V.V.VANNIAPERUMAL COLLEGE FOR WOMEN

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

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

V.V.Vanniaperumal College for Women, Virudhunagar, established in 1962, offers 20 UG Programmes, 14 PG Programmes, 6 M.Phil. Programmes and 6 Ph.D. Programmes. The 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 and Computer Applications.
Commerce & Management	:	Commerce, Commerce (Computer Applications), Commerce (Professional Accounting), Business Administration.

PG PROGRAMMES

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

* AICTE approved Programmes

PRE-DOCTORAL PROGRAMMES (M.Phil.)

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

OUTLINE OF CHOICE BASED CREDIT SYSTEM - UG

1. Core Courses
2. Discipline Specific Elective Courses (DSEC)
3. Allied Courses
4. Skill Enhancement Courses (SEC)
5. Non Major Elective Courses (NMEC)
6. Ability Enhancement Compulsory Courses (AECC)
7. Generic Elective Courses (GEC)
8. Internship / Field Project
9. Self Study Courses
10. Extra Credit Courses (Optional)

List of Non Major Elective Courses (NMEC) Offered

UG PROGRAMMES

Name of the Course	Semester	Department
History of India upto A.D.1858	III	History(EM)
இந்திய வரலாறு கி.பி. 1858 வரை	III	History (TM)
Indian National Movement (A.D 1885-1947)	IV	History(EM)
இந்திய தேசிய இயக்கம் (கி.பி. 1885 – 1947)	IV	History(TM)
English for Professions I	III	English
English for Professions II	IV	
இக்கால நீதி இலக்கியம்	III	Tamil
உரைநடை இலக்கியம்	IV	
Basic Hindi – I	III	Hindi
Basic Hindi – II	IV	
Practical Banking	III	Commerce
Basic Accounting Principles	IV	
Business Management	III	Business Administration
Entrepreneurship	IV	
Quantitative Aptitude – I	III	Mathematics
Statistics and Operation Research	IV	
Physics in Everyday life	III	Physics
Fundamentals of Electronics	IV	
Industrial Chemistry	III	Chemistry
Drugs and Natural Products	IV	
Applied Zoology	III	Zoology
Animal Science	IV	
Basic Food Science	III	Home Science – Nutrition and Dietetics
Basic Nutrition and Dietetics	IV	
Women and Health	III	Biochemistry
Lifestyle associated disorders	IV	
Medical Lab Technology	III	Microbiology
Applied Microbiology	IV	
Infectious Diseases	III	Biotechnology
Organic Farming	IV	
Basics of Fashion	III	Costume Design And Fashion
Interior Designing	IV	
Introduction to Computers and Office Automation	III	Computer Science
Introduction to Internet and HTML 5	IV	
Spreadsheet	III	Information Technology
Introduction to HTML	IV	
Fundamentals of Computers	III	Computer Applications
Web Design with HTML	IV	
Horticulture – I	III	Botany
Horticulture – II	IV	
மருத்துவ தாவரவியல் - I	III	
மருத்துவ தாவரவியல் - II	IV	
Library and Information Science – I	III	Library Science
Library and Information Science – II	IV	

மேல்நிலை கல்வி வரை தமிழை முதன்மை பாடமாக எடுத்து படிக்காத மாணவிகள் கீழ்கண்ட பாடங்களை கட்டாயம் படிக்க வேண்டும்

1. அடிப்படைத் தமிழ் - எழுத்தறிதல்
2. அடிப்படைத் தமிழ் - மொழித்திறனறிதல்

List of Non Major Elective Courses (NMEC)

(2023-2024 onwards)

UG PROGRAMMES

Name of the Course	Semester	Department
History of India upto A.D.1858	III	History(EM)
இந்திய வரலாறு கி.பி. 1858 வரை	III	History (TM)
Indian National Movement (A.D 1885-1947)	IV	History(EM)
இந்திய தேசிய இயக்கம் (கி.பி. 1885 – 1947)	IV	History(TM)
English for Professions I	III	English
English for Professions II	IV	
இக்கால நீதி இலக்கியம்	III	Tamil
உரைநடை இலக்கியம்	IV	
Basic Hindi – I	III	Hindi
Basic Hindi – II	IV	
Fundamental Hindi – I	III	Hindi
Fundamental Hindi – II	IV	
Practical Banking	III	Commerce
Basic Accounting Principles	IV	
Financial Literacy I	III	
Financial Literacy II	IV	
Self-Employment And Start-Up Business	III	Commerce CA
Fundamentals Of Marketing	IV	
Women Protection Laws	III	Commerce (Professional Accounting)
Basic Labour Laws	IV	
Business Management	III	Business Administration
Entrepreneurship	IV	
Quantitative Aptitude I	III	Mathematics
Basic Statistics		
Quantitative Aptitude II	IV	
Operations Research		
Physics in Everyday life -I	III	Physics
Physics in Everyday life -II	IV	
Industrial Chemistry	III	Chemistry
Drugs and Natural Products	IV	
Applied Zoology	III	Zoology
Animal Science	IV	
Basic Food Science	III	Home Science – Nutrition and Dietetics
Basic Nutrition and Dietetics	IV	
Women and Health	III	Biochemistry
Lifestyle Associated Disorders	IV	
Medical Lab Technology	III	Microbiology
Applied Microbiology	IV	
Infectious Diseases	III	Biotechnology
Organic Farming	IV	
Basics of Fashion	III	Costume Design And Fashion
Interior Designing	IV	

Introduction to Computers and Office Automation	III	Computer Science
Introduction to Internet and HTML 5	IV	
MS Office	III	Information Technology
Introduction to HTML	IV	
Fundamentals of Computers	III	Computer Applications
Web Design with HTML	IV	
Horticulture – I	III	Botany
Horticulture – II	IV	
மருத்துவ தாவரவியல் - I	III	
மருத்துவ தாவரவியல் - II	IV	
Library and Information Science – I	III	Library Science
Library and Information Science - II	IV	
Cadet Corps for Career Development I	III	National Cadet Corps
Cadet Corps for Career Development II	IV	

மேல்நிலைக் கல்வி வரை தமிழை முதன்மைப் பாடமாக எடுத்துப் படிக்காத மாணவிகள் கீழ்க்கண்ட பாடங்களைக் கட்டாயம் படிக்க வேண்டும்

1. அடிப்படைத் தமிழ் - எழுத்தறிதல்
2. அடிப்படைத் தமிழ் - மொழித்ரதிறனறிதல்

List of Ability Enhancement Compulsory Courses (AECC) & Generic Elective Courses (GEC) Offered

ABILITY ENHANCEMENT COMPULSORY COURSES (AECC)

1. Value Education
2. Environmental Studies

GENERIC ELECTIVE COURSES -1

1. Human Rights
2. Women Studies

GENERIC ELECTIVE COURSES -2

1. Constitution of India
2. Modern Economics
3. Adolescent Psychology
4. Disaster Management

B. OUTCOME BASED EDUCATION (OBE) FRAMEWORK

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

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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 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 Biotechnology

- To impart quality education in Biotechnology to the students with sound disciplinary knowledge
- 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 B.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 professional 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 the 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 effectively the acquired knowledge and skill in the field of Arts, Physical Science, Life Science, Computer Science, Commerce and Management for higher studies and employment. (*Disciplinary Knowledge*)

2 communicate proficiently and confidently with the ability to express original/complex ideas effectively in different situations. (*Communication Skills)*

3 identify, formulate and solve problems in real life situations scientifically / systematically by adapting updated skills in using modern tools and techniques. (*Scientific Reasoning and Problem Solving)*

4 critically analyse, synthesize and evaluate data, theories and ideas to provide valid suggestions for the betterment of the society. (*Critical Thinking and Analytical Reasoning)*

5 use ICT in a variety of self-directed lifelong learning activities to face career challenges in the changing environment. (*Digital Literacy, Self - Directed and Lifelong Learning)*

6 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)*

7 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 UG Programme**.** Programme Specific Outcomes denote what the students would be able to do at the time of graduation. They are Programme specific. It is mandatory that each PO should be mapped to the respective PSO.

On completion of B.Sc. Biotechnology Programme, the students will be able to

PO1: Disciplinary knowledge

PSO1a: Apply the knowledge on fundamental concepts of life sciences such as Biochemistry, Microbiology, Genetics and Molecular biology and its related courses in higher studies.

PSO1b: Understand the principles and handling of various instruments used in Biochemistry, Microbiology and chemistry laboratory and to equip the practical skills in Biotechnology

PO2: Communication Skills.

PSO2:Explain various concepts and processes of Biological sciences both in verbal and written form and illustrate the techniques related to Biotechnology.

PO3: Scientific Reasoning and Problem Solving

PSO3a: apply their theoretical knowledge and transferable skills to identify and solve problems in day today life

PSO3b: Employ interdisciplinary knowledge to provide better solutions and new ideas in various branches of Biotechnology innovatively to work in a biotechnology laboratory or in an industry

PO4: Critical thinking and Analytical Reasoning

PSO4a: critically think and apply the concepts in life sciences in identifying the problems which can be addressed through Biotechnology

PSO4b: 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

PO5: Digital Literacy, Self - directed and Lifelong learning

PSO5: Make use of modern ICT tools and to adapt to the technological advancements in the emerging areas of Biotechnology.

PO6: Cooperation / Team Work and Multi-Cultural Competence

PSO6: Work effectively as a member or leader of a team in institution, industry, society through the acquired skills from paper presentation, Industrial visit and Internship programme.

PO7: Moral and Ethical awareness

PSO7: Understand the IPR, ethics in life science and adapting ecofriendly techniques for sustainable development.

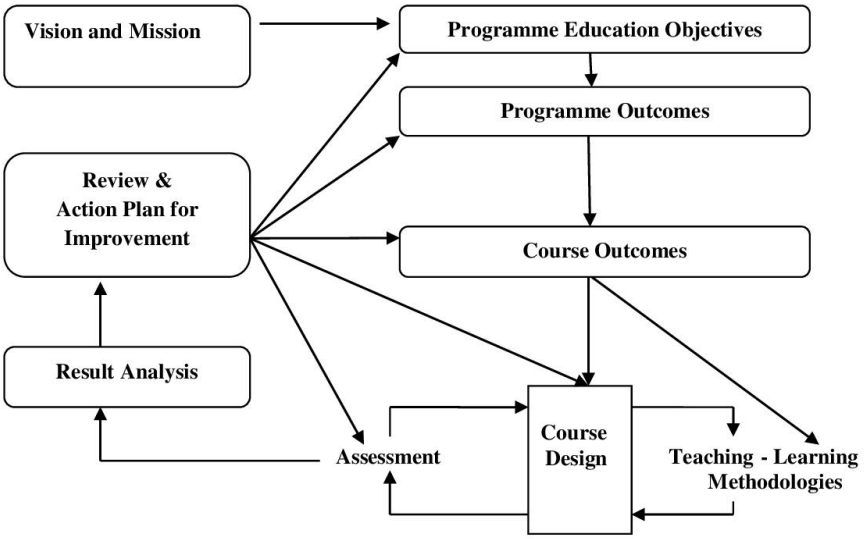
PO-PEO Mapping Matrix

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

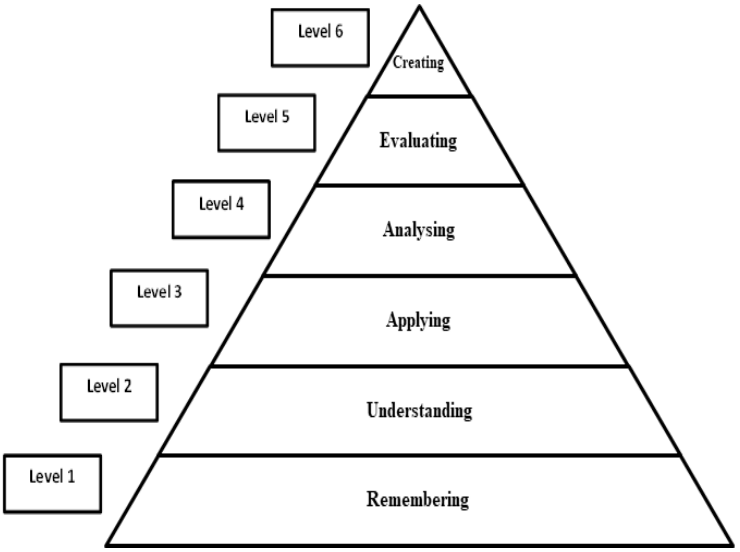
B.1.4 Course Outcomes (COs)

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



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

BLOOM'S TAXONOMY



CO – PO Mapping of Courses

After framing the CO statements, the COs framed for each Course is mapped with POs based on the relationship that exists between them. The COs which are not related to any of the POs is indicated with (-), signifying Nil. Measurement Mapping is based on Four Points Scale [High (H), Medium (M), Low (L) and Nil (-)]. For calculating weighted percentage of contribution of each Course in the attainment of the respective POs, the weights assigned for H, M and L are 3, 2and 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
CO1							
CO2							
CO3							
CO4							
CO5							

ELIGIBILITY FOR ADMISSION

The candidate should have passed the Higher Secondary Examination conducted by the Board of Higher Secondary Education, Tamil Nadu or any other equivalent examination accepted by the Academic Council with Biology as one of the subjects in Higher Secondary Course.

DURATION OF THE PROGRAMME

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

MEDIUM OF INSTRUCTION

English

COURSES OFFERED

Part I	:	Tamil/Hindi/Alternate Course
Part II	:	English
Part III	:	Core Courses
		Discipline Specific Elective Courses
	:	Allied Courses
	:	Self Study Course
Part IV	:	Skill Enhancement Courses (SEC)
	:	Internship/ Field Project
	:	Non-Major Elective Courses (NMEC)
	:	Ability Enhancement Compulsory Courses (AECC)
	:	Generic Elective Courses (GEC)
	:	Self Study Course
Part V	:	National Service Scheme/ Physical Education/ Youth Red Cross Society/ Red Ribbon Club/ Science Forum/ Eco Club/ Library and Information Science/ Consumer Club/ Health and Fitness Club and National Cadet Corps/ Rotaract club

B.2. EVALUATION SCHEME

B.2.1. PART II

Components	Internal Assessment Marks	External Examination Marks	Total Marks
Theory	15	75	100
Practical	5+5		

INTERNAL ASSESSMENT
Distribution of Marks

Mode of Evaluation		Marks
Periodic Test	:	15
Practical	:	10
Total	**:**	**25**

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

B.2.1.1 PART II (II UG – 2023-2024 onwards)

Components	Internal Assessment Marks	External Examination Marks	Total Marks
Test	15	60	100
Practical	10	15	

INTERNAL ASSESSMENT
Distribution of Marks

Mode of Evaluation		Marks
Periodic Test	:	15
Practical	:	10
Total	**:**	**25**

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

EXTERNAL ASSESSMENT
Distribution of Marks

Mode of Evaluation		Marks
Theory	:	60
Practical	:	15
Total	**:**	**75**

B.2.1 PART I & PART III - Core Courses, Discipline Specific Elective Courses & Allied Courses

Components	Internal Assessment Marks	External Examination Marks	Total Marks
Theory	25	75	100
Practical	40	60	100
Project	100		100

INTERNAL ASSESSMENT
Distribution of Marks
Theory

Mode of Evaluation			Marks
Periodic Test		:	15
Assignment	Core:I UG-K4 Level, II & III UG – K5 Level	:	5
	Part I & Allied: K4 Level		
	DSEC:K5 Level		
Quiz	K2:Level	:	5
Total		**:**	**25**

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

Two Assignments - Better of the two will be considered

Three Quiz Tests - Best of the three will be considered

Practical

Mode of Evaluation		Marks
Test	:	15
Model Examination		15
Performance	:	10
Total	**:**	**40**

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

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

Section	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A Q.No.(1- 4)	Multiple Choice	4	4	1	4
B Q.No.(5- 7)	Internal Choice - Either Or Type	3	3	7	21
C Q.No.(8-9)	Internal Choice - Either Or Type	2	2	10	20
				Total	**45***

*The total marks obtained in the Periodic Test will be calculated for 15 marks

EXTERNAL EXAMINATION

Question Pattern **Duration: 3 Hours**

Section	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A Q. No.(1- 10)	Multiple Choice	10	10	1	10
B Q. No.(11 -15)	Internal Choice – Either Or Type	5	5	7	35
C Q. No.(16-18)	Internal Choice - Either Or Type	3	3	10	30
				Total	**75**

PROJECT

Assessment by Internal examiner only

Distribution of Marks

Mode of Evaluation		Marks
Project work and Report	:	60
Presentation and Viva-Voce	:	40
Total		**100**

B.2.2 PART III - SELF STUDY COURSE

Core Courses Quiz – Online

Assessment by Internal Examiner only

- Question Bank is prepared by the Faculty Members of the Departments.
- No. of Questions to be taken 700.
- Multiple Choice Question pattern is followed.
- Online Test will be conducted in VI Semester for 100 Marks.
- Model Examination is conducted after two periodic tests.

Distribution of Marks

Mode of Evaluation		Marks
Periodic Test	:	40
Model Examination	:	60
Total	**:**	**100**

Two Periodic Tests - Better of the two will be considered

B.2.3 PART IV - Skill Enhancement Courses & Non Major Elective Courses

INTERNAL

ASSESSMENT

Distribution of Marks

Theory

Mode of Evaluation			Marks
Periodic Test		:	25
Assignment	SEC:K4 Level	:	10
	NMEC:K3 Level		
Quiz	K2 Level	:	5
Total		**:**	**40**

Three Periodic tests - Average of the best two will be considered
Two Assignments - Best of the two will be considered
Three Quiz Tests - Best of the three will be considered

Question Pattern **Duration: 1 Hour**

Section	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A Q. No.(1- 3)	Open Choice	3	3	5	15
B Q. No.4	Internal Choice - Either Or Type	1	1	10	10
				Total	**25**

EXTERNAL EXAMINATION

Question Pattern **Duration: 2 Hours**

Section	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A Q. No.(1-6)	Internal Choice - Either Or Type	6	6	5	30
B Q. No.(7- 9)	Internal Choice - Either Or Type	3	3	10	30
				Total	**60**

B.2.4 PART IV- Ability Enhancement Compulsory Courses (AECC) & Generic Elective Courses (GEC)

Assessment by Internal Examiner only

- Model Examination is conducted after two periodic tests.
- Book and Study Material prepared by the Faculty of the respective departments will be prescribed.

Distribution of Marks

Mode of Evaluation			Marks
Periodic Test		:	30
Assignment	K2 Level	:	10
Model Examination		:	60
Total		**:**	**100**

Two Periodic tests - Better of the two will be considered

Two Assignments - Better of the two will be considered

Question Pattern for Periodic Test **Duration: 1 Hour**

Section	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A Q. No.(1- 3)	Internal Choice - Either Or Type	3	3	6	18
B Q. No.4	Internal Choice - Either Or Type	1	1	12	12
				Total	**30**

Question Pattern for Model Examination **Duration: 2 Hours**

Section	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A Q. No.(1- 5)	Internal Choice - Either Or Type	5	5	6	30
B Q. No.(6- 8)	Internal Choice - Either Or Type	3	3	10	30
				Total	**60**

B.2.5 PART IV – Self Study Course

Practice for Competitive Examinations - Online

Assessment by Internal Examiner only

- Question Bank prepared by the Faculty Members of the respective Departments will be followed.
- Multiple Choice Question pattern is followed.
- Online Test will be conducted in V Semester for 100 Marks.
- Model Examination is conducted after two periodic tests.

Subject wise Allotment of Marks

Subject		Marks
Tamil	:	10
English	:	10
History	:	10
Mathematics	:	10
Current affairs	:	10
Commerce, Law & Economics	:	10
Physical Sciences	:	10
Life Sciences	:	15
Computer Science	:	5
Food and Nutrition	:	5
Sports and Games	:	5
Total		**100**

Distribution of Marks

Mode of Evaluation		Marks
Periodic Test	:	40
Model Examination	:	60
Total	**:**	**100**

Two Periodic Tests - Better of the two will be considered

PART IV- Internship/ Field Project

Internship / Field Project is compulsory for II year UG Science Students

- **Internship:** A designated activity that carries one credit involving not less than 15 days of working in an organization under the guidance of an identified mentor
- **Field Project:** Students comprising of maximum 5 members in a team need to undertake project that involve conducting surveys inside/outside the college premises and collection of data from designated communities or natural places.
- Assessment by Internal Examiner only

Mode of Evaluation		Marks
Onsite Learning/Survey	:	50
Report	:	25
Viva-Voce	:	25
Total		**100**

B.2.6 Part V – Extension Activities

Assessment by Internal examiner only

Distribution of Marks

Mode of Evaluation		Marks
Attendance	:	5
Performance	:	10
Report/Assignment/Project/Camp/Practical	:	10
Total	**:**	**25***

*The marks obtained will be calculated for 100 mark

EXTRA CREDIT COURSES (OPTIONAL)

Assessment by Internal Examiner only

Distribution of Marks

Question Pattern

Section	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A Q.No.(1- 10)	Multiple Choice	10	10	1	10
B Q.No.(11- 15)	Internal Choice - Either Or Type	5	5	9	45
C Q.No.(16-20)	Open choice	5	3	15	45
				Total	**100**

ELIGIBILITY FOR THE DEGREE

- The candidate will not be eligible for the Degree without completing the prescribed Courses of study, lab work, *etc.*, and a minimum Pass marks in all the Courses.
- No Pass minimum for Internal Assessment.
- Pass minimum for External Examination is 27 marks out of 75 marks for Core Courses, Discipline Specific Elective Courses and Allied Courses.
- Pass minimum for External Examination is 21 marks out of 60 marks for Skill Enhancement Courses and Non Major Elective Courses.
- The aggregate minimum pass percentage is 40.
- Pass minimum for External Practical Examination is 21 marks out of 60 marks.
- Pass minimum for Ability Enhancement Compulsory Courses and Generic Elective Courses is 40 marks.
- Pass minimum for Self Study Courses is 40 marks.

ATTENDANCE

- For UG, PG and M.Phil. Programmes,
  a) The students who have attended the classes for 76 days (85%) and above are permitted to appear for the Summative Examinations without any condition.
  b) The students who have only 60-75 days (66% - 84%) of attendance are permitted to appear for the Summative Examinations after paying the required fine amount and fulfilling other conditions according to the respective cases.
  c) 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.
  d) 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 Part V in UG Programmes, the students require 75 % of attendance to get a credit.
- For Certificate, Diploma, Advanced Diploma and Post Graduate Diploma Programmes, the students require 75% of attendance to appear for the Theory/Practical Examinations.

These rules come into effect from 2020-2021 onwards.

B.3 ASSESSMENT MANAGEMENT PLAN

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

B.3.1 Assessment Process for CO Attainment

Assessment is one or more processes carried out by the institution that identify, collect and prepare data to evaluate the achievement of Course Outcomes and Programme Outcomes.

Course Outcome is evaluated based on the performance of students in the Continuous Internal Assessments and in End Semester Examination of a Course. Target levels of attainment shall be fixed by the Course teacher and Heads of the respective departments.

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

Indirect Assessment – Done through Course Exit Survey.

CO Assessment Rubrics

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

CO Attainment

Direct CO Attainment

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

Attainment Levels of COs

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

Target Setting for Assessment Method

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

Formula for Attainment for each CO

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

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

Indirect CO Attainment

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

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

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

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

B.3.2 Assessment Process for Overall PO Attainment

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

PO Assessment Tools

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

Programme Articulation Matrix (PAM)

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

Indirect Attainment of POs for all Courses

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

Attainments of POs for all Courses

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

Overall PO Attainment= [75% of Direct PO Attainment + 25% of Indirect PO Attainment (Graduate Exit Survey & Participation in Co- curricular and Extracurricular Activities)] Expected Level of Attainment for each of the Programme Outcomes

POs	Level of Attainment
Value > = 70%	Excellent
Value > = 60 % and Value < 70%	Very Good
Value > = 50 % and Value < 60%	Good
Value > = 40% and Value < 50%	Satisfactory
Value < 40%	Not Satisfactory

Level of PO attainment

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

B.3.3 Assessment Process for PEOs

The curriculum is designed so that all the courses contribute to the achievement of PEOs. The attainment of PEOs is measured after 5 years of completion of the programme only through Indirect methods.

Target for PEO Attainment

Assessment Criteria	Target (UG)	Target (PG)
Record of Employment	25% of the class strength	30% of the class strength
Progression to Higher Education	40% of the class strength	5% of the class strength
Record of Entrepreneurship	2% of the class strength	5% of the class strength

Attainment of PEOs

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

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

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

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

Expected Level of Attainment for each of the Programme Educational Objectives

POs	Level of Attainment
Value > = 70%	Excellent
Value > = 60 % and Value < 70%	Very Good
Value > = 50 % and Value < 60%	Good
Value > = 40% and Value < 50%	Satisfactory
Value < 40%	Not Satisfactory

Level of PEO Attainment

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

C. PROCESS OF REDEFINING THE PROGRMME EDUCATIONAL OBJECTIVES

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

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BACHELOR OF SCIENCE
BIOTECHNOLOGY (2026)

Outcome Based Education with Choice Based Credit System
Programme Structure - Allotment of Hours and Credits
For those who join in the Academic Year 2020-2021

Components	Semester						Total Number of Hours (Credits)
	I	II	III	IV	V	VI	
Part I : Tamil /Hindi	6 (3)	6 (3)	6 (3)	6 (3)	-	-	24 (12)
Part II : English	6 (3)	6(3)	6 (3)	6 (3)	-	-	24 (12)
Part III : Core Courses, Discipline Specific Elective Courses, Allied Courses & Self Study Course							
Core Course	4 (4)	4 (4)	5 (5)	5 (5)	4 (4)	5 (4)	27 (26)
Core Course	4 (4)	4 (4)	-	-	4 (4)	5 (4)	17(16)
Core Course	-	-	-	-	4 (4)	5 (4)	9 (8)
Core Course Practical	2 (0)	2 (2)	2 (0)	2 (2)	3 (0) 3 (0) 2 (0)	3 (3) 3 (3) 2 (2)	14 (7) 6 (3) 4 (2)
DSEC	-	-	-	-	4 (4)	5 (4)	9 (8)
Project					0 (1)		0 (1)
Allied Course I	4(4) 2 (0)	4 (4) 2 (2)	-	-	-	-	8 (8) 4 (2)
Allied Course II	-	-	4 (4)	4 (4)	-	-	8 (8)
Allied Course Practical	-	-	2 (0)	2 (2)	-	-	4 (2)
Self Study Course	-	-	-	-		0 (1)	0 (1)
Part IV : Skill Enhancement Courses, Non Major Elective Courses, Ability Enhancement Compulsory Courses, Generic Elective Courses, Self Study Course &Internship/ Field Project							
SEC	-	2 (2)	2 (2)	2 (2)	2 (2)	2 (2)	10 (10)
SEC	-	-	-	-	2 (2)	-	2 (2)
Non Major Elective Course	-	-	2(2)	2 (2)	-	-	4 (4)
AECC - Value Education	2 (2)	-	-	-	-	-	2 (2)
AECC - Environmental Studies	-	-	-	-	2 (1)	-	2 (1)
GEC -1	-	-	1 (1)	-	-	-	1 (1)
GEC -2	-	-	-	1 (1)	-	-	1 (1)
Self Study Course					0 (1)	-	0 (1)
Internship/ Field Project	-	-	-	0 (1)	-	-	0 (1)
Part V : Extension Activities	-	-	-	0 (1)	-	-	0 (1)
Total	**30 (20)**	**30 (24)**	**30 (20)**	**30 (26)**	**30 (23)**	**30(27)**	**180 (140)**

DSEC: Discipline Specific Elective Course
SEC: Skill Enhancement Course
AECC: Ability Enhancement Compulsory Course
GEC: Generic Elective Course

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PART I - TAMIL

S. No.	Sem.	Code	Title of the Course	Credits	Marks
1.	I	20UTAG11	பொதுத்தமிழ் தாள் I	3	100
2.	II	20UTAG21	பொதுத்தமிழ் தாள் II	3	100
3.	III	20UTAG31	பொதுத்தமிழ் தாள் III	3	100
4.	IV	20UTAG41	பொதுத்தமிழ் தாள் IV	3	100
	TOTAL			**12**	**400**

PART I - HINDI

S. No.	Sem.	Code	Title of the Course	Credits	Marks
1.	I	20UHDG11 22UHDG11	Hindi - Paper I Prose – I & II, Ancient Stories - I, General Essays, Functional Hindi – I & Grammar General Hindi – I	3	100
2.	II	20UHDG21 22UHDG21	Hindi - Paper II Drama, One Act Play, Letter, Correspondence, Functional Hindi – II & Grammar General Hindi – II	3	100
3.	III	20UHDG31 22UHDG31	Hindi - Paper III Ancient Poetry, Drama, Indian History, Hindi Grammar & Functional Hindi III Advanced Hindi – I	3	100
4.	IV	20UHDG41 22UHDG41	Hindi - Paper IV Modern Poetry, Hindi Literary Essays, Letter Correspondence, Conversation & Functional Hindi IV Advanced Hindi - II	3	100
	TOTAL			**12**	**400**

PART II - ENGLISH

S.No.	Sem.	Code	Title of the Course	Credits	Marks
1.	I		English – Paper I	3	100
		20UENG11A	English for Advanced Learners I		
		20UENG11B	English for Career Guidance - I		
		20UENG11C	English for Communicative Competence-I		
2.	II		English – Paper II	3	100
		20UENG21A	English for Advanced Learners II		
		20UENG21B	English for Career Guidance - II		
		20UENG21C	English for Communicative Competence - II		

3.	III		English – Paper III	3	100
		20UENG31A	English for Advanced Learners III		
		20UENG31B	English for Career Guidance – III		
		20UENG31C	English for Communicative Competence – III		
		22UENG31	Communicative English – I		
4.	IV		English – Paper IV	3	100
		20UENG41A	English for Advanced Learners IV		
		20UENG41B	English for Career Guidance – IV		
		20UENG41C	English for Communicative Competence – IV		
		22UENG41	Communicative English – II		
	TOTAL			**12**	**400**

PART III – CORE & DISCIPLINE SPECIFIC ELECTIVE COURSE

Sl.No.	Sem.	Code	Title of Paper	Credits	Marks
1	I	20UBOC11	Biochemistry	4	100
2	I	20UBOC12	Fundamentals of Genetics	4	100
3	II	20UBOC21/ 20UBOC21N	Molecular Biology	4	100
4	II	20UBOC22	Food Biotechnology	4	100
5	II	20UBOC21P	Biochemistry, Genetics, Molecular Biology, Food Biotechnology lab	2	100
6	III	20UBOC31	Microbiology	5	100
7	IV	20UBOC41/ 20UBOC41N	Recombinant DNA Technology	5	100
8	IV	20UBOC41P	Microbiology & rDNA technology lab	2	100
9	V	20UBOC51	Animal Biotechnology	4	100
10	V	20UBOC52	Immunology	4	100
11	V	20UBOC53	Plant Biotechnology	4	100
12	V	20UBOE51 20UBOE52 20UMBE53	**Discipline Specific Elective Course -1** 1.Genomics and Proteomics 2.Marine Biotechnology 3.Nanobiotechnology	4	100
13	V	20UBOC5PR	Project	1	100
14	VI	20UBOC61	Bioinformatics	4	100
15	VI	2UBOC62	Environmental Biotechnology	4	100
16	VI	20UBOC63	Industrial Biotechnology	4	100
17		20UMBE61 20UBOE62 20UBOE63	Discipline Specific Elective 2–(DSE 2) Pharmaceutical Microbiology Medical Biotechnology IPR, Bioethics and Biosafety	4	100
18	VI	20UBOQ61	Core Courses Quiz– Online	1	100
19	VI	20UBOC61P	Lab in Plant Biotechnology, Environmental Biotechnology	3	100
20	VI	20UBOC62P	Lab in Animal Biotechnology and Immunology	3	100
21	VI	20UBOC63P	Lab in Industrial Biotechnology and Bioinformatics	2	100
			Total	**72**	**2100**

PART III – ALLIED COURSE I- CHEMISTRY

S. No.	Sem.	Code	Title of the Course	Credits	Marks
1.	I	20UCHA11	Allied Course -I Chemistry	4	100
2.	II	20UCHA21	Allied Course -I Chemistry	4	100
3.	II	20UCHA21P	Allied Chemistry practical	2	100
			Total	**10**	**300**

PART III - ALLIED COURSE II- CONCEPTS IN BIOLOGY

S. No.	Sem.	Code	Title of the Course	Credits	Marks
1.	III	20UBIA31	Biology-I (Cell biology)	4	100
2.	IV	20UBIA41	Biology-II (Applied biology)	4	100
3.	IV	20UBIA41P	Biology practical (Cell Biology, Applied biology practical)	2	100
			Total	**10**	**300**

PART IV - SKILL ENHANCEMENT COURSES

S. No.	Sem.	Code	Title of the Course	Credits	Marks
1.	II	20UBOS21	Bioinstrumentation	2	100
2.	III	20UBOS31	Biofertilizer technology	2	100
3.	IV	20UBOS41	Mushroom cultivation	2	100
4.	V	20UBOS51	Medical coding and clinical research	2	100
5.	V	20UBOS52	Herbal Technology	2	100
6.	VI	20UBOS61	DNA fingerprinting	2	100
			Total	**12**	**600**

PART IV – NON MAJOR ELECTIVE COURSES

S. No.	Sem.	Code	Title of the Course	Credits	Marks
1.	I	20UBON31	Infectious diseases	2	100
2.	II	20UBON41	Organic Farming	2	100
			Total	**4**	**200**

PART IV- ABILITY ENHANCEMENT COMPULSORY COURSES, GENERIC ELECTIVE COURSES AND INTERNSHIP / FIELD PROJECT

S. No.	Sem.	Code	Title of the Course	Credits	Marks
1.	I	20UGVE11	Value Education	2	100
2.	V	20UGES51	Environmental Studies	1	100
3.	III	20UGEH31 20UGEW32	Human Rights/ Women Studies	1	100
4.	IV	20UGEC41	Constitution of India/	1	100
		20UGEM42	Modern Economics/		
		20UGEA43	Adolescent Psychology/		
		20UGED44	Disaster Management		
		20UBOIF41	Internship/Field Project	1	100
5.	V	20UGCE51	Practice for Competitive Examinations - Online	1	100
			Total	**7**	**600**

PART V -EXTENSION ACTIVITIES

S. No.	Semester	Code	Title of the Course	Credit
1	I, II,III, IV	20UVNS1 20UVNS2	National Service Scheme	1
2		20UVPE1	Physical Education	
3		20UVYR1 20UVYR2	Youth Red Cross Society	
4		20UVRR1	Red Ribbon Club	
5		20UVSF1	Science Forum	
6		20UVEC1	Eco Club	
7		20UVLI1	Library and Information Science	
8		20UVCC1	Consumer Club	
9		20UVHF1	Health and Fitness Club	
10		20UVNC1 20UVNC2	National Cadet Corps	
11		20UVRO1	Rotaract Club	

PART III - ALLIED COURSE II- CONCEPTS IN BIOLOGY (For Microbiology)

S. No.	Sem.	Code	Title of the Course	Credits	Marks
1.	III	20UBIA31	Biology-I (Cell biology)	4	100
2.	IV	20UBIA41	Biology-II (Applied biology)	4	100
3.	IV	20UBIA41P	Biology practical (Cell Biology, Applied biology practical)	2	100
			Total	**10**	**300**

EXTRA CREDIT COURSES (Optional)

S.No	Sem	Code	Title of the Course	Credits	Total Marks
1	V	20UBOO51	Stem cell technology	2	100

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BACHELOR OF BIOTECHNOLOGY

Programme Code – 2026

PROGRAMME CONTENT

Semester	Course Code	Courses	Hours per week	Credits	Exam. Hours	Marks		
						Int.	Ext.	Total
Part I	20UTAG11	Tamil/Hindi I	6	3	3	25	75	100
Part II	20UENG11A/ 20UENG11B/ 20UENG11C	English I	6	3	3	25	75	100
Part III	20UBOC11	**Core Course -1** Biochemistry	4	4	3	25	75	100
	20UBOC12	**Core Course -2** Fundamentals of Genetics	4	4	3	25	75	100
	20UBOC21P	**Core Practical – I** (Biochemistry, Genetics, Molecular Biology, Food Biotechnology lab)	2	-	3	-	-	-
	20UCHA11	**Allied Course -I** Chemistry	4	4	3	25	75	100
	20UCHA21P	Chemistry practicals	2	-	3	-	-	-
Part IV	20UGVE11	Value Education	2	2	-	100	-	100
		TOTAL	**30**	**20**				**600**

Semester		Course Code	Courses	Hours per week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
II	Part I	20UTAG21	Tamil /Hindi II	6	3	3	25	75	100
	Part II	20UENG21A/ 20UENG21B/ 20UENG21C	English II	6	3	3	25	75	100
	Part III	20UBOC21	**Core Course - 4** Molecular Biology	4	4	3	25	75	100
		20UBOC22	**Core Course - 5** Food Biotechnology	4	4	3	25	75	100
		20UBOC21P	**Core Practical –I** (Biochemistry, Genetics, Molecular Biology, Food Biotechnology lab)	2	2	3	40	60	100
		20UCHA21	**Allied Course -I** Chemistry	4	4	3	40	60	100
		20UCHA21P	Allied Chemistry practical	2	2	3	40	60	100
	Part IV	20UBOS21	**SEC-1** Bioinstrumentation	2	2	2	25	75	100
		TOTAL		**30**	**24**				**800**

Semester		Course Code	Courses	Hours per week	Credits	Exam. Hours	Marks		
							Int	Ext	Total
III	Part I	20UTAG31	Tamil/ Hindi III	6	3	3	25	75	100
	Part II	20UENG31A/ 20UENG31B/ 20UENG31C	English III	6	3	3	25	75	100
	Part III	20UBOC31	**Core Course -5** Microbiology	5	5	3	25	75	100
		20UBOC41P	**Core Practical II** Microbiology and rDNA technology lab	2	-	3	-	-	-
		20UBIA31 20UBIA41P	**Allied course-II** Cell biology Cell Biology & Applied Biology practicals	4 2	4 -	3 3	25 -	75 -	100
	Part IV	20UBOS31	**SEC -2** Biofertiliser technology	2	2	2	40	60	100
		20UBON31	**NMEC-1** Infectious diseases	2	2	2	40	60	100
		20UGEH31 20UGEW32	**Generic Elective -1** 1.Human Rights 2. Women studies	1	1	2	100	-	100
			TOTAL	**30**	**20**				**700**

Semester		Course Code	Courses	Hours per week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
IV	Part I	20UTAG41	Tamil /Hindi IV	6	3	3	25	75	100
	Part II	20UENG41A/ 20UENG41B/ 20UENG41C	English IV	6	3	3	25	75	100
	Part III	20UBOC41	**Core Course - 6** Recombinant DNA Technology	5	5	3	25	75	100
		20UBOC41P	**Core Practical –2** (Microbiology &rDNA technology lab)	2	2	3	40	60	100
		20UBIA41	**Allied Course – II** Applied Biology	4	4	3	25	75	100
		20UBIA41P	Cell Biology& Applied Biology Practicals	2	2	3	40	60	100
	Part IV	20UBOS41	**SEC -3** Mushroom cultivation	2	2	2	40	60	100
		20UBON41	**NMEC-2** Organic farming	2	2	2	40	60	100
		20UBOIF41	Internship/Field Project	0	1	-	100	-	100
			Generic Elective -2	1	1	2	100	-	100
		20UGEC41	Constitution of India						
		20UGEM42	Modern Economics						
		20UGEA43	Adolescent psychology						
		20UGED44	Disaster Management						
	Part V		Extension Activities	-	1	-	100	-	100
			TOTAL	**30**	**26**				**1100**

Semester		Course Code	Courses	Hours per week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
V	Part III	20UBOC51	**Core Course – 7** Animal Biotechnology	4	4	3	25	75	100
		20UBOC52	**Core Course - 8** Immunology	4	4	3	25	75	100
		20UBOC53	**Core Course – 9** Plant biotechnology	4	4	3	25	75	100
		20UBOC61P	**Core Practical –3** Lab in Plant Biotechnology, Environmental Biotechnology.	3	-	3	-	-	-
		20UBOC62P	**Core Practical –4** Lab in Animal Biotechnology and Immunology	3	-	3	-	-	-
		20UBOC63P	**Core Practical –5** Lab in Industrial Biotechnology and Bioinformatics	2	-	3	-	-	-
		20UBOE51 20UBOE52 20UMBE53	**DSEC -1** 1.Genomics and Proteomics 2.Marine Biotechnology 3.Nanobiotechnology	4	4	3	25	75	100
		20UBOC5PR	**Core Course – 10** Project	0	1	-	100		100
	Part IV	20UBOS51	**SEC -4** Medical coding and clinical research	2	2	2	40	60	100
		20UBOS52	**SEC -5** Herbal technology	2	2	2	40	60	100
		20UGES51	Environmental Studies	2	1	2	100	-	100
		20UGCE51	Practice for Competitive Examinations - Online	-	1	-	100	-	100
			TOTAL	**30**	**23**				**900**

Semester		Course Code	Courses	Hours per week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
VI	Part III	20UBOC61	**Core Course -11** Bioinformatics	5	4	3	25	75	100
		20UBOC62	**Core Course -12** Environmental Biotechnology	5	4	3	25	75	100
		20UBOC63	**Core Course - 13** Industrial Biotechnology	5	4	3	25	75	100
		20UBOC61P	**Core Practical –3** Lab in Plant Biotechnology and Environmental Biotechnology.	3	3	3	40	60	100
		20UBOC62P	**Core Practical –4** Lab in Animal Biotechnology, Immunology.	3	3	3	40	60	100
		20UBOC63P	**Core Practical –5** Lab in Industrial Biotechnology and Bioinformatics.	2	2	3	40	60	100
		20UMBE61 20UBOE62 20UBOE63	**DSEC -2** Pharmaceutical Microbiology Medical Biotechnology IPR, Bioethics and Biosafety	5	4	3	25	75	100
		20UBOQ61	Self Study Course: Core Courses Quiz - Online	-	1	-	100		100
	Part IV	20UBOS61	**SEC -6** DNA fingerprinting	2	2	2	40	60	100
	TOTAL			**30**	**27**				**900**

V.V.VANNIAPERUMAL COLLEGE FOR WOMEN

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VIRUDHUNAGAR – 626 001

BACHELOR OF BIOTECHNOLOGY
REVISED PROGRAMME CONTENT

Semester		Course Code	Courses	Hours per week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
I	Part I	20UTAG11	Tamil/Hindi I	6	3	3	25	75	100
	Part II	20UENG11A/ 20UENG11B/ 20UENG11C	English I	6	3	3	25	75	100
	Part III	20UBOC11	**Core Course -1** Biochemistry	4	4	3	25	75	100
		20UBOC12	**Core Course -2** Fundamentals of Genetics	4	4	3	25	75	100
		20UBOC21P	**Core Practical – I** (Biochemistry, Genetics, Molecular Biology, Food Biotechnology lab)	2	-	3	-	-	-
		20UCHA11	**Allied Course -I** Chemistry	4	4	3	25	75	100
		20UCHA21P	Chemistry practicals	2	-	3	-	-	-
	Part IV	20UGVE11	Value Education	2	2	-	100	-	100
	TOTAL			**30**	**20**				**600**

Semester		Course Code	Courses	Hours per week	Credits	Exam. Hours	Marks		
							Int.	**Ext.**	**Total**
II	Part I	20UTAG21	Tamil /Hindi II	6	3	3	25	75	100
	Part II	20UENG21A/ 20UENG21B/ 20UENG21C	English II	6	3	3	25	75	100
	Part III	20UBOC21N	**Core Course - 4** Molecular Biology	4	4	3	25	75	100
		22UBOC22	**Core Course - 5** Plant and animal diversity	4	4	3	25	75	100
		20UBOC21P	**Core Practical –I** (Biochemistry, Genetics, Molecular Biology, Food Biotechnology lab)	2	2	3	40	60	100
		20UCHA21	**Allied Course -I** Chemistry	4	4	3	40	60	100
		20UCHA21P	Allied Chemistry practical	2	2	3	40	60	100
	Part IV	20UBOS21N	**SEC-1** Bioinstrumentation	2	2	2	25	75	100
		TOTAL		**30**	**24**				**800**

Semester		Course Code	Courses	Hours per week	Credits	Exam. Hours	Marks		
							Int	Ext	Total
III	Part I	20UTAG31	Tamil/ Hindi III	6	3	3	25	75	100
	Part II	20UENG31A/ 20UENG31B/ 20UENG31C	English III	6	3	3	25	75	100
	Part III	20UBOC31	**Core Course -5** Microbiology	5	5	3 23	25	75	100
		20UBOC41P	**Core Practical II** Microbiology and rDNA technology lab	2	-	3	-	-	-
		20UBIA31 20UBIA41P	**Allied course-II** Cell biology Cell Biology & Applied Biology practicals	4 2	4 -	3 3	25 -	75 -	100
	Part IV	20UBOS31	**SEC -2** Biofertiliser technology	2	2	2	40	60	100
		20UBON31	**NMEC-1** Infectious diseases	2	2	2	40	60	100
		20UGEH31 20UGEW32	**Generic Elective -1** 1.Human Rights 2. Women studies	1	1	2	100	-	100
			TOTAL	**30**	**20**				**700**

Semester		Course Code	Courses	Hours per week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
IV	Part I	20UTAG41	Tamil /Hindi IV	6	3	3	25	75	100
	Part II	20UENG41A/ 20UENG41B/ 20UENG41C	English IV	6	3	3	25	75	100
	Part III	20UBOC41N	**Core Course - 6** Recombinant DNA Technology	5	5	3	25	75	100
		20UBOC41P	**Core Practical –2** (Microbiology &rDNA technology lab)	2	2	3	40	60	100
		20UBIA41 20UBIA41P	**Allied Course – II** Applied Biology Cell Biology& Applied Biology Practicals	 4 2	 4 2	 3 3	 25 40	 75 60	 100 100
	Part IV	20UBOS41	**SEC -3** Mushroom cultivation	2	2	2	40	60	100
		20UBON41	**NMEC-2** Organic farming	2	2	2	40	60	100
		20UBOIF41	Internship/Field Project	0	1	-	100	-	100
			Generic Elective -2	1	1	2	100	-	100
		20UGEC41	Constitution of India						
		20UGEM42	Modern Economics						
		20UGEA43	Adolescent psychology						
		20UGED44	Disaster Management						
	Part V		Extension Activities	-	1	-	100	-	100
			TOTAL	**30**	**26**				**1100**

Semester		Course Code	Courses	Hours per week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
V	Part III	20UBOC51	**Core Course – 7** Animal Biotechnology	4	4	3	25	75	100
		20UBOC52	**Core Course - 8** Immunology	4	4	3	25	75	100
		20UBOC53	**Core Course – 9** Plant biotechnology	4	4	3	25	75	100
		20UBOC61P	**Core Practical –3** Lab in Plant Biotechnology, Environmental Biotechnology.	3	-	3	-	-	-
		20UBOC62P	**Core Practical –4** Lab in Animal Biotechnology and Immunology	3	-	3	-	-	-
		20UBOC63P	**Core Practical –5** Lab in Industrial Biotechnology and Bioinformatics	2	-	3	-	-	-
		20UBOE51 20UBOE52 20UMBE53	**DSEC -1** 1.Genomics and Proteomics 2.Marine Biotechnology 3.Nanobiotechnology	4	4	3	25	75	100
		20UBOC5PR	**Core Course – 10** Project	0	1	-	100		100
	Part IV	20UBOS51	**SEC -4** Medical coding and clinical research	2	2	2	40	60	100
		20UBOS52	**SEC -5** Herbal technology	2	2	2	40	60	100
		20UGES51	Environmental Studies	2	1	2	100	-	100
		20UGCE51	Practice for Competitive Examinations - Online	-	1	-	100	-	100
			TOTAL	**30**	**23**				**900**

Semester		Course Code	Courses	Hours per week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
VI	Part III	20UBOC61	**Core Course -11** Bioinformatics	5	4	3	25	75	100
		20UBOC62	**Core Course -12** Environmental Biotechnology	5	4	3	25	75	100
		20UBOC63	**Core Course - 13** Industrial Biotechnology	5	4	3	25	75	100
		20UBOC61P	**Core Practical –3** Lab in Plant Biotechnology and Environmental Biotechnology.	3	3	3	40	60	100
		20UBOC62P	**Core Practical –4** Lab in Animal Biotechnology and Immunology.	3	3	3	40	60	100
		20UBOC63P	**Core Practical –5** Lab in Industrial Biotechnology and Bioinformatics.	2	2	3	40	60	100
		20UMBE61 20UBOE62 20UBOE63	**DSEC -2** Pharmaceutical Microbiology Medical Biotechnology IPR, Bioethics and Biosafety	5	4	3	25	75	100
		20UBOQ61	Self Study Course: Core Courses Quiz - Online	-	1	-	100		100
	Part IV	20UBOS61	**SEC -6** DNA fingerprinting	2	2	2	40	60	100
	TOTAL			**30**	**27**				**900**

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B.Sc. BIOTECHNOLOGY
(2020-21 onwards)

Semester I	**BIOCHEMISTRY**	Hours/Week: 4	
Core Course-1		Credits: 4	
Course Code **20UBOC11**		Internal 25	External 75

COURSE OUTCOMES

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

CO1: define the classification and structure of biomolecules such as carbohydrates, proteins, nucleic acids, enzymes and lipids. [K1]

CO2: describe the chemistry of biomolecules, metabolism and mechanism of enzyme action. [K2]

CO3: explain the relationship between biomolecules, mechanism of enzyme action and the metabolism. [K2]

CO4: apply the knowledge of chemistry and properties of biomolecules such as Carbohydrates, proteins, nucleic acids, enzymes and lipids. [K3]

CO5: analyze the metabolic pathways of various biomolecules. [K4]

UNIT I

Carbohydrates: Atoms and Interaction between biomolecules. Carbohydrates - Classification, Structure and biological functions of monosaccharide (glucose, fructose). Disaccharides (Lactose, sucrose) and polysaccharides (glycogen, cellulose), Mucopolysaccharides. Glycolysis, citric acid cycle, Electron transport chain, Oxidative phosphorylation. **(**12 Hours)

UNIT II

Aminoacids: Classification, physical and chemical properties. Proteins: Biological importance, classification, general properties. Primary structure, secondary structure, tertiary structure and quarternary structure- forces stabilizing the structure of proteins. Catabolism of aminoacids: Transamination, aminoacids as precursors of Heme.

(12 Hours)

UNIT III

Enzyme: Nomenclature, Classification, specificity, E.S complex, thermodynamics of enzyme action, apo enzyme, holoenzyme, isoenzyme, vitamins as coenzyme, Michaelis- Menton equation, Line weaver-Burk plot, Km and Vmax, Competitive and non competitive inhibitors. Methods of purification of enzymes. (12 Hours)

UNIT IV

Lipids: Biological significance, nomenclature and classification, simple lipids: fatty acids and their properties, triglycerides, cholesterol, compound lipids- phospholipids and glycolipids. Beta – oxidation of fatty acid. (12 Hours)

UNIT V

Nucleic acids: DNA and RNA composition, Structure, functions, types, and biological importance. Biosynthesis (Denovo synthesis only) and degradation of nucleic acids. (12 Hours)

TEXT BOOK

Ambika shanmugam. (2013). *Fundamentals of Biochemistry for medical Students*, (7th Edition) Lippincott Williams & Wilkins.

REFERENCE BOOKS

1. Albert L. Lehninger, David L. Nelson and Michael M. Cox. (2008). *Principles of Biochemistry*. 5th edition, New York: W. H. Freeman and Company.
2. Lubert. Stryer. Jeremy M. Berg, John L. Tymoczko. (2007). *Biochemistry* 6th edition.New York:W. H. Freeman and Company
3. Robert K. Murray, Victor W. Rodwell, David Bender, Kathleen M. Botham, P. Anthony Weil, Peter J. Kennelly. (2009). Harper's *Biochemistry*, (28thedn.). Mc Graw HillPublisher.
4. D. Voet, J. G. Voet and C. W. Pratt. (2013). *Fundamentals of Biochemistry*, (4th Edition) Wiley Publisher.

Course Code 20UBOC11	PO1		PO2	PO3		PO4		PO5	PO6	PO7
	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
CO1	H	-	H	L	L	L	L	L	-	-
CO2	H	M	H	L	L	M	L	M	-	-
CO3	H	M	L	L	L	H	M	L	-	-
CO4	H	M	M	M	M	M	H	M	-	-
CO5	H	M	H	M	H	L	M	M	-	-

Dr.V.Jeyasimga
Head of the Department

Ms.A.Mahalakshmi
Course Designer

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B.Sc. BIOTECHNOLOGY
(2020-21 onwards)

Semester I	**FUNDAMENTALS OF GENETICS**	Hours/Week: 4	
Core Course-2		Credits: 4	
Course Code **20UBOC12**		Internal 25	External 75

COURSE OUTCOMES

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

CO1: recall the key concepts of Genetics. [K1]

CO2: summarise the historical development of Genetics, inheritance, variation, Sex determination, chromosomal mapping and evolution. [K2]

CO3: outline the Mendelian and non Mendelian inheritance, allelic interaction, linkage and population genetics. [K2]

CO4: explain the concepts of genetics using specific examples or by solving simple genetic problems. [K3]

CO5: analyze the Mendelian laws, allelic interaction, sex linkage, chromosomal mapping and evolution. [K4]

UNIT I

Introduction: Historical developments in the field of genetics. Organisms suitable for genetic experimentation and their genetic significance. Mendelian genetics: Mendel's experimental design, monohybrid, di-hybrid and trihybrid crosses, Law of segregation & Principle of independent assortment. (12 Hours)

UNIT II

Allelic interactions: Concept of dominance, recessiveness, incomplete dominance, co-dominance, semi-dominance, pleiotropy, multiple allele, pseudo-allele, essential and lethal genes. Non allelic interactions: Interaction producing new phenotype complementary genes,epistasis (dominant & recessive), duplicate genes and inhibitory genes (12 Hours)

UNIT III

Sex determination and sex linkage : Mechanisms of sex determination, Environmental factors and sex determination, sex differentiation, Barr bodies, dosage compensation, genetic balance theory, Fragile-X-syndrome and chromosome, sex influenced dominance, sex limited gene expression, sex linked inheritance. (12 Hours)

UNIT IV

Genetic Linkage, crossing over and chromosome mapping: Linkage and recombination of genes in a chromosome crossing over, Cytological basis of crossing over, Molecular mechanism of crossing over, Crossing over at four strand stage, Multiple crossing overs Genetic mapping. Extra chromosomal inheritance: maternal inheritance, cytoplasmic inheritance. (12 Hours)

UNIT V

Evolution and population genetics: Inbreeding and out breeding, Hardy Weinberg law assumption, (prediction, derivation), allelic and genotype frequencies, changes in allelic frequencies, systems of mating, evolutionary genetics, natural selection. (12 Hours)

TEXT BOOKS

1. Sambamurty A.V.S.S, (2012) Genetics - Narosa publishing company.
2. Ajoypaul, *Text book of genetics - from genes to genomes,* Books and allied Pvt.Ltd.

REFERENCE BOOKS

1. Alan G. Atherly, Jack. R, Girton, Jhon. F, Mc Donald,(1999).*The science of Genetics*.Sounders College Publishers.
2. Benjamin Lewin. (2008). *Genes* IX.Jones & Bartlett Learning Publisher.
3. Hartl. D.L.,(2000).*A Primer of population Genetics.*IIIEdition, SinauerAssociatesinc.SunderlandPublisher.
4. Darnell, Lodish, Baltimore,(1994) *Molecular cell Biology,*Scientific American Books, Inc.,
5. Stephen L.Wolfe, (1993). *Molecular and cellular Biology*, Wadsworth Publishing Company.
6. A.Gardner, R.T.Howell and T.Davies, (2008) *Human genetics*. VinodVasishtha for Viva Books Private Limited.
7. Monroe W. Strick berger, (2010*) Genetics (III edition)* PHI learningLearning Private Limited.

Course Code 20UBOC12	PO1		PO2	PO3		PO4		PO5	PO6	PO7
	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
CO1	H	-	H	-	M	H	-	-	-	-
CO2	H	-	H	M	M	H	M	-	-	-
CO3	H	-	H	M	M	H	M	M	-	-
CO4	H	M	H	M	H	H	M	-	-	-
CO5	H	L	M	M	H	H	M	L	-	-

Dr.V.Jeyasimga
Head of the Department

Dr.V.Jeyasimga
Course Designer

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ALLIED COURSE I CHEMISTRY FOR BIOTECHNOLOGY
(2020 -21 onwards)

Semester I	**ALLIED COURSE I- ORGANIC, INORGANIC AND PHYSICAL CHEMISTRY – I**	Hours/Week: 4	
Allied Course -I		Credits: 4	
Course Code **20UCHA11**		Internal 25	External 75

COURSE OUTCOMES

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

CO1: define the basic principles, statements, laws and theories in chemistry. [K1]

CO2: understand the fundamental concepts in organic, inorganic and physical chemistry. [K2]

CO3: illustrate the preparations, uses and applications of polymers, hydrogen and water, various metallurgical process, bonding theories, colloids, sols, emulsion and gels. [K2]

CO4: predict the type of reactions involved in polymers preparation, utility of biomedical polymers, suitable process for metal extraction and water purification, shape of molecules using VSEPR, VB and MO theories, properties of gaseous and colloidal substances. [K3]

CO5: analyze different methodology of preparing polymers, separation of metals from their ores, water purification processes, various bonding theories, gas laws and properties of various colloids, applications of colloids and biomedical polymers. [K4]

UNIT I

1. Polymers – Polymerization – Definition – Classification – examples –Preparation and uses of polythene, PVC, teflon, polystyrene, dacron, nylon- 6,6.
2. Natural and synthetic rubbers – examples – vulcanization of rubber- Preparation and uses of SBR, Buna – N and neoprene.
3. Biomedical polymers – characteristics – examples - Biomedical applications of polymer.

(12 Hours)

UNIT II

1. Metallurgy

Ores, minerals – various steps in the metallurgical processes – Froth floatation – calcination – roasting – leaching – smelting – Mond's process – Van Arkel –de-Boer process – Zone refining – Electrolytic refining – Extraction of titanium.

2. Hydrogen

Isotopes of hydrogen– Heavy water – uses- ortho and para hydrogen Interconversion. Occluded hydrogen – Nascent hydrogen – uses of hydrogen.

3. Water

Hardness of water – Types of hardness – Removal of hardness – sodalime, Permutit and Ion-exchange processes - Demineralisation process – purification of water using chlorine, Ozone and UV light. **(**12 Hours)

UNIT III

1. Bonding – Valence bond theory – postulates – Types of overlapping- σ & π bonds -Concept of hybridization – sp, sp^2 and sp^3 hybridisation – VSEPR Theory – NH_3 and H_2O molecules.
2. Molecular orbital theory – postulates – Application to the formation of H_2, O_2 and He_2 molecules. Comparison of VBT and MOT. **(**12 Hours)

UNIT IV

1. Gas Laws - Boyle's law – Charles law – Gay Lussac's law – Ideal gas equation – Avogadro's law – molar gas volume – Dalton's law of partial pressure -Graham's law of diffusion

2. Kinetic Theory of gases - Postulates – Kinetic gas equation (Derivation not required) – Deduction of gas laws from kinetic gas equation.

3. Different types of Velocities – Average velocity, RMS velocity, most probable velocity – relationship between them. (No derivation)

4. Ideal and real gases - Definition – Deviation of real gases from ideal behavior – reasons for deviation. **(**12 Hours)

UNIT V

1. Colloids – Definition and classification.
2. Sols – Different types – examples –Dialysis – electro osmosis – electrophoresis – stability of colloids- Gold number.
3. Emulsion – Types of emulsion – Emulsifier – Examples – Cleansing action of soap.
4. Gels – Types of gels – examples – Properties – Hydration – Swelling – syneresis – Thixotropy.
5. Applications of colloids. **(**12 Hours)

TEXT BOOKS

1.P.L.Soni, (2008) *Text book of Organic Chemistry*, Latest Edition.Sultan Chand & Sons.

2. P.L.Soni, (2008).*Text book of Inorganic Chemistry*,Latest Edition. Sultan Chand & Sons.

3. P.L.Soni, (2008).*Text book of Physical chemistry*LatestEdition.SultanChand & Sons.

REFERENCE BOOKS

1. Bahl and Arun Bahl,*Advanced Organic Chemistry*,22nd Edition.S.Chand&Company Ltd.
2. Puri, Sharma, Kalia, (2008).*Principles of Inorganic Chemistry*, 43rd Edition. Vishal
3. Publishing Co.
4. Puri,Sharma,Patania,*Principles of Physical Chemistry*, 43rd Edition. Vishal Publishing Co

Course Code 20UCHA11	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	M	M	L	M	M	H
CO2	H	M	M	L	M	M	H
CO3	M	M	M	L	H	M	H
CO4	M	M	M	L	H	M	H
CO5	M	M	M	L	H	M	H

Mrs. M.Dhanalakshmi
Head of the Department

R.Nagasathya
Course Designer/s

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B.Sc. BIOTECHNOLOGY
(2020 -21 onwards)

Semester II	**MOLECULAR BIOLOGY**	Hours/Week: 4	
Core Course-3		Credits: 4	
Course Code **20UBOC21**		Internal 25	External 75

COURSE OUTCOMES

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

CO1: recall the basic concepts in Molecular biology. [K1]

CO2: outline the process of DNA replication, transcription, translation, mutation and gene regulation. [K2]

CO3: explain the mechanism of DNA replication, transcription, translation, mutation and gene regulation. [K2]

CO4: apply the concepts of central dogma of life, gene mutations and regulation. [K3]

CO5: analyze the various steps involved in DNA replication, transcription, translation, mutation and gene regulation and molecular level import export functioning of the cell. [K4]

UNIT I

Central dogma of molecular Biology: DNA Replication and its types. Prokaryotic and Eukaryotic DNA replication, Mechanism of DNA replication, Enzymes and accessory proteins involved in DNA replication. (12 Hours)

UNIT II

Transcription: Prokaryotic Transcription, Eukaryotic Transcription, RNA polymerase. Transcriptional and post-transcriptional modifications in RNA. Gene silencing, 5' cap formation, 3'-end processing and polyadenylation, splicing, Editing, Nuclear export of RNA. (12 Hours)

UNIT III

Translation: Prokaryotic and eukaryotic translation, the translation machinery, Mechanisms of initiation, elongation and termination, co-and post-translational modifications of proteins. Import into nucleus, mitochondria and chloroplast. Receptor mediated endocytosis. (12 Hours)

UNIT IV

Mutations & Gene mutations: Missense, nonsense and frame shift mutations. Lethal Mutations, Biochemical Mutations, Phenotypic effects of Mutation, Molecular basis of Mutation. Site directed Mutagenesis. Mutagens: Physical and chemical mutagens. Repair: Mismatch repair, NER, BER, light induced repair, SOS repair. DNA Repair – light and dark mechanisms. (12 Hours)

UNIT V

Gene Regulation mechanism: General aspects of Regulation, The lactose system and the operon model, The Galactose operon, The Arabinose operon, The Tryptophan operon, Relative positions of Promoters and Operators, Feedback Inhibition. (12 Hours)

REFERENCE BOOKS

1. Freifelder, D. (2008), *Molecular Biology*, 2nd Edition. Jones &Barlett Publishers International.
2. Alberts, B. Johnson, A. Lewis, J. Rah, M. Roberts, K. Walter, P. (2002), *Molecular Biology of the cell*,4th Edition. Garland Science publisher.
3. Watson, J.D. Basker, T.A. Bell, S.P. Gann, A. Levine, M. Losick, R. (2009), *Molecular Biology of the gene*, 5th edition.Benjamin Cummings publisher.
4. Primrose., S. B., and Twyman.,R.M., (2006)., *Principles of gene manipulation and genetics* , 7th edition. Blackwell publisher.

Course Code 20UBOC21	PO1		PO2	PO3		PO4		PO5	PO6	PO7
	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
CO1	H	-	H	H	-	-	H	-	-	-
CO2	H	L	H	H	L	-	H	L	-	-
CO3	H	-	H	H	M	M	-	-	-	
CO4	H	-	H	H	L	H	L	M	-	-
CO5	H	-	H	M	M	H	H	H	-	-

Dr.V.Jeyasimga
Head of the Department

Mrs.Sinthia Ganesan
Course Designer

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B.Sc. BIOTECHNOLOGY
(2022 -23onwards)

Semester II	**MOLECULAR BIOLOGY**	Hours/Week: 4	
Core Course-3		Credits: 4	
Course Code **20UBOC21N**		Internal 25	External 75

COURSE OUTCOMES

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

CO1: recall the basic concepts in Molecular biology. [K1]

CO2: outline the process of DNA replication, transcription, translation, mutation and gene regulation. [K2]

CO3: explain the mechanism of DNA replication, transcription, translation, mutation and gene regulation. [K2]

CO4: apply the concepts of central dogma of life, gene mutations and regulation.[K3]

CO5: analyze the various steps involved in DNA replication, transcription, translation, mutation and gene regulation and molecular level import export functioning of the cell. [K4]

UNIT I

Central dogma of molecular Biology: History and scope of Molecular Biology, DNA as genetic material, Prokaryotic and eukaryotic genome organization. DNA Replication and its types. Prokaryotic and Eukaryotic DNA replication, Mechanism of DNA replication, Enzymes and accessory proteins involved in DNA replication (12 Hours)

UNIT II

Transcription: Prokaryotic Transcription, Eukaryotic Transcription, RNA polymerase. Promoters (Pribnow Box, TATA Box), post-transcriptional modifications in RNA. Gene silencing, 5' cap formation, 3'-end processing and polyadenylation, splicing, Editing, Nuclear export of mRNA. (12 Hours)

UNIT III

Translation: Genetic code, Prokaryotic translation - Polysomes, coupled transcription-translation and eukaryotic translation, the translation machinery, Mechanisms of initiation,

elongation and termination, co-and post-translational modifications of proteins. Import into nucleus, mitochondria and chloroplast. Receptor mediated endocytosis. (12 Hours)

UNIT IV

Gene Regulation mechanism: General aspects of Regulation, The lac operon model, The Galactose operon, The Arabinose operon, The Tryptophan operon, Relative positions of Promoters and Operators, Feedback Inhibition. Gene Regulation in eukaryotes-Britten-Davidson Model- Homeobox in Gene Regulation. (12 Hours)

UNIT V

Mutations &DNA repair: Substitution, Insertion and Deletion, Missense, nonsense and frame shift mutations. Lethal Mutations, Biochemical Mutations, Phenotypic effects of Mutation, Molecular basis of Mutation. Site directed Mutagenesis. Mutagens: Physical and chemical mutagens. Repair: Mismatch repair, NER, BER, light induced repair, SOS repair. DNA Repair – light and dark mechanisms. (12 Hours)

Text Books

1. Freifelder, D. (2015) , Essentials of Molecular Biology, 4th Ed, Jones &Barlett Publishers.

REFERENCE BOOKS

1. Alberts, B. Johnson, A. Lewis, J. Rah, M. Roberts, K. Walter, P. (2002), *Molecular Biology of the cell,*4th Edition. Garland Science publisher.
2. Watson, J.D. Basker, T.A. Bell, S.P. Gann, A. Levine, M. Losick, R. (2009), *Molecular Biology of the gene*, 5th edition. Benjamin Cummings publisher.
3. Primrose., S. B., and Twyman.,R.M., (2006)., *Principles of gene manipulation and genetics* , 7th edition. Blackwell publisher.
4. Rastogi., V. B., (2010)., *Fundamentals of Molecular Biology* , 2nd edition. Ane Books Pvt. Ltd.
5. Vyas, S.P. Mehta, A. (2014)., *Cell and Molecular Biology* , 2nd edition. CBS Publishers & Distribution Pvt. Ltd

6.Veerbala Rastogi. Principles of molecular biology. Medtech Publishers, 2016.

E-Resources

https://youtu.be/rEed9iU0WtM

Course Code 20UBOC21N	PO1		PO2	PO3		PO4		PO5	PO6	PO7
	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
CO1	H	-	H	H	-	-	H	-	-	-
CO2	H	L	H	H	L	-	H	L	-	-
CO3	H	-	H	H	M	M	-	-	-	
CO4	H	-	H	H	L	H	L	M	-	-
CO5	H	-	H	M	M	H	H	H	-	-

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VIRUDHUNAGAR - 626 001

B.Sc. BIOTECHNOLOGY
(2020 -21 onwards)

Semester II	**FOOD BIOTECHNOLOGY**	Hours/Week: 4	
Core Course-4		Credits: 4	
Course Code **20UBOC22**		Internal 25	External 75

COURSE OUTCOMES

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

CO1: recall the composition, preservation, processing, and packaging of food products and IPR. [K1]

CO2: explain the basic principles in food industry and the role of biotechnology in various stages of food product development **[**K2]

CO3: summarize the food ingredients, methods of preservation, processing, packaging and labeling of foods. [K2]

CO4: apply the knowledge of food chemistry, food preservation, food processing and food packaging for exploiting agricultural commodities effectively. [K3]

CO5: examine the methods of food preservation, processing, food industry operation and appraise the IPR, ethical issues in the development of GM foods. [K4]

UNIT I

Food chemistry: Constituents of food – Carbohydrates, Lipids, Proteins, Water, Vitamins and Minerals. Food additives- intentional and non intentional additives, preservatives, colors, flavouring agents, antioxidants. biogums, fat substitutes, biocolors, organic acids and sweeteners.

(12 Hours)

UNIT II

Food spoilage and preservation: Food spoilage-Principles and methods of food preservation. Asepsis- High temperature, Low temperature, drying-dehydration, driers, Irradiation, Functional role of Biotechnology in food processing and preservation. (12 Hours)

UNIT III

Food Processing: Raw material characteristics; cleaning, sorting and grading of foods; physical conversion operations - mixing, emulsification, extraction, filtration, centrifugation, membrane separation, crystallization, heat processing. Storage: frozen storage (12 Hours)

UNIT IV

Food Products: Food and beverage yeast: Bread, Alcoholic beverages-wine, dairy products – cheese, Meat, poultry and fish products. Vegetable and fruit products- Sauerkraut, jam,jellies, Probiotics and prebiotics. Scope of food biotechnology- GM Foods-Their contribution to food production enhancement. (12 Hours)

UNIT V

Food Packaging, labeling & bioethics Packaging- functions , classifications, materials used, edible food wraps, labelling- guiding principles.- labelling genetically modified foods. Food Biotechnology and Intellectual property rights (IPR), benefits of securing IPRs, bioethics in food biotechnology. (12 Hours)

TEXT BOOKS

1. Ravishankar Rai V. (2016). *Advances in Food Biotechnology*, Wiley- Blackwell
2. Kalidasshetty. (2005). *Food Biotechnology*, Taylor & Francis group.
3. B.H. Lee, 'Fundamentals of Food Biotechnology', VCH Publishers, New York, U.S.A.
4. M.P. Tombs, 'Biotechnology in Food Industry', Wiley-Blackwell, U. K.
5. Srilakshmi. B.(2018)., *Food science*, New age international publishers.

REFERENCE BOOKS

1.Frazier., C. and Dennis C. Westhoff. (2013). *Food microbiology*, McGraw-Hill publisher.

Course Code 20UBOC22	PO1		PO2	PO3		PO4		PO5	PO6	PO7
	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
CO1	H	M	H	H	H	L	L	-	-	L
CO2	H	M	H	H	H	L	L	-	L	-
CO3	H	L	H	H	H	L	L	-	L	H
CO4	H	M	H	H	H	L	H	-	L	-
CO5	H	M	H	H	H	L	H	-	M	H

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B.Sc. BIOTECHNOLOGY

(2022 -23 onwards)

Semester II	**PLANT AND ANIMAL DIVERSITY**	Hours/Week: 4	
Core Course-4		Credits: 4	
Course Code **22UBOC22**		Internal 25	External 75

COURSE OUTCOMES

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

CO1: recall the classification and diversity of plant and animal kingdom. [K1]

CO2: explain the economic importance and the characteristic features of various groups of plants and animals **[**K2]

CO3: Explain the morphology and life cycle of plants and animals [K2]

CO4 : apply the knowledge of biodiversity to explore and conserve plants and animals. [K3]

CO5: Assess the classification and applications of plant and animal kingdom [K4]

UNIT I

Algae, Fungi, Bryophytes

General characters and classification (up to class level) and economic importance of Algae, Fungi and Bryophytes, Type study (development of sex organs need not be discussed) Algae– *Sargassum*, *Fungi* - Yeast, Bryophytes - *Marchantia*. (12 Hours)

UNIT II

Pteridophytes, Gymnosperms,

General Characters, Classification, Morphology and economic importance of Pteridophytes and Gymnosperms Type study- Pteridophytes - *Selaginella;* Gymnosperms - *Pinus:*Classification: Artificial, Natural and Phylogenetic system of classification - Bentham and Hooker system of classification. Monocot flower-*Musa paradisiaca*, Dicot flower- *Tribulus terrestris*. Preparation of Herbarium and its importance, (12 hours)

UNIT III

Invertebrates

Classification of animal kingdom – general characteristics of invertebrates, Phylum Protozoa – general characteristics – life cycle of *Plasmodium vivax* , coral reefs formation and types, Phylum Coelenterata – general characteristics – polymorphism in coelenterates – general characteristics of Phylum Platyhelminthes –*Taenia solium*– general characteristics of Phylum Annelida –*Megascolex* , Arthropoda- *Periplanata americana* –general characteristics of Phylum Mollusca – *Pila globosa*, economic importance of invertebrates. (12 hours)

UNIT IV

Chordata-I

General characteristics of Chordates – classification – general characteristics of subphylum Hemichordata (Balanoglossus – tongue worm) – subphylum Urochordata and Cephalochordata and subphylum Vertebrata - general characteristics of Class Amphibia (parental care in Amphibians) – Class Pisces (types of scales) and Class Reptilia (poisonous and non-poisonous snakes) – classification up to orders –economically important forms. (12 hours)

Unit-V

Chordata-II

General characteristics – Class Aves – different modes of flight – flight adaptations – beak and feet modifications in birds – Pigeon, Class Mammalia General characters-Rabbit (kinds of teeth) – adaptive radiation in mammals (aquatic and terrestrial) – Classification of Aves and Mammalia up to order – economically important forms. (12 hours)

TEXTBOOKS

1. E.L.Jordan.*Invertebrate Zoology*. S.Chand Publication, New Delhi, 2010.

2. E.L.Jordan. *Chordate Zoology*.S.Chand Publication, New Delhi, 2010.

3. Susilkumar Mukherjee. *College Botany*. New central Book agency Publisher, 2012.

4. Annie Ragland and V. Kumaresan. *Botany for Degree students*. Saras publication, 2014.

REFERENCES

Books

1. Pandey S.B.*Botany for Degree students*. S Chand & company, New Delhi, 2010.

2. Smith G.M. *Cryptogamic botany*. Volume I and II, Tata McGraw Hill, India, 2009.

3. Subramanyam. *Modern plant Taxonomy*. Vikas Publishing House

4. Ekambaranatha Iyer, M. and Ananthakrishna, T.N. A Manual of zoology. Reprint S. Viswanathan publishers, Chennai, 2003., New Delhi, 2003.

Course Code **22UBOC22**	PO1		PO2	PO3		PO4		PO5	PO6	PO7
	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
CO1	H	H	H	-	L	L	-	L	-	-
CO2	H	H	M	-	-	L	-	L	-	-
CO3	H	M	M	-	L	-	-	L	L	-
CO4	H	H	M	L	L	L	L	L	L	-
CO5	H	L	M	L	M	L	-	L	L	-

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ALLIED COURSE I CHEMISTRY FOR BIOTECHNOLOGY
(2020 -21 onwards)

Semester II	**ALLIED COURSE I- ORGANIC, INORGANIC AND PHYSICAL CHEMISTRY – II**	Hours/Week: 4	
Allied Course -I		Credits: 4	
Course Code **20UCHA21**		Internal 25	External 75

COURSE OUTCOMES

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

CO1: know about the basic concepts in organic, inorganic and physical chemistry. [K1]

CO2: understand the chemical constituent in oils, fats, soaps, detergents, biomolecules, fuels, fertilizers and pollutants. [K2]

CO3: identify the methods of preparation for organic and inorganic compounds, sources, effects and control measures of pollutions, methods for removal of salt from water. [K2]

CO4: comprehend the classification of biomolecules, fuels, fertilizers, catalyst, pollutions, application of adsorption and biomolecule. [K3]

CO5: analyze the oils, fats and biomolecules functions, sources of pollutions, characteristics of catalysts and the effects with control measures for various pollution. [K4]

UNIT I

1. Oils and Fats – Definition – Properties - Distinction between them -Hydrogenation, Hydrogenolysis, Rancidification and Drying of oils – Preparation of Vanaspathi- Analysis of oils and Fats – Saponification and iodine number.

2. Soaps and Detergents

Soap – Definition – Different types – Manufacture of soap – Kettle process - Detergent – Definition – Synthetic detergents – examples – Distinction between soaps and detergents. **(**12 Hours)

UNIT II

1. Carbohydrates – classification – Differences between glucose and fructose – Inter conversion of glucose and fructose – Haworth structure of glucose and fructose- Differences between starch and cellulose – Derivatives of cellulose and their uses.
2. Amino acids – classification – preparation of α-amino acids– properties – Zwitterion – isoelectric point .
3. Proteins – classification – Biological function – colour reaction of proteins.
4. Nucleic acids – RNA and DNA – Biological functions (Elementary idea only).

(12 Hours)

UNIT III

1. Fuels – classification – Advantages of gaseous fuels – constituents and uses of water gas, producer gas, LPG, Gobar gas and natural gas.
2. Fertilizers – classification – Macro and micro nutrients – Functions of nutrients preparation and uses of urea, ammonium sulphate, superphosphate, triple superphosphate, potassium nitrate and NPK. (12 Hours)

UNIT IV

1. Air pollution – Definition – sources of air pollution –classification and effects of air pollutants – Ozone layer- formation and depletion – Green house effect – Acid rain – Preventive measures of air pollution.
2. Water pollution –types and sources of water pollution –classification and effects of water pollutants-control of water pollution-Desalination of sea water by electrodialysis and reverse osmosis.
3. Radioactive pollution – sources – nuclear waste disposal – Effects of radiations.

(12 Hours)

UNIT V

1. Adsorption – Characteristics – Types of adsorption and comparison – Factors influencing adsorption – Langmuir and Freundlich adsorption isotherm (No derivation) – Applications of adsorption.
2. Catalysts – Characteristics- Different types with examples – Catalytic poisoning – promoters with examples. (12 Hours)

TEXT BOOKS

1. Soni P.L.,(2008).*Text book of Organic Chemistry*, Latest Edition.Sultan Chand & Sons.

2. Soni P.L.,(2008).*Text book of Inorganic Chemistry*, Latest Edition. Sultan Chand & Sons.

3. Jayashree Ghosh,(2013). *Fundamental Concepts of Applied Chemistry*,S.Chand & Company Ltd.

4. Soni, P.L.(2008).*Text book of Physical chemistry*, Latest Edition,Sultan Chand & Sons.

REFERENCE BOOKS

1. Jain, M.K. & Sharma, S.C. (2016). *Modern Organic Chemistry*, 1st Edition.New Delhi: Vishal Publishing Co.

2. Sindhu P.S.,*Environmental Chemistry*.

3 Jain, P.C. & Monika Jain. (2013). *Engineering Chemistry.* 1st Edition.New Delhi: Dhanpat Rai Publishing Company Pvt.Ltd.

4. Puri, Sharma, Pathania, (2008). *Elements of Physical Chemistry*, 4th Edition. Jalandhar Delhi: Vishal Publishing & Co.

Course Code 20UCHA21	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	H	M	L	L	M	H
CO2	H	H	M	L	L	M	H
CO3	H	H	M	L	L	M	H
CO4	H	H	M	L	L	M	H
CO5	H	H	M	L	L	M	H

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ALLIED COURSE I CHEMISTRY FOR BIOTECHNOLOGY
(2020-2021 onwards)

Semester II	**VOLUMETRIC ANALYSIS**	Hours/Week: 2	
Allied Course I Practical		Credits: 2	
Course Code **20UCHA21P**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: apply the Principles involved in the Volumetric analysis. [K3]

CO2: find out the strength of standard solutions. [K3]

CO3: estimate the amount of the substance present in the given solution by volumetric analysis. [K3]

CO4: determine the concentration of the unknown solutions. [K4]

CO5: analyse and evaluate the accuracy of the results. [K4]

a. **Acidimetry and Alkalimetry:**

1. Titration between a strong acid and strong base
2. Titration between a strong acid and weak base.
3. Titration between a weak acid and strong base

b.Permanganimetry:

Titration between potassium permanganate and

i) oxalic acid ii) ferrous sulphate and iii) ferrous ammonium sulphate (Mohr's salt)

c.Iodometry:

Titration between sodium thiosulphate and i) potassium permanganate and ii) potassium dichromate.

Course Code 20UCHA21P	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	H	M	H	H	H	H
CO2	H	H	M	H	M	H	H
CO3	H	H	M	H	H	H	H
CO4	H	H	M	H	H	H	H
CO5	H	H	L	H	H	H	H

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B.Sc. BIOTECHNOLOGY
(2020 -21 onwards)

Semester II	**BIO INSTRUMENTATION**	Hours/Week: 2	
Skill Enhancement Course-1		Credits: 2	
Course Code **20UBOS21**		Internal 40	External 60

COURSE OUTCOME

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

CO1: define the basic principles and terminologies associated with colorimetry, chromatography, centrifugation, electrophoresis and tracer techniques. [K1]

CO2: describe the components of instruments and their maintenance. [K2]

CO3: explain the operation methods of instruments. [K2]

CO4: apply the knowledge of biotechniques to estimate and separate biomolecules following good laboratory practices. [K3]

CO5: compare the merits of bio instruments and their applications in laboratory. [K4]

UNIT I

Colorimetry and Spectroscopy - Beer-Lambert's Law. Visible light spectroscopy - spectrophotometer and colorimeter: Principle, instrumentation and applications. Fluorescence spectroscopy, Fourier Transmission Infra Red spectroscopy**.**

(6 Hours)

UNIT II

Separation & Identification of Materials - Concept of Chromatography. Principle and applications of Chromatographic techniques - Partition Chromatography, Paper Chromatography, Adsorption Chromatography, Thin Layer Chromatography, Ion Exchange Chromatography. (6 Hours)

UNIT III

Centrifugation - Basic principles; Types of centrifuge - microfuge, and high-speed and

ultracentrifuge; Preparative centrifugation, analytical centrifugation. Differential and density gradient centrifugation; applications. (6 Hours)

UNIT IV

Electrophoresis - Theory and applications of electrophoresis; agarose and polyacrylamide, Disc- and slab-gel electrophoresis; Gradient electrophoresis - Capillary electrophoresis; 2D Electrophoresis - Isoelectric focusing, pulse-field gel electrophoresis. (6 Hours)

UNIT V

Tracer techniques-Methods for detecting radioactivity- GM and Scintillation counters, Applications of radioisotopes, Autoradiography. Good laboratory practices, Care and maintenance of laboratory equipments, Laboratory safety symbols, Potential hazards of laboratory techniques. (6 Hours)

REFERENCE BOOKS

1. Sivasankar., B.(2010) "*Bioseparations*" First edition. New Delhi: PHI Learning Pvt Ltd.
2. Veerakumari. (2006). "*Bioinstrumentation"*, 1st Edition, MJP Publishers.
3. K.L Ghatak.(2001). "*Techniques and methods in Biology"* - First edition. New Delhi: PHI Learning Private Limited.
4. P. Palanivelu (2013) "*Analytical Biochemistry and Separation techniques*" – 4th edition. Twenty First Century Publication.

Course Code 20UBOS21	PO1		PO2	PO3		PO4		PO5	PO6	PO7
	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
CO1	H	H	H	-	L	L	-	L	-	-
CO2	H	H	M	-	-	L	-	L	-	M
CO3	H	M	M	-	L	-	-	L	L	-
CO4	H	H	M	L	L	L	L	L	L	M
CO5	H	L	M	L	M	L	-	L	L	M

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B.Sc. BIOTECHNOLOGY
(2022 -23onwards)

Semester II	**BIO INSTRUMENTATION**	Hours/Week: 2	
Skill Enhancement Course-1		Credits: 2	
Course Code **20UBOS21N**		Internal 40	External 60

COURSE OUTCOME

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

CO1: define the basic principles and terminologies associated with colorimetry, chromatography, centrifugation, electrophoresis and tracer techniques. [K1]

CO2: describe the components of instruments and their maintenance. [K2]

CO3: explain the operation methods of instruments. [K2]

CO4: apply the knowledge of biotechniques to estimate and separate biomolecules following good laboratory practices. [K3]

CO5: compare the merits of bio instruments and their applications in the laboratory. [K4]

UNIT I

pH Meter, Colorimetry and Spectroscopy - Beer-Lambert's Law. Colorimeter, spectrophotometer ,Visible light spectroscopy - Principle, instrumentation and applications. Atomic Absorption Spectroscopy, Fourier Transmission Infrared spectroscopy**.** (6 Hours)

UNIT II

Centrifugation - Basic principles; Types of centrifuge , types of rotors - microfuge, and high-speed and ultracentrifuge; Preparative centrifugation, analytical centrifugation. Differential and density gradient centrifugation; isopycnic centrifugation applications. (6 Hours)

UNIT III

Chromatography - Concept of Chromatography Principle and applications of Chromatographic techniques - Paper Chromatography, , Thin Layer Chromatography, Affinity Chromatography Ion Exchange Chromatography HPLC and Gas chromatography and Gel filtration Chromatography (6 Hours)

UNIT IV

Electrophoresis - Theory and applications of electrophoresis; agarose and polyacrylamide, Disc- and slab-gel electrophoresis; Gradient electrophoresis - Capillary electrophoresis; 2D Electrophoresis - Isoelectric focusing, pulse-field gel electrophoresis.

(6 Hours)

UNIT V

Tracer techniques-Radio active substances – Radio activity, Methods for detecting radioactivity- GM and Scintillation counters, Applications of radioisotopes, Autoradiography – application, safety, Good laboratory practices, personal protection equipments, Care and maintenance of laboratory equipments, Laboratory safety symbols, Potential hazards of laboratory techniques. (6 Hours)

REFERENCE BOOKS

1. Sivasankar., B.(2010) "*Bioseparations*" First edition. New Delhi: PHI Learning Pvt Ltd.
2. Veerakumari. (2006). "*Bioinstrumentation"*, 1st Edition, MJP Publishers.
3. K.L Ghatak.(2001). "*Techniques and methods in Biology"* - First edition. New Delhi: PHI Learning Private Limited.
4. P. Palanivelu (2013) "*Analytical Biochemistry and Separation techniques*" – 4th edition. Twenty First Century Publication.

E-Resources

https://www.digimat.in/nptel/courses/video/102107028/L12.html

Course Code 20UBOS21N	PO1		PO2	PO3		PO4		PO5	PO6	PO7
	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
CO1	H	H	H	-	L	L	-	L	-	-
CO2	H	H	M	-	-	L	-	L	-	M
CO3	H	M	M	-	L	-	-	L	L	-
CO4	H	H	M	L	L	L	L	L	L	M
CO5	H	L	M	L	M	L	-	L	L	M

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B.Sc. BIOTECHNOLOGY
(2020 -21 onwards)

Semester I&II	**Lab in Biochemistry, Genetics, Molecular Biology and Food Biotechnology**	Hours/Week: 2	
Core Practical-I		Credits: 2	
Course Code **20UBOC21P**		Internal 40	External 60

COURSE OUTCOME

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

CO1: apply the basic concepts learnt in theory for the estimation of biomolecules and to solve simple problems in Genetics. [K3]

CO2: identify and explain the salient features of the given spotters. [K3]

CO3: make use of formula, tables and graphs for the estimation of biomolecules. [K3]

CO4: infer the result and complete the record work. [K3]

CO5: analyse the problems and situations in the related subject area. [K4]

1. Verification of Beer lambert's law.
2. pH meter and preparation of buffers – Acetate buffer, Phosphate buffer.
3. Preparation of standard graph and estimation of Proteins – Lowry's method.
4. Preparation of standard graph and estimation of glucose -Dinitrosalicyclic acid.
5. Estimation of amino acids
6. Estimation of fatty acids – titrimetric.
7. Estimation of Ascorbic acid – dye method.
8. Qualitative tests for Carbohydrates, Proteins and lipids.
9. Mendel's law of genetics - . Mono and Dihybrid crosses Simple problems.
10. Observation of Genetic model organisms (*Arabidopsis thaliana* and *Coenorrabditis elegans)* - Permanent slides
11. Identification of Barr body (Buccal epithelium smear).
12. Polyacrylamide gel electrophoresis (SDS-PAGE) –Demonstration.
13. Paper chromatography and thin layer chromatography.
14. Gel filtration chromatography of proteins – Demonstration.

15. Visit to any food processing industry.

REFERENCE BOOKS

1. Douglas A skoog, F.James Holler, Timothy A.Nieman, (1997). *Principles of Instrumental Analysis* 5th edition. Brooks ColePublishers.
2. J Jayaraman (1988). *Laboratory Manual of Biochemistry*, Wiley EasternPublishers.
3. Keith Wilson,John Walker,(2000). *Principles and Techniques of Practical Biochemistry*, 5th edition, Cambridge University Press.

Course Code 20UBOC21P	PO1		P02	PO3		PO4		PO5	PO6	PO7
	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
CO1	H	H	H	L	L	L	L	L	-	-
CO2	H	H	H	L	L	H	M	-	-	-
CO3	H	H	H	M	H	H	M	-	M	L
CO4	M	H	H	H	H	H	M	L	M	L
CO5	M	H	H	H	H	H	M	L	M	L

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B.Sc. BIOTECHNOLOGY
(2020 -21 onwards)

Semester III	**MICROBIOLOGY**	Hours/Week: 5	
Core Course-6		Credits: 5	
Course Code **20UBOC31**		Internal 25	External 75

COURSE OUTCOMES

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

CO1: recall the fundamental concepts in microbiology. [K1]

CO2: describe the history of microbiology, microscopy, classification, cultivation, lifecycle, growth and nutritional requirements of microorganisms. [K2]

CO3: explain the contributions of microbiologists, working of Microscopy, identification of the microbes, sterilization techniques, lifecycle and interaction of microorganisms. [K3]

CO4: analyze the history, ultrastructure of microbes, cultivation, life cycle, function and clinically important microbes. [K4]

CO5: determine the interaction and relationship of microbes, host and the factors affecting growth of microorganisms. [K5]

UNIT I

History of Microbiology – Scope and applications of Microbiology, Biogenesis and abiogenesis. Contributions of Redi, Spallanzani, Needham, Pasteur, Tyndal, Joseph Lister, Koch, Edward Jenner and Flemming. Microbial evolution. (15 Hours)

UNIT II

History and Development of Microscopy: Numerical aperture and its importance, resolving power, principles and applications of dark field, phase contrast, fluorescent microscopy. Electron microscopy (TEM) - Principle, diagram and applications. **Concept of Sterilization** – Definition, Types of sterilization. (15 Hours)

UNIT III

Classification of Microorganisms- Whittaker's five kingdom classification. Classification of bacteria (based on size), virus (based on genetic material), algae (based on colour), protozoans (based on locomotion) and fungi. Ultrastructure of microbes- Bacteria, fungi, algae, protozoa and viruses. Prokaryotic cells: Ultra Structure and function, Cell walls, Cell membranes, Flagella, Pili, Capsules. Gram positive bacteria –*Bacillus,* Gram negative bacteria – *E.coli.* (15 Hours)

UNIT IV

Cultivation and Identification of Microorganisms - Media and its types. Culture techniques –Pure culture, anaerobic culture - preservation of cultures. Bacterial nutrition, Nutritional types of Bacteria, factors influencing bacterial growth. Typical growth curve, Measurement of bacterial growth- measurement of cell number and cell mass. Staining - Mechanism of gram staining, acid fast staining, capsule staining, flagella staining, endospore staining. (15 Hours)

UNIT V

Lifecycle and Interaction of Microorganisms - Life cycle of fungi - *Rhizopus.* Structural properties and life cycles (in brief) of Plant viruses (Tobacco Mosaic Virus), Animal viruses (Adenovirus), bacterial virus (T4 phage). Plant - microbe interaction-symbiosis (mycorrhizae), clinically important microorganisms. (15 Hours)

TEXT BOOKS

1. Prescott, Harley & Klein. (2006). *Microbiology*, 6th Edition. New York: McGraw. Hill CO.
2. Pelczar, M. Chan J E.C.S. &Kreig, N.R. (1993). *Microbiology*, Europe: Tata Mac.Graw Hill.
3. Ananthanarayan, R &Paniker, C.K.J (2005). *A Textbook of Microbiology*, 7th Edition. Hyderabad, India: Orient Longman Ltd.
4. Parija S.C, (2009). *Textbook of Microbiology & Immunology,* India: Elsevier.

REFERENCES

1. Schlegel, H.G. (1993). *General Microbiology*, 7th Edition. New York: Cambridge University Press.
2. Nester, E. W. Roberts, C. V. & Nester, M.T. (1995). *Microbiology,* USA: *A Human perspective*, IOWA.

Course Code 20UBOC31	PO1		PO2	PO3		PO4		PO5	PO6	PO7
	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
CO1	H	-	H	-	L	M	-	-	-	-
CO2	H	M	H	H	M	-	L	-	-	L
CO3	H	H	H	M	H	H	L	M	-	-
CO4	H	M	H	L	L	H	-	M	-	L
CO5	H	L	H	H	L	-	H	M	-	L

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V.V.VANNIAPERUMAL COLLEGE FOR WOMEN
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VIRUDHUNAGAR - 626 001

B.Sc. BIOTECHNOLOGY
(2020 -21 onwards)

Semester III	**BIOFERTILIZER TECHNOLOGY**	Hours/Week: 2	
Skill Enhancement Course-II		Credits: 2	
Course Code **20UBOS31**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: recall the bio fertilizer types, organic manures, marketing and storage. [K1]

CO2: explain the various microbial sources of fertilizers, their cultivation, and utilization in organic farming practices. [K2]

CO3: employ the knowledge of current understanding of biofertilisers, nitrogen fixation at gene level and mass production of bio fertilizers. [K3]

CO4: illustrate the identification, mass production and application of biofertilisers for various crops. [K3]

CO5: analyse the problems related to organic cultivation, biofertilizers usage and give suggestions. [K4]

UNIT I

Introduction- Difference between chemical and biofertilizers. Advantages of biofertilizers. Biofertilizer and its types, Bacterial, algal and fungal Biofertilizers, mass cultivation and field application of *Rhizobia. Azotobacter.* (6 Hours)

UNIT II

Nitrogen Fixation –Symbiotic and nonsymbiotic, Mechanism of N_2 fixation with reference to *Rhizobia* and *Azotobacter*, Nif genes, Nodulation by *Rhizobium.* (6 Hours)

UNIT III

Algal and fungal biofertilizers - Blue green algae- *Nostoc,Anabaena,* mass cultivation of BGA - Algalization, Seaweed liquid fertilizer, fungal biofertilisers - VAM fungi-uses and mass cultivation. (6 Hours)

UNIT IV

Organic Farming - Advantages of organic farming, , Raw materials for composting, Composting, Recycling of wastes through vermicomposting. Vermi composting- Pit method, Heap method, Windrow method, Bin or tray method. (6 Hours)

UNIT V

Organic Manures: Green manures, Vermi wash preparation and applications. Pancha kavya-production and uses. Biofertilizer-storage, shelf life, Quality control and marketing. (6 Hours)

TEXT BOOKS

1. Subba Rao, N.S, (1982). *Biofertilizers in Agriculture*, New Delhi, Oxford and IBH Publication.
2. Subbarao, N.S, (2007). *Soil Microbiology*, New Delhi, Oxford and IBH Publishing co.

REFERENCE BOOKS

1. Dubey, R.C &D.K.Maheshwari, (2000). *A Textbook of Microbiology*, New Delhi: S.Chand Publication.
2. Dubey, R.C, (2006). *A Textbook of Biotechnology*, New Delhi: S.Chand Publication.
3. Kumaresan, V. (2009). *Biotechnology*, Kanyakumari: Saras Publication.

Course Code 20UBOS31	PO1		PO2	PO3		PO4		PO5	PO6	PO7
	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
CO1	H	L	H	M	M	L	-	M	L	-
CO2	H	L	H	M	L	L	-	M	L	-
CO3	H	M	H	M	M	M	L	M	L	-
CO4	H	M	H	M	M	M	L	M	-	-
CO5	H	M	H	H	H	H	L	-	L	M

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VIRUDHUNAGAR - 626 001

ALLIED BIOLOGY FOR BIOCHEMISTRY, MICROBIOLOGY AND BIOTECHNOLOGY
(2020 -2021 onwards)

Semester III	**CELL BIOLOGY**	Hours/Week: 4	
Allied Course		Credits: 4	
Course Code **20UBIA31**		Internal 25	External 75

COURSE OUTCOMES

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

CO1 : state the basic cytological techniques. [K1]

CO2 : explain the origin, structure and chemistry of each organelles. [K2]

CO3 : interpret the functions of cell organelles. [K2]

CO4 : identify the importance of cell as a basic unit of life. [K3]

CO5 : distinguish the harmful viruses, cancer cells and living with hygienic Environment. [K4]

UNIT I

Basic techniques for cytological studies - Microscopy - Light and Electron microscope (brief account only). Sub cellular fractionations - Ultra centrifugation, Differential and Density gradient centrifugation. Cell count Method – Haemocytometer. Histochemical staining: Proteins - Mercuric Bromophenol blue method. Lipids and lipoproteins - Sudan black B method. (12 Hours)

UNIT II

Cell Structure - Prokaryotic and Eukaryotic (brief account only). Plasma membrane - Ultra structure of Fluid mosaic model, chemistry and functions (brief account only). Protoplasm – Physical and Biological properties.

(12 Hours)

UNIT III

Membrane systems in Eukaryotes - Endoplasmic Reticulum, Golgi complex and Ribosomes – Origin, structure and functions.

(12 Hours)

UNIT IV

Cell Organelles in Eukaryotes – Nucleus, Mitochondria, Chloroplast and Chromosomes - Origin, structure and functions.

(12 Hours)

UNIT V

Cell cycle – Cell Division – Mitosis and Meiosis – Stages and significance, Cell growth – Oncogens, Comparative aspects of Normal and Cancerous cell.

(12 Hours)

TEXT BOOKS

1. Verma, P.S. & Agarwal, V.K. (2006). *Cell Biology,* New Delhi: S. Chand & Company Ltd.,
2. Mariyakuttikan, G. (1992). *Cell Biology,* JAC Publication.

REFERENCE BOOKS

1. De Robertis, P, Nowinski, E.D and Saez, A, (2001 reprint), *Cell Biology,* WB Saunders Co, Philadelphia.
2. Debnath, M. (2008). *Molecular cell Biology,* Jaipur: Vol 2.Pointers Publishers.
3. Dalela, R.C, (1984). *Cytology,* Jai Prakash Nath & Co.
4. Rastogi, S.C. (1990). *Cell Biology,* New Delhi: Tata Mc Graw Hill Publishing Company Ltd.,

Course Code 20UBIA31	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	M	M	M	L	L	-
CO2	H	M	M	M	L	L	-
CO3	H	M	M	M	L	L	-
CO4	H	M	M	M	L	L	-
CO5	H	M	M	M	L	L	-

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B.Sc. BIOTECHNOLOGY
(2020 -21 onwards)

Semester IV	**RECOMBINANT DNA TECHNOLOGY**	Hours/Week: 5	
Core Course-8		Credits: 5	
Course Code **20UBOC41**		Internal 25	External 75

COURSE OUTCOMES

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

CO1: define the main principles, methods for preparation and cloning of DNA in various organisms. [K1]

CO2: outline the tools and methods of gene transfer involved in r-DNA technology and recombinant products. [K2]

CO3: illustrate the types of vectors, restriction enzymes and the transfer of DNA into the host cell. [K3]

CO4: analyze the vectors, Restriction enzymes, gene transfer methods and the recombinant products.[(K4]

CO5: evaluate the suitability of vectors, restriction endonucleases, methods of gene transfer for the production of recombinant products. [K5]

UNIT I

Gene recombination and Gene transfer: Genetic exchange in bacteria – transformation, transduction (generalized and specialized) Co transduction and conjugation – chromosome transfer by Hfr strains – arriving at *E.Coli* genetic map (15 Hours)

UNIT II

DNA modifying enzymes: Types and uses in molecular biology; Restriction enzymes, DNA polymerases-DNA ligase, Reverse transcriptase, Terminal transferase, T_4 polynucleotide kinases & Alkaline phosphatase, DNA dependent RNA polymerases. Taq DNA polymerases. (15 Hours)

UNIT III

Cloning vectors and their applications: Plasmids-high and low copy number of plasmids. Cosmids- Ti plasmid, Phagemids – M13 phages, expression vectors, artificial chromosomes – YAC, BAC. Expression vectors for prokaryotes & Eukaryotes.

DNA cloning - Sticky end and blunt end Ligation, adaptors and linkers, construction and application of genomic and c-DNA libraries. PCR based cloning approaches. (15 Hours)

UNIT IV

rDNA Transfer methods: Bacteria, plant and animal – physical methods – electroporation, microinjection, particle gun bombardment, Biological method of gene transfer – retro viral vectors, chemical method - lipofection. Screening of recombinants-α complementation, blue white selection. Analysis of recombinants: Principles of hybridization. Northern blotting, Southern blotting, Western blotting. (15 Hours)

UNIT V

Biotechnological applications of rDNA technology: Synthesis and purification of proteins from cloned genes- Native and fusion protein. Production of enzymes. Therapeutic products for use in human health care- insulin, alpha interferon, Hepatitis B vaccine, corona virus vaccine. (15 Hours)

TEXT BOOKS

1. S. B. Primrose and R. M. Twyman, (2006) P*rinciples of gene manipulation and genomics*, Victoria, Australia:Blackwell Scientific Publications.
2. U. Sathyanarayana, (2005) *Text book of Biotechnology*, Kolkata: Books and Allied Publishers.

REFERENCE BOOKS

1. Julia Lodge, Pete Lund and Steve Minchin & Taylor and Francis, (2007). UK: *Gene cloning*.
2. Desmond S.T. Nicholl, (2004). *An introduction to genetic Engineering*, New York: Cambridge University Press.
3. T.A. Brown (2006). *Gene cloning and DNA Analysis* a*n introduction*, US: Blackwell scientific Publications.
4. Michal Janitz, (2008). *Next- generation Genome sequencing,* US: Wiley-Blackwell Publications.
5. J.D. Watson, M. Gilman, J. Witowski& Mark Zoller, (1992). *Recombinant DNA*, Newyork: Scientific American Books.
6. Winnacker, E.L. (1987). *From Genes to clones: Introduction to gene technology*, New York, USA: federal Republic of Germany.

Course Code 20UBOC41	PO1		PO2	PO3		PO4		PO5	PO6	PO7
	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
CO1	H	-	H	-	L	M	M	L	-	-
CO2	H	-	H	H	M	M	M	-	-	-
CO3	H	L	H	H	M	M	M	L	-	-
CO4	H	L	H	H	M	M	L	L	-	-
CO5	H	L	M	H	M	L	L	L	-	L

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B.Sc. BIOTECHNOLOGY
(2022 -23 onwards)

Semester IV	**RECOMBINANT DNA TECHNOLOGY**	Hours/Week: 5	
Core Course-8		Credits: 5	
Course Code **20UBOC41N**		Internal 25	External 75

COURSE OUTCOMES

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

CO1: define the main principles, methods for preparation and cloning of DNA in various organisms. [K1]

CO2: outline the tools and methods of gene transfer involved in r-DNA technology and recombinant products. [K2]

CO3: illustrate the types of vectors, restriction enzymes and the transfer of DNA into the host cell. [K3]

CO4: analyze the vectors, Restriction enzymes, gene transfer methods and the recombinant products.[(K4]

CO5: evaluate the suitability of vectors, restriction endonucleases, methods of gene transfer for the production of recombinant products. [K5]

UNIT I

Basics of Gene transfer: Insertion of Foreign DNA into Host Cells: Transformation, Transduction, Conjugation principle, Hfr strains - types, mapping and types, (15 Hours)

UNIT II

Tools of r-DNA Technology: Restriction enzymes, Types and uses in molecular biology DNA polymerases-DNA ligase, Reverse transcriptase, Terminal transferase, T_4 polynucleotide kinases & Alkaline phosphatase, DNA dependent RNA polymerases. Taq DNA polymerases, preparation and purification of DNA from living cells. (15 Hours)

UNIT III

Cloning vectors and their applications: Plasmids-Properties, high and low copy number of plasmids. Cosmids- Ti plasmid, Phagemids – M13 phages, expression vectors, artificial chromosomes – YAC, BAC. Expression vectors for prokaryotes & Eukaryotes. CaMV, DNA cloning - Sticky end and blunt end Ligation, adaptors and linkers, construction and application of genomic and c-DNA

libraries. PCR in gene recombination, deletion, addition, overlap extension (15 Hours)

UNIT IV

Gene Transfer methods: Bacteria, plant and animal – physical methods – electroporation, microinjection, particle gun bombardment, Biological method of gene transfer – retro viral vectors, chemical method - lipofection. Calcium phosphate mediated transfer, Screening of recombinants-α complementation, direct selection, Immunological methods, blue white selection. Analysis of recombinants: Principles of hybridization. Northern blotting, Southern blotting, Western blotting.

(15 Hours)

U**NIT V**

Biotechnological applications of rDNA technology: Synthesis and purification of proteins from cloned genes- Native and fusion protein. Gene therapy- Delivery techniques – *Ex vivo & In vivo,*Therapeutic products for use in human health care- insulin, alpha interferon, Hepatitis B vaccine, Corona virus vaccine, recombinant DNA debate and bioethics. (15 Hours)

TEXT BOOKS

1. S. B. Primrose and R. M. Twyman, (2006) P*rinciples of gene manipulation and genomics*, Victoria, Australia:Blackwell Scientific Publications.
2. U. Sathyanarayana, (2005) *Text book of Biotechnology*, Kolkata: Books and Allied Publishers.

REFERENCE BOOKS

1. Julia Lodge, Pete Lund and Steve Minchin & Taylor and Francis, (2007). UK: *Gene cloning*.
2. Desmond S.T. Nicholl, (2004). *An introduction to genetic Engineering*, New York: Cambridge University Press.
3. T.A. Brown (2006). *Gene cloning and DNA Analysis* a*n introduction*, US: Blackwell scientific Publications.
4. Michal Janitz, (2008). *Next- generation Genome sequencing,* US: Wiley-Blackwell Publications.
5. J.D. Watson, M. Gilman, J. Witowski& Mark Zoller, (1992). *Recombinant DNA*, Newyork: Scientific American Books.
6. Winnacker, E.L. (1987). *From Genes to clones: Introduction to gene technology*, New York, USA: federal Republic of Germany.

e-Resources

https://youtu.be/6ztkp2dqp_I

https://www.khanacademy.org/science/biology/biotech-dna-technology/dna-cloning-tutorial/v/dna-cloning-and-recombinant-dna

https://www.khanacademy.org/science/biology/biotech-dna-technology/dna-cloning-tutorial/a/restriction-enzymes-dna-ligase
https://www.khanacademy.org/science/biology/biotech-dna-technology/dna-cloning-tutorial/a/bacterial-transformation-selection

Course Code 20UBOC41N	PO1		PO2	PO3		PO4		PO5	PO6	PO7
	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
CO1	H	-	H	-	L	M	M	L	-	-
CO2	H	-	H	H	M	M	M	-	-	-
CO3	H	L	H	H	M	M	M	L	-	-
CO4	H	L	H	H	M	M	L	L	-	-
CO5	H	L	M	H	M	L	L	L	-	L

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ALLIED BIOLOGY FOR BIOCHEMISTRY, MICROBIOLOGY AND BIOTECHNOLOGY

(2020 -2021 onwards)

Semester IV	**APPLIED BIOLOGY**	Hours/Week: 4	
Allied Course		Credits: 4	
Course Code **20UBIA41**		Internal 25	External 75

COURSE OUTCOMES

On completion of the course, students will be able to

CO1 : find the applied areas of Biology. [K1]

CO2 : learnt skills related to laboratory as well as industries based work. [K2]

CO3 : explain the applications areas of Biology in various industries and how to become an entrepreneur. [K2]

CO4 : solve the issues related to the applied areas of Biology. [K3]

CO5 : analyze the applied potential areas/branches of Biology. [K4]

UNIT I

Mushroom cultivation

Introduction - morphology and reproduction of mushroom - nutritive and medicinal value of mushrooms, identification of edible and poisonous mushrooms, cultivation methods of oyster and button mushrooms. Contaminations in mushroom cultivation- fungi - green mould disease, bacteria – bacterial blotch disease and virus – die back disease. Mushroom recipes, Post harvesting technology. Economic importance of mushrooms. (13 Hours)

UNIT II

Vermiculture

Morphological features of earthworm, Cultivable species of earthworm (any five) and its significance. Vermicomposting methods (bin and windrow) and conditions required for vermicomposting. Vermicast and vermiwash, economic importance of earthworms. (11 Hours)

UNIT III

Apiculture

Life cycle of honeybee, Ecological services of honey bees. Bee hive - natural and artificial bee hive - Newton's bee hive. Rearing appliances. Enemies and diseases of honeybee

Nosemosis, Acariasis, American fowl brood. Chemical composition, nutritional and medicinal values of honey, honey harvesting and processing, economic importance of honeybees. (11 Hours)

UNIT IV

Sericulture

Type of Silkworms, Life cycle of *Bombyx mori*. Moriculture- mulberry cultivation. Rearing operations – disinfection, hatching, brushing, bed cleaning, feeding, mounting and harvesting. Rearing appliances. Diseases of silkworm – Bebrine and Muscardine. Economic importance of silkworm.

(13 Hours)

UNIT V

Horticulture

Introduction, tools of horticulture techniques, methods of vegetative propagation – cuttage – stem and leaf, layerage – simple, compound and air layering, graftage – whip and cleft. Indoor gardening - Hanging pots, Planning and layout of kitchen garden and orchards. (12 Hours)

TEXT BOOK

Kumaresan, V. (2009). *Biotechnology*, Nagercoil: Saras Publication.

REFERENCE BOOKS

1. Bahl, N. (2006). *Hand book on Mushrooms* (Ed-IV), New Delhi: Oxford and IBH Publishing Co Pvt Ltd,
2. Ravindranathan, K.R. (2003). *Economic Zoology*, New Delhi: Dominant Publishers and Distributors.
3. Sathe, T.V. (2006). *Fundamentals of Bee Keeping*, Delhi: Daya Publishing House
4. Ganga,G & Sulochana Chetty, J. (1998). *An Introduction to Sericulture (Ed-II),* New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.

Course Code 20UBIA41	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	M	L	L	L	L	-
CO2	H	M	M	M	L	L	-
CO3	H	M	M	M	L	L	-
CO4	M	M	M	M	L	L	-
CO5	M	M	M	M	M	L	-

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B.Sc. BIOTECHNOLOGY
(2020 -21 onwards)

Semester IV	**MUSHROOM CULTIVATION**	Hours/Week: 2	
Skill Enhancement Course-3		Credits: 2	
Course Code **20UBOS41**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: recall the identification, cultivation, economics and nutritional value of mushrooms. [K1]

CO2: describe the edible mushrooms, their production, profit and food value of mushrooms. [K2]

CO3: illustrate the cultivation methods, and the operation of mushroom industry and nutritional benefits of mushrooms. [K3]

CO4: investigate the edibility of mushrooms, mushroom cultivation system for various types of mushrooms and mushroom industry. [K3]

CO5: analyze the mushroom industry operation, cultivation methods, value added products and recipes from mushroom. [K4]

UNIT I

Introduction: History of edible mushrooms – Major genera of edible mushrooms – Structure and key for identification. Medicinal and poisonous mushrooms – identification and effects example: *Amanita. Milky*, Straw& Oyster mushroom - General morphology, distinguishing characteristics, spore germination and life cycle. (6 Hours)

UNIT II

Fundamentals of cultivation system- small village unit & larger commercial unit. Principles of mushroom farm layout- location of building plot, design of farm, bulk chamber,composting platform, equipments and facilities, pasteurization room & growing rooms. (6 Hours)

UNIT III

Cultivation of button & Oyster mushrooms – Mushroom mother stock culture, preparation of spawn. collection of raw materials, substrate preparation, spawning, Incubation, Cropping, insect and pest control, harvesting. (6Hours)

UNIT IV

Mushroom industry – Preservation and packaging of Mushroom. Economics of mushroom production and marketing, mushroom spent waste-uses **(**6Hours)

UNIT V

Nutritional value of mushroom: Medicinal value of mushrooms – *Ganoderma*-cosmetic value, antiviral value, antibacterial effect, antifungal effect, anti-tumour effect. Preparation of mushroom soup, biscuit, pulav, Mushroom gravy etc. (6Hours)

REFERENCE BOOKS

1. Aneja, K.R, (2008). *A Textbook of Basic and Applied Microbiology*,New Delhi: New Age International.
2. Pathak, V.N., N. Yadav & M. Gaur, (2010). *Mushroom Production and Processing Technology*. New Delhi:Vedams E-books Pvt Ltd.

Course Code 20UBOS41	PO1		PO2	PO3		PO4		PO5	PO6	PO7
	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
CO1	H	L	H	-	-	H	H	-	-	-
CO2	H	M	L	L	H	-	L	L	-	L
CO3	H	M	H	H	L	M	H	-	-	L
CO4	H	H	H	M	M	L	M	H	-	-
CO5	H	H	H	M	H	M	M	M	-	L

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B.Sc. BIOTECHNOLOGY
(2020 -21 onwards)

Semester IV	**LAB IN MICROBIOLOGY AND RECOMBINANT DNA TECHNOLOGY**	Hours/Week: 2	
Core Practical-II		Credits: 2	
Course Code **20UBOC41P**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: apply the basic concepts learnt in theory for the practicals related to isolation, characterization and cultivation of microbes. [K3]

CO2: identify the given spotters and explain. [K3]

CO3: experiment with the isolation of bacteria, bacterial staining methods, antibacterial activity of plant extracts and molecular techniques. [K3]

CO4: infer the results and complete the record work. [K3]

CO5: analyse the problems and situations in related subject area. [K4]

1. Microbiological techniques-media preparation-sterilization techniques,
2. Isolation of microbes - pure culture technique - streaking, spreading, pour plate.
3. Isolation of halophilic bacteria
4. Staining techniques - simple staining, gram stain, endospore staining
5. Motility test.
6. Biochemical tests (Catalase, acid and gas production, IMVIC, Oxidase test).
7. Evaluation of antibacterial activity of plant extracts.
8. Growth curve of bacteria.
9. Conjugation
10. Transformation: $CaCl_2$ mediated transformation.
11. Isolation of plasmid DNA
12. Isolation of RNA
13. Restriction digestion & ligation

REFERENCE BOOKS

1. Cappucino, Sherman, (2002). *Microbiology* – A laboratory manual, Addison Wesley.
2. Gunasekaran,P.(1996).*Lab Manual in Microbiology*, New Age International Publishers.
3. Kannan, N. (2002). *Lab Manual in Microbiology*, New Delhi: Panima Publishers.

Course Code 20UBOC41P	PO1		PO2	PO3		PO4		PO5	PO6	PO7
	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
CO1	H	H	H	M	M	-	L	L	M	L
CO2	M	H	H	M	L	-	L	L	H	L
CO3	M	H	H	M	L	M	L	L	H	L
CO4	L	H	H	M	L	M	L	L	H	-
CO5	M	H	H	M	L	M	L	L	H	M

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VIRUDHUNAGAR - 626 001

ALLIED BIOLOGY FOR BIOCHEMISTRY, MICROBIOLOGY AND BIOTECHNOLOGY

(2020 -2021 onwards)

Semester IV	**Allied Biology Practical – I**	Hours/Week: 2	
Allied Course	**Cell Biology and Applied Biology**	Credits: 2	
Course Code **20UBIA41P**		Internal 40	External 60

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: apply the basic concepts learnt in biology for the preparation of slides. [K3]

CO2: identify and dissect the biological specimens and to draw the anatomical features. [K3]

CO3: observe and comment on the biological specimens. [K3]

CO4: infer about the mitotic cell division stage and completion of the record work. [K3]

CO5: analyze and categorize the functions of cell organelles and in the related area. [K4]

Botany

1. Parts and functions of compound Microscope.
2. Spotters - Plasma membrane – Fluid mosaic model.
3. Study of cell organelles - Chloroplast, Mitochondria, Endoplasmic reticulum and Golgi complex.
4. Cell division - Mitosis and Meiosis Studies
5. Histochemical localization of proteins and lipids (Pea and Coconut).
6. Morphology and anatomy of edible mushroom (*Pleurotus* and *Agaricus*)
7. Demonstration of Horticulture techniques - Whip and cleft grafting

Zoology

1. Preparation of human blood smear and identification of blood cells. Mounting of buccal epithelium.
2. Spotters - Study of Cell organelles: Ribosomes, Lysosomes, Chromosomes- Giant chromosome and Nucleus.
3. Identification and differentiation among honeybees - Queen, Worker and Drone bee.
4. Newton's hive and other appliances (Queen Excluder, Honey extractor, Bee veil and Smoker)
5. Vermicompost – Demonstration only.

6. Various developmental stages of silkworm (Chart)

7. Identification of diseased silkworms – (Pebrine, Muscardine)

Course Code 20UBIA41P	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	M	H	M	L	M	L
CO2	H	M	H	M	L	M	L
CO3	H	M	H	M	L	M	L
CO4	H	M	H	M	L	M	L
CO5	H	M	H	M	L	M	L

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Dr.B. Karunai Selvi
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Dr. R. Radha Lakshmi,
Dr.R. Murugalakshmi Kumari,
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Semester IV	**Internship / Field Project (2020 -21 onwards)**	Hours/Week: 0
PART IV		Credit: 1
Course Code **20UBOI41G**		Internal 100

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 inter personal skills built through site visits. [K3]

CO4: exhibit the written communication skills acquired through internship/field project. [K3]

CO5: analyze the observations and results and communicate their academic and technological knowledge appropriately oral means. [K4]

GENERAL INSTRUCTIONS:

- **Internship:** A designated activity that carries one credit involving not less than 15 days of working in an organization under the guidance of an identified mentor
- **Field Project:** Students comprising of maximum 5 members in a team need to undertake a project that involves conducting surveys inside/outside the college premises and collection of data from designated communities or natural places.
- Internal Assessment only.

Course Code 20UBOI41G	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	M	M	M	M	H	-
CO2	H	M	M	M	M	H	
CO3	H	M	-	-	-	H	
CO4	H	H	M	M	-	M	H
CO5	H	M	H	H	M	-	

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B.Sc. BIOTECHNOLOGY

(2020 - 21 onwards)

Semester V	**ANIMAL BIOTECHNOLOGY**	**Hours/Week: 4**	
Core Course- 7		**Credits: 4**	
Course Code 20UBOC51		**Internal** 25	**External** 75

COURSE OUTCOMES

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

CO 1: recall the fundamentals of animal cell culture, cell lines and genetic engineering. [K1]

CO 2: Explain about the cell lines, stem cells, genetically modified animals and IPR. [K2]

CO 3: Describe the transgenic animals and its production techniques for various animals and their applications with ethical consideration. [K3]

CO 4: Analyse the cell culture methods, various applications of stem cells and transgenic animals in Biotechnology. [K4]

CO 5: Evaluate the need for bioethics in animal biotechnology and evaluate the patenting aspects of biotechnological products. [K5]

UNIT I:

Introduction to animal cell culture: History and scope of animal biotechnology– Animal cell culture: Fundamentals, facilities. Types of culture media, Cell culture initiation, Preparation and sterilization of media, Isolation and culture of explants, primary culture. (12 Hours)

UNIT II

Cell lines: Cell type selection, Cell lines: HeLa Cell lines, MCF 7 Cell lines. Maintenance of cell lines, large scale culture of cell lines, storage of cell lines, organ culture - methods and applications, Monoclonal Antibodies - production and applications. (12 Hours)

UNIT III

Genetic engineering in animals: Transgenesis-methods of transferring genes into animal oocytes, eggs, and embryos by physical, chemical and biological methods. Biopharming - Transgenic animals (Mice, Cows, Pigs, Sheep, Goat, fish). Artificial insemination, embryo transfer technology, invitro fertilization and cryopreservation. (12 Hours)

UNIT IV

Applications of transgenic animals: Gene therapy - types and applications. Animal Biotechnology for production of regulatory proteins, vaccines, hormones, and other therapeutic proteins. Gene-knockout mice. Animal viral vectors- SV40, adeno virus. (12Hours)

UNIT V

Stem Cells, Bioethics and IPR: Stem cells - Definitions, types, characteristics, and applications of stem cells. Need for bioethics, ethical implication of transgenic animals, monitoring the welfare of transgenic animals, keeping of transgenic animals, Patenting of biotechnological products. (12Hours)

REFERENCE BOOKS

1. Ramadass, (2008). Animal Biotechnology- Recent concepts and Developments, Chennai: MJP Publishers.
2. Ramadass, A.&Aruni.W. (2011). Animal Tissue culture, Chennai: MJP Publishers.
3. Singh,B.Gautam,S. K. Chauhan,M.S. &Singla,S. K. (2015). Text Book of Animal Biotechnology,NewDelhi: The Energy and Resources Institute (TERI).
4. Ian Freshney, R. (2016). Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications 7th edition, Wiley-Blackwell.
5. Satyanarayana. U, Biotechnology (2008). Kolkata: Books and Allied (p) Ltd.

Course Code 20UBOC51	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**
	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**
CO1	H	H	H	M	M	-	L	L	H	L
CO2	M	H	H	M	L	-	L	L	H	L
CO3	M	H	H	M	L	M	L	L	H	L
CO4	L	H	H	M	L	M	L	L	H	L
CO5	M	H	H	M	L	M	L	L	H	H

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B.Sc. BIOTECHNOLOGY
(2020 - 21 onwards)

Semester V	**IMMUNOLOGY**	**Hours/Week: 4**	
Core Course- 8		**Credits: 4**	
Course Code 20UBOC52		**Internal** 25	**External** 75

COURSE OUTCOMES

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

CO1: define the basic concepts of Immunology. [K1]

CO2: explain the structural properties and functions of immune cells and antigen antibody interaction. [K2]

CO3: discuss the complement system and immunological disorders. [K3]

CO4: examine the immunological response and regulation and malfunction of immune system. [K4]

CO5: assess the techniques involved in antigen – antibody interactions immunological disorders. [K5]

UNIT I

Introduction: Historical perspective, Innate immunity, adaptive immunity, cells of the immune system – B lymphocytes, T lymphocytes, Natural Killer cells, Mononuclear phagocytes, Granulolytic cells, mast cells, dendritic cells. Organs of the Immune system – Primary lymphoid organs, Secondary lymphoid organs. (12 Hours)

UNIT II

Antigen and Antibody: Immunogenicity, cell mediated and Humoral immunity, antigenicity, Properties of antigen, Haptens, Adjuvants and Epitope. Basic structure of Antibodies, Antibody classes and biological activity. Monoclonal antibody. (12 Hours)

UNIT III

Antigen – Antibody Interaction: Strength of Antigen-Antibody Interaction. Precipitation, Agglutination, Radioimmunoassay, ELISA, Western blotting, immunoelectrophoresis, Immunoprecipitation, Immunofluorescence, Flowcytometry and Immunoelectron Microscopy.

(12 Hours)

UNIT IV

Complement system: complement activation – classical pathway, alternative pathway and lectin pathway. Major Histocompatibility complex – Organization and structure of Class I, II and III Antigen presentation - Endogenous antigen, Exogenous antigen. (12Hours)

UNIT V

Immune system in Health and Disease: Tolerance, Organ Specific Autoimmunity (Myasthenia gravis) Systemic Autoimmune disease (Rheumatoid arthritis). Transplantation Immunology – Graft acceptance and Rejection. Vaccines- Types, Active and Passive immunization, Hypersensitivity (12 Hours)

REFERENCE BOOKS

1. Goldsby, A.R., Kindt, J.T., & Osborne, A.B. (2007).
2. Kuby, J. (2018). Immunology.8th edition. Newyork: W. H. Freeman & Co.
3. Roitt, I. (2000). Essentials of immunology. IV Edition. New York: Blackwell. Sci.
4. Abbas, K.A.,Lichtman, H.A.,&Pillai. (2019). Basic Immunology. 6th edition. Elsevier.
5. Owen, J,Jenny Punt, J &Stranford,S. (2013).

Course Code 20UBOC52	PO1		PO2	PO3		PO4		PO5	PO6	PO7
	PSO 1.a	PSO 1.b	PSO2	PSO 3.a	PSO 3.b	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7
CO1	M	M	M	H	M	M	-	L	H	-
CO2	M	H	H	M	L	-	L	L	H	-
CO3	M	H	H	M	L	M	L	L	H	-
CO4	L	H	H	M	L	M	L	L	H	-
CO5	M	H	H	M	L	M	L	L	H	-

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B.Sc. BIOTECHNOLOGY
(2020 - 21 onwards)

Semester V	**PLANT BIOTECHNOLOGY**	**Hours/Week: 4**	
Core Course- 9		**Credits: 4**	
Course Code 20UBOC53		**Internal** 25	**External** 75

COURSE OUTCOMES

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

CO1: define the concepts in Plant Biotechnology. [K1]

CO2: describe the micropropagation techniques, plant genome and genetically modified plants. [K2]

CO3: Explain plant tissue culture techniques for conservation of endangered plants and development of crop improvement. [K3]

CO4: analyze the use of plant tissue and cell culture techniques in crop improvement. [K4]

CO5: evaluate the plant tissue culture techniques and gene transfer techniques. [K5]

UNIT I

Plant tissue culture: History of plant tissue culture – concept of Totipotency, Laboratory organization - sterilization techniques – Media preparation –Types of media – MS media, Nitsh media, Gamborgs media – Plant growth regulators. Role of tissue culture in agriculture and forestry.

(12 Hours)

UNIT II

Micropropagation: Plant micro propagation – micro grafting – advantages – virus elimination and shoot tip cultures from plants. Anther and microspore culture, ovary culture, embryo culture and embryo rescue. (12 Hours)

UNIT III

Somatic hybridization: Protoplast isolation – fusion - Culture regeneration - somatic hybrids - Somatic embryogenesis - Synthetic seeds- types, preparation, applications. Somaclonal and Gametoclonal variation. Cryopreservation and germplasm conservation. Conservation of plant genetic resources-establishment of gene banks (12 Hours)

UNIT IV

Plant genome and gene transfer methods: Plant genome organization, *Arabidopsis* genome initiative, Gene transfer techniques in plants-physical transfer-electroporation, microinjection, particle

gun bombardment, liposome mediated transfer, chemical method, Ti plasmid mediated gene transfer. Viral vectors-CaMv, plant viral vectors, marker genes, reporter genes with reference to plant system (12 Hours)

UNIT V

Genetically modified plants: Molecular marker aided plant breeding- RAPD, RFLP. Plant as a bioreactor for Secondary metabolites production. applications of GM plants, Edible vaccines from transgenic plants, Genetically Modified plants-Flavr saur tomato, golden rice, Bt cotton. (12 Hours)

REFERENCE BOOKS

1. Satyanarayana. U, Biotechnology (2008). Kolkata: Books and Allied (p) Ltd.
2. Abdin, M.Z., Kiran, U., Kamaluddin, M., and Ali, A. (2017). Plant Biotechnology: Principle and Applications, Springer Nature Singapore Pvt. Ltd.
3. Stewart, J.R, Neal, C., (2016). Plant Biotechnology and Genetics: Principles, Techniques and Applications 2nd Edition, Wiley Publications.
4. Singh,B.D. (2015). Plant Biotechnology, New Dehli: Kalyani Publishers.
5. Slater, A, Scott,N.W., & Fowler, M,R.(2008).Plant Biotechnology: The genetic manipulation of plants UK , Oxford University Press.

Course Code 20UBOC53	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**
	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**
CO1	H	L	H	-	-	M	M	-	L	-
CO2	H	H	H	-	-	H	M	-	L	-
CO3	H	L	H	M	L	H	M	M	-	-
CO4	H	M	H	H	M	H	L	-	M	-
CO5	H	M	M	H	M	H	M	-	M	L

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B.Sc. BIOTECHNOLOGY
(2020 - 21 onwards)

Semester V	**GENOMICS AND PROTEOMICS**	**Hours/Week: 4**	
DSEC- 1		**Credits: 4**	
Course Code 20UBOE51		**Internal** 25	**External** 75

COURSE OUTCOMES

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

CO1: Recall the concept of genomes, proteomes and meta genomes. [K1]

CO2: Understand the methods used in the sequencing of genomes, proteomes and meta genome. [K2]

CO3: Apply the knowledge gained from the history and genome projects. [K3]

CO4: Analyse genome and proteome structure organization using tools and software. [K4]

CO5: Predict the structure of genomes, proteomes and meta genomes. [K5]

UNIT I

Introduction - definition and history, Types of Genomics; structural genomics, functional genomics, and comparative genomics. Structure and organization of prokaryotic and eukaryotic genomes. (12 Hours)

UNIT II

Genome sequencing: Microbial genome sequencing project; viral and bacterial, eukaryotic genome sequencing; human genome project. Methods of genome sequencing; Sanger's method, next generation sequencing, whole genome shotgun sequencing, expressed sequencing tag. (12 Hours)

UNIT III

Genome assembly and gene prediction; trimming of vector sequences and sequence quality determination, genome finishing, gene prediction using Algorithms and software, single nucleotide polymorphisms. (12Hours)

UNIT IV

Proteomics: definition and types of proteomics; Expression proteomics, structural proteomics and functional proteomics, protein structure databases, protein structure prediction. (12 Hours)

UNIT V

Metagenomics and Transcriptomics: definition and history, meta genomic projects, nucleic acid extraction and enrichment strategies, applications of meta genomics. Microarray analysis, SAGE

(12Hours)

REFERENCE BOOKS

1. S.K. Aggarwal, (2018). Genomes, Med Tech.
2. R.C. Dubey, (2014). Advanced Biotechnology, S. Chand & Company Pvt. Ltd. First edition.
3. S.C. Rastosi, (2014). Molecular Biology, CBS Publishers & Distributors Pvt. Ltd.
4. S.B. Primrose and R.M. Twyman, (2007). Principles of Gene Manipulation and Genomics, Seventh Edition, Blackwell Publishing.
5. Anthony J.F. Griffiths, Susan R. Wessler, Sean B. Carroll, John Doebley, (2012). Introduction To Genetic Analysis -Tenth edition, W.H.Freeman and Company.

Course Code 20UBOE51	PO1		PO2	PO3		PO4		PO5	PO6	PO7
	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
CO1	H	-	H	M	M	L	H	M	-	-
CO2	H	H	M	H	L	H	H	M	L	-
CO3	H	-	M	H	H	H	M	M	L	M
CO4	M	H	M	H	M	M	M	H	-	-
CO5	H	M	M	H	M	H	M	H	M	L

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B.Sc. BIOTECHNOLOGY
(2020 - 21 onwards)

Semester V	**MARINE BIOTECHNOLOGY**	**Hours/Week: 4**	
DSEC- 1		**Credits: 4**	
Course Code 20UBOE52		**Internal** 25	**External** 75

COURSE OUTCOMES

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

CO1: Explain principle features of marine biodiversity their cultivation and application. [K1]

CO2: Describe the marine living organisms and their utilization in terms of industrial products in conserving marine environment. [K2]

CO3: Explain the utilization of marine organisms in industrial product development, bioremediation. [K3]

CO4: Analyse the significance of marine natural resources,mass cultivation methods and bioremediation of marine pollution. [K4]

CO5: Solve the problems related to marine environment Conservation. [K5]

UNIT I

Marine Living Resources: Plant resources: phytoplankton, seaweeds, seagrasses and mangroves – their distribution and utilization. Animal resources: Zooplankton, corals, crustaceans, and finfish – their distribution and utilization. (12 Hours)

UNIT II

Bioactive Marine Natural products: Types of products: Pigments, Antibiotic, anti-tumour, anti-inflammatory, cytotoxic, anti-viral compounds of marine origin. Marine toxins: Saxitoxin, brevitoxin and ciguatoxin. Marine prostaglandins and marine cosmetic products. (12Hours)

UNIT III

Seaweed farming– Methods of seaweed cultivation: Lagoon culture, Coir rope culture, Net cultivation method, Seaweed culture by spore method. Indoor & Outdoor mass cultivation & harvesting strategies of marine species of *Spirulina*. Edible seaweeds. (12 Hours)

UNIT IV

Marine microbiology: Marine microorganisms, Bioluminescence, Microbial biofilms; Marine polysaccharides - biomedical and biotechnological applications - Molecular pathogenicity of aquacultural pathogens; gene regulation and molecular biology of marine hyperthermophils.

(12Hours)

UNIT V

Bioremediation of Marine pollution: Marine pollution - Bioremediation – Degradation of chlorinated hydrocarbons - Biofouling organisms - Problems due to biofouling - Antifouling paints and its environmental pollution – Gene Development of disease resistance in aquacultural species-crustaceans, corals, fin fishes. (12 Hours)

REFERENCE BOOKS

1. Attaway,D.H.,Zaborsky, O.R., (2001). Marine Biotechnology, Volume 1, Pharmaceutical and Bioactive Natural Products. Newyork: Plenum press.
2. Le Gal Y. & Halvorson, H.O. (2013). New Developments in Marine Biotechnology, US: Springer
3. Castro,P & Huber, M. (2015). Marine Biology, Newyork: McGraw-Hill Higher Education.
4. Se- Kwon Kim, (2011).Handbook of Marine Macroalgae: Biotechnology and Applied Phycology. UK: Wiley Publishers.

Course Code 20UBOE52	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**
	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**
CO1	H	-	H	M	M	L	H	M	-	-
CO2	H	H	M	H	L	H	H	M	L	-
CO3	H	-	M	H	H	H	M	M	L	M
CO4	M	H	M	H	M	M	M	H	-	-
CO5	H	M	M	H	M	H	M	H	M	L

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B.Sc. BIOTECHNOLOGY

(2020 – 2021 onwards)

Semester V	**NANOBIOTECHNOLOGY**	Hours/Week: 4	
DSEC – 1		Credits: 4	
Course Code **20UMBE53**		Internal 25	External 75

COURSE OUTCOMES

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

CO1: Relate the basic concepts of Nanotechnology- Biotechnology for biomedical application. [K1]

CO2: Understand the production and Characterization Techniques of nanomaterials and their influences on human health. [K2]

CO3: Apply the nanomedicine in drug delivery based on classification and assess their Environmental risks. [K3]

CO4: Analyse the characterised nanomaterials in treating diseases and their impact in Environment. [K4]

CO5: Interpret the application of classified nanomaterials and comment their toxic effects. [K5]

UNIT I

History and Scope of Nanotechnology- Basics- Nanobiotechnological devices: Nanorobot and Nanoshell. Nanoparticle – Introduction – Morphology, Classification and Properties of Nanoparticles (12 Hours)

UNIT II

Nanoparticles: Carbon nanotubes, Dendrimers, Quantum dots, Gold nanoparticles, Silver nanoparticles, liposomes and their application- Synthesis of Nanoparticles- physical, chemical method and Biological Sources: Plants, bacteria and Fungi. (12 Hours)

UNIT III

Characterization of Nanoparticles: Ultraviolet Spectroscopic analysis, X-ray diffraction and energy dispersive, Scanning Electron Microscope, Transmission Electron Microscope, Fourier Transform Infrared Spectroscopy, Atomic Force Microscopy. (12 Hours)

UNIT IV

Biomedical application of Nanoparticles – Drug delivery System: Dendrimers, Hydrogel - Quantum dot technology in Cancer Treatment and cell repair Machines. Nanocomposite: uses and Application. Biosensor - Diagnostic Imaging techniques. (12 Hours)

UNIT V

Health and Environmental impacts of Nanotechnology: Routes of entry of Nanomaterials in the body - Toxic mechanisms - Toxicological Health Effects by nanoparticles – Integrated concept of risk assessment - Environmental implications of nanoparticles. (12 Hours)

TEXT BOOKS

1. Subbiah Balaji. (2010).*Nanobiotechnology*, 1st edition.New Delhi: MJP Publishers.
2. Manasi Karkare. (2017).*Nanotechnology*, 1st edition.New Delhi: I.K.International Publishing House Pvt. Ltd.

REFERENCE BOOKS

1. Shanmugam, S. (2011).*Nanotechnology*, 1st edition.New Delhi: MJP Publishers.
2. Pradeep, T. (2013). *Nano: The essentials*, 1stedition.New York: McGraw Hill Publications.

Course Code (20UMBE53)	PO1		PO2	PO3		PO4		PO5	PO6	PO7
	PSO 1a	PSO 1b	PSO 2	PSO 3a	PSO 3b	PSO 4a	PSO 4b	PSO 5	PSO 6	PSO 7
CO1	H	L	H	L	M	H	M	M	L	M
CO2	H	L	M	L	H	M	L	M	-	-
CO3	H	M	M	H	M	H	L	L	-	-
CO4	M	M	M	L	M	M	L	L	-	-
CO5	L	L	M	M	L	H	M	L	L	-

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B.Sc. BIOTECHNOLOGY
(2020 - 21 onwards)

Semester V	**MEDICAL CODING AND CLINICAL RESEARCH**	**Hours/Week: 2**	
SEC- 04		**Credits: 2**	
Course Code		**Internal**	**External**
20UBOS51		40	60

COURSE OUTCOMES

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

CO1: define the basic concepts in medical coding and clinical research. [K1]

CO2: describe the types of coding and clinical trials in drug development process with ethics. [K2]

CO3: summarize the diagnostic codes and Pharmacovigilance study in drug development process. [K2]

CO4: explain CPT codes and drug development process in clinical research and ethics. [K3]

CO5: Analyse the coding accuracy,coding rituals,modifiers and Pharmacovigilance study. [K4]

UNIT I

Coding Procedures: Introduction- Basics and Principles of medical coding –Overview and responsibilities. Standardization of coding and coding overview. History of ICD and CPT. Introduction to ICD –9 -CM versus ICD –10 –CM. Coding accuracy. (6 Hours)

UNIT II

Coding Rules: Introduction to CPT –Medical coding, structure of CPT codes. Categories of CPT codes. Absence of codes and special cases. Coding rituals and modifiers. (6 Hours)

UNIT III

Basics in Clinical Research: Introduction, history of clinical research and overview. Scope of clinical research. GCP and ICH. Different phases of clinical research. (6 Hours)

UNIT IV

Drug Development Process: Drug studies -new drug development process. Pre-clinical toxicology: General principles, Systemic toxicology (Single dose and repeat dose toxicity studies), Types of clinical trials- single blinding, double blinding, Open access, Randomized trials and their examples, interventional study, Basic terminologies in Pharmacology. (6 Hours)

UNIT V

Pharmacovigilance: Introduction, aim and objective of Pharmacovigilance study. Method, Plans, procedures, scope of Pharmacovigilance study. Pharmacovigilance study in India. Ethics to be followed in clinical research trials. (6 Hours)

REFERENCE BOOKS

1. Gupta. S.K, (2007). Basic Principles of Clinical Research and Methodology. New Delhi: Jaypee Brothers Medical Publishers Pvt. Limited
2. Gupta. S.K, (2011). Drug Discovery and Clinical Research. New Delhi: Jaypee Brothers Medical Publishers Pvt. Limited
3. Eric T. Herfindel, Dick R. Gourley. (2000).7th edition. Textbook of Therapeutics Drug and Disease management. USA: Williams and Wilkins.
4. Diehl, M.O., (2005). Medical transcription guide: do's and don'ts. USA: Saunders publishers.

Course Code 20UBOS51	PO1		PO2	PO3		PO4		PO5	PO6	PO7
	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
CO1	M	M	H	L	M	M	M	L	M	-
CO2	H	L	M	L	M	L	-	-	M	H
CO3	M	L	H	L	L	L	-	-	L	L
CO4	M	L	H	L	L	M	-	-	-	H
CO5	L	L	H	M	M	M	L	-	M	-

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Head of the Department — Course designer

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B.Sc. BIOTECHNOLOGY
(2020 - 21 onwards)

Semester V	**HERBAL TECHNOLOGY**	**Hours/Week: 2**	
SEC- 05		**Credits: 2**	
Course Code 20UBOS52		**Internal** 40	**External** 60

COURSE OUTCOMES

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

CO1: Recall the traditional medicine system and herbal drug extraction and manufacturing process. [K1]

CO2: explain about the classification of drugs, active principles testing and functional foods drugs. [K2]

CO3: summarize the significance of herbal medicine, GMP, patenting and regulations. [K2]

CO4: analyze the cultivation of herbal drug extraction process, nutraceuticals, patenting and regulations. [K3]

CO5: assess the suitable extraction process of herbal plants, GMP and regulation for drug manufacturing. [K4]

UNIT I

Herbal medicines: History scope and significance of herbal medicine– Ayurveda – Unani – Homeopathy – Siddha – Yoga and naturopathy – herbal plants - Harvesting – Post harvesting – Conditions of storage. Methods of classification- Alphabetical, Morphological, Taxonomical, Pharmacological, Chemical and chemotaxonomical classification. (6 Hours)

UNIT II

Herbal drug extraction: Infusion – Decoction – Digestion – Maceration – Percolation – Successive solvent extraction – Super critical fluid extraction – Steam distillation – Head space techniques – Sepbox – Selection of a suitable extraction process. Chromatographic separation techniques. (6 Hours)

UNIT III

Active principles and nutraceuticals: Active principles and methods of their testing Health benefits and role of Nutraceuticals in ailments like Diabetes, CVS diseases, Cancer, Irritable bowel

syndrome and various Gastro intestinal diseases. herbs as health food: Alfaalfa, Ginger, Fenugreek, Garlic, Amla, Ginseng, Ashwagandha, Spirulina. (6 Hours)

UNIT IV

S**chedule T – Good Manufacturing Practice of Indian systems of medicine:** Herbal drugs industry: Present scope and future prospects. Components of GMP (Schedule – T) and its objectives Infrastructural requirements, working space, storage area, machinery and equipment, standard operating procedures, health and hygiene, documentation and record. (6 Hours)

UNIT V

Patenting and Regulatory requirements of natural products: Definition of the terms: Patent, IPR, Farmers right, Breeder's right, Bioprospecting and Biopiracy. Patenting aspects of Traditional Knowledge and Natural Products. Case study of Curcuma & Neem. Regulations in India (ASU DTAB, ASU DCC), Regulation of manufacture of ASU drugs - Schedule Z of Drugs & Cosmetics Act for ASU drugs. (6 Hours)

TEXT BOOKS

1. Kumar G.S. & Jayaveera K.N (2014). A Textbook of Pharmacognosy and Phytochemistry, New Delhi: S.Chand & Company Pvt. Ltd.

REFERENCE BOOKS

1. Mishra, S.B. (2019). Essentials of Herbal technology, Educreation Publisher.
2. Agarwal, S.S., & M. Paridhavi, (2012). Herbal Drug Technology, Universities Press.
3. Yaniv, Z & Bachrach, U. (2005). Handbook of Medicinal plants, New york, Food products press.
4. Green, A. (2000). Principles of Ayurveda, London, Thomsons Publishers.

Course Code 20UBOS52	PO1		PO2	PO3		PO4		PO5	PO6	PO7
	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
CO1	H	L	H	M	L	M	M	L	L	L
CO2	H	M	H	M	L	M	H	-	-	L
CO3	H	M	H	M	L	M	H	-	L	M
CO4	H	M	L	L	M	L	H	-	L	H
CO5	H	M	L	L	M	L	L	-	M	H

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B.Sc. BIOTECHNOLOGY

(2020 - 21 onwards)

Semester V	**STEM CELL TECHNOLOGY**	**Hours/Week: 0**	
Extra credit course		**Credits: 2**	
Course Code 20UBOO51		**Internal** 100	

COURSE OUTCOMES

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

CO1: Recall the basics of stem cell technology. [K1]

CO2: explain about the classification of stem cells, their differentiation and applications. [K2]

CO3: summarize the significance of stem cell technology in modern medical field and the ethical regulations. [K3]

CO4: analyze the types of stem cells, its use in gene therapy and ethical issues. [K4]

CO5: assess the therapeutic applications of stem cells. [K5]

Unit- I: Introduction to stem cells

Definition, properties, proliferation, culture of stem cells, medical applications of stem cells, ethical and legal issues in use of stem cells.

Unit- II: Types of stem cells.

Stem Cell biology and therapy, types embryonic stem cell, Adult stem cell, Embryonic Stem Cells, culture and the potential benefits of stem cell technology

Unit- III: Therapeutic applications of stem cells

Gene Therapy: Introduction, History and evolution of Gene therapy, optimal disease targets, Failures and successes with gene therapy and future prospects, Genetic Perspectives for Gene Therapy, **Gene Delivery** methods: Viral vectors and Non-viral Vectors

Unit-IV Methodologies for pluripotent stem cell culture, characterization of pluripotency and differentiation into different lineages.

Unit-V: Ethical Issues associated with stem cell-based regenerative medicine

Regulatory and Ethical Considerations of stem cell and Gene Therapy, Assessing Human Stem Cell Safety, Use of Genetically Modified Stem Cells in Experimental Gene Therapies.

Reference books

1.Marshak, D, Gardener,R.L., Gottlieb, D., Stem Cell Biology (2001),Cold Spring Harbour Laboratory Press

2. *Alexander Battler, Jonathan Leo,*Stem Cell and Gene-Based Therapy: Frontiers in Regenerative Medicine, (2007).Springer,

Course Code 20UBOO51	PO1		PO2	PO3		PO4		PO5	PO6	PO7
	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
CO1	H	L	H	M	L	M	M	L	L	H
CO2	H	M	H	M	L	M	H	-	-	L
CO3	H	M	H	M	L	M	H	-	L	M
CO4	H	M	L	L	M	L	H	-	L	H
CO5	H	M	L	L	M	L	L	-	M	H

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B.Sc. BIOTECHNOLOGY

(2020 - 21 onwards)

Semester V	**PROJECT**	Hours/Week: 1	
Core Course - 10		Credits: 1	
Course Code **20UBO5PR**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: apply the basic concepts learnt concepts to select projects in Biotechnology and interdisciplinary fields. [K3]

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 skill acquired in the related project work illustrate the work done by them by means of graphs tables and figures. [K3]

CO4: analyze 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]

Students are expected to select a project in the field of Biotechnology Textiles and fashion. Two students can do one project. Minimum pages for project report should be 20 pages. Two typed copies of the report on the completed project will be submitted to the Controller of Examination through the Head of the department in the month of November during V semester. Evaluation will be done internally.

Mode of Evaluation		**Marks**
Project work and report	:	60
Presentation and Viva-Voce	:	40

Course Code 20UBO5PR	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**
	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**
CO1	H	H	H	M	L	M	M	L	L	L
CO2	H	H	H	M	L	M	H	-	-	L
CO3	H H	H H	H	M	L	M	H	-	L	M
CO4	H	H	H	L	M	L	H	-	L	-
CO5	H	H	H	L	M	L	L	-	M	-

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B.Sc. BIOTECHNOLOGY

(2020 - 21 onwards)

Semester VI	**BIOINFORMATICS**	Hours/Week: 4	
Core Course – 11		Credits: 4	
Course Code		Internal	External
20UBOC61		25	75

COURSE OUTCOMES

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

CO1: Describe the basics of bioinformatics. [K1]

CO2: Explain the various types of biological databases alignment methods and prediction tools. [K2]

CO3: Make use of databases and tools for alignment and structure prediction. [K3]

CO4: Analyze sequence alignments and perform database searching.[K4]

CO5: Perform multiple sequence alignment using visualization tools. [K5]

UNIT I

Basics of Bioinformatics: Central dogma of molecular biology; Introduction to Bioinformatics; History, Scope and Applications of Bioinformatics; Role of computers in bioinformatics. (12 Hours)

UNIT II

Types of Biological Databases: General introduction of Biological Databases; Nucleic acid databases (NCBI, DDBJ and EMBL). Protein databases (Primary, Composite, and Secondary).

(12 Hours)

UNIT III

Specialized Biological Databases: Metabolic or Enzyme database: KEGG pathway database, **S**tructure databases (CATH, SCOP), Software Tools for 3D Molecular Graphic visualization of protein

(12 Hours)

UNIT IV

Pairwise sequence alignment and database searching: Sequence alignment, scoring functions in sequence alignment, Pair wise Alignment, Dot-plot, Dynamic Programming, Global alignment, local alignment, Gap penalty, and Database similarity using BLAST & FASTA.

(12 Hours)

UNIT V

Multiple sequence alignment and phylogenetics: Scoring multiple sequence alignments, Progressive alignment method, Iterative alignment method, Block-based alignment, Evolutionary analysis: Cladistic methods (Maximum parsimony and Maximum likelihood) and Phenetic methods (UPGMA and Neighbor Joining). Phylogenetic analysis tools - PHYLIP. (12Hours)

REFERENCE BOOKS

1. Harisha, S. (2010).Fundamentals of Bioinformatics, New Delhi: I.K.International Publishing House.
2. Lesk, A. (2014).Introduction to Bioinformatics, UK: Oxford Universities Press.
3. Jenny, Bourne, P.E. (2011). Structural Bioinformatics, New Jersey: Wiley Publications.
4. Gromiha, M. M. (2011). Protein Bioinformatics: From Sequence to Function, Academic Press.

Rastogi S. C. et al (2013), Bioinformatics: Methods and Applications - Genomics, Proteomics and Drug Discovery, PHI Learning Pvt. Ltd

Course Code 20UBOC61	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**
	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**
CO1	M	M	H	H	L	M	H	M	L	-
CO2	M	L	H	H	M	M	H	M	L	-
CO3	L	L	H	H	M	M	H	M	L	-
CO4	L	L	H	H	M	M	H	M	L	-
CO5	L	L	H	H	M	M	H	M	L	L

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B.Sc. BIOTECHNOLOGY

(2020 - 21 onwards)

Semester VI	**ENVIRONMENTAL BIOTECHNOLOGY**	Hours/Week: 4	
Core Course – 12		Credits: 4	
Course Code **20UBOC62**		Internal 25	External 75

COURSE OUTCOMES

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

CO1: Recollect the energy resources and methods used to conserve them and waste treatment. [K1]

CO2: Describe the utilization of biomass, various methods used in the treatment of wastes and biocontrol. [K2]

CO3: Apply biotechnological methods for energy conversion, waste reduction, ecofriendly mining and biocontrol of plant pathogens. [K3]

CO4: Compare the various biotechnological processes in waste renewal and reduction and ecofriendly agricultural and industrial processes. [K4]

CO5: evaluate the given conditions or situations related to environmental biotechnology and give solutions. [K5]

UNIT I

Energy resources: Energy resources- Nuclear energy, Fossil fuel energy-Biomass energy-Composition of Biomass (Cellulose and lignin).Aquatic Biomass- *Salvinia.* Biomass of renewable waste-Biomass conversion by Biological Processes (enzyme digestion, anaerobic digestion-Biogas production). (12 Hours)

UNIT II

Waste treatment: Biological waste treatment- sewage treatment-primary treatment- screening, sedimentation, secondary treatment- Aerobic and anaerobic, tertiary treatment- oxidation pond, ion exchange method. Reuse of sewage. Removal of heavy metals from water. Treatment of tannery industry effluent. (12 Hours)

UNIT III

Biodegradation: Biodegradation of xenobiotics, hydrocarbons, polychlorinated biphenyl compounds, superbug- construction and application. Strain development by genetic engineering. Bioremediation- Types- *In-situ* and *Ex-situ* Bioremediation. Phytoremediation- methods and application. (12 Hours)

UNIT IV

Biocontrol, Biomining, Biofuels: Biocontrol of plant pathogens- Bacterial, fungal and viral pesticides. Biomining- methodology and advantages. Bioleaching- methods and microbes involved in bioleaching. Biofuels- Ethanol, Biodiesel, Bio-hydrogen. (12 Hours)

UNIT V

Applications of Biotechnology in Environment: Biosensors- types and applications. Biochips- structure and applications. Environmentally important molecular probes and hybridization techniques. Bioplastics – Production and applications. (12 Hours)

REFERENCE BOOKS

1. Chatterji, A.K.(2011) 3nd edition, Introduction to Environmental Biotechnology, New Delhi,Prentice Hall of India Pvt. Ltd.
2. Kumar,R., Sharma,A.K.,&Ahluwalia,S.S. (2017).Advances in Environmental Biotechnology, Springer Publications.
3. Kaushik, G. (2015). Applied Environmental Biotechnology: Present Scenario and Future Trends, Springer Publications.
4. Thakur, I,S.(2011) Second edition, Environmental Biotechnology, New Delhi, I.K.International publishing house.

Course Code 20UBOC62	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**
	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**
CO1	M	-	H	L	M	L	-	-	L	M
CO2	H	H	H	H	M	M	-	L	L	M
CO3	H	L	M	H	M	M	L	-	-	H
CO4	H	-	M	H	H	M	L	L	M	H
CO5	H	M	H	H	M	H	M	M	M	M

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B.Sc. BIOTECHNOLOGY

(2020 - 21 onwards)

Semester VI	**INDUSTRIAL BIOTECHNOLOGY**	Hours/Week: 5	
Core Course- 13		Credits: 4	
Course Code		Internal	External
20UBOC63		25	75

COURSE OUTCOMES

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

CO1: Describe the historical developments in fermentation, screening of industrially important microbes, bioreactors and the processes involved in biotechnology industry. [K1]

CO2: Explain the various types of media for microbes parts of fermenter and their operation and product development. [K2]

CO3: Apply various microbes for industrial production and recovery in bioreactors. [K3]

CO4: Analyse the significance of microbes in industries bioreactors suitable for the production of microbial products. [K4]

CO5: Assess the application of microbes in industrial processes and adopt suitable downstream processing. [K5]

UNIT I

Historical developments in Fermentation: Outline of upstream processing; Screening of industrially important microbes – primary screening, secondary screening; Strain improvement; Inoculum development; Preservation of strains. (12 Hours)

UNIT II

Media preparation: Media formulation; Sterilization; Types of fermentation - batch and continuous culture systems; Methods of immobilization. (12 Hours)

UNIT III

Bioreactor: Design, parts and their function; Types of bioreactors- CSTR, Air lift, Bubble column, packed bed, tower; Monitoring and control of process variables (Temperature, pH and DO). (12 Hours)

UNIT IV

Downstream processing: Solid–liquid separation; Floatation, flocculation, filtration, centrifugation; Cell disruption; Concentration – evaporation, liquid-liquid extraction, membrane filtration, precipitation, adsorption, purification – chromatography; Formulation –drying, crystallization. (12 Hours)

UNIT V

Production of microbial products: Enzymes - Amylase, Protease, Amino acid- Glutamic acid, lysine, Vitamins- Riboflavin, Antibiotics- Penicillin, Streptomycin, Organic acid- Citric acid, Solvent- Ethanol, and SCP *(Spirulina).* (12 Hours)

REFERENCE BOOKS

1. Ponmurugan, P.Ramasubramanian,N and Fredimoses. (2012). Experimental Procedures in Bioprocess technology and Downstream processing. Chennai: Anjana Book House.
2. Prasad, N.K. (2010). Down Stream Process technology: A New Horizon in Biotechnology.New Delhi: PHI Learning Pvt. Ltd.
3. Wittmann,C, &Liao, C.J (2017). Industrial Biotechnology: Products and Processes. Wiley Publishers.
4. Kaur,L&Khajuria, R.(2015). Industrial Biotechnology: Principles and Applications.Nova Science Publishers
5. Flickinger, M.V. (2013). Upstream Industrial Biotechnology. Wiley Publishers.

Course Code 20UBOC63	PO1		PO2	PO3		PO4		PO5	PO6	PO7
	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
CO1	H	-	H	-	L	M	-	-	-	-
CO2	H	M	H	H	M	-	L	-	M	L
CO3	H	H	H	M	H	H	L	M	H	-
CO4	H	M	H	L	L	H	-	M	M	L
CO5	H	L	H	H	L	-	H	M	L	L

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B.Sc. BIOTECHNOLOGY

(2020 -21 onwards)

Semester VI	**PHARMACEUTICAL MICROBIOLOGY**	Hours/Week: 5	
DSEC – 2		Credits:4	
Course Code **20UMBE61**		Internal 25	External 75

COURSE OUTCOMES

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

CO1: Recall the principles of pharmacology, concept of drug discovery and identify the specific drugs belong to major drug classes for therapeutic use. [K1]

CO2: Explain the pharmacokinetics and mechanism of drug action at macromolecular levels and understand the tests involved in checking the quality of pharmaceutical product. [K2]

CO3: Apply the knowledge of systemic pharmacology, drug-receptor interactions and its resistance mechanisms to design a novel drug with the aid of computer. [K3]

CO4: Analyse the pharmacotherapy, adverse effects of specific drugs and also categorize the practices to be followed in pharmaceutical industry. [K4]

CO5: Evaluate the ways of specific drug action on microbes and illustrate the stages of drug development. [K5]

UNIT I

Pharmacognosy: Nature and Sources of drugs- Microbiological, mineral and plant and animal. Pharmacology- Introduction- Routes of drug administration (local and systemic). Pharmacokinetics: absorption, distribution, metabolism and excretion of drugs. **(**14 Hours)

UNIT II

Pharmacodynamics: Mechanism of action of drugs, Factors modifying drug action, Drug – receptor interaction, Site of drug action, Structure activity relationship. Adverse reactions of drugs, Drug toxicity (14 Hours)

UNIT III

Pharmacotherapy of diabetes (Insulin), Peptic Ulcer (PPIs,) Anaemia (Hematinics). Principles of Drug Design Synthetic procedures (Theoretic Aspects): Drug discovery (Lead identification and optimization, Target identification and validation) and Drug development (clinical trials)- Traditional analog (QSAR) and Computer Aided Drug Designing (CADD). (17 Hours)

UNIT IV

Chemotherapy and Antibiotics: Mechanism of action of antimicrobial drugs – Penicillin, Polymyxin, Aminoglycosides, Isoniazid, Rifampin, Sulfonamides, Tetracycline, Amphotericin B, Acylovir, Metronidazole. Micellaneous drugs: Vitamins and Minerals. Drug resistance in bacteria. (17 Hours)

UNIT V

Assessment of microbial contamination in pharmaceutical industry: Microbial limit tests, Preservative efficacy test (challenge test). Quality Assurance: Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP). (13 Hours)

TEXT BOOK

Satoskar, Kale, Bhandarka,S. (1999). *Pharmacology and Pharmacotherapeutics*, 16th edition. Mumbai: Popular prakashan.

REFERENCE BOOKS

1. Prescott, Harley & Klein, (2008). *Microbiology*, 6th edition. New York: The McGraw-Hill companies.
2. Patrick, & Murray, R. (1990). *Medical Microbiology*, 1st edition. Missouri: The C.V. Mosby Company.
3. Hugo, W.B., Russell, A. D., (1998). *Pharmaceutical Microbiology*, 6th edition. Oxford: Blackwell Science.

Course Code (20UMBE61)	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**
	PSO 1a	**PSO 1b**	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4a**	**PSO 4b**	**PSO 5**	**PSO 6**	**PSO 7**
CO1	H	L	H	H	M	M	L	H	H	M
CO2	H	H	H	H	H	M	L	M	M	M
CO3	H	H	M	M	H	H	L	L	L	M
CO4	L	M	L	M	M	H	L	L	H	L
CO5	L	H	M	L	M	M	L	L	M	L

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B.Sc. BIOTECHNOLOGY

(2020 - 21 onwards)

Semester VI	**MEDICAL BIOTECHNOLOGY**	Hours/Week: 5	
DSEC-02		Credits: 4	
Course Code		Internal	External
20UBOE62		**25**	75

COURSE OUTCOMES

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

CO1: understand the molecular basis of human diseases and the applications of medical Biotechnology in diagnosing, curing genetic disorders and assisted reproduction. [K2]

CO2: summarize the characteristics of autosomal disorders and genetic mutations and therapeutic methods. [K2]

CO3: illustrate the genetic disorders, their root cause, diagnosis, treatment, and ART. [K3]

CO4: analyze the applications of modern technology used to detect and cure genetic disorders and infertility. [K4]

CO5: evaluate the given disease conditions or situations related to medical biotechnology and give suggestions. [K5]

UNIT I

Introduction: History and scope of medical biotechnology, current status and future prospects. Molecular basis of human diseases - Pathogenic mutations. Gain of function mutations: Oncogenes, Huntingtons Disease, Pittsburg variant of alpha 1 antitrypsin. Loss of function - Tumour Suppressor. Genomic. Dynamic Mutations - Fragile- X syndrome, Myotonic dystrophy. Mitochondrial diseases.

(12 Hours)

UNIT II

Diagnostics Methods: Prenatal diagnosis - Invasive techniques and Non-invasive techniques. Diagnosis using protein (Troponin.) and enzyme markers (CPK). DNA / RNA based diagnosis- Molecular markers, PCR based assay (12 Hours)

UNIT III

Protein therapeutics: Pharmaceuticals- Interferons, Human growth hormone, tumour necrosis factor, Recombinant antibodies-preventing rejection of transplanted organs, Hybrid human mouse monoclonal antibodies,enzymes-DNA ase I, Alginate lyase, Lactic acid bacteria-Interleukin-10,Leptin (12 Hours)

UNIT IV

Gene therapy: Types, Approaches of Gene therapy (*Ex vivo, In vivo*). Gene augmentation – ADA deficiency; Prodrug therapy/ suicide gene – glioma, Encapsulation technology and therapeutics-Diabetes. DNA based vaccines, subunit vaccines – Herpes Simplex Virus, Recombinant attenuated vaccines– Cholera (12 Hours)

UNIT V

Advanced Medical Biotechnology: Assisted reproductive technology- artificial insemination, *Invitro* fertilization technology, Embryo transfer technique, Gametes intra-fallopian transfer, Zygote intra-fallopian transfer, Intra Cytoplasmic Sperm Injection. (12 Hours)

TEXT BOOKS

1. Nallari, P. & Rao, V. V. (2010). Medical Biotechnology, Oxford University Press.

REFERENCE BOOKS

1. Khan, F. A. (2014). Biotechnology in Medical Sciences, CRC Press.
2. Bernard R. Glick, Terry L. Delovitch, Cheryl L. Patten, (2013). Medical Biotechnology, 1st edition, New Jersey: Wiley Publishiers.
3. Judit Pongracz, Mary Keen, (2009). Medical Biotechnology, Elsevier Publications.
4. Jogdand, S. N. (2011). Medical Biotechnology. Maharashtra: HIMALAYA Publishing House

Course Code 20UBOE62	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**
	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**
CO1	H	-	H	L	M	L	-	L	-	H
CO2	H	L	M	M	M	M	-	L	-	H
CO3	M	L	H	M	M	M	L	M	M	H
CO4	H	-	H	M	H	M	L	L	M	H
CO5	H	M	M	H	M	H	H	M	M	H

Dr.V.Jeyasimga — Head of the Department

Mrs. K.Indira — Course Designer

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B.Sc. BIOTECHNOLOGY

(2020 - 21 onwards)

Semester VI	**IPR, BIOETHICS AND BIOSAFETY**	**Hours/Week: 4**	
DSEC- 02		**Credits: 4**	
Course Code		**Internal**	**External**
20UBOE63		25	75

COURSE OUTCOMES

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

CO1: Define the various forms of intellectual property, bioethics, biosafety levels, and biohazards. [K1]

CO2: Describe the organizations involved in IPR, Bioethics and Biosafety in India and abroad. [K2]

CO3: Explain the process of patenting, animal welfare and risk assessment. [K3]

CO4: Compare the merits and demerits of IPR, Bioethics and GEOs. [K4]

CO5: Assess the role of IPR, Bioethics and Biosafety procedures in protection of humans and animal rights. [K5]

UNIT I

Introduction: Forms of Intellectual Property - Patent, Copyright, Trademark, Design, Geographical Indication and Trade Secrets, WTO and EMR, IPR in India. (12 Hours)

UNIT II

Patents: Protection by Patents, Patentable Inventions, Patenting of biotechnological inventions in India, Patentable and non Patentable, applying for Patents. (12 Hours)

Unit III

Bioethics - need for Bioethics, Applications of Bioethics, Prevention of Cruelty to Animals Act, CPCSEA guidelines for laboratory animal facility, Animal Welfare Board, Biopiracy.

(12 Hours)

Unit IV

Introduction to Biosafety: Primary and Secondary Barriers, Biosafety Levels-BSL1, BSL2, BSL3, BSL4, Biosafety Cabinets, Safety measures in the laboratory- Personal safety, good laboratory practices and basic Biosafety equipment's. (12 Hours)

Unit V

Biohazards: Biohazardous agents and laboratory-acquired infections, disposal of biohazardous waste, dangers of Genetically Engineered Organisms, Containment, Risk Assessment and Release of GEOs. (12 Hours)

REFERENCE BOOKS

1. Research methodology for Biological sciences – N. Gurumani, MJP Publishers, 2014.
2. Ramadass, P (2008), Animal Biotechnology, MJP Publishers,.
3. Florence Pariera Raja, (2013) Animal Biotechnology, Wisdom Press.
4. Ashish S. Verma, Surajit Das, Anchal Singh, (2014).
5. Laboratory Manual for Biotechnology S.Chand
6. Satyanarayana, U. Biotechnology (2010), Books and Allied (p) Ltd.

Course Code 20UBOE61	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**
	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**
CO1	H	-	H	L	M	L	-	L	-	H
CO2	H	L	M	M	M	M	-	L	-	H
CO3	M	L	H	M	M	M	L	M	M	H
CO4	H	-	H	M	H	M	L	L	M	H
CO5	H	M	M	H	M	H	H	M	M	H

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B.Sc. BIOTECHNOLOGY

(2020 - 21 onwards)

Semester VI	**DNA FINGERPRINTING**	Hours/Week:2	
SEC-6		Credits:2	
Course Code **20UBOS61**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: recall the fundamentals and the History of fingerprinting. [K1]

CO2: describe the methods involved in fingerprinting. [K2]

CO3: define the fingerprint patterns and techniques involved in forensics and agriculture genetics. [K2]

CO4: apply DNA fingerprinting in Agriculture, genetics and in forensics. [K3]

CO5: analyse the techniques of DNA fingerprinting, Case studies and applications. [K4]

UNIT I

Introduction: History of Finger printing –Patterns – classification – uses of Finger prints in crime investigation – direct and latent prints – developments of powders – chemistry of powders – other methods of development, transfer of Finger prints. (6 Hours)

UNIT II

Methods in fingerprinting: Principles of computerized prints, blood stains, grouping and identification, (6 Hours)

UNIT III

Genetic finger printing: DNA typing, DNA profiling, DNA Finger printing methods – PCR analysis, RFLP analysis, AFLP. (6 Hours)

UNIT IV

Plant DNA finger printing: DNA structure, the process of DNA Finger printing, DNA Finger printing in agricultural genetic programs, plant DNA Finger printing. (6 Hours)

UNIT V

Application of DNA Finger printing: disputed paternity and DNA tests, Fake DNA evidences and case studies. (6 Hours)

REFERENCE BOOKS

1. Bernasol, R, Flick,B.R and Pasternak,J.J. (2000), Molecular Biotechnology, Principles and applications of recombinant DNA, New Delhi:Panima Publishing Corporation,.
2. Dash, H.R,Shrivastava, P,Mohapatra, B.K &Surajit Das, (2018). DNA Fingerprinting: Advancements and Future Endeavors, New Delhi: Springer Publications.
3. Dolf. G, (2013). DNA Fingerprinting: Approaches and Applications, Basel :Birkhauser.
4. Weising, K, Nybom, H,Pfenninger,M, Wolff, K,&Kahl, G (2005). DNA Fingerprinting in Plants: Principles, Methods, and Applications, 2nd edition, Boca raton: CRC Press.
5. Epplen, J,&Lubjuhnn, T. (2012). DNA Profiling and DNA Fingerprinting, Germany: Springer Science & Business Media.

Course Code 20UBOS61	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**
	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**
CO1	H	M	L	M	H	M	L	L	L	L
CO2	H	M	-	-	H	M	L	H	L	-
CO3	H	M	-	L	H	M	L	H	H	-
CO4	H	M	-	L	H	M	L	H	H	-
CO5	H	M	L	L	H	M	l	H	H	L

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B.Sc. BIOTECHNOLOGY
(2020 - 21 onwards)

Semester VI	**LAB IN PLANT BIOTECHNOLOGY AND ENVIRONMENTAL BIOTECHNOLOGY**	Hours/Week: 3	
Core Practical – 3		Credits: 3	
Course Code **20UBOC61P**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: Apply the basic concepts learnt in theory for the practicals related to isolation, identification, cultivation of microbes by following the lab safety measures. [K3]

CO2: Identify the given spotters and explain. [K3]

CO3: illustrate the surface sterilization of explants, callus induction, synthetic seed preparation, protoplast and DNA isolation, BOD, COD,TDS of Water samples. [K3]

CO4: Infer the results and completion of record work. [K3]

CO5: Analyse the problems and situations in related subject area. [K4]

1. Murashige and Skoog medium, preparation of stocks, hormones (NAA, 2, 4-D and BAP).
2. Surface sterilization of seeds and growth of axenic plant.
3. Callus induction, regeneration of shoots, root induction in shoots.
4. Cell suspension culture
5. Isolation of Protoplast-enzymatic method.
6. Synthetic seed preparation.
7. Isolation of chromosomal DNA from plant.
8. Tumour induction using *Agrobacterium tumifaciens.*
9. Methods of Water and Soil sampling and assessment of pH.
10. Isolation of coliforms from sewage.
11. Physical characterization of industrial waste.
12. Determination of COD and BOD in water.
13. Estimation of Total Dissolved Solids (TDS) of water sample.
14. Water quality analysis – MPN test

REFERENCE BOOKS

1. Smith, R. H. (2006). Plant tissue culture -Techniques and Experiments. 2nd edition USA : Elsevier Science and Technology Books.

Course Code 20UBOC61P	PO1		PO2	PO3		PO4		PO5	PO6	PO7
	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
CO1	H	H	L	H	L	-	L	L	H	L
CO2	H	H	H	H	H	-	H	H	H	L
CO3	H	H	H	H	H	H	H	H	H	L
CO4	H	H	M	H	M	M	M	M	M	L
CO5	H	H	L	H	L	L	L	L	L	L

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B.Sc. BIOTECHNOLOGY

(2020 - 21 onwards)

Semester VI	**LAB IN ANIMAL BIOTECHNOLOGY AND IMMUNOLOGY**	Hours/Week: 3	
Core Practical – 4		Credits: 3	
Course Code **20UBOC62P**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: Apply the basic concepts learnt in theory for the practicals related to animal tissue culture and immunology. [K3]

CO2: Identify the given spotters and explain. [K3]

CO3: perform DNA isolation and immunological techniques. [K3]

CO4: Infer the results and completion of record work. [K3]

CO5: Analyse the problems and situations in related subject area. [K4]

1. Basic design of animal cell culture laboratory.
2. Preparation of animal tissue culture medium and membrane filtration.
3. Preparation of primary culture from chick embryo.
4. Cell counting and cell viability.
5. Isolation of DNA from blood
6. Preparation of serum and plasma
7. Coombs Test
8. Blood grouping
9. Widal test.
10. Single Immuno diffusion
11. Double and radial immunodiffusion
12. Rocket immunoelectrophoresis.
13. ELISA
14. Western blotting

REFERENCE BOOKS

1. Weir,D.M. (1986).Handbook of experimental immunology, Vol.I to IV.BlackwellScientific publishers.
2. Hay, F.C. & Westwood, O.M.R. (2002) 4th edition Practical immunology, Blackwell Publishing.
3. John Vennison. S. (2009) Laboratory Manual for Genetic Engineering, New Delhi: PHI Learning Pvt. Ltd.

Course Code 20UBOC62P	PO1		PO2	PO3		PO4		PO5	PO6	PO7
	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
CO1	H	H	L	H	L	-	L	L	H	L
CO2	H	H	H	H	H	-	H	H	H	L
CO3	H	H	H	H	H	H	H	H	H	L
CO4	H	H	M	H	M	M	M	M	M	L
CO5	H	H	L	H	L	L	L	L	L	L

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B.Sc. BIOTECHNOLOGY

(2020 - 21 onwards)

Semester VI	**LAB IN INDUSTRIAL BIOTECHNOLOGY AND BIOINFORMATICS**	Hours/Week: 2	
Core Practical – 5		Credits: 2	
Course Code **20UBOC63P**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: Apply the basic concepts learnt in theory for the practicals related to Industrial biotechnology and bioinformatics. [K3]

CO2: Identify the given spotters and explain. [K3]

CO3: illustrate the isolation of bacteria, growth kinetics bacteria, sequence alignment. [K3]

CO4: Infer the results and completion of record work. [K3]

CO5: analyse the problems and situations in related subject area. [K4]

1. Bioreactor- demonstration.
2. Production of Microbial enzymes
3. Determination of microbial growth curve
4. Purification of cell extract by column chromatography
5. Immobilization of yeast cells.
6. Preparation of wine from grapes
7. Estimation of ethanol
8. BLAST.
9. FASTA.
10. Pairwise sequence Alignment
11. Multiple sequence alignment using CLUSTAL – W
12. Literature mining using pub med central and Medline.
13. 13.Primer Design
14. 14.Retrieve metabolic pathways using KEGG PATHWAY Database

REFERENCE BOOK

1. Verma, A, S., Das, S. & Singh, A. (2014). *Laboratory manual for Biotechnology*, New Delhi: S.Chand Publishing.

Course Code 20UBOC63P	**PO1**		**PO2**	**PO3**		**PO4**		**PO5**	**PO6**	**PO7**
	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**
CO1	H	H	L	H	L	-	L	L	H	L
CO2	H	H	H	H	H	-	H	H	H	L
CO3	H	H	H	H	H	H	H	H	H	L
CO4	H	H	M	H	M	M	M	M	M	L
CO5	H	H	L	H	L	L	L	L	L	L

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