

INTERNAL ASSESSMENT
Distribution of Marks
Theory

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

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

Practical

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

Practical Test - Average of the two Practical Tests will be considered
Performance - Attendance and Record

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

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

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

Summative Examination

External Assessment

Distribution of Marks

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

Summative Examination

Question Pattern **Duration: 3 Hours**

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

B.2.2 Project

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

Distribution of Marks

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

Internal Assessment:

Pre-submission Presentation - 10 Marks

Review Report - 20 Marks

One Open Online Course related to the Project - 10 Marks

External Assessment:

Project Report - 40 Marks

Viva Voce - 20 Marks

B. 2.3 Skill Enhancement Course - Professional Competency Skill

Types of Question – Multiple Choice Questions Only

INTERNAL ASSESSMENT

Distribution of Marks

Theory

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

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

Two Assignments - Better of the two will be considered

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

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

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

Summative Examination
External Assessment

Distribution of Marks

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

Summative Examination
Question Pattern **Duration: 3 Hours**

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

B. 2.4 Internship / Industrial Training

Internship / Industrial Training is mandatory for all the Students

- **Internship:** Students have to involve in a designated activity, working in an organization for maximum of 30 days (not less than 20 days) under the guidance of an identified mentor.
- **Industrial Training:** Students have to undertake in-plant training in industries individually or in group for maximum of 30 days (not less than 20 days)
- Internship / Industrial Training must be done during the second semester holidays

Distribution of Marks

Mode of Evaluation		Marks
Internal Assessment	:	75
External Assessment	:	25
Total	:	**100**

Internal Assessment

Mode of Evaluation		Marks
Onsite Learning/Survey	:	50
Report	:	25
Total		**75**

External Assessment

Mode of Evaluation		Marks
Viva-Voce	:	25
Total		**25**

B.2.5. Self Study - Online Course

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

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

Distribution of Marks

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

Two Periodic Tests - Better of the two will be considered

B.2.6. Extension Activities

Assessment by Internal Examiner only

Distribution of Marks

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

*The marks obtained will be calculated for 100 marks

B.2.7 Transfer of credits earned through MOOC (UGC recognized Courses)

- Students can opt for minimum of
  - 12 weeks Courses for Core Courses
  - 8 weeks Courses for Elective Courses
  - 4 weeks Courses for Skill Enhancement Course
- The Online Courses opted by the students will be verified and approved by the Head of the Department and forwarded to the Controller of Examinations through the Principal.
- Students are required to register for the equivalent Online Courses through the Institution's SWAYAM-NPTEL Local Chapter after submitting a Permission letter to the Head of the Department.
- The Course should be completed before the beginning of that particular Semester in which the selected Course is offered.
- The student should submit the Course Completion Certificate immediately after receiving it, to the Department.
- The Head of the Department has to send the list of the students and their Course Completion Certificates to the Controller of Examinations through the Principal.
- The students who have submitted the Completion Certificate are exempted from appearing the Periodic Tests and Summative Examinations of the respective course but without any exemption for class attendance.
- Credits allotted for the particular Course in the Curriculum will be transferred after the completion of the Online Course
- Students can earn up to 10 credits within the mandatory credits requirements of the Degree Programme by completing UGC recognised Online Courses.

B.2.8. EXTRA CREDIT COURSES (OPTIONAL)

2.8.1 Extra Credit Course offered by the Department.

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

Distribution of Marks

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

Question Pattern for Model Examination

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

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

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

4weeks Course - 1 credit

8 weeks Course - 2 credits

12 weeks Course - 3 credits

ELIGIBILITY FOR THE DEGREE

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

B.3ASSESSMENT 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 therespective departments.

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

Indirect Assessment - Done through Course Exit Survey.

CO Assessment Rubrics

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

CO Attainment

Direct CO Attainment

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

Target Setting for Assessment Method

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

Formula for Attainment for each CO

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

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

Attainment Levels of COs

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

Indirect CO Attainment

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

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

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

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

B.3.2 Assessment Process for Overall PO Attainment

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

PO Assessment Tools

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

Programme Articulation Matrix (PAM)

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

Indirect Attainment of POs for all Courses

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

Attainments of POs for all Courses

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

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

Expected Level of Attainment for each of the Programme Outcomes

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

Level of PO Attainment

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

B.3.3 Assessment Process for PEOs

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

Target for PEO Attainment

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

Attainment of PEOs

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

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

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

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

Expected Level of Attainment for each of the Programme Educational Objectives

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

Level of PEO Attainment

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

C. PROCESS OF REDEFINING THE PROGRMME EDUCATIONAL OBJECTIVES

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

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

MASTER OF BIOTECHNOLOGY (7024)

Outcome Based Education with Choice Base Credit System
Programme Structure - Allotment of Hours and Credits
For those who join in the Academic Year 2024-2025

Components	Semester				Total Number of Hours (Credits)
	I	II	III	IV	
Core Course	6 (5)	6 (5)	6 (5)	6 (5)	24 (20)
Core Course	6 (5)	6 (5)	6 (5)	6 (5)	24 (20)
Core Course	-	-	6 (5)	-	6 (5)
Core Course Practical	6 (4)	6 (4)	6 (4)	-	18 (12)
Project	-	-	-	6 (5)	6(5)
Elective Course (DSEC)	6 (3)	4 (3)	3 (3)	-	13 (9)
Elective Course (Generic)	6 (3)	4 (3)	-	-	10 (6)
Elective Course(NME)	-	4 (2)	3 (2)	-	7 (4)
Elective Course- (Industry / Entrepreneurship)	-	-		6 (3)	6 (3)
Skill Enhancement Course/ Professional Competency Skill	-	-	-	6 (3)	6 (3)
Self Study Course	-	-	0 (1)	-	0 (1)
Internship/Industrial Activity	-	-	0 (2)	-	0 (2)
Extension Activity	-	-	-	0 (1)	0 (1)
Total	**30 (20)**	**30 (22)**	**30 (27)**	**30 (22)**	**120 (91)**
Extra Credit Course(Optional) - Offered by the Department	-	-	0(2)	-	0(2)
Extra Credit Course(Optional) - MOOC	-	-	-	-	Limited to a maximum of 15 credits

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	Bioinformatics	24PBOC31	6	5	3	25	75	100
2	Core Course -8	Immunology	24PBOC32	6	5	3	25	75	100
3	Core Course -9	Bioprocess Technology	24PBOC33	6	5	3	25	75	100
4	Core Course -10 Practical -3	Bioinformatics, Immunology, Bioprocess Technology Practical	24PBOC31P	6	4	6	40	60	100
5	Elective Course -6 (DSEC)	NanoBiotechnology	24PBOE31	3	3	3	25	75	100
6	Elective Course -7 (NME)	Gene manipulation Technology	24PBON31	3	2	3	25	75	100
7	Self Study Course	Practice for CSIR NET- General Paper	24PGOL32	-	1	-	100	-	100
8	Internship/ Industrial Activity	Internship	24PBOI31	-	2	-	75	25	100
			Total	**30**	**27**				**800**
9	Extra Credit Course	Molecular Developmental Biology	24PBOO31	-	2	3	100	-	100

SEMESTER IV

S.No.	Components	Title of the Course	Course Code	Hours Per Week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
1.	Core Course -11	Research Methodology	24PBOC41	6	5	3	25	75	100
2	Core Course -12	Biostatistics	24PBOC42	6	5	3	25	75	100
3.	Core course-13	Project	24PBOC43PR	6	5	-	40	60	100
4.	Elective Course- 8 (Industry / Entrepreneurship)	Bioethics, Biosafety, Clinical Trials, IPR & Entrepreneurship	24PBOE41	6	3	3	25	75	100
5.	Skill Enhancement Course/ Professional Competency Skill	Life Sciences for Competitive Examinations	24PBOS41	6	3	3	25	75	100
6.	Extension Activity			-	1	-	100	-	100
Total				**30**	**22**				**600**

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

M.SC. BIOTECHNOLOGY

(2024 -2025 onwards)

Semester III	**BIOINFORMATICS**	**Hours/Week: 6**	
Core Course 7		**Credits: 5**	
24PBOC31		**Internal 25**	**External 75**

Course outcomes

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

CO1: understand the basic concepts of Bioinformatics, history, scope, and importance of Bioinformatics and role of the internet in Bioinformatics [K2]

CO2: describe the concept of Bioinformatics [K3]

CO3: apply the sequence alignment,Genomic sequencing,Protein database and drug discovery [K3]

CO4: examine the sequence alignment, genome variation, protein structure and drug discovery [K4]

CO5: discuss the ethical, legal, and social issues related to bioinformatics research, including data privacy, consent in genomic research, and the implications of personalized medicine. [K4]

UNIT-I

Database concepts, Introduction to internet and its application, Introduction to bioinformatics, Protein and nucleotide databases, Information retrieval from biological databases, Sequence alignment and database searching-similarity searches using BLAST and FASTA. Artificial Intelligence: Introduction to biological neural network, motivation for artificial neural network (ANN), Big data analysis - DNA/RNA/protein sequence or structure data, gene expression data, protein-protein interaction (PPI) data, pathway data and gene ontology (GO) data

(18 Hours)

UNIT-II

Sequence alignment basics, match, mismatch, similarity, scoring an alignment, gap penalty, protein vs DNA alignments, Dot-matrix alignment, pairwise alignment. Global and local alignment algorithms, multiple sequence alignment-progressive alignment and Iterative alignment algorithms, consensus sequence, patterns and profiles, Database searching: Pairwise alignment based rigorous algorithm (Smith and Waterman) and Heuristic algorithms (FASTA and Blast). Multiple sequence alignment based database searching. PSI- Blast, PAM and Blosum matrices

(18 Hours)

UNIT-III

Bioinformatics for genome sequencing, EST Clustering and analyses, Finding genes in prokaryotic and eukaryotic genomes, Regulatory sequence analysis, Bioinformatics for Genome maps and markers, Bioinformatics for understanding Genome variation, Protein structure-X-ray crystallography, The protein databank and the PDBSum-SCOP, CATH, DALI and HSSP;Visualization of molecular structures-RasMol and Pymol; Protein secondary structure prediction, Fold Recognition; Transmembrane topology prediction (18 Hours)

UNIT-IV

Molecular visualization tools. Rasmol, Chime, and Spdb viewer. Structure analysis tools. VAST and DALI, Structural biology - Homology modeling, Bioinformatics for microarray designing and transcriptional profiling, Bioinformatics for metabolic reconstruction, Bioinformatics for phylogenetic analysis (18 Hours)

UNIT-V

Medical application of Bioinformatics. Disease genes, Drug Discovery. History. Steps in drug discovery. Target Identification. Target Validation. QSAR. Lead Identification. Preclinical pharmacology and toxicology. ADME. Drug designing. Rational drug design. Computer aided drug design. Ligand based approach. Target based approach (18 Hours)

Reference Books:

1. DassanayakeS.Ranil, Y.I.N. Silva Gunawardene, 2011. Genomic and Proteomic Techniques, Narosa Publishing House Pvt. Ltd, New Delhi.
2. Thiagarajan B, Rajalakshmi.P.A., 2009. Computational Biology, MJP publishers, Chennai.
3. BosuOrpita, SimminderKaur Thukral, 2007. Bioinformatics Databases, Tools and Algorithms, Oxford University press, New Delhi.
4. Rastogi.S.C, Mendiratta.N, Rastogi.P, 2004. Bioinformatics methods and applications, Prentice-Hall of India private limited, New Delhi.
5. Lohar s. Prakash, 2009. Bioinformatics, MJP Publishers, Chennai.

6. Stephen misener and Stephen A. Krawetz., 2000. Bioinformatics methods and protocols, Humana press Inc, New Jersey.
7. Durbin.R, S.Eddy, A.Krogh and G.Mitchison, 1998. Biological sequence analysis, Cambridge university press, Cambridge.

Course Code	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**	**PO8**
24PBOC31	**PSO 1a**	**PSO 1b**	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4a**	**PSO 4b**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO1	3	2	1	1	3	3	3	2	3	2	1
CO2	3	2	1	1	3	3	3	2	3	1	1
CO3	3	1	1	1	2	2	2	1	1	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1
CO5	3	2	2	2	2	2	2	1	1	1	1

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

Dr.V.Jeyasimga
Head of the Department

Ms.K.Srinithi
Course designer

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

M.SC. BIOTECHNOLOGY

(2024 -2025 onwards)

Semester III	**IMMUNOLOGY**	**Hours/Week: 6**	
Core Course 8		**Credits: 5**	
24PBOC32		**Internal 25**	**External 75**

COURSES 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 concepts of immunoglobulin, cells of the immune system, antigen antibody interaction . [K3]

CO3 : explain the functions of key immune cells, antigens, immunoglobulins, and hypersensitivity reactions, advanced immunotechniques, vaccine, monoclonal antibodies, and immunotherapy applications in research and clinical settings. [K3]

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

CO5 : analyze the immune system, covering its history, types, cellular and molecular components, antigen recognition, immune responses, monoclonal antibodies, transplantation and tumor immunology and hypersensitivity reactions . [K4]

Unit I

History and overview of the immune system. Types of immunity - innate, acquired, passive and active, self vs non-self-discrimination. Physiology of immune response: HI and CMI specificity and memory. Cells and organs of the immune system .Lymphoid tissue, origin and development. Hematopoiesis and differentiation of lymphocytes.

(18 hours)

Unit II

Lymphocyte- sub-populations of mouse and man. APC cells, lymphokines, Phagocytic cells, macrophage, dendritic cells, K and NK Cells. Nature and biology of antigens, epitopes, haptens, adjuvants. Immunoglobulins- structure, distribution and function. Immunoglobulin super family Isotypic, Allotypic and Idiotypic variants, generation of antibody diversity. **(18 hours)**

Unit III

Monoclonal antibody production and its applications. Types of vaccine and vaccination schedule. Role of MHC antigens in immune responses, Structure and function of class I and class II MHC molecules. MHC antigens in transplantation and HLA tissue typing. Transplantation immunology- immunological basis of graft rejection, clinical transplantation and Immunosuppressive therapy. Tumour Immunology - Tumour antigen, Immune response to tumours. **(18 hours)**

Unit IV

Effector mechanisms in immunity - macrophage activation, cell mediated cytotoxicity, cytotoxicity assay. Hypersensitivity reactions and types. The complement system, mode of activation, classical and alternate pathway, biological functions of C proteins.

(18 Hours)

U**nit V**

Immunotechniques- Principle and Applications: Immunodiffusion, Immunofluorescence, Insitu localization technique - FISH and GISH. RIA and ELISA, FACS, Western blot, ELISPOT assay. Agglutination tests. VDRL test.Purification of antibodies, Quantitation of immunoglobulin by RID, EID and nephelometry, CMI techniques and Immunotherapy.

(18 hours)

Text Books

1. Khan R .(2022). Immunology. 2nd Edition, Pearson India.
2. Bhende P.M & Lele M.J. (2016). Basic Immunology. 1st Edition , Himalaya Publishing House.

3. Rao C.V,.(2010).An Introduction to Immunology. 1st Edition , Narosa Publishing House.
4. Joshi K.R. (2019).Fundamentals of Immunology and Immunotechnology. 2nd Edition , McGraw Hill Education.
5. Kakrani S.L. & Gupta R.K.(2017).Immunology and Serology. 1st Edition , Jaypee Brothers Medical Publishers.

Reference Books:

1. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt. (2011) . Roitt.S Essential Immunology. 12th Edition, Wiley-Blackwell. USA.
2. Kannan. I. (2010). Immunology. 1st Edition , MJP Publishers, Chennai.
3. Abbas, A.K., Lichtman A.H.L. and.Pillai S . (2010). Cellular and Molecular Immunology. 6th Edition,Saunders Elsevier Publications, Philadelphia.
4. Seemi Garhat Bashir. (2009).Textbook of Immunology. 1st Edition, PHI Learning Pvt. Ltd., New Delhi.
5. Thomas J. Kindt, Barbara A. Osborne, and Richard A. Goldsby. (2006).Kuby Immunology, 6th Edition, W.H. Freeman & Company.

Web Resources

1. https://microbenotes.com/immunofluorescence/
2. https://www.msdmanuals.com/professional/infectious-diseases/laboratory-diagnosis-of-infectious-disease/immunologic-tests-for-infectious-disease?ruleredirectid=743

Course Code 24PBOC32	PO1		PO2	PO3		PO4		PO5	PO6	PO7	PO8
	PSO 1a	PSO 1b	PSO 2	PSO 3a	PSO 3b	PSO 4a	PSO 4b	PSO 5	PSO 6	PSO 7	PSO 8
CO1	2	2	2	3	3	2	1	2	1	3	2
CO2	2	2	2	2	2	2	1	2	1	2	2
CO3	2	2	1	2	2	2	1	2	1	2	3
CO4	3	2	2	2	3	2	2	2	1	2	2
CO5	3	3	2	2	2	2	1	3	1	2	2

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

Dr.V. Jeyasimga
Head of the Department

Dr.R.Gloria Jemmi Christobel
Course Designer

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

M.SC. BIOTECHNOLOGY

(2024 -2025 onwards)

Semester III	**Bioprocess Technology**	**Hours/week -6**	
Core course 9		**Credits: 5**	
Course code-24PBOC33		**Internal 25**	**External 75**

COURSE OUTCOMES

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

CO1: Know the principles, processes, and applications of fermentation, including microbial growth kinetics, bioreactor design, bio separation techniques, downstream processing, and industrial applications, along with food safety, effluent treatment, and fermentation economics. (K2)

CO2: Explain fermentation principles to design and optimize microbial growth conditions, bioreactor operations, and downstream processing techniques for industrial bioproduct production. (K3)

CO3: Apply innovative strategies for improving fermentation efficiency, and determine effective bio separation and effluent treatment methods to enhance bio product yield and food safety compliance. (K3)

CO4: Examine fermentation processes, microbial growth kinetics, and bioreactor operations to illustrate their role in industrial bioproduct production. (K4)

CO5: Analyze bio separation techniques, downstream processing methods, and effluent treatment strategies to illustrate their impact on fermentation efficiency and food safety.(K4)

Unit I:

Introduction to fermentation. General requirements of fermentation. Microbial growth kinetics of batch and continuous culture. Solid substrate, slurry fermentation and its application. Microbial cell culture. Immobilization of cells and enzymes. Food Safety: Introduction to food safety aspects and food related hazards – HACCP and ISO.

(18 hours)

Unit II

Design of fermenters, body construction. Types of bioreactors: Submerged reactors, surface reactors, mechanically agitated reactors, non- mechanically agitated reactors. Upstream processing, Media for Industrial fermentation and Sterilization. Microbial Growth Kinetics. Isolation and improvement of industrially important microorganisms. **(18 hours)**

Unit III

Introduction to bioproducts and bioseparation. Primary recovery process: Cell disruption methods. Cell lysis and Flocculation: Osmotic and mechanical methods of lysis. Flocculation by electrolysis; polymorphic flocculation. Precipitation methods. Filtration: Principles, Conventional, Crossflow filtration. Sedimentation: Principles, Sedimentation coefficient. Extraction Principles, Liquid-liquid extraction, aqueous two phase extraction, supercritical fluid extraction.

(18 hours)

Unit IV

Downstream Processing: Chromatography techniques - types, Membrane separation, ultrafiltration. Drying. Principles and operation of vacuum dryer, shelf dryer, rotary dryer, freezer and spray dryer. Crystallization and Whole broth processing.

(18 hours)

Unit V

Aerobic and anaerobic fermentation processes and their application in the field of biotechnology industry. Production of commercially important primary and secondary metabolites - Antibiotics- Penicillin, Streptomycin, Enzymes - Amylase, Protease, Amino acid- Glutamic acid, lysine, Vitamins- Riboflavin, Organic acid - citric acid, penicillin and insulin. Solvent- Ethanol. Effluent Treatment and Fermentation Economics.

(18 hours)

Text books:

1. Michael L.Shuler, FikretKargi. (2003) Bioprocess Engineering. Second Edition. PHIpublishers.
2. P.A.Belter, E.L .Cursler, and W.S.Hu. (1988) Bioseparation: Downstream processing for Biotechnology. John Wiley and sons.

Reference Books:

1. Min-tzeLiong, (2011) Bioprocess Sciences and Technology. NovaScience Pub Inc.
2. R.G. Harrison, P.Todd, SR.Rudge and D.P. Petrides. (2003) Bioseparation science and engineering. Oxford Press.

Useful Websites:

www.wildfermentation.com/John Schollar and BenedikteWatmore, Practical Fermentation-a technical guide

web.mit.edu/professional/short.../fermentation_technology.html

Course Code 24PBOC33	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1a	**PSO 1b**	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4a**	**PSO 4b**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO1	3	2	2	3	3	3	2	2	3	3	2
CO2	2	2	2	2	2	3	2	2	3	2	2
CO3	2	2	1	2	2	3	3	2	3	2	3
CO4	3	2	2	3	3	2	2	3	3	2	2
CO5	3	3	2	3	2	3	2	3	3	2	2

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

Dr.V.Jeyasimga
Head of the Department

Dr.D.Karthiyaini
Course designer

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

M.SC. BIOTECHNOLOGY

(2024 -2025 onwards)

Semester III	**Bioinformatics, Immunology, Bioprocess Technology Practical**	**Hours/Week: 6**	
Core Course 10 Practical -3		**Credits: 4**	
24PBOC31P		**Internal 40**	**External 60**

COURSES OUTCOMES

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

CO1 : understand the fundamental techniques in bioinformatics, immunology, and bioprocess technology, including sequence retrieval, immune cell identification, and fermentation processes. [K2]

CO2 : explain the working procedures for biological data analysis, immunological testing, and industrial-scale microbial production. [K2]

CO3 : illustrate bioinformatics tools for sequence analysis, immunological techniques for diagnosis, and bioprocess methods for microbial production and enzyme estimation. [K3]

CO4 : Infer the results of bioinformatics workflows, immunological assays, and bioprocess optimization and complete the record [K3]

CO5 : analyse the bioinformatics tools, immune response mechanisms, and bioprocess parameters to develop systematic approaches for scientific analysis and application [K4]

(A) Bioinformatics Practical

1. Sequence retrieval from Genbank

2. Sequence retrieval from Uniprot

3. Sequence identity search - Sequence similarity search using BLAST

4. Sequence similarity search using FASTA

5. Sequence similarity search using PSI BLAST

6. Sequence similarity search using PHI- BLAST

7. Prediction of signal sequence using SignalP online tool

8. Pattern Search (Domains & Motifs) using Pfam

9. ORF gene Search - Genscan

10. Sequence translation using ExPASy translate tool

11. Characterization of retrieved protein sequence by ProtParam tool

12. Pair-wise global sequence alignment using EBI-EMBOSS Needleman Wunsch tool

13. Pair-wise local sequence alignment using EBI-EMBOSS Smith Waterman tool

14. Multiple sequence alignment using EBI-CLUSTALW2

15. PHYLOGENY- Phylogenetic tree using PHYLIP

16. Prediction of secondary protein structure using GOR (Garnier Osguthorpe-Robson) server

17. Prediction of tertiary protein structure using SWISS-MODEL Server

18. Molecular visualization of proteins using RASMOL

19. Docking of small molecules with protein structure using Hex software

20. Docking of two proteins using PatchDock (Protein-Protein docking) tool

21. Retrieval of E.Coli glycolytic pathway from KEGG

(B) Immunology Practical

1. Identification of various immune cells from human peripheral blood

2. Lymphocyte separation and identification

3. Determination of lymphocyte viability by trypan blue method

4. WBC counting

5. Preparation of serum and plasma

6. Electrophoretic profile of human serum in native PAGE

7. Preparation of cellular antigen – human RBC

8. Immunodiagnostics: CRP

9. Immunodiagnostics: Widal

10. Immunodiagnostics: RA

11. Immunodiagnostics: Blood grouping and typing

12. Immunodiagnostics: hCG

13. ELISA

14. Radial Immunodiffusion

15. Ouchterlony Immunodiffusion

16. Immunoelectrophoresis

17. Rocket electrophoresis

(C) Bioprocess Technology - Practical

1. Parts and design of fermenter

2. Solid state fermentation

3. Submerged fermentation

4. Foaming and antifoaming agents

5. Media preparation and sterilization - Media standardization (C:N ratio) for maximum biomass production of an industrially important microorganism

6. Isolation of industrially important microorganisms for microbial processes

7. Conservation of Bacteria by Lyophilization

8. Production and estimation of protease & amylase

10. Production of wine using grapes

11. Production of penicillin

12. Determination of penicillin activity

13. Citric acid production

14. Use of alginate for cell immobilization.

15. Cell disruption (Sonication)

16. Aqueous Two Phase Extraction of enzymes

Text Books

1. Andreas D. Baxevanis, Francis Ouellette B. F. (2005) Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. 3rd Edition. Wiley-Interscience Publisher.
2. Richard Durbin, Sean R. Eddy, Anders Krogh, Graeme Mitchison. (2006) Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids (Reprint). 1st Edition . Cambridge University Press.
3. Bains.J. S. (2018) Immunology: Textbook for Medical Students. 1st Edition. Jaypee Brothers Medical Publishers.
4. Rao R. V. N. (2011) Immunology: Basic and Clinical Principles. 1st Edition. I.K. International Publishing House
5. Saxena R.K. (2016) Immunology: A Practical Approach. 2nd Edition. New Age International Publishers.
6. Doran P. M. (2010) Bioprocess Engineering Principles.1st Edition. Wiley India.
7. Raj J. R. M. (2008) Industrial Microbiology. 1st Edition. CBS Publishers & Distributors.
8. Gupta P. S. P. S. K. (2011) Industrial Microbiology. 1st Edition. Kalyani Publishers.

Reference Books:

1. David W. Mount. (2004) Bioinformatics: Sequence and Genome Analysis. 2nd Edition. Cold Spring Harbor Laboratory Press.
2. Lijun Chen. (2013). Bioinformatics: Sequence Alignment and Primer Design. 1st Edition, Springer.

3. Playfair J. H. L.(2008).Laboratory Techniques in Immunology. 1st Edition. Cambridge University Press.
4. Catherine M. N. Thomas. (2012). Immunology: A Laboratory Manual. 2nd Edition (2012). Springer.
5. Anwar M. S. R. (2015). Practical Immunology: Techniques and Applications. 1st Edition, Elsevier India
6. Wulf Crueger and Anneliese Crueger.(2013). Biotechnology: A Textbook of Industrial Microbiology, Sinauer Associates .
7. Raj K. S.(2010).Microbial Biotechnology.1st Edition, New Age International Publishers.

Web Resources

1. **https://vlab.amrita.edu/index.php/www.cse.unr.edu/~bebis/www.ncbi.nlm.nih.gov/index.php?sub=3&brch=69&sim=1098&cnt=1**

2. **https://media.hhmi.org/biointeractive/vlabs/immunology2/content/index.html?_gl=1*12k63hi*_ga*MTI2MTQxMzI4LjE3NDYxNzQ2NTQ.*_ga_H0E1KHGJBH*MTc0NjE3NDY1NC4xLjAuMTc0NjE3NDY3MC4wLjAuMA..**

Course Code 24PBOC31P	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1a	**PSO 1b**	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4a**	**PSO 4b**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO1	2	2	2	3	3	2	1	2	1	3	2
CO2	2	2	2	2	2	2	1	2	2	2	2
CO3	2	2	1	2	2	2	1	2	2	2	3
CO4	3	2	2	2	3	2	2	2	2	2	2
CO5	3	3	2	2	2	2	1	3	2	2	2

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

Dr.V. Jeyasimga
Head of the Department

Dr.R.Gloria Jemmi Christobel
Course Designer

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

M.SC. BIOTECHNOLOGY

(2024 -2025 onwards)

Semester: III	**NANOBIOTECHNOLOGY**	**Hours/Week: 3**	
Elective course -6 DSEC		**Credits: 3**	
Course code- 24PBOE31		**Internal 25**	**External 75**

COURSE OUTCOMES

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

CO1: Recall the basic concepts in Nanobiotechnology [K2]

CO2: illustrate the types, synthesis and application of nanomaterials [K3]

CO3: apply the concept of nanotechnology for preparing various nanomaterials and nanostructures [K3]

CO4: Explain the preparation and application of nanomaterials in diagnosis, therapy and in textiles. [K4]

CO5: analyse the nature of nanomaterials, their applications and toxicity [K4]

Unit-I

Introduction to Nanotechnology- Scientific revolution, Feynman's vision, Classification of nanobiomaterials -Types of nanomaterials – nanoparticles, nanotubes, nanowires, Nanofibers, Size dependent variation in the properties of Nanomaterials, Nature's Nano Phenomena. (9 Hours)

Unit-II

Preparation of Nanomaterial, Top down and bottom up approaches, Biosynthesis, Nanobiomaterials- Polymer-chitosan, , PLGA, Ceramic, Metal based Nanobiomaterials, Carbon based Nanomaterials, DNA based Nanostructures, Protein based Nanostructures, Quantum dots, Magnetic Nanoparticles, Nanofibres, Hydrogels, Films and Scaffolds. Nanoparticle Characterization-UV visible,Flourescent spectroscopy, FTIR, XRD,SEM,TEM (9 Hours)

Unit-III

Application of Nanomaterials in Bone substitutes and Dentistry, Food and Cosmetic applications, Bio-sensors and Lab-on-a-chip, Bio-devices and implantable devices, Bioremediation, Nanomaterials for anti-microbial coating – medical implants and paints, Application of Nanotechnology in textile industry. (9 Hours)

Unit-IV

Nanomaterials for diagnosis and therapy, Implications of drug delivery, Nano-carriers for application in medicine, polymeric nanoparticles as drug carriers, Drug release mechanism, Targeted Drug Delivery using nanocarriers, Nanoparticle technologies for cancer therapy and diagnosis, Point of Care and Personalized medicine, Magnetic nanoparticles for imaging and Hyperthermia (9 Hours)

Unit-V

Nanotoxicology, Portals of Entry of the nanoparticles into the Human Body, Bio-toxicity of Nanoparticles, Nanoparticles in Mammalian systems and Health threats, Biological response and cellular interaction of implant materials and scaffolds, Risk assessment and Safety Regulation of nanoparticles. (9 Hours)

Text books

1. B. Bhushan, (2004). S Handbook of Nanotechnology Springer-Verlag
2. Challa Kumar, (2007). The Chemistry of Nanomaterials: Synthesis, Properties and Applications, Nanomaterials for medical diagnosis and therapy, Wiley-VCH,
3. Mansoor M. Amiji, (2007), Nanotechnology for cancer therapy, CRC Press, K.K.Jain, Nano Biotechnology, Horizons Biosciences, 2006
4. Dieter Vollath, (2008). Nanomaterials: An introduction to synthesis, properties and application, Wiley VCH,
5. Cato T. Laurencin and Lakshmi S. Nair.(2008) Nanotechnology and Tissue Engineering The Scaffold, CRC Press taylor & Francis Group.
6. Gabor .L et al,(2008). Introduction to Nanoscience and Nanotechnology, CRC Press
7. Hornyak, G. Louis, Tibbals, H. F., Dutta, Joydeep, (2009).Fundamentals of Nanotechnology, CRC Press.

8. Assessing Nanoparticle Risks to Human Health, Gurumurthy Ramachandran, Elesvier, 2011.

Reference Books:

1. Shanmugam, S., (2011), Nanotechnology, Mjp publication.
2. Kurt E. Geckeler, Hiroyuki Nishide. (2010). Advanced nanomaterials, Wiley VHC..
3. T.Laurencin, Lakshmi S. Nair. (2012).Nanotechnology and tissue engineering, CRC press.
4. Francis D Souza, Karl M. Kadish.(2011). Handbook of carbon nanomaterials.World scientific publishing co. pte. ltd.
5. Oded Shoseyov (Editor), Ilan Levy, (2010). NanoBioTechnology: BioInspired Devices and Materials of the Future, Humana Press.
6. Chad A. Mirkin and Christof M. Niemeyer,(2007). Nanobiotechnology II: More Concepts and Applications, Wiley-VCH.
7. Challa S.S.R.Kumar (Ed). (2006). Biologicals and pharmaceutical nanomaterials, Wiley-VCH Verlag Gmbh & Co, KgaA.
8. K.K.K.Jain (2006). Nanobiotechnology in Molecular Diagnostics: Current Techniques and Applications Horizon Bioscience
9. Niemeyer, C.M., Mirkin, C.A. (Eds). (2004). Nanobiotechnology Concepts, Applications and Perspectives, Wiley-VCH, Weinheim.
10. Andrzej W. Miziolek, Shashi P.Karna, J malthew Mauro and Richard A.Vaia.(2005) Defense Applications of Nanomaterials : Springer

Web resources

:http://www.zyvex.com/nano www.fda.gov/nanotechnology/
www.nature.com/nnano/

Course Code 24PBOE31	PO1		PO2	PO3		PO4		PO5	PO6	PO7	PO8
	PSO 1a	PSO 1b	PSO 2	PSO 3a	PSO 3b	PSO 4a	PSO 4b	PSO 5	PSO 6	PSO 7	PSO 8
CO1	2	2	2	2	1	2	3	2	2	2	1
CO2	2	2	2	3	2	3	2	3	2	2	1
CO3	3	3	2	3	2	3	2	3	2	3	1
CO4	2	2	2	3	1	2	2	2	1	2	1
CO5	2	3	3	3	2	3	3	3	2	2	2

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

Dr.V.Jeyasimga
Head of the Department

Dr.V.Jeyasimga
Course designer

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

M.SC., BIOTECHNOLOGY

(2024 -2025 onwards)

Semester: III	**GENE MANIPULATION TECHNOLOGY**	Hours/Week: 3	
Elective course -7 NME		Credits: 2	
Course code- 24PBON31		Internal 25	External 75

Course Outcome

On completion of the course, students will be able to

CO1: recall the basics of Basics of Gene Manipulation Technology (K1)

CO2: Acquire adequate knowledge in the use of Genome Sequencing and Transcriptomics (K2)

CO3: Apply the knowledge to create Constructions of DNA Libraries Constructions of DNA Libraries.(K2)

CO4: explain the benefits of Protein Engineering & Pharmaceutical Products (K3)

CO5: Evaluate the importance of Gene Cloning & Applications of Gene Cloning(K4)

UNIT-I

Basics of Gene Manipulation Technology-Restriction Enzymes-Cutting and Joining Reactions-Vectors-Selection of Recombinants- Agarose Gel Electrophoresis-Southern Blotting- Hybridization-Autoradiography-PCR- Native Page- SDS-Page-2D Gel Electrophoresis- Western Blotting. (9 Hours)

UNIT-II

Constructions of DNA Libraries- Vectors Used In the Construction of CDNA and Genomic DNA Libraries- Chromosome Walking- Positive Selection and Subtractive Hybridization- Preparation of (BAC/YAC Library). (9 Hours)

UNIT-III

Genome Sequencing and Transcriptomics- Sanger's Sequencing, Whole Genome Shot gun Sequencing- Comparative Genome Sequencing- Transcriptome Analysis- DNA Microarray-Expression of Recombinant Proteins. (9 Hours)

UNIT-IV

Protein Engineering & Pharmaceutical Products- Site Directed Mutage nesis- Protein Analysis- Therapeutic Protein- Vaccines. (9 hours)

UNIT-V

Applications of Gene Cloning- creating Transgenic Animals and Plants- Reporter Genes- Animal Cloning, Gene expression in plants- Biosafety and Bioethics (9 Hours)

Text Books

1. Sandy B. Primrose, Richard Twyman,(2006),Principles of Gene Manipulation and Genomics,Wiley-Blackwell,(7th edition) ,ISBN: 978-1-405-13544-3
2. R.W. Old,(1985)Principles of gene manipulation: An introduction to genetic engineering, University of California Press, ISBN-10 : 0520041437
3. Nicholl, D. S. T. (2008). *An introduction to genetic engineering*. Cambridge University Press.(3rd ed)

References Books

1. Christopher Howe,(2014) An Introduction Gene Cloning And Manipulation,Cambridge University Press, ISBN 0511296533,(2nd edition)
2. Sambrook, J., & Russell, D. W. (2001). *Molecular cloning: A laboratory manual* Cold Spring Harbor Laboratory Press,(3rd ed., Vol. 1).
3. Brown, T. A. (2010). *Gene cloning and DNA analysis: An introduction,* Wiley-Blackwell publisher,(6th ed.).
4. Thiel, T. (2002). *Biotechnology: Nucleic acids to protein—A laboratory project*. Tata McGraw-Hill publisher
5. Old, R. W., & Primrose, S. B. (1994). *Principles of gene manipulation*. Blackwell Science. (5th ed.)
6. Setlow, J. K. (Ed.). (2002). *Genetic engineering: Principles and methods* (Vol. 24). Springer. ISBN: 978-0-306-47473-2
7. Glick, B. R., & Pasternak, J. J. (1994). *Molecular biotechnology: Principles and applications of recombinant DNA*. ASM Press**.**

Web Sources

- https://biokamikazi.files.wordpress.com/2013/06/gene-and-genomics.pdf
- https://www.egyankosh.ac.in/bitstream/123456789/96178/1/Unit-11.pdf
- https://uomustansiriyah.edu.iq/media/lectures/4/4_2019_04_09!08_45_57_PM.pdf
- https://www.kwcsangli.in/uploads/Principles-of-Gene-Manipulation-and-Genomics-PDFDrive-.pdf

- https://lecturesug3.files.wordpress.com/2013/02/primrose-principle-of-gene-manupulation.pdf

Course Code 24PBON31	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1a	**PSO 1b**	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO1	3	2	2	3	3	3	2	3	3	2
CO2	2	2	2	2	2	3	2	3	2	2
CO3	2	2	1	2	2	3	2	3	1	1
CO4	3	2	2	3	3	2	3	3	2	2
CO5	3	3	2	3	1	3	3	3	2	2

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

Dr.V.Jeyasimga
Head of the Department

Ms.K.Srinithi
Course designer

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

M.SC. BIOTECHNOLOGY

(2024 -2025 onwards)

Semester III	**PRACTICE FOR CSIR NET – GENERAL PAPER**	Hours/Week: -	
Self-Study Course		Credits: 1	
Course Code **24PGOL32**		Internal 100	External -

COURSE OUTCOMES

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

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

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

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

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

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

UNIT I

Typical Problems- Series formation

Numerical Ability- Numbers

UNIT II

Geometrical Type Problems-Mensuration and quantitative comparison

UNIT III

Typical Problems- Moving locomotive problem

Numerical Ability- Distance and Directions

UNIT IV

Daily Life Problems

Finding the X – Average - Monetary problems

UNIT V

Logical Reasoning

Data interpretation – Observational ability – Logical puzzles

BOOKS FOR STUDY:

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

REFERENCE BOOKS

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

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

Course code 24PGOL32	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	3	3	2	2	-	2	-	-
CO2	3	3	3	3	-	2	-	-
CO3	3	3	3	3	-	3	-	-
CO4	3	2	3	3	-	3	-	-
CO5	3	2	3	3	-	3	-	-

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

Dr. M. C. Maheswari
Head of the Department

Dr. T. Anitha
Course Designer

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

M.SC. BIOTECHNOLOGY

(2024 -2025 onwards)

Semester III	**INTERNSHIP**	**Hours/Week: -**	
Course Code 24PBOI31		**Credits: 2**	
		Internal 75	**External 25**

COURSE OUTCOMES

On completion of the Internship/Field Project, students will be able to

CO1: relate their theoretical insights with hands-on experience. [K3]

CO2: develop technical skills to their respective field of study. [K3]

CO3: demonstrate the attributes such as observational skills, team spirit and interpersonal skills built through site visits. [K3]

CO4:analyse the written communication skills acquired through internship. [K4]

CO5: evaluate the observations and results and communicate their academic and technological knowledge appropriately through oral means. [K5]

Guidelines/ Regulations:

- Each student must go for Internship training in a reputed Industry/Company/Clinical Laboratory/ Organization/Educational Institution.
- Students should produce the Completion Certificate after the Completion of Internship period.
- A report of 15 – 20 pages must be submitted by each student after the completion of the Internship period.
- External Viva-voce examination will be conducted.

Course code 24PBOI31	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	2	2	2	3	2	2	2	3
CO2	2	2	3	2	3	2	2	3
CO3	3	2	3	2	2	2	3	3
CO4	2	2	3	2	2	1	2	1
CO5	3	3	3	3	3	2	2	2

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

Dr.V.Jeyasimga
Head of the Department

Dr.V.Jeyasimga
Course Designer

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

M.SC. BIOTECHNOLOGY

(2024 -2025 onwards)

Semester III	**MOLECULAR DEVELOPMENTAL BIOLOGY**	**Hours/Week: -**
Extra Credit Course		**Credits: 2**
24PBOO31		**Internal 100**

COURSES OUTCOMES

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

CO1 **:** Understand the key concepts of developmental biology, including gametogenesis, fertilization mechanisms, cleavage and gastrulation, vertebrate organogenesis, and genetic regulation of development and disorders.

CO2 **:** Illustrate the molecular mechanisms underlying gametogenesis, fertilization, cleavage, gastrulation, and organogenesis in vertebrates and invertebrates.

CO3 **:** make use of developmental principles to understand morphogenetic movements, organizer function, and genetic regulation of developmental disorders.

CO4 **:** Correlate the processes of gametogenesis, fertilization, cleavage, gastrulation, and organ formation, with normal and abnormal embryonic development.

CO5 **:** Correlate the molecular and genetic mechanisms of early development with structural and functional outcomes in vertebrates and invertebrates, and discover their implications in developmental disorders.

Unit I

Definition and scope of developmental biology. Gametogenesis - Spermatogenesis and Oogenesis. Structure of Sperm and oocyte. Instructive and permissive interactions, competence, epithelial - mesenchymal interactions. Important signaling pathways in vertebrate development.

Unit II

Fertilization - Definition, mechanism of fertilization in mammal & sea urchin. Types of Fertilization. Nieuwkoop center, Molecular role of organizer.

Unit III

Cleavage in *Xenopus*, Chick and mammals, Regulation of cleavage cycle. Morphogenetic movements, Gastrulation in *Xenopus*, Chick and mammals. Fate Maps .

Unit IV

Vertebrate Development: Formation of the neural tube, myogenesis, and hematopoiesis. Mechanism of vertebrate eye development.

U**nit V**

Drosophila Maternal effect genes, induction at single cell level - differentiation of photoreceptors in *Ommatidia*. Developmental disorders Spina bifida, Anencephaly, and craniorachischis, Cyclopia, thanotrophic dysplasia.

Text Books:

1. T.Subramoniam, 2011, Molecular Developmental Biology, 2nd edition, Alpha Science International Ltd.
2. Manju yadav, 2008, Molecular Developmental Biology, 1st edition, Discovery publishing house Pvt Lt**d.**

Reference Books:

1. Scott F.Gilbert, 2010. Developmental Biology, 9th edition, Sinauer Associates Inc.
2. Subramoniam, T. 2002. Developmental Biology. 1st edition. Narosa publications.
3. Richard M.Twynman, 2001 Developmental Biology. (2 nd edition), Viva Publications, New Delhi.

Web resources:

sackler.tufts.edu/.../Cell-Molecular-and-Developmental-Biology www.devbio.com/

Dr.V. Jeyasimga **Dr.S.Gurupavithra**
Head of the Department **Course Designer**

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

M.SC. BIOTECHNOLOGY

(2024 -2025 onwards)

SEMESTER: IV	**RESEARCH METHODOLOGY**	**Hours/Week: 6-**	
Core course 11		**Credits: 5**	
24PBOC41		**Internal 25**	**External 75**

COURSE OUTCOMES

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

CO1: understand the fundamental principles, concepts, and rationale that underpin research techniques (K2)
CO2: explain the purpose, structure, and components of a research proposal and a dissertation. (K3)
CO3: apply the appropriateness of statistical methods for Interpretation research (K3)

CO4: apply the Suitable office tools for research and complete the Research (K4)

CO5: analyze the search engines in a research context. (K4)

UNIT-I

Research Methodology - An Introduction: Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Importance of knowing how research is done, Research Process, Criteria for good research. Defining the Research Problem; Research Design; Sampling Design; Methods of Data Collection; Processing and Analysis of Data; Sampling Fundamentals.

(18 Hours)

UNIT-II

Review of literature, Writing the Research Report (Thesis and publications): Components of research report - Title, Authors, Addresses, Abstract, Keywords, Introduction, Review of literature, Materials and Methods, Results, Discussion, Summary, Acknowledgements and Bibliography

(18 Hours)

UNIT-III

Standard Deviation- T test. Analysis of Variance components (ANOVA) for fixed effect model; Total, treatment and error of squares, Degrees of freedom, Confidence interval; ANOVA for random effects model, Estimation of variance components, Model adequacy checking. Two factor Factorial Design, Basic definitions and principles, main effect and interaction, response surface and contour plots, General arrangement for a two factor factorial design

(18 Hours)

UNIT-IV

Spreadsheet Tool: Introduction to spreadsheet application, features and functions, Using formulas and functions, Data storing, Features for Statistical data analysis, Generating charts/ graph and other features. Presentation Tool: Introduction to presentation tool, features and functions, Creating presentation, Customizing presentation, Showing presentation. Tools Microsoft Power Point, Open Office or similar tool

(18 Hours)

UNIT-V

Web Search: Introduction to Internet, Use of Internet and WWW, Using search engine like Google, Yahoo, PubMed, Science direct, Scopus etc., and Using advanced search techniques. Introduction to Plagiarism. Types of Plagiarism. Ethical aspects of Plagiarism **.T**ools for Plagiarism detection and management

(18 Hours)

Text Books:

1. Yogesh kumar singh (2002), Fundamentals of Research Methodology and Statistics, New Age International (P) Ltd., Publishers Published by New Age International (P) Ltd., Publishers
2. Kothari.C.R. 2004, Research Methodology Methods and Techniques,Published by New Age International (P) Ltd., Publishers.second edition

Reference Books:

1. Montgomery, Douglas C. (2007), 5/e, Design and Analysis of Experiments, (Wiley India).
2. Montgomery, Douglas C. & Runger, George C. (2007), 3/e, Applied Statistics & Probability for Engineers (Wiley India).
3. Kothari C.K. (2004), 2/e, Research Methodology- Methods and Techniques (New Age International, New Delhi).

4. Krishnaswamy, K.N., Sivakumar, Appa Iyer and Mathiranjan M. (2006), Management Research Methodology; Integration of Principles, Methods and Techniques (Pearson Education, New Delhi).
5. The complete reference Office Xp – Stephan L. Nelson, Gujulia Kelly (TMH).
6. Basic Computer Science and Communication Engineering – R. Rajaram (SCITECH).

Web sources:

- www.ask.com/Methodology+Research
- www.qmethod.org/

Course Code 24PBOC41	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1a	**PSO 1b**	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO1	3	3	2	3	3	3	3	3	3	3
CO2	3	2	2	3	3	3	3	3	3	2
CO3	2	2	1	2	2	3	2	3	1	1
CO4	3	2	2	3	3	2	3	3	2	2
CO5	3	3	2	3	1	3	3	3	2	2

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

Dr.V.Jeyasimga
Head of the Department

Ms.K.Srinithi
Course designer

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

MSC. BIOTECHNOLOGY

(2024-2025 onwards)

Semester IV	**BIOSTATISTICS**	Hours/Week: 6	
Core course 12		Credits: 5	
Course Code **24PBOC42**		Internal 25	External 75

Course Outcome

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

CO1: understand the major methods of collection and presentation of data. [K2]

CO2: acquire basic knowledge about methods of statistical tools. [K3]

CO3: apply the methods of setting hypotheses and calculation of errors. [K3]

CO4: update the knowledge on Tests of significance for large and small samples. [K4]

CO5: analyze various statistical tools and packages and integrate them for specific research. [K4]

Unit I

Statistics: Scope, collection, classification, tabulation of statistical data. Diagrammatic representation - graphs, graph drawing, graph paper, plotted curve. Sampling method and standard errors, random sampling, use of random numbers, expectation of sample estimates - means, confidence limits, standard errors and variance. Measures of central tendency – measures of dispersion – skewness, kurtosis, moments. **(18 hours)**

Unit II

Correlation and regression, correlation table, coefficient of correlation, Z transformation, regression, relation between regression and correlation. Probability – Markov chains applications, Probability distributions – Binomial (Gaussian distribution) and negative binomial, compound and multinomial distributions – Poisson distribution. **(18 hours)**

Unit III

Normal distribution, graphic representation. frequency curve and its characteristics, measures of central value, dispersion, coefficient of variation and methods of computation, Basis of Statistical Inference, Sampling Distribution, Standard error, Testing of hypothesis – Null Hypothesis –Type I and Type II errors. **(18 hours)**

Unit IV

Tests of significance for large and small samples based on Normal, t, z distributions with regard to mean, variance, proportions and correlation coefficient, chi-square test of goodness of fit – contingency tables – c2 test for independence of two attributes – Fisher and Behrens 'd' test – 2×2 table – testing heterogeneity – r X c table – chi-square test in genetic experiments – partition X 2 – Emerson's method. **(18 hours)**

Unit V

Tests of significance: t tests, F tests. Analysis of variance: one way classification, Two way classification, CRD, RBD, LSD. Spreadsheets: Data entry, mathematical functions, statistical function, Graphics display, printing spreadsheets, use as a database word processes, databases, statistical analysis packages and graphics/presentation packages. **(18 hours)**

Text Books:

1. Sundar Rao P. S.S., Jesudian G. and Richard J. (1987) An Introduction to Biostatistics, 2nd edition,. Prestographik, Vellore, India.
2. Veer bala Rastogi. (2011) Fundamentals of Biostatistics. Ane books Pvt Ltd, Chennai.

References Books:

1. Rosner, B (2005) Fundamentals of Biostatistics, Duxbury Press.
2. Warren J Gregory E, Grant R (2004) Statistical Methods in Bioinformatics, 1st edition, Springer.
3. Milton J.S. (1992) Statistical methods in the Biological and Health Sciences, 2nd edition. Mc Graw Hill.
4. Zar, J.H. (1984) Bio Statistical Methods. Prentice Hall, International Edition.

Useful Websites:
www.statsoft.com/textbook/ biosun1.harvard.edu/
www.bettycjung.net/Statsites.htm
www.ucl.ac.uk/statistics/biostatistics

Course Code 24PBOC42	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1a	**PSO 1b**	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4a**	**PSO 4b**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO1	1	3	3	1	3	1	1	1	3	1	1
CO2	1	3	3	1	2	1	2	1	3	1	2
CO3	3	2	2	2	3	1	3	1	3	1	3
CO4	1	2	2	3	3	3	3	2	3	2	3
CO5	1	3	3	3	3	3	3	3	3	2	3

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

Dr.V. Jeyasimga
Head of the Department

Dr. D. Karthiyaini
Course Designer

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

M.SC. BIOTECHNOLOGY

(2024 -2025 onwards)

Semester IV	**PROJECT**	Hours/Week: 6	
Core Course - 13		Credits: 5	
Course Code **24PBO43PR**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: apply the basic concepts learnt to select projects in Biotechnology and interdisciplinary fields. [K2]

CO2: apply the theoretical knowledge to design experiments to measure the required parameters accordingly. [K3]

CO3: execute the technical skills in handling the equipment,apparatus,and exhibit written communication skills acquired in the related project work illustrate the work done by them by means of graphs tables and figures. [K3]

CO4: present the results. and communicate academic and technological knowledge orally. [K4]

CO5: assess the project to meet the challenges at higher education level/societal level. K5]

Project Guidelines

- Project will be done by the final year students in the fourth semester under the guidance of respective guides.
- Each learner can select her research project in any one of the areas of Biotechnology in consultation with her guide and the Head of the department.
- For projects internal marks will be awarded by the respective guide and external marks will be awarded in the external examinations held at the end of the semester.
- Only individual projects should be allotted.

- The report of the project must be in the prescribed form. It should be typed neatly in MS word (12 pt, Times New Roman, 1.5 spacing)
- The format of the project report should have the following components.
    - ❖ First page should contain:

      Title of the project report

      Name of the candidate Register number

      Name of the supervisor

      Address of the institution

      Month & year of submission
    - ❖ Contents
    - ❖ Certificate by supervisor
    - ❖ Declaration by candidate
    - ❖ Acknowledgement
    - ❖ Chapters
    - ❖ References

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

Distribution of Marks

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

Internal Assessment: Pre-submission Presentation - 10 Marks

Review Report - 20 Marks

One Open Online Course related to the Project - 10 Marks

External Examination: Project Report - 40 Marks

Viva Voce - 20 Marks

Course Code 24PBO43PR	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1.a	**PSO 1.b**	**PSO 2**	**PSO 3.a**	**PSO 3.b**	**PSO 4.a**	**PSO 4.b**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO1	3	3	3	2	1	2	2	1	1	1	1
CO2	3	3	3	2	1	2	3	1	-	1	1
CO3	3	3	3	2	1	2	3	-	1	2	1
CO4	3	3	3	1	2	1	2	1	1	-	1
CO5	3	3	3	1	2	1	2	1	2	-	1

Dr.V.Jeyasimga

Head of the Department

Dr.V.Jeyasimga

Course designer

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

M.SC. BIOTECHNOLOGY

(2024 -2025 onwards)

Semester IV		**Hours/week -6**	
Elective course - 8		Credits: 3	
Course code 24PBOE41	**BIOETHICS, BIOSAFETY, CLINICAL TRIALS, IPR & ENTREPRENEURSHIP**	**Internal 25**	**External 75**

Course Outcome

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

CO1 : Summarize the ethical concerns, regulations, and biosafety guidelines related to genetically modified organisms, clinical trials, and biomedical research. [K2]

CO2 : Identify key principles of bioethics, biosafety, and intellectual property rights to apply them in biotechnology and healthcare sectors. [K3]

CO3 : Develop strategies for protecting traditional knowledge, plant breeders' rights, and geographical indications under national and international laws. [K3]

CO4 : Analyze and compare different forms of intellectual property, including patents, copyrights, trademarks, and industrial designs, to contrast their significance in biotechnology and entrepreneurship. [K4]

CO5 : Correlate bioethics, biosafety, clinical research regulations, and intellectual property rights to their applications in biotechnology, healthcare, and entrepreneurship. [K4]

Unit I

Introduction to Bioethics Need for bioethics in social and cultural issues. Bioethics & GMO's Issues and concerns pertaining to Genetically modified foods & food crops, Organisms and their possible health implications and mixing up with the gene-pool. Bioethics in Medicine Protocols of ethical concerns related to prenatal diagnosis, gene therapy, Organ transplantation,

Xenotransplantation, Containment facilities for genetic engineering experiments, regulations on field experiments and release of GMO`s labeling of GM foods. **(18 hours)**

Unit II

Clinical trials –Regulations. Bioethics & Cloning Permissions and Procedures in Animal Cloning, Human cloning, Risks and hopes. Bioethics in Research Stem cell research, Human Genome Project, Use of animals in research, human volunteers for Clinical research, Studies on Ethnic races. Ethics in patient care, Informed consent. **(18 hours)**

Unit III

Biosafety – Biological risk assessment. Biological agents and Hazard groups. Criteria in biological risk assessment. Guidelines for categorization of genetically modified plants for field test. Regulation, national and international guidelines of Biosafety, rDNA guidelines, Regulatory requirements for drugs and Biologics GLP. Biosafety levels. Safety equipments and Biological Safety cabinets. **(18 hours)**

Unit IV

IPR: Introduction to Intellectual Property rights, Patenting – Factors for patentability – Novelty, Non-obviousness, Marketability. Procedures for registration of Patents. Copyright works, ownership, transfer and duration of Copyright. Renewal and Termination of Copyright. Industrial Designs - Need for Protection of Industrial Designs. Procedure for obtaining Design Protection. Infringement, Right of Goodwill, Passing Off. Trademarks - Introduction to Trademarks. Need for Protection of Trademarks. Classification of Trademarks. Indian Trademarks Law. Procedural Requirements of Protection of Trademarks**. (18 Hours)**

Unit V

Geographical Indications - Indication of Source and Geographical Indication. Procedure for Registration, Duration of Protection and Renewal. Infringement, Penalties and Remedies. Layout- Designs of Integrated Circuits: Conditions and Procedure for Registration. Duration and Effect of Registration Protection of Plant variety and Plant breeders' rights in India. Protection of traditional knowledge, Bioprospecting and biopiracy. India's new IP Policy (2016), Govt of India's steps to promote IPR. Career opportunities in IP. Entrepreneurship: Definition and importance, Characteristics and functions of an entrepreneur. **(18 hours)**

Text Books

1. Sateesh M.K. (2008) Bioethics & Biosafety. IK International publications.
2. Ganguli P. (2001) Intellectual Property Rights. Tata Mcgraw Hill.
3. Ramesh Chandra. (2004). Issues Of Intellectual Property Rights. Isha Books.
4. Erbisch F.h., Maredia K.M, (2000), Intellectual Property Rights In Agricultural Biotechnology, Universities Press.

Reference Books:

1. Ajit Parulekar and Sarita D'Souza (2006) Indian Patent Law: Legal and Business Implications. Macmillan India publication.
2. Santaniello,V., Evenson, R.E., Zilberman, D. and Carlson, G.A. (2003) Agriculture and Intellectual Property Rights. University Press publication.
3. Shiv Sahai Singh, (2004) Law Of Intellectual Property Rights, Deep & Deep Publications (p) Ltd.
4. Subbian A, Bhaskaran S, (2007) Intellectual Property Rights: Heritage, Science And Society Int. Treaties, Deep & Deep Publications.
5. Elad Harison (2008). Intellectual Property Rights, Innovation and Software Technologies. Edward Elgar Publishing Limited, UK.

Web resources :

USPTO Web Patent Databases at: www.uspto.gov/patft

Government of India's Patents Website: patinfo.nic.in

Intellectual property India: www.ipindia.nic.in

Course Code 24PBOE41	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1.a	**PSO 1b**	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO1	3	2	2	3	3	3	2	3	3	2
CO2	2	2	2	2	2	3	2	3	2	2
CO3	2	2	1	2	2	3	2	3	2	3
CO4	3	2	2	3	3	2	3	3	2	2
CO5	3	3	2	3	2	3	3	3	2	2

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

Dr.V.Jeyasimga
Head of the Department

Dr.D.Karthiyaini
Course designer

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

M.SC. BIOTECHNOLOGY

(2024 -2025 onwards)

Semester IV	**LIFE SCIENCES FOR COMPETITIVE EXAMINATIONS**	Hours/Week: 6	
Professional Competency Skill		Credits: 3	
Course Code **24PBOS41**		Internal 25	External 75

Course Outcome

On completion of the course, students will be able to

CO1 : know the fundamental concepts of developmental biology, ecological interactions, genetic principles, physiological mechanisms, and evolutionary processes to understand the structural and functional organization of life.[K1]

CO2: understand the developmental mechanisms, ecological conservation, genetic inheritance, physiological regulation, and evolutionary relationships to analyze biological processes and solve real-world problems. [K2]

CO3: explain morphogenesis, ecological balance, genetic variations, physiological homeostasis, and evolutionary trends to understand their impact on biodiversity and human welfare.[K2]

CO4 : Solve biological problems by integrating the knowledge of embryonic development, ecosystem interactions, genetic inheritance, physiological regulations, and evolutionary adaptations in various life forms.[K3]

CO5 : Analyse the developmental abnormalities, environmental challenges, genetic disorders, physiological responses, and evolutionary processes to propose sustainable and scientific solutions in biology. [K4]

UNIT I

Developmental biology: Basic concepts of development - Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development.Gametogenesis, fertilization and early development- Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation, cleavage, blastula

formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination. Morphogenesis and organogenesis in animals - Cell aggregation and differentiation in *Dictyostelium*; axes and pattern formation in *Drosophila*, amphibia and chick; organogenesis – vulva formation in *Caenorhabditis elegans*, eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development- larval formation, metamorphosis; environmental regulation of normal development; sex determination. Morphogenesis and organogenesis in plants- Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in *Arabidopsis* and *Antirrhinum.* Programmed cell death, aging and senescence**. (18 Hours)**

UNIT II

Diversity of life forms: Principles & methods of taxonomy- Concepts of species and hierarchial taxa, biological nomenclature, classical & quantititative methods of taxonomy of plants, animals and microorganisms. Levels of structural organization:Unicellular, colonial and multicellular forms. Levels of organization of tissues, organs & systems. Comparative anatomy, adaptive radiation, adaptive modifications. Classification of plants, animals and microorganisms. Evolutionary relationships among taxa. Natural history of Indian subcontinent:Major habitat types of the subcontinent, geographic origins and migrations of species. Common Indian mammals, birds. Seasonality and phenology of the subcontinent. Organisms of health & agricultural importance:Common parasites and pathogens of humans, domestic animals and crops. Organisms of conservation concern: Rare, endangered species. Conservation strategies.

Ecological principles: The Environment: Physical environment; biotic environment; biotic and abiotic interactions. Habitat and Niche: Concept of habitat and niche. Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations. Species Interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis. Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones. Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax.. Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.Conservation Biology: Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves)**. (18 Hours)**

UNIT III

Inheritance Biology : Allele, multiple alleles, pseudoallele, complementation tests.Extensions of Mendelian principles : Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters. Gene mapping methods : Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants. Extra chromosomal inheritance : Inheritance of Mitochondrial and chloroplast genes, maternal inheritance. Human genetics : Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders. Quantitative genetics : Polygenic inheritance, heritability and its measurements, QTL mapping. Structural and numerical alterations of chromosomes : Deletion, duplication, inversion, translocation, ploidy and their genetic implications. Recombination : Homologous and non-homologous recombination including transposition. **(18 Hours)**

UNIT IV

System physiology – animal : Blood and circulation - Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, hemostasis. Cardiovascular System: Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above. Respiratory system - Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration. Nervous system - Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture.Sense organs - Vision, hearing and tactile response.Excretory system - Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.Thermoregulation - Comfort zone, body temperature – physical, chemical, neural regulation, acclimatization. Stress and adaptation Digestive system - Digestion, absorption, energy balance, BMR.Endocrinology and reproduction - Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, gametogenesis, ovulation, neuroendocrine regulation. **(18 Hours)**

UNIT V

Evolution and behaviour : Emergence of evolutionary thoughts-Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis. Origin of cells and unicellular evolution: Origin of basic biological

molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiment of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells. Paleontology and Evolutionary History: The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multicellular organisms. Molecular Evolution:Concepts of neutral evolution, molecular divergence and molecular clocks; Molecular tools in phylogeny, classification and identification; Protein and nucleotide sequence analysis; origin of new genes and proteins; Gene duplication and divergence. The Mechanisms: Population genetics – Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution. Brain, Behavior and Evolution: Approaches and methods in study of behavior; Proximate and ultimate causation; Altruism and evolution-Group selection, Kin selection, Reciprocal altruism; Neural basis of learning, memory, cognition, sleep and arousal; Biological clocks; Development of behavior; Social communication; Social dominance; Use of space and territoriality; Mating systems, Parental investment and Reproductive success; Parental care; Aggressive behavior; Habitat selection and optimality in foraging; Migration, orientation and navigation; Domestication and behavioral changes. **(18 Hours)**

TEXT BOOKS

1. Singh A.P. and Kumar Pushkar.(2024).CSIR NET Life Science Practice Book (Volume 1 & 2), Upkar Prakashan publishers.
2. Surbhi Jain.(2024).CSIR NET Life Science Exam Guide ,Arihant Publications .
3. EduGorilla,CSIR NET Life Science - 10 Mock Tests & Solved Papers,2024.EduGorilla Publisher.
4. Ajay Kumar. (2024). CSIR NET Life Sciences Complete Guide & Practice Book, Upkar Prakashan.

REFERENCE BOOKS

1. CSIR UGC NET Life Sciences Theory and Practice Combo Set,2024.Pathfinder Publication.
2. Rupendra Singh, Dr. Anubha Shukla, Shama Shukla.(2019).CSIR NET Life Sciences Practice Books Set,10th edition, CATALYST Center Of Excellence Pvt. Ltd.
3. IFAS Academic Team ,PYQ Solution Book: NTA UGC CSIR NET Examination Life Sciences (20 Years Solved Papers), Edition :2024, IFAS Publications.
4. CSIR-UGC NET Life Sciences Previous Year Papers with Explanations, Edition: 2024, Arihant Publications.

5. Malhotra A. M. , Promod Singh K. A. Trueman's CSIR-UGC NET Life Sciences, Edition: 2024, Danika Publishing Company.
6. RPH Editorial Board. (2024).CSIR-UGC NET Life Science Previous Years Papers with Explanations,Ramesh Publishing House

Course Code 24PBOS41	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1a	**PSO 1b**	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4a**	**PSO 4b**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO1	2	2	2	3	3	3	2	2	3	3	2
CO2	2	2	2	2	2	3	3	2	3	2	2
CO3	2	2	2	2	2	3	2	2	3	2	3
CO4	3	2	2	3	3	2	2	2	3	2	2
CO5	3	3	2	3	2	3	2	3	3	2	2

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

Dr.V. Jeyasimga
Head of the Department

Dr.R.Gloria Jemmi Christobel
Course Designer