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

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

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

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

A. CHOICE BASED CREDIT SYSTEM (CBCS)

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

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

UG PROGRAMMES

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

PG PROGRAMMES

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

* AICTE approved Programmes

OUTLINE OF CHOICE BASED CREDIT SYSTEM – UG

1. Core Courses
2. Elective Courses
   - Generic Elective Courses
   - Discipline Specific Elective Courses (DSEC)
   - Non Major Elective Courses (NMEC)
3. Skill Enhancement Courses (SEC)
4. Environmental Studies (EVS)
5. Value Education
6. Self Study Courses (Online)
7. Extra Credit Courses (Self Study Courses) (Optional)

List of Non Major Elective Courses (NME)

(2023-2024 onwards)

UG PROGRAMMES

Name of the Course	Course Code	Semester	Department
Introduction to Tourism	23UHIN11	I	History(EM)
Indian Constitution	23UHIN21	II	History(EM)
சுற்றுலா ஓர் அறிமுகம்	23UHIN11	I	History (TM)
இந்திய அரசியலமைப்பு	23UHIN21	II	History(TM)
Popular Literature and Culture	23UENN11	I	English
English for Professions	23UENN21	II	
பேச்சுக்கலைத்திறன்	23UTAN11	I	Tamil
பயன்முறைத் தமிழ்	23UTAN21	II	
Practical Banking Basic Accounting Principles	23UCON11 23UCON22	I II	Commerce (Aided)
Financial Literacy-I Financial Literacy -II	23UCON12 23UCON21	I II	Commerce (SF)
Self-Employment and Startup Business	23UCCN11	I	Commerce CA (SF)

Fundamentals of Marketing	23UCCN21	II	
Women Protection Laws	23UCPN11	I	Commerce (Professional Accounting)
Basic Labour Laws	23UCPN21	II	
Basics of Event Management	23UBAN11	I	Business Administration
Business Management	23UBAN21	II	
Quantitative Aptitude I	23UMTN11	I	Mathematics
Quantitative Aptitude II	23UMTN21	II	
Physics for Everyday life -I	23UPHN11	I	Physics
Physics for Everyday life -II	23UPHN21	II	
Food Chemistry	23UCHN11	I	Chemistry
Drugs and Natural Products	23UCHN21	II	
Ornamental fish farming and Management	23UZYN11	I	Zoology
Biocomposting for Entrepreneurship	23UZYN21	II	
Foundations of Baking and Confectionery	23UHSN11	I	Home Science – Nutrition and Dietetics
Basic Nutrition and Dietetics	23UHSN21	II	
Nutrition and Health	23UBCN11	I	Biochemistry
Life Style Diseases	23UBCN21	II	
Social and Preventive Medicine	23UMBN11	I	Microbiology
Nutrition & Health Hygiene	23UMBN21	II	
Herbal Medicine	23UBON11	I	Biotechnology
Organic farming and Health Management	23UBON21	II	
Basics of Fashion	23UCFN11	I	Costume Design And Fashion
Interior Designing	23UCFN21	II	
Office Automation	23UCSN11	I	Computer Science
Introduction to Internet and HTML 5	23UCSN21	II	
Office Automation	23UITN11	I	Information Technology
Introduction to HTML	23UITN21	II	
Introduction to HTML	23UCAN11	I	Computer Applications
Fundamentals of Computers	23UCAN21	II	
Introduction to HTML	23UGDN11	I	Computer Applications - Graphic Design
Fundamentals of Computers	23UGDN21	II	
Organic Farming	23UBYN11	I	Botany
Nursery and Landscaping	23UBYN12		
Mushroom Cultivation	23UBYN21	II	
Medicinal Botany	23UBYN22		
Cadet Corps for Career Development I	23UNCN11	I	National Cadet Corps
Cadet Corps for Career Development II	23UNCN21	II	

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

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 Biochemistry

To empower our students with scientific knowledge and skills and transform intellectually, socially and personally.

Mission of the Department of Biochemistry

The department of Biochemistry Discovers and transfers new knowledge about Biochemistry, basis of life through

- enhancing understanding of biochemistry, molecular biology, and science in general.
- providing an atmosphere to acquire skills in identifying the link between biological and human resources and transform it to develop entrepreneur skill.
- extending the fundamental knowledge of biochemistry by leading innovative research and careers, to create a positive impact on society

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.

Program Educational Objectives (PEOs) of B.Sc. Biochemistry Programme
The students will be able to

- apply fundamental knowledge related to pure sciences in an interdisciplinary manner for providing innovative solutions to need based problems for national and global impact.
- analyze scientific data, draw objective conclusions related to Biochemistry and apply this knowledge for human welfare.
- gain domain knowledge and know-how for successful career in academia and industry.

Key Components of the Mission Statement	PEO1	PEO2	PEO3
Enhancing understanding of biochemistry, molecular biology, and science	√	√	√
To develop entrepreneur skill	√	√	√
Innovative research and careers, to create a positive impact on society	√	√	√

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 articulate innovative thoughts and ideas proficiently in both in spoken and written forms. (*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 through assignments, case studies, Internship and projects for the fullfillment of the local, national and global developmental needs. (*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.

PROGRAMME SPECIFIC OUTCOMES

On completion of B.Sc. Biochemistry programme the students will be able to

PO1 - *Disciplinary Knowledge*

PSO 1: Apply the fundamental knowledge of Biochemistry incorporated with knowledge in related courses that would enable them to comprehend the emerging and advanced biochemical concepts in life sciences to pursue higher studies with entrepreneurial outlook for better placement

PO2 – *Communication Skills*

PSO 2: Apply the acquired conceptual knowledge with communicative skills by connecting disciplinary and interdisciplinary aspects of Biochemistry, Microbiology, Biotechnology and Biology which can be extended to society.

PO3 – *Scientific Reasoning and Problem Solving*

PSO 3.a: Evaluate the need and impact of scientific solutions on the environment and society, keeping in view of their sustainable development and to have entrepreneurial skills acquired by skill oriented course.

PSO3.b: Strengthen their biochemical, biological and chemical experimental techniques to meet future challenges in their career.

PO4 – *Critical Thinking and Analytical Reasoning*

PSO 4.a: Analyze the techniques, reactions and concepts in various fields of Biochemistry through the research activities and to provide valid suggestions to the industry and to the business world.

PSO 4.b: Apply the principles of various fields of biochemistry to provide cost effective solutions in life science related issues with the knowledge required to become good entrepreneur for the betterment of society.

PO5 – *Digital Literacy, Self - Directed and Lifelong Learning*

PSO 5.a: Use standard laboratory protocols of Biochemistry and biology and apply computers for data acquisition through available software.

PSO 5.b: Apply various technical knowledge with more parameters and update their academics as lifelong learning activities.

PO6 – *Co-operation/Team Work and Multicultural Competence*

PSO 6: Uphold leadership qualities, team spirit and good interpersonal skills in team Works for life and for business life.

PO7 –*Moral and Ethical Awareness*

PSO 7: Follow the global standards of codes of conduct in life science community and practice the imbibed moral values in their profession and society to maintain a sustainable environment.

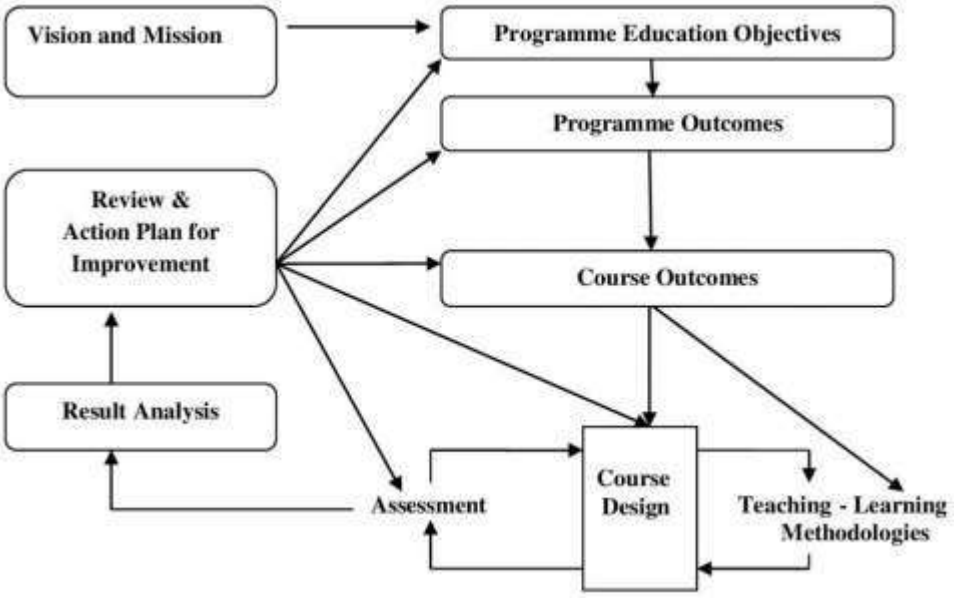
PO-PEO Mapping Matrix

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

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

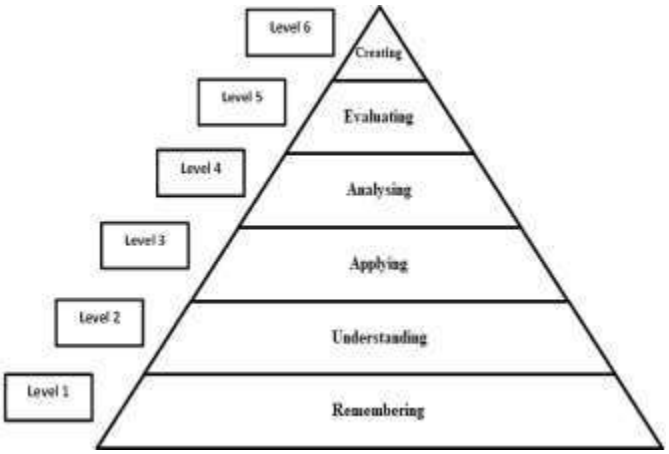
B.1.4 Course Outcomes (COs)

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 and Chemistry 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 Course
Part II	:	English
Part III	:	Core Courses
		Elective Courses • Generic Elective Courses • Discipline Specific Elective Courses
		Self Study Course - online
Part IV	:	Skill Enhancement Courses (SEC)
		Elective Course (NMEC)
		Environmental Studies Value Education
		Field Project/Internship
		Self Study Course - online
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/ National Cadet Corps/ Rotaract Club

B.2 EVALUATION SCHEME

B.2.1. PART II

Components	Internal Assessment Marks	Summative Examination Marks	Total Marks
Theory	15	60	100
Practical	5	15	
Assignment	5	-	

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

B.2.2. Part I & PART III - Core Courses, Elective Courses (Generic, DSEC)

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

INTERNAL ASSESSMENT

Distribution of Marks

Theory

Mode of Evaluation			**Marks**
Periodic Test		:	15
Assignment	K3 Level	:	5
Quiz	K1 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**
Practical Test*	:	30
Record & Performance	:	10
Total	**:**	**40**

*Average of the two Practical Tests will be considered

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

Section	**Q. No.**	**Types of Question**	**No. of Questions**	**No. of Questions to be answered**	**Marks for each Question**	**Total Marks**
A	1 - 4	Multiple Choice	4	4	1	4
B	5 -6	Internal Choice - Either … or Type	3	3	7	21
C	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

SUMMATIVE EXAMINATION

Question Pattern **Duration: 3 Hours**

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

PROJECT

Assessment by Internal Examiner Only

Internal Assessment

Distribution of Marks

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

B.2.3 PART IV - Skill Enhancement Courses, Non Major Elective Courses and Foundation Course

B.2.3.1 FOUNDATATION COURSE

INTERNAL ASSESSMENT
Distribution of Marks
Theory

Mode of Evaluation			**Marks**
Periodic Test		:	15
Assignment	K2 Level	:	5
Quiz	K1 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

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

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

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

SUMMATIVE EXAMINATION

Mode of Evaluation		**Marks**
Summative Examination	:	50
Online Quiz (Multiple Choice Questions - K2 Level)	:	25
Total	**:**	**75**

Question Pattern **Duration: 2 Hours**

Section	**Q.No.**	**Types of Question**	**No. of Questions**	**No. of Questions to be answered**	**Marks for each Question**	**Total Marks**
A	1 - 5	Internal Choice - Either … or Type	5	5	6	30
B	6 - 7	Internal Choice – Either… or Type	2	2	10	20
	Total					**50**

B.2.3.2 Skill Enhancement Course - Entrepreneurial skills

INTERNAL ASSESSMENT ONLY
Distribution of Marks

Mode of Evaluation		**Marks**
Periodic Test	:	15
Assignment	:	5
Quiz	:	5
Model Examinations	:	60
Online Quiz(Multiple Choice Questions - K2 Level)	:	15
Total	**:**	**100**

Question Pattern for Periodic Tests **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**

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

Two Periodic Tests - Better of the two will be considered

Two Assignments - Better of the two will be considered

Two Quiz Tests - Better of the two will be considered

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.2.3.3 Skill Enhancement Courses/ Non Major Elective Courses

INTERNAL ASSESSMENT

Distribution of Marks

Theory

Mode of Evaluation			**Marks**
Periodic Test		:	15
Assignment	K3 Level	:	5
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

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

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

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

SUMMATIVE EXAMINATION

Mode of Evaluation		**Marks**
Summative Examination	:	50
Online Quiz (Multiple Choice Questions - K2 Level)	:	25
Total	**:**	**75**

Question Pattern **Duration: 2 Hours**

Section	Q.No.	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A	1 - 5	Internal Choice - Either … or Type	5	5	6	30
B	6 - 7	Internal Choice – Either… or Type	2	2	10	20
	Total					**50**

B.2.4 PART IV- ENVIRONMENTAL STUDIES / VALUE EDUCATION

INTERNAL ASSESSMENT ONLY

Evaluation Pattern

Mode of Evaluation		Marks
Periodic Test	:	15
Assignment - K3 Level	:	10
Online Quiz (Multiple Choice Questions - K2 Level)	:	25
Poster Presentation - K3 Level		10
Report - K3 Level		10
Model Examination	:	30
Total	**:**	**100**

Three Assignment - Best of the three will be considered

Question Pattern for Periodic Tests **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***

Two Periodic tests - Better of the two will be considered

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

Question Pattern for Model Examination **Duration: 2 ½ Hours**

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

*The total marks obtained in the Model Examination will be calculated for 30 marks

B. 2. 5 PART IV- Internship / Industrial Training

- Internship / Industrial Training is mandatory for all the Students
- **Internship:** Students have to involve in a designated activity, working in an organization under the guidance of an identified mentor for a period of 15 days.
- **Industrial Training:** Student has to undertake in-plant training in industries individually or in group for a period of 15 days.
- Internship / Industrial Training must be done during the fourth semester holidays
- **Internal Assessment only.**

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

B.2.6 SELF STUDY COURSE

B.2.6.1 PART III - Discipline Specific Quiz – Online

- Assessment by Internal Examiner only
- Question Bank is prepared by the Faculty Members of the Departments for all the Core and Elective Courses offered in all the Semesters.
- 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	:	25
Model Examination	:	75
Total	**:**	**100**

Two Periodic Tests - Better of the two will be considered

B.2.6 .2 PART IV - 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	:	25
Model Examination	:	75
Total	**:**	**100**

Two Periodic Tests - Better of the two will be considered

B.2.7. Part V – Extension Activities

INTERNAL ASSESSMENT 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 marks

B.2.8 EXTRA CREDIT COURSES (OPTIONAL)

2.8.1 Extra Credit Course offered by the Department.

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

Distribution of Marks

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

Question Pattern for Model Examination

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

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

- The Courses shall be completed within the first V Semesters of the Programme.
- The allotment of credits is as follows **(Maximum of 10 credits)**

4weeks Course - 1 credit

8 weeks Course - 2 credits

12 weeks Course - 3 credits

ELIGIBILITY FOR THE DEGREE

- The candidate will not be eligible for the Degree without completing the prescribed Courses of study, lab work, *etc.,* and a minimum Pass marks in all the Courses.
- No Pass minimum for Internal Assessment for all the Courses.
- Pass minimum for External Examination is 27 marks out of 75 marks for Core Courses, Elective Courses (Generic Elective, DSEC Courses)
- Pass minimum for External Examination is 18 marks out of 50 marks for Skill Enhancement Courses and Non Major Elective Courses (NMEC).
- The aggregate minimum pass percentage is 40.
- Pass minimum for External Practical Examination is 21 marks out of 60 marks.

- Attendance

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.

B.3 ASSESSMENT MANAGEMENT PLAN

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

B.3.1 Assessment Process for CO Attainment

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

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

Indirect Assessment – Done through Course Exit Survey.

CO Assessment Rubrics

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

CO Attainment

Direct CO Attainment

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

Target Setting for Assessment Method

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

Formula for Attainment for each CO

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

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

Attainment Levels of COs

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

Indirect CO Attainment

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

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

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

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

B.3.2 Assessment Process for Overall PO Attainment

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

PO Assessment Tools

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

Programme Articulation Matrix (PAM)

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

Indirect Attainment of POs for all Courses

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

Attainments of POs for all Courses

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

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

Expected Level of Attainment for each of the Programme Outcomes

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

Level of PO Attainment

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

B.3.3 Assessment Process for PEOs

The curriculum is designed so that all the Courses contribute to the achievement of PEOs. The attainment of PEOs is measured after 5 years of completion of the Programme only through indirect methods.

Target for PEO Attainment

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

Attainment of PEOs

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

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

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

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

Expected Level of Attainment for each of the Programme Educational Objectives

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

Level of PEO Attainment

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

C. PROCESS OF REDEFINING THE PROGRMME EDUCATIONAL OBJECTIVES

The College has always been involving the key stakeholders in collecting information and suggestions with regard to curriculum development and curriculum revision. Based on the information collected the objectives of the Programme are defined, refined and are inscribed in the form of PEOs. The level of attainment of PEOs defined earlier will be 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. Biochemistry Programme.

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BACHELOR OF SCIENCE BIOCHEMISTRY (2021)

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

Components	Semester						Total Number of Hours (Credits)
	I	II	III	IV	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, Elective Courses & Self Study Course							
Core Course	5 (5)	5 (5)	5 (5)	4 (4)	5 (5)	5 (5)	29 (29)
Core Course	-	-	-	-	5 (5)	5 (5)	10 (10)
Core Course	-	-	-	-	5 (5)	5 (5)	10 (10)
Core Course Practical	3 (2)	3 (2)	3 (2)	3 (2)	3 (2)	3 (2)	18 (12)
Core Course Project	-	-	-	-	1 (1)	-	1(1)
Elective Course (DSEC)	-	-	-	-	5 (3)	5 (4)	10 (7)
Elective Course (DSEC)	-	-	-	-	4 (3)	5 (3)	9 (6)
Elective Course I (Allied)	4 (3)	4 (3)	-	-	-	-	8 (6)
Elective Course I Practical I (Allied)	2 (1)	2 (1)	-	-	-	-	4 (2)
Elective Course II (Allied)	-	-	4 (3)	4 (3)	-	-	8 (6)
Elective Course II Practical II (Allied)	-	-	2 (1)	2 (1)	-	-	4 (2)
Self Study Course	-	-	-	-	-	0 (1)	0 (1)
Part IV : Skill Enhancement Courses, Elective Courses, , Environmental Studies, Value Education, Self Study Course &Internship/ Industrial Training							
SEC	2 (2)	-	1 (1)	2 (2)	-	-	5 (5)
SEC	-	2 (2)	2 (2)	2 (2)	-	2 (2)	8 (8)
Elective Course(NME)	2 (2)	2 (2)	-	-	-	-	4 (4)
Value Education	-	-	-	-	2 (2)	-	2 (2)
Environmental Studies	-	-	1 (0)	1 (2)	-	-	2 (2)
Self Study Course	-	-	-	-	0 (1)	-	0 (1)
Internship/ Industrial Training	-	-	-	-	0 (1)	-	0 (1)
Part V : Extension Activities	-	-	-	-	-	0 (1)	0 (1)
Total	**30 (21)**	**30 (21)**	**30 (20)**	**30 (22)**	**30 (28)**	**30 (28)**	**180 (140)**
Extra Credit Course (Self Study Course)	-	-	-	-	0 (2)	-	0 (2)

DSEC: Discipline Specific Elective Course SEC: Skill Enhancement Course

NMEC: Non Major Elective Course

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B.Sc. Biochemistry
SEMESTER V

S.No.	Components		Title of the Course	Course Code	Hours Per Week	Credits	Exam. Hours	Marks		
								Int.	Ext.	Total
1.	**Part III**	Core Course-5	Enzymes	23UBCC51	5	5	3	25	75	100
2.		Core Course-6	Intermediary Metabolism	23UBCC52	5	5	3	25	75	100
3.		Core Course- 7	Clinical Biochemistry	23UBCC53	5	5	3	25	75	100
4.		Core Course Practical - 5	Clinical Biochemistry Practical	23UBCC51P	3	2	3	40	60	100
5.		Core Course Project	Project	23UBCC54PR	1	1	-	100	-	100
6.	**Part III**	Elective Course-1 (DSEC-1)	Immunology /Bioinformatics	23UBCE51/ 23UBCE52	5	3	3	25	75	100
7.		Elective Course-2 (DSEC-2)	Research Methodology/ Genetics	23UBCE53/ 23UBCE54	4	3	3	25	75	100
8.	**Part IV**		Value Education	23UVEG51	2	2	2	100	-	100
9.		Self Study Course	Practice for Competitive Examinations	23UGCE51	-	1	-	100	-	100
10.		Internship/ Industrial Training	Internship	23UBCI51	-	1	-	100	-	100
				Total	**30**	**28**				**1000**
11.	Extra Credit Course (Self Study Course)		First Aid	23UBCO51	-	2	3	100	-	100

SEMESTER VI

S. No.	Components		Title of the Course	Course Code	Hours Per Week	Credits	Exam. Hours	Marks		
								Int.	Ext.	Total
1.	**Part III**	Core Course -8	Molecular Biology	23UBCC61	5	5	3	25	75	100
2.		Core Course -9	Human Physiology	23UBCC62	5	5	3	25	75	100
3.		Core Course - 10	Plant Biochemistry and plant Therapeutics	23UBCC63	5	5	3	25	75	100
4.		Core Course Practical - 6	Molecular Biology and Haematology Practical	23UBCC61P	3	2	3	40	60	100
5.		Elective Course-3 (DSEC-3)	Biotechnology/ Molecular Biophysics	23UBCE61/ 23UBCE62	5	4	3	25	75	100
6.		Elective Course-4 (DSEC-4)	Biochemical Pharmacology/ Biofertilizers and Biopesticides	23UBCE63/ 23UBCE64	5	3	3	25	75	100
7.		Self Study Course	Discipline Specific Quiz - online	23UBCQ61	-	1	-	100	-	100
8.	**Part IV**	SEC – 7	Medical Coding	23UBCS61	2	2	2	25	75	100
9.	**Part V**		Extension Activities		-	1	-	100	-	100
				Total	**30**	**28**				**900**

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B.Sc. Biochemistry
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Semester V	**ENZYMES**	Hours/Week: 5	
Core Course 5		Credits: 5	
Course Code 23UBCC51		Internal 25	External 75

COURSE OUTCOMES

On completion of this course, students will be able to

CO1 : understand the basic principles of enzyme function, nomenclature, and classification. [K1]

CO2 : explain the mechanism of enzyme catalysis and factors affecting enzyme activity.and enzyme kinetics. [K2]

CO3 : describe the enzyme kinetics principles to analyze enzyme behavior and reaction rates. [K2]

CO4 : assess the different types of enzyme inhibition and their impact on enzyme activity. [K3]

CO5 : analyze the role of enzyme expression units, turnover number, and specific activity in enzyme research. [K3]

Unit I: Introduction to enzymes: Nomenclature and Classification based on IUB with examples, enzyme as catalyst-Activation energy, Enzyme specificity-absolute, Group, linkage and stereo specificities. Concept of Active site, Lock and key hypothesis and induced fit theory, Enzyme expression Units-IU, turnover number, katal and specific activity. (15 Hours)

Unit II: Mechanism of enzyme catalysis – Acid Base catalysis, covalent catalysis,electrostatic catalysis, metal ion catalysis, proximity and orientation effect. Coenzymes -Definition, types, co-enzymatic forms of vitamins- NAD/NADP, FAD, FMN, Coenzyme A TPP, PLP, lipoic acid and biotin. Multi enzyme complexes - Pyruvate dehydrogenase complex. Isoenzyme with reference to LDH and CK. (15 Hours)

Unit III: Enzyme kinetics --Definition of kinetics, Factors affecting enzyme activity - temperature, pH, substrate and enzyme concentration, activators-cofactors, Derivation of Michaelis - Menton equation for uni substrate reactions , Line weaver - Burk plot, Eadie – Hofstee plot. Significance of Km and V max and their determination using the plots. (15 Hours)

Unit IV: Enzyme inhibition - Reversible and irreversible inhibition-types of reversible inhibitors, competitive, non-competitive, un-competitive inhibitors. Graphical representation by L-B plot, (Kinetic derivations not required), Determination of Km and Vmax in the presence and absence of inhibitors. Allosteric enzymes - Sigmoidal curve, positive and negative modulators.

(15 Hours)

Unit V: Applications of enzymes -Immobilized enzymes - methods of immobilization-adsorption, covalent bonding, crosslinking, encapsulation, entrapment and applications of immobilized enzymes. Biosensors – e.g. Glucose sensors. Industrial applications of enzymes – Food, textile and pharmaceutical industries.

(15 Hours)

Textbooks

1. Sathyanarayana, U., & Chakrapani, U. (2013). *Biochemistry* (4th ed.). Elsevier India Pvt. Ltd.; Books & Allied Pvt. Ltd.
2. Agarwal, G. R., Agarwal, K., & Agarwal, O. P. (2015). *Textbook of biochemistry (physiological chemistry)* (18th ed.). Goel Publishing House.
3. Devasena, T. (2010). *Enzymology* (1st ed.). Oxford University Press.

Reference Books

1. Palmer, T. (2008). *Enzymes: Biochemistry, biotechnology, clinical chemistry* (2nd ed.). East West Press Pvt. Ltd.
2. Nelson, D. L., & Cox, M. M. (2005). *Principles of biochemistry* (4th ed.). W. H. Freeman and Company.
3. Voet, D., Voet, J. G., & Pratt, C. W. (2004). *Principles of biochemistry* (4th ed.). John Wiley & Sons, Inc.
4. Zubay, G. L., Parson, W. W., & Vance, D. E. (1995). *Principles of biochemistry* (1st ed.). Wm. C. Brown Publishers.

Web resources

www.biologydiscussion.com/notes/enzymes notes

https://www.britannica.com/science/protein/The-mechanism-of-enzymatic-action

https://www.youtube.com/watch?v=oVJ2LJxO6tU

Course Code (23UBCC51)	**PO1**	**PO2**	**PO3**		**PO4**		**PO5**		**PO6**	**PO7**
	PSO 1	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4a**	**PSO 4 b**	**PSO 5a**	**PSO 5b**	**PSO 6**	**PSO 7**
CO 1	3	3	3	3	2	2	3	3	3	3
CO 2	3	3	3	2	3	2	3	2	2	3
CO 3	3	3	2	2	2	2	3	3	2	3
CO 4	3	3	3	2	3	2	3	3	3	3
CO 5	3	2	3	3	3	2	3	3	3	3

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

Dr.P.Annapoorani
Head of the Department

Mrs.M.Sharmila Devi
Course Designer

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Semester V	**INTERMEDIARY METABOLISM**	Hours/Week: 5	
Core Course 6		Credits: 5	
Course Code 23UBCC52		Internal 25	External 75

COURSE OUTCOMES

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

CO1 : recall the fundamental concepts of bioenergetics, carbohydrate, lipid, amino acid, and nucleotide metabolism. [K1]

CO2 : explain the biochemical pathways of energy production and macromolecule metabolism. [K2]

CO3 : describe the interconnections between metabolic pathways and their role in maintaining cellular homeostasis. [K2]

CO4 : apply knowledge of metabolic pathways to understand energy balance, biosynthesis, metabolism in biological systems and its regulatory mechanisms.. [K3]

CO5 : Illustrate the bioenergetics, biological oxidation, enzyme regulation and biochemical adaptations in metabolism under physiological and pathological conditions. [K3]

Unit I: Bioenergetics-High energy compounds: Role of high energy compounds, free energy hydrolysis of ATP and other organophosphates, ATP-ADP cycle.

Biological Oxidation: Electron transport chain -its organization and function. Inhibitors of ETC. Oxidative phosphorylation, P/Oratio, Peter Mitchell's chemiosmotic hypothesis. Mechanism of ATP synthesis, uncouplers of oxidative phosphorylation, substrate level phosphorylation with examples. (15 Hours)

Unit II: Metabolism of carbohydrates -Glycolysis, TCA Cycle, Amphibolic nature and integrating role of TCA cycle. Anaplerosis, Pentose Phosphate Pathway (HMP shunt), Gluconeogenesis, Glycogenesis, Glycogenolysis and its regulation, glyoxylate cycle, Entner-Doudoroff pathway and Cori cycle. (15 Hours)

Unit III: Metabolism of lipids -Oxidation of fatty acids - α, β and ω -oxidation of saturated fatty acids, Oxidation of fatty acids with odd number of carbon atoms and unsaturated fatty acids, Ketogenesis, Biosynthesis of saturated fatty acids and unsaturated fatty acids, Biosynthesis and degradation of triglycerides, phospholipids and cholesterol. (15 Hours)

Unit IV: Metabolism of amino acid- Metabolic nitrogen pool, Catabolism of amino acid: Oxidative deamination, non – oxidative deamination, transamination and decarboxylation, Biogenic amines, Urea cycle and its regulation. (15 Hours)

Unit V: Metabolism of nucleotides-Biosynthesis of purines and pyrimidines, - de novo synthesis and salvage pathways, Degradation of purines and pyrimidines, Conversion of ribo nucleotide to deoxyribo nucleotide (15 Hours)

Textbooks

1. Sathyanarayana, U., & Chakrapani, U. (2015). *Biochemistry* (4th ed.). Elsevier India Pvt. Ltd.
2. Chatterjea, M. N., & Shinde, R. (2002). *Textbook of medical biochemistry* (5th ed.). Jaypee Brothers Medical Publishers Pvt. Ltd.

Reference Books

1. Nelson, D. L., & Cox, M. M. (2008). *Lehninger principles of biochemistry* (5th ed.). W. H. Freeman and Company.
2. Murray, R. K., Granner, D. K., & Rodwell, V. W. (2006). *Harper's illustrated biochemistry* (27th ed.). McGraw Hill Publishers.
3. Voet, D., Voet, J. G., & Pratt, C. W. (2010). *Principles of biochemistry* (4th ed.). John Wiley & Sons, Inc.
4. Zubay, G. L., Parson, W. W., & Vance, D. E. (1995). *Principles of biochemistry* (2nd ed.). Wm. C. Brown Publishers.
5. Garrett, R. H., & Grisham, C. M. (2005). *Biochemistry* (3rd ed.). Thomson Learning Inc.

Web resources

1.https://nptel.ac.in/courses/104/105/104105102/

2.http://www.nptelvideos.in/2012/11/biochemistry-i.html

3.https://www.saddleback.edu/faculty/jzoval/mypptlectures/ch15_metabolism/lecture_notes_ch15_metabolism_current-v2.0.pdf

Course Code (23UBCC52)	**PO1**	**PO2**	**PO3**		**PO4**		**PO5**		**PO6**	**PO7**
	PSO 1	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4a**	**PSO 4 b**	**PSO 5a**	**PSO 5b**	**PSO 6**	**PSO 7**
CO 1	3	3	3	2	2	2	2	3	2	1
CO 2	3	3	3	2	2	2	2	3	2	1
CO 3	3	3	3	2	3	2	3	3	2	1
CO 4	3	3	3	2	3	2	2	3	2	1
CO 5	3	3	3	2	3	2	3	3	2	2

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

Dr.P. Annapoorani
Head of the Department

Dr. P.Annapoorani
Dr.R.Salini
Course Designers

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Semester V	**CLINICAL BIOCHEMISTRY**	Hours/Week: 5	
Core Course 7		Credits: 5	
Course Code 23UBCC53		Internal 25	External 75

COURSE OUTCOMES

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

CO1 : explain the basic concepts of carbohydrate and lipid metabolic disorders and its diagnostic methods. [K1]

CO2 : describe the liver, kidney and gastric functions and specific diagnostic methods used for biological sample. [K2]

CO3 : assess the role of enzyme markers in clinical diagnostic studies. [K2]

CO4 : apply the knowledge of aetiology , pathology, diagnosis and interpretation of diseases which helpful the students for further employment in basic research and the health profession. [K3]

CO5 : infer the variations in the levels of biochemical constituents and their relationship with various diseases. [K3]

UNIT I : Disorders of carbohydrate metabolism: Maintenance of blood glucose by hormone with special reference to insulin and glucagon. Abnormalities in glucose metabolism: Diabetes mellitus- types, causes, biochemical manifestations, diagnosis and treatment, glycated hemoglobin. Inborn errors of carbohydrate metabolism, glycosuria, Fructosuria, Pentosuria, Galactosemia and Glycogen storage diseases. (15 Hours)

UNIT II: Disorders of Lipid Metabolism**:** Lipid Profile, Atherosclerosis, Fatty liver and hyperlipidemia. Hypercholesterolemia, Lipidosis and Xanthomatosis, Tay-Sach`s disease, Niemann-Pick disease, lipotropic agents. (15 Hours)

UNIT III: Liver Function Tests**:** Bilirubin metabolism and jaundice, Estimation of conjugated and total bilirubin in serum (Diazo method). Detection of bilirubin and bile salts in urine (Fouchet's test and Hay's Sulphur test). Thymol turbidity test, prothrombin time, serum enzymes in liver disease serum transaminases (SGPT & SGOT) and lactate dehydrogenase (LDH).

Kidney Function Tests**:** Measurement of urine pH, volume, specific gravity, osmolality, sediments in urine, inulin, urea and creatinine clearance tests. Concentration and dilution tests. Phenol red test. Levels of plasma protein and its significance related to kidney function. Proteinuria. (15 Hours)

UNIT IV: Gastric Function test: Composition of gastric juice, collection of gastric contents, examination of gastric residuum, fractional test meal (FTM), stimulation test-alcohol and histamine stimulation, Tubeless gastric analysis. (15 Hours)

UNIT V: Clinical enzymology**:** Enzymes of diagnostic importance- LDH, creatine kinase, transaminases, phosphatases, Isoenzymes of lactate dehydrogenase. (15 Hours)

Textbooks

1. Chatterjee, M. N., & Shinde, R. (2012). *Text book of medical biochemistry* (8th ed.). Jaypee Brothers Medical Publishers (P) Ltd.
2. Shanmugam, A. (2016). *Biochemistry for medical students* (8th ed.). Wolters Kluwer India Pvt. Ltd.

Reference Books

1. Mayne, P. D. (1994). *Clinical chemistry in diagnosis and treatment* (6th ed.). ELBS Publication.
2. Devlin, T. M. (2014). *Text book of biochemistry with clinical correlations* (7th ed.). John Wiley & Sons.
3. Tietz, N. W. (2014). *Fundamentals of clinical chemistry and molecular diagnostics* (7th ed.). Saunders.

Course Code (23UBCC53)	**PO1**	**PO2**	**PO3**		**PO4**		**PO5**		**PO6**	**PO7**
	PSO1	**PSO2**	**PSO 3a**	**PSO 3b**	**PSO 4a**	**PSO 4 b**	**PSO 5a**	**PSO 5b**	**PSO 6**	**PSO 7**
CO 1	3	3	3	3	2	2	2	3	2	2
CO 2	3	3	3	3	2	3	2	3	2	2
CO 3	3	3	3	3	3	3	3	3	3	3
CO 4	3	3	3	3	3	3	3	3	3	3
CO 5	3	3	3	3	3	3	3	3	3	3

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

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

Mrs.P.Ramalakshmi — **Course Designer**

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Quality Education with Wisdom and Values

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

Semester V	**CLINICAL BIOCHEMISTRY PRACTICAL**	Hours/Week: 3	
Core Course Practical - 5		Credits: 2	
Course Code 23UBCC51P		Internal 40	External 60

COURSE OUTCOMES

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

CO1: describe the principles and procedures in qualitative and quantitative determination of unknown constituents in the biological samples. [K2]

CO2: estimate the concentration of unknown components in the biological samples. [K2]

CO3: predict the normal and abnormal parameters of biological samples using colorimetry and other basic biochemical and hematological methods. [K3]

CO4: calculate the results for the colorimetry, hematology, and enzyme assays of biological samples and to complete the record work. [K3]

CO5: determine the normal and abnormal parameters of biological samples analyzed by colorimetry and other basic biochemical methods for enzyme assay hematological experiments. [K3]

1. Collection and preservation of blood and urine samples.
2. Estimation of creatinine by Jaffe's method (serum & urine)
3. Estimation of urea by diacetyl monoxime method (serum & urine)
4. Estimation of uric acid (serum & urine)
5. Estimation of cholesterol by Zak's method
6. Estimation of Glucose by Ortho Toluidine method
7. Estimation of Protein by Lowry's method
8. Estimation of Hemoglobin by Shali's/Drabkins method

9. Assay of SGPT and SGOT
10. Qualitative analysis of normal constituents of urine

Urea, Creatinine, Phosphorus, Calcium

Abnormal constituents

a) Calcium

b) Sugar (Glucose, fructose, pentose)

c) Protein

d) Aminoacids (Tyrosine, Histidine, Tryptophan)

e) Ketone bodies

f) Bile pigments with clinical significance.

Textbooks

1. Manickam, S. S. (2018). *Biochemical methods* (3rd ed.). New Age International Pvt Ltd Publishers.
   ISBN 10: 8122421407 / ISBN 13: 9788122421408
2. Plummer, D. T. (1971). *An introduction to practical biochemistry*. Tata McGraw Hill. ISBN: 97800708416
3. Gowenlock, A. H. (1998). *Varley's practical clinical biochemistry* (6th ed.). CBS Publishers, India.
4. Godkar, B. (2020). *Textbook of medical laboratory technology* (Vols. 1 & 2, 3rd ed.). Bhalani Publishers.
5. Mukerjee, K. L. (1996). *Medical lab technology* (Vols. I & II, 1st ed.). Tata McGraw Hill.
6. Chawla, R. (2014). *Practical clinical biochemistry: Methods and interpretations* (4th ed.). Jaypee Brothers Medical Publishers.

Reference Books

1. Singh, S. K. (2005). *Introductory practical biochemistry* (2nd ed.). Alpha Science International,Ltd.
   ISBN 10: 8173193029 / ISBN 13: 9788173193026
2. Ashwood, E. R., & Poole, C. F. (2001). *Tietz fundamentals of clinical chemistry*. WB Saunders Company; Oxford Science Publications, USA.ISBN 10: 0721686346 / ISBN 13: 978072168634

Web resources

1. https://www.elsevier.com/journals/clinical-biochemistry/0009-9120/guide-for-authors
2. http://rajswasthya.nic.in/RHSDP%20Training%20Modules/Lab.%20Tech/Biochemistry/Dr.%20Jagarti%20Jha/Techniques%20In%20Biochemistry%20Lab.pdf

3.https://dspace.cuni.cz/bitstream/handle/20.500.11956/111493/Clinical_biochemistrypdf.pdf?sequence=1&isAllowed=y

4.https://dspace.cuni.cz/bitstream/handle/20.500.11956/111493/Clinical_biochemistrypdf.pdf?sequence=1&isAllowed=y *

Course Code (23UBCC51P)	**PO1**	**PO2**	**PO3**		**PO4**		**PO5**		**PO6**	**PO7**
	PSO 1	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4a**	**PSO 4 b**	**PSO 5a**	**PSO 5b**	**PSO 6**	**PSO 7**
CO 1	3	3	3	3	3	3	3	2	2	3
CO 2	3	3	3	3	3	3	3	2	2	3
CO 3	3	3	3	3	3	3	3	2	2	3
CO 4	3	3	3	3	3	3	3		2	3
CO 5	3	3	3	3	3	3	3	2	2	3

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

Mrs. M.Rajakumari
Dr.P. Annapoorani Dr.R.Salini
Head of the Department **Course Designer**

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B.Sc. Biochemistry
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Semester V	**PROJECT**	Hours/Week: 1
Core Course Project		Credits: 1
Course Code 23UBCC54PR		Internal 100

COURSE OUTCOMES

On completion of the Project, students will be able to

CO1: understand the theoretical knowledge to analyse the biological samples. [K2]

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

CO3 : experiment the technical skills in handling the equipments during the analysis of the Biological samples. [K3]

CO4: utilize the results of the project work that is being executed and to correlate them for improving the society. [K3]

CO5: analyze the experiments carried out during the project work and conclude the findings with the existing results.[K4]

Students are expected to select a project in the field of Biochemistry, biology and related interdisciplinary fields. 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.

Project work & Report - 60 marks

Presentation & Viva-voce - 40 marks

Course Code 23UBCC54PR	**PO1**	**PO2**	**PO3**		**PO4**		**PO5**		**PO6**	**PO7**
	PSO 1	**PSO 2**	**PSO 3.a**	**PSO 3.b**	**PSO 4a**	**PSO 4 b**	**PSO 5a**	**PSO 5b**	**PSO 6**	**PSO 7**
CO 1	3	3	2	3	3	2	3	3	3	1
CO 2	3	2	3	3	3	3	3	3	3	1
CO 3	3	3	2	3	3	3	3	3	3	2
CO 4	3	3	3	3	2	3	3	3	2	2
CO 5	3	3	3	2	3	3	3	2	3	3

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

Dr.P.Annapoorani
Head of the Department

Dr. P. Annapoorani
Course Designer

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Semester V	**IMMUNOLOGY**	Hours/Week: 5	
DSEC -1		Credits: 3	
Course Code 23UBCE51		Internal 25	External 75

COURSE OUTCOMES

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

CO1: describe the structure and functions of major lymphatic systems including biochemical and cellular mechanisms for maintaining homeostasis and the reasons for vaccination [K1]

CO2: outline, compare and contrast the key mechanisms and cellular players of innate and adaptive immunity and how they relate and the types of vaccines [K2]

CO3**:** explain the principle of Ag-Ab interaction in various immunoassay techniques to identify antigens and antibodies and to know their applications in diagnosis of various diseases [K2]

CO4: illustrate how the immune responses by CD4 and CD8 T cells and B cells are initiated and regulated in various immune reactions such as hypersensitivity, autoimmune diseases and transplantation reactions. [K3]

CO5: relate the basic immunological principles in research and in clinical diagnosis/ applied science [K3]

UNIT I: Structure and function of primary lymphoid organs (thymus, bone marrow), secondary lymphoid organs (spleen, lymph node), Cells involved in immune system-Functions-Phagocytosis-Inflammation. (15 Hours)

UNIT II: Antigens - Nature, Immunogens, haptens, cross reactions -Immunoglobulin- types-structure and function. Cells involved in antibody formation, Clonal selection theory, Co-operation of T-cell with B-cell. Differentiation of T and B lymphocyte - Humoral and cell mediated immunity. Monoclonal antibody – Production and application in biology. (15 Hours)

UNIT III: Immunity and its types-Innate, Acquired, active and passive. - Natural and Artificial - Commonly used toxoid vaccines, killed vaccines, live attenuated vaccines, rDNA Vaccines, DNA and subunit vaccines (15 Hours)

UNIT IV: Hypersensitivity – Immediate (Type 1) and Delayed (Type IV), Auto- immune diseases with examples. Organ specific and systemic autoimmunity. SLE, RA. Transplantation – Types of Grafts, structure and functions of MHC, graft Vs host reaction, immunosuppressive Agents. (15 Hours)

UNIT V: Antigen-antibody reactions, General features of Antigen Antibody reactions. Precipitation, Immuno- diffusion, SID and DID -Oudin Procedure, Oakley Fulthorpe Procedure, radio- immunodiffusion, Ouchterlony double diffusion, CIE, Rocket electrophoresis, Agglutination-Coomb's test Complement Fixation test-Wasserman's reaction, RIA, ELISA.

(15 Hours)

Textbooks

1. Kuby, J. (2018). *Immunology* (5th ed.). W.H. Freeman. ISBN-10: 1319114709 / ISBN-13: 978-1319114701
2. Rao, C. V. (2017). *Immunology* (3rd ed.). Alpha Science International Ltd. ISBN-10: 1842652559 / ISBN-13: 978-1842652558
3. Tizard, I. (1995). *An introduction to immunology*. Harcourt Brace College Publications.

Reference Books

1. Murphy, K. M., Travers, P., & Walport, M. (2007). *Janeway's immunobiology* (7th ed.). Garland Science.
2. Abbas, A. K., Lichtman, A. H., & Pober, J. S. (1994). *Cellular and molecular immunology* (2nd ed.). B. Saunders Company.
3. Abbas, A., Lichtman, A., & Pillai, S. (2019). *Basic immunology: Functions and disorders of the immune system* (6th ed.). Elsevier. ISBN: 9780323549431 (eBook: 9780323639095)
4. Delves, P., Martin, S., Burton, D., & Roitt, I. (2006). *Roitt's essential immunology* (11th ed.). Wiley-Blackwell.

Web resources

1. https://onlinecourses.nptel.ac.in/noc22_bt40/preview
2. https://onlinecourses.swayam2.ac.in/cec20_bt05/preview
3. https://youtu.be/8uahFPl6ny8

Course Code (23UBCE51)	PO1	PO2	PO3		PO4		PO5		PO6	PO7
	PSO 1	PSO 2	PSO 3a	PSO 3b	PSO 4a	PSO 4b	PSO 5a	PSO 5b	PSO 6	PSO 7
CO 1	3	3	3	3	2	2	2	3	2	2
CO 2	3	3	3	3	2	3	2	3	2	2
CO 3	3	3	3	3	3	3	3	3	3	3
CO 4	3	3	3	3	3	3	3	3	3	3
CO 5	3	3	3	3	3	3	3	3	3	3

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

Dr. P. Annapoorani
Head of the Department

Dr. R.Renuka
Course Designer

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Semester V	**BIOINFORMATICS**	Hours/Week: 5	
DSEC -1		Credits: 3	
Course Code 23UBCE52		Internal 25	External 75

COURSE OUTCOMES

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

CO1 : write the basic concepts of bioinformatics, networks, databases, various alignment techniques and genome sequencing [K1]

CO2 : understand the concept of bioinformatics, databases, sequence alignment techniques, metabolomics and genomics databases and tools [K2]

CO3 : outline the overview of database, sequence alignment, usage of Matrix, application of bioinformatics in genomics and metabolomics. [K2]

CO4 : apply the concept about alignment algorithms, matrix, biological databases, BLAST and molecular visualization tools. [K3]

CO5 : relate the role of bioinformatics, pairwise database searching tools, sequence alignment techniques, metabolomics and genomics databases and tools [K3]

Unit I: Introduction to Bioinformatics – Bioinformatics and its applications. –Genome, Metabolome-Definition and its applications. Metabolome-Metabolome database-E.coli metabolome database, Human Metabolome database.Transcriptome-Definition and applications. (15 Hours)

Unit II : Biological Databases - definition, types and examples –, Nucleotide sequence database (NCBI, EMBL, Genebank, DDBJ) Protein sequence database- SwissProt, TrEMBL, Structural Database-PDB,Metabolic database-KEGG (15 Hours)

Unit III: Sequence Alignment-Local and Global alignment-Dot matrixanalysis, PAM, BLOSUM. Dynamic Programming, Needleman- Wunch algorithm, Smith waterman algorithm. Heuristic methods of sequence alignment (15 Hours)

Unit IV : BLAST-features, types (BLASTP, BLASTN, BLASTX), PSI BLAST, result format. DNA Microarray-Procedure and applications. (15 Hours)

Unit V: Structural genomics-Whole genome sequencing (Shotgun approach), Comparative genomics-tools for genome comparison, VISTA servers and pre computed tools. Molecular visualization tools. RASMOL, Swiss PDB viewer. Nutrigenomics-Definition and applications (15 Hours)

Textbooks

1. Jiang, R., Zhang, X., & Zhang, M. Q. (2013). *Basic of bioinformatics*. Tsinghua University Press, Beijing, Springer.
2. Choudhuri, S. (2014). *Bioinformatics for beginners: Genes, genomes, molecular evolution, databases and analytical tools*.Academic Press. Elsevier
3. Kumaresan, V., Sangaralingam, R. (2021). *Bioinformatics*. Saras Publication.
4. Lesk, A. (2019). *Introduction to bioinformatics*. 5th edition OUP Oxford.

Reference Books

1. Balamurugan, S., Krishnan, A. T., Goyal, D., & Chandrasekaran, B. (2021). *Computation in bioinformatics: Multidisciplinary applications*. Scrivener Publishing, Wiley.
2. Sharma, N., Ojha, H., Raghav, P., & Goyal, R. K. (2021). *Chemoinformatics and bioinformatics in the pharmaceutical sciences*. Academic Press.

Web resources

1. https://nptel.ac.in/courses/102/106/102106065/
2. http://www.digimat.in/nptel/courses/video/102106065/L65.html
3. https://www.slideshare.net/sardar1109/bioinformatics-lecture-notes

Course Code (23UBCE52)	PO1	PO2	PO3		PO4		PO5		PO6	PO7
	PSO 1	PSO 2	PSO 3a	PSO 3b	PSO 4a	PSO 4b	PSO 5a	PSO 5b	PSO 6	PSO 7
CO 1	3	3	2	2	3	2	3	3	3	1
CO 2	3	3	2	2	3	3	3	3	2	1
CO 3	3	3	3	3	3	3	3	3	3	1
CO 4	3	3	3	3	3	3	3	3	3	3
CO 5	3	3	3	3	3	3	3	3	3	3

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

Dr.P. Annapoorani
Head of the Department

Dr.R.Salini
Course Designer

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Semester V	**RESEARCH METHODOLOGY**	Hours/Week: 4	
DSEC-2		Credits: 3	
Course Code 23UBCE53		Internal 25	External 75

COURSE OUTCOMES

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

CO1 : recall the characteristics, types of research, experimental design, statistical analysis, computer and scientific writing. [K1]

CO2 : explain the research design in biochemistry, literature search, analysis of data and data documentation. [K2]

CO3 : describe the research problem, designing biological experiment, statistical analysis Methods, computer and statistical analysis. [K2]

CO4 : identify the uses of research design, experimental design, statistical analysis, M.S.Office and literature search to analyse data. [K3]

CO5: apply the research knowledge to identify the research methods, Databases, Interpret statistics, Interpret graphs and charts and also writing the article for research publications. [K3]

UNIT I: Characteristics and types of Research, Research Methods versus Methodology, Research designs in Biochemistry: experimental, *in vitro, in vivo, in situ*, clinical trials. Identification and criteria of selecting a research problem (Hypothesis); Formulation of objectives; Research plan and its components. (12 hours)

UNIT II: Experimental design- Objective, Design of work, Guidelines for design of experiments, Literature Search - Databases for literature search, Material and methods, Designing biological experiments, Compilation and documentation of data. (12 hours)

UNIT III: Statistical Analysis: Measures of variation - standard deviation, Non-linear regression, Standard error. Analysis of variance for one-way and two-way classified data and multiple comparison procedures. Significance - students "t" test, chi-square test. Dunnet's test (12 hours)

UNIT IV: Computer and its role in research: Basics of MS word, MS Excel: tabulation, calculation and data analysis, preparation of graphs, histograms and charts. Use of statistical software SPSS. Power Point: preparation of presentations and scientific poster designing

(12 hours)

UNIT V: Scientific writing for journals - Preparation of Abstract, Impact factor, h-index, i-10 index, citation index, Dissertation/Thesis writing: format, content and chapterization, writing style, drafting titles & sub-titles, captions and legends. Writing results, discussion and conclusions. Bibliography and references, referencing style - Harvard and Vancouver systems, Appendices and acknowledgement; Ethical issues in research; Intellectual property right and plagiarism. (12 hours)

Textbooks

1. Garg, B. L., Karadia, R., Agarwal, F., & Agarwal, U. K. (2002). *An introduction to research methodology*. RBSA Publishers.
2. Kothari, C. R. (2004). *Research methodology: Methods and techniques*. New Age International.
3. Sinha, S. C., & Dhiman, A. K. (2002). *Research methodology* (2 vols.). EssEss Publications.
4. Gurumani, N. (2014). *Research methodology for biological sciences*. MJP Publishers.

Reference Books

1. Pandey, P., & Pandey, M. M. (2015). *Research methodology: Tools and techniques*. [Publisher not provided].
2. Coley, S. M., & Scheinberg, C. A. (1990). *Proposal writing*. Sage Publications.
3. Day, R. A. (1992). *How to write and publish a scientific paper*. Cambridge University Press.
4. Fink, A. (2009). *Conducting research literature reviews: From the internet to paper*. Sage Publications.
5. *Scientific thesis writing and paper presentation*. (2010). MJP Publishers.
6. Sinha, S. C., & Dhiman, A. K. (2002). *Research methodology* (2 vols.). Vedams Books (P) Ltd.

Web Resources

1. https://explorable.com/research-methodology
2. http://www.scribbr.com

Course Code (23UBCE53)	PO1	PO2	PO3		PO4		PO5		PO6	PO7
	PSO 1	PSO 2	PSO 3a	PSO 3b	PSO 4a	PSO 4 b	PSO 5a	PSO 5b	PSO 6	PSO 7
CO 1	3	3	3	3	2	2	2	3	2	2
CO 2	3	3	3	3	2	3	2	3	2	2
CO 3	3	3	3	3	3	3	3	3	3	3
CO 4	3	3	3	3	3	3	3	3	3	3
CO 5	3	3	3	3	3	3	3	3	3	3

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

Dr. P. Annapoorani
Head of the Department

Dr. R. Sreebha
Course Designer

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Semester V	**GENETICS**	Hours/Week: 4	
DSEC -2		Credits: 3	
Course Code 23UBCE54		Internal 25	External 75

COURSE OUTCOMES

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

CO1: Define history of genetics, karyotyping, linkages, chromosome number and allele frequency. [K1]

CO2: Explain Mendelism, segregation, dominance, independent assortment, epistasis, sex determination, linkages, cytogenetics, pedigree analysis, coupling repulsion theories, ploidies, an Hardy- Weinberg's equation an variation. [K2]

CO3: outline the Laws of Mendel – law of segregation, law of dominance and law of independent assortment, linkages, mutations and variations. [K2]

CO4: apply the concept of Mendelian laws, traits, epistasis, chromosomal aberrations, crossing over and speciation. [K3]

CO5: relate the role of Chromosomal inheritance, cytogenetics in medicine, syndromes, genetic mapping, chromosomal aberrations, significance of mutations' Hardy Weinberg's law in and factors producing changes in population. [K3]

UNIT I : Introduction: A brief overview of the modern history of genetics; Mendelism and the chromosomal theory - Mendel's experiments, segregation, dominance, independent assortment; Epistasis; Multiple alleles; one gene-one enzyme hypothesis. Inheritance – Sex linked inheritance and extra chromosomal inheritance. (12 hours)

UNIT II : Cytogenetics: Normal human karyotype, sex chromosomes and sex determination patterns, dosage compensation. Sex linkage-X Linkage in Drosophila and Human. sex limited and sex influenced traits, Chromosomal banding, Human cytogenetics in medical Science, Pedigree analysis. (12 hours)

UNIT III : Linkage: Types of linkage and theories of linkage, coupling and repulsion, factors affecting linkage, Non disjunction: types in man, syndromes. Genetic mapping. (12 hours)

UNIT IV: Changes in chromosome number and structure: Monoploidy, euploidy, and polyploidy, Mutations - Point mutation: transversion, transition, deletion, missense, nonsense and frame shift; Chromosomal aberrations, crossing over, and significance of mutation.

(12 hours)

UNIT V: Population genetics: Gene pool, allele frequency, genotype frequency, and Hardy-Weinberg equation; Variation, Mutation, Mechanisms of speciation, factors producing changes in populations. (12 hours)

Textbooks

1. Verma, P. S., & Agarwal, V. K. (2004). *Cell biology, genetics, molecular biology, evolution and ecology*. New Delhi, India: S. Chand & Co. Ltd.

Reference Books

1. Sambamurthy. (1999). *Genetics*. New Delhi, India: Nasoa Publishing House.
2. Sinnott, E. W., Dunn, L. C., & Dobzhansky, T. (1958). *Principles of genetics* (5th ed.). New York, NY: McGraw Hill.

Course Code (23UBCE54)	PO1	PO2	PO3		PO4		PO5		PO6	PO7
	PSO 1	PSO 2	PSO 3a	PSO 3b	PSO 4a	PSO 4b	PSO 5a	PSO 5b	PSO 6	PSO 7
CO 1	3	3	3	3	3	2	2	3	-	-
CO 2	3	3	3	3	3	2	3	3	2	1
CO 3	3	3	3	2	2	3	3	2	2	2
CO 4	3	2	3	3	3	3	3	3	1	2
CO 5	3	2	3	3	2	2	2	2	1	2

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

Dr.P. Annapoorani
Head of the Department

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

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Semester V	**INTERNSHIP**	Hours/Week:-
Part IV		Credits: 1
Course Code 23UBCI51		Internal 100

COURSE OUTCOMES

On completion of the Internship, students will be able to

CO1: relate the theoretical insights with hands-on experience. [K2]

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]

Guidelines/ Regulations:

- Each student must go for Internship training in a reputed Industry / Company / Organization/ Educational Institution/ Clinical Laboratory/ Hospital.
- Students should produce the completion certificate after the completion of Internship period.
- A report of 10-15 pages must be submitted by each student after the completion of the Internship period.
- Internal Viva-voce examination will be conducted.
- Students with diverse disabilities must complete a 10 day internship programme at their preferred places.

Course Code 23UBCI51	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	3	3	3	-
CO2	3	2	2	3	2	3	-
CO3	3	2	-	2	2	3	-
CO4	3	3	2	2	3	2	3
CO5	3	2	3	2	3	-	-

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

Dr.P.Annapoorani
Head of the Department

Dr. P. Annapoorani
Course Designer

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B.Sc. Biochemistry
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Semester V	**FIRST AID**	Hours/Week:-
Extra Credit Course-1		Credits: 2
Course Code 23UBCO51		Internal: 100

COURSE OUTCOMES

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

CO1 : define the basic concepts, aims and rules of first aid.

CO2 : understand the basic idea of first aid during emergencies and special conditions.

CO3 : demonstrate the important techniques like CPR and first aid during unconsciousness and poisonous bites.

CO4 : utilize the first aid training methods and plan to render first aid in special conditions and disasters.

CO5 : analyse the guidelines for first aid and ways to offer first aid in emergencies.

UNIT I: Aims and important rules of first aid, dealing with emergency, types and content of a first aid kit. First aid technique – Dressing and Bandages, fast evacuation technique, transport techniques.

UNIT II: Basics of Respiration – CPR, first aid during difficult breathing, drowning, choking, strangulation and hanging, swelling within the throat, suffocation by smoke or gases and asthma.

UNIT III: Common medical aid- first aid for wounds, cuts, head, chest, abdominal injuries, shocks, burns, amputations, fractures, dislocation of bones.

UNIT IV: First aid related to unconsciousness, stroke, fits, convulsions- seizures, epilepsy.

UNIT V: First aid in poisonous bites (Insects and snakes), honey bee stings, animal bites, disinfectant, acid and alkali poisoning.

Textbooks

1. Goel, G., Rajput, K., & Mungali, M. (2022). *First aid and health*. [ISBN 978-93-92208-19-5].
2. Indian Red Cross Society. (2016). *Indian first aid manual*. Retrieved from https://www.indianredcross.org/publications/FA-manual.pdf
3. American Red Cross. (2011). *Red Cross first aid/CPR/AED instructor manual*.

Web resources

1) https://www.redcross.org/take-a-class/first-aid/first-aid-training/first-aid-online

2) https://www.firstaidforfree.com/

Course Code (23UBCO51)	**PO1**	**PO2**	**PO3**		**PO4**		**PO5**		**PO6**	**PO7**
	PSO 1	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4a**	**PSO 4b**	**PSO 5a**	**PSO 5b**	**PSO 6**	**PSO 7**
CO 1	3	3	3	3	3	2	3	2	2	3
CO 2	3	3	3	3	3	2	2	2	2	3
CO 3	3	3	3	3	3	3	2	2	3	3
CO 4	3	3	3	3	3	2	3	2	2	3
CO 5	3	3	3	3	3	2	2	2	2	3

Dr.P.Annapoorani
Head of the Department

Dr. Sinthia Ganeshan
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B.Sc. Biochemistry
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Semester VI	**MOLECULAR BIOLOGY**	Hours/Week: 5	
Core Course-8		Credits: 5	
Course Code 23UBCC61		Internal 25	External 75

COURSE OUTCOMES

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

CO1 : state the principles of origin of nucleic acids replication, transcription, translation, and gene expression and gene mutation. [K1]

CO2 : understand the mechanisms of replication, transcription, translation, gene expression, genome mutation. [K2]

CO3 : illustrate the normal and abnormal events of central dogma, and genetic material evolution. [K2]

CO4 : identify the organic evolution of nucleic acids and the molecular mechanisms in Prokaryotes. [K3]

CO5 : interpret the cell functions at the molecular level with respect to nucleic acids origin, replication, transcription, translation, mutation and gene expression. [K3]

Unit I: Origin of life, Urey Miller Experiment**,** Central Dogma of molecular Biology, DNA as the unit of inheritance. Experimental evidences by Griffith are transforming principle, Avery, McLeod and McCarthy's experiment, and Hershey and Chase Experiment. Replication in prokaryotes: Modes of replication, Meselson and Stahl's experimental proof for semiconservative replication. Mechanism of Replication – Initiation, events at Ori C, Elongation – replication fork, semi discontinuous replication, Okazaki fragments, and termination. Bidirectional replication, Inhibitors of replication. Models of replication-theta, rolling circle and D loop model. (15 Hours)

Unit II: Transcription - Mechanism of transcription: DNA dependent RNA polymerase(s), recognition, binding and initiation sites, TATA/ Pribnow box, elongation and termination. Post-transcriptional modifications; inhibitors of transcription. RNA splicing and processing of mRNA, tRNA and rRNA. Reverse transcription. (15 Hours)

Unit III: Genetic Code and its characteristics, Wobble hypothesis. Translation: Adaptor role of tRNA, Activation of amino acids, Initiation, elongation and termination of protein synthesis, post-translational modifications and inhibitors of protein synthesis. (15 Hours)

Unit IV: Regulation of Gene Expression In Prokaryotes – Principles of gene regulation, negative and positive regulation, concept of operons, regulatory proteins, activators, repressors, regulation of lac operon and trp operon. (15 Hours)

Unit V: Mutation: Types-Nutritional, Lethal, Conditional mutants. Missense mutation and other point mutations. Spontaneous mutations; chemical and radiation – induced mutations. DNA repair: Direct repair, Photoreactivation, Excision repair, Mismatch repair, Recombination repair and SOS repair. (15 Hours)

Textbooks

1. Rastogi, V. B. (2008). *Fundamentals of molecular biology* (1st ed.). Ane Books India.
2. Friefelder, D. (1987). *Molecular biology* (2nd ed.). Narosa Publishing House.
3. Verma, P. S., & Agarwal, V. K. (2013). *Cell biology, genetics, molecular biology, evolution and ecology* (1st ed.). S. Chand & Company Pvt. Ltd.

Reference Books

1. Karp, G. (2010). *Cell and molecular biology: Concepts and experiments* (6th ed.). John Wiley & Sons, Inc.
2. DeRobertis, E. D. P., & DeRobertis, E. M. F. (2010). *Cell and molecular biology* (8th ed.). Lippincott Williams & Wilkins.
3. Watson, J. D. (2013). *Molecular biology of the gene* (7th ed.). Benjamin Cummings.
4. Malacinski, G. M. (1992). *Freifelder's essentials of molecular biology* (4th ed.). Narosa Publishing House.

Web resources

1. www.mednotes.net/notes/biology

2. https://www.onlinebiologynotes.com/repair-mechanism-of mutation/

3. https://teachmephysiology.com/biochemistry/protein-synthesis/dna-translation/

Course Code (23UBCC61)	PO1	PO2	PO3		PO4		PO5		PO6	PO7
	PSO 1	PSO 2	PSO 3.a	PSO 3.b	PSO 4a	PSO 4 b	PSO 5a	PSO 5b	PSO 6	PSO 7
CO 1	3	3	3	3	3	3	3	2	1	-
CO 2	3	3	3	3	3	3	3	2	1	1
CO 3	3	3	3	3	3	3	3	2	1	1
CO 4	3	3	3	3	3	3	3	2	1	1
CO 5	3	3	3	3	3	3	3	2	1	1

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

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Semester VI	**HUMAN PHYSIOLOGY**	Hours/Week: 5	
Core Course-9		Credits: 5	
Course Code 23UBCC62		Internal 25	External 75

COURSE OUTCOMES

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

CO1 : recall the structure of important physiological systems including the circulatory, respiratory, nervous, digestive, reproductive and endocrine systems. [K1]

CO2 : explain the principles, functions and structures of various organs in the human body. [K2]

CO3 : outline the circulatory, respiratory, digestive, nervous, reproductive and endocrine systems of the human body. [K2]

CO4 : Identify the importance and working mechanisms of the various organs in the human body. [K3]

CO5 : analyse the relationship between anatomy and physiology of the human body. [K3]

UNIT I: Respiratory System- Overview of respiratory system, Types of respiration, Transport of respiratory gases, Exchange of respiratory gases in lungs and tissues –Chloride Shift & Bohr's effect, Lung surfactant.

Circulatory System- Structure and functions of the Heart. Arterial and venous system, Cardiac cycle, Pace maker, Blood pressure and Factors affecting blood pressure. (15 Hours)

UNIT II: **Nervous system-** Structure of neuron, synaptic transmission, reflex action, neurotransmission- Resting membrane and Action potential. neuro transmitters- acetyl choline, Noradrenaline, Dopamine, Serotonin, Histamine, GABA, Substance P.

Muscular system- structure and types of muscles - skeletal, smooth and cardiac muscles, muscle proteins- types and functions, mechanism of muscle contraction. (15 Hours)

UNIT III: **Digestive system-** composition, functions of saliva, gastric pancreatic intestine and bile secretions, structure of digestive system, Digestion, absorption of carbohydrates, lipids, proteins.

Excretory system- Structure of nephron, mechanism of urine formation, Concentration and acidification of Urine. Role of kidneys in the maintenance of acid base balance. (15 Hours)

UNIT IV: Reproductive system:-Oogenesis, spermatogenesis, capacitation and transport of sperm- blood testis barrier. Fertilization, early development, Implantation, Placentation and Parturition. (15 Hours)

UNIT V: **Endocrinology-** Classification of hormones, endocrine glands and their secretions, structure and functions of Insulin, thyroxine. Steroid hormones- Corticosteroids, Sex hormones – testosterone and estrogen, menstrual cycle. (15 Hours)

Textbooks

1. Sembulingam, K., & Sembulingam, P. (2016). *Essentials of medical physiology* (7th ed.). Jaypee Brothers Medical Publishers (P) Ltd.
2. Chatterjee, C. C. (1988). *Human physiology* (Vols. I & II, 1st ed.). Medical Allied Agency.
3. Kuttikan, M., & Arumugam. (2017). *Animal physiology*. Saras Publication.

Reference Books

1. Chatterjee, M. N., & Shinde, R. (2007). *Text book of medical biochemistry physiology* (7th ed.). Jaypee Brothers Medical Publishers.
2. Meyer, M., Meyer, R., & Meij, H. (2002). *Human physiology* (3rd ed.). A.I.T.B.S Publishers.
3. Guyton, A. C., & Hall, J. E. (2011). *Textbook of medical physiology* (12th ed.). W.B. Saunders Company.
4. Guyton, A. C., & Hall, J. E. (2010). *Text book of medical physiology* (12th ed.). Saunders Publishers.
5. Marieb, E. N. (1995). *Human anatomy and physiology* (3rd ed.). Benjamin/Cummings (a Pearson education company).

Web resources

1. https://www.youtube.com/watch?v=6qnSsV2syUE
2. https://www.youtube.com/watch?v=9_h0ZXx1lFw
3. https://slideplayer.com/slide/9431799/

Course Code 23UBCC62	PO1	PO2	PO3		PO4		PO5		PO6	PO7
	PSO 1	PSO 2	PSO 3.a	PSO 3.b	PSO 4a	PSO 4 b	PSO 5a	PSO 5b	PSO 6	PSO 7
CO 1	3	3	2	2	3	2	1	1	-	1
CO 2	3	3	2	2	3	2	-	2	-	1
CO 3	3	3	2	3	2	3	2	2	-	2
CO 4	3	2	3	3	3	3	3	2	1	1
CO 5	3	2	3	3	2	2	2	2	-	2

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

Dr. P. Annapoorani
Head of the Department

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Semester VI	**PLANT BIOCHEMISTRY AND PLANT THERAPEUTICS**	Hours/Week: 5	
Core Course-10		Credits: 5	
Course Code 23UBCC63		Internal 25	External 75

COURSE OUTCOMES
On Completion of the course, the students will be able to

CO1: describe the structure and functions of photosynthetic apparatus, pigments and pathways, secondary metabolites, plant hormones, formation of free radicals, antioxidants and herbal therapeutics. [K1]

CO2**:** explain different types of photosynthetic pigments and energetics of light and dark reactions, hormonal actions as growth regulators, types of free radicals formed, role of enzymatic and non-enzymatic antioxidant in defence mechanism and medicinal properties of plants. [K2]

CO3: understand the bioactive principles in herbs, role of antioxidants in prevention of diseases, phytochemicals as antioxidants. [K2]

CO4: outline, compare and contrast the key mechanisms of light and dark reactions of photosynthesis, functions of plant hormones and therapeutic plants. [K3]

CO5: charting the function of hormones, harmful effects of free radicals and plant defence mechanism in research and in clinical diagnosis/ applied science [K3]

UNIT I: Photosynthesis- Photosynthesis apparatus, pigments of photosynthesis, photochemical reaction, photosynthetic electron transport chain, path of carbon in photosynthesis-Calvin cycle, Hatch – lack pathway (4 ways) CAM path way, significance of photosynthesis. (15 Hours)

UNIT II: Secondary metabolites: Structure, Types, Sources, Biosynthesis and function of phenolics, tannins, lignins, terpenes and alkaloids. Medicinal properties of secondary metabolite. (15 Hours)

UNIT III: Plant hormones -Structure and function of plant hormones such as ethylene, cytokinins, auxins, Absicic acid, Florigin and Gibberlins. (15 Hours)

UNIT IV: Free radicals, types, production, free radical induced damages, lipid peroxidation, reactive oxygen species, antioxidant defence system, enzymatic and non-enzymatic antioxidants, role of antioxidants in prevention of disease, phytochemicals as antioxidants. (15 Hours)

UNIT V: Plant therapeutics: Bioactive principles in herbs, plants with antidiabetic, anticancer, antibacterial, antiviral, anti-malaria and anti-inflammatory properties. (15 Hours)

Textbooks

1. Singh, M. P., & Panda, H. (2005). *Medicinal herbs with their formulations*. Daya Publishing House, Delhi.
2. Devlin, N. R., & Witham, F. H. *Plant Physiology*. CBS Publications.
3. Anderson, J. W., & Bradall, J. (1994). *Molecular activities of plant cell – An introduction to plant biochemistry*. Blackwell Scientific Publications.

Reference Books

1. Khan, I. A., & Khanum, A. (2004). *Role of biotechnology in medicinal and aromatic plants* (Vols. 1 & 10). Ukka 2 Publications, Hyderabad.
2. Heldt, H. W. (2010). *Plant biochemistry and molecular biology* (4th ed.). Oxford University Press.
3. Bowsher, C., Steer, M., & Tobin, A. (2008). *Plant biochemistry*. Garland Science.
4. Taiz, L., Zeiger, E., Møller, I. M., & Murphy, A. (2010). *Plant physiology and development* (6th ed.). Oxford University Press.

Web resources

1. https://www.intechopen.com/books/secondary-metabolites-sources-and applications/anintroductory- chapter-secondary-metabolites
2. https://www.toppr.com/guides/biology/plant-growth-and development/plantgrowth

Course Code (23UBCC63)	**PO1**	**PO2**	**PO3**		**PO4**		**PO5**		**PO6**	**PO7**
	PSO 1	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4a**	**PSO 4b**	**PSO 5a**	**PSO 5b**	**PSO 6**	**PSO 7**
CO 1	3	3	2	2	1	1	-	2	1	1
CO 2	3	3	2	2	2	1	-	2	1	1
CO 3	3	3	2	1	2	2	-	3	1	1
CO 4	3	3	3	2	3	2	1	3	1	2
CO 5	3	3	3	2	3	2	1	3	1	3

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

Dr. P. Annapoorani
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Semester VI	**MOLECULAR BIOLOGY AND HAEMATOLOGY PRACTICAL**	Hours/Week: 3	
Core Course Practical -6		Credits: 2	
Course Code 23UBCC61P		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : apply the principles and procedures in qualitative and quantitative determination of Nucleic acids. [K2]

CO2 : make use of molecular techniques to detect the concentration of Nucleic acids in the biological samples. [K2]

CO3 : identify the normal and abnormal parameters of biological samples using colorimetry and other basic biochemical and hematological methods. [K3]

CO4 : observe and calculate the results for the colorimetry and hematological assays and to complete the record work. [K3]

CO5 : infer the normal and abnormal parameters of biological samples analyzed by colorimetry and hematological experiments. [K3]

MOLECULAR BIOLOGY

1. Qualitative analysis of Nucleic acids
2. Estimation of Nucleic acids (DNA,RNA)
3. Isolation of DNA
4. Separation of DNA by AGE

HEMATOLOGY

1. Collection and preservation of blood sample.
2. Estimation of Hemoglobin by Shali's/Drabkins method
3. RBC Counting
4. WBC Counting

5. Total and differential count of white blood cells

6. Erythrocyte sedimentation rate

7. Blood clotting time

8. Blood grouping

REFERENCES

1. Plummer, D. T. (2001). *An introduction to practical biochemistry*. Tata McGraw Hill. ISBN 97800708416.
2. Gowenlock, A. H. (1998). *Varley's practical clinical biochemistry* (6th ed.). CBS Publishers.
3. Tietz, P. M. (2018). *Fundamentals of Clinical chemistry*. W.B. Saunders Company, Harcourt (India) Pvt. Ltd.
4. Sood, R. (1996). *Laboratory technology (methods and interpretation)* (4th ed.). J.P. Brothers.
5. Mukherji, S. (2007). *Medical laboratory techniques* (Vols. I, II & III, 5th ed.). Tata McGraw Hill.

Course Code (23UBCC61P)	**PO1**	**PO2**	**PO3**		**PO4**		**PO5**		**PO6**	**PO7**
	PSO 1	**PSO 2**	**PSO 3.a**	**PSO 3.b**	**PSO 4a**	**PSO 4 b**	**PSO 5a**	**PSO 5b**	**PSO 6**	**PSO 7**
CO 1	3	3	3	3	3	3	3	2	2	3
CO 2	3	3	3	3	3	3	3	2	2	3
CO 3	3	3	3	3	3	3	3	2	2	3
CO 4	3	3	3	3	3	3	3	2	2	3
CO 5	3	3	3	3	3	3	3	2	2	3

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

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Mrs.M.Rajakumari — **Course Designer**

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Semester VI	**BIOTECHNOLOGY**	Hours/Week: 5	
DSEC-3		Credits: 4	
Course Code 23UBCE61		Internal 25	External 75

COURSE OUTCOMES

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

CO1: remember the basic principles and practices of microbiological, molecular and analytical methods, which are extensively used in biotechnology. [K1]

CO2: understand the Basic concepts of biotechnological tool and its mechanism in host cell, Developments made in the field of biotechnology for use in human welfare and solving problems in the society. [K2]

CO3: apply the knowledge in the basics of research and development in biotechnological field and integrate scientific and technological knowledge on the use of bioprocesses for industrial products. [K2]

CO4: Illustrate the applications of Genetic engineering in biological research and biotechnological industries for entrepreneurial development and investigate the different strategies of recombinant DNA technology and resolve the problems encountered. [K3]

CO5: examine the biological science techniques that manipulate living organisms and biological systems to produce novel products in the field of microbial, plant, animal and environmental biotechnology and the results behind the molecular and microbiological techniques for the development of new techniques in future. [K3]

Unit-I: Recombinant DNA technology - Principles of gene cloning: restriction endonucleases and other enzymes used in manipulating DNA molecules. Ligation of DNA molecules, DNA ligase, linkers and adapters, homopolymer tailing.end labeling and construction maps of PBR322, λ bacteriophage. (15 Hours)

Unit-II: Plant tissue culture- basic requirements for culture, M S medium, callus culture, protoplast culture. Vectors – Ti plasmid (cointegration vector and binary vector), Viral vectors- TMV, CaMV and their applications. Transgenic plants – pest resistant, herbicide resistant and stress tolerant plants**.** (15 Hours)

Unit- III: Animal cell lines and organ culture - culture methods and applications. Transgenic animals: transgenic mice- Production and its applications. Stem cell technology: definition, types, and applications. (15 Hours)

Unit-IV: PCR –Principle, types and its application in clinical diagnosis and forensic science. Southern blotting, Northern blotting and DNA finger printing Technique-principle and their applications. (15 Hours)

Unit-V: Fermentation technology – Fermenters - general design, fermentation processes - Media used, downstream processing. Production and applications of ethanol, Streptomycin and Proteases. Production of edible vaccines. (15 Hours)

Textbooks

1. Kumaresan, V. (2015). *Biotechnology* (6th ed.). Saras Publications.
2. Watson, J. D., Caudy, A. A., Myers, R. M., & Witkowski, J. (2006). *Recombinant DNA: Genes and genomes - a short course* (3rd ed.). W.H. Freeman & Co.
3. Satyanarayana, U. (2008). *Biotechnology*. Books & Allied (P) Ltd.
4. Cassida, L. (2007). *Industrial microbiology*. New Age International.

Reference Books

1. Gupta, P. K. (2010). *Elements of biotechnology*. Rastogi Publications.
2. Dubey, R. C. (2006). *Text book of biotechnology* (4th ed.). S. Chand Publishing.
3. Watson, J. D. (1992). *Recombinant DNA technology* (2nd ed.). W.H. Freeman.
4. Singh, B. D. (2008). *Biotechnology* (3rd ed.). G.G. Publications.
5. Reed, G. (2004). *Prescott and Dunn's industrial microbiology*. CBS Publishers & Distributors.
6. Clark, D. P., & Pazdernik, N. J. (2009). *Biotechnology: Applying the genetic revolution*. Elsevier.
7. Click, B. R., & Pasternak, J. J. (2010). *Molecular biotechnology: Principles and applications of recombinant DNA* (4th ed.). American Society for Microbiology.

Web Sources

1. NPTEL Certification course - Gene Therapy by Sachin Kumar https://nptel.ac.in/courses/102/103/102103041/Coursera Certification course –Vaccines
2. https://futureoflife.org/background/benefits-risks-biotechnology/
3. https://www.sciencedirect.com/topics/neuroscience/genetic-engineering
4. http://www.biologydiscussion.cm/biotechnology/techniques-biotechnology/important-techniques-of-biotechnology-3-techniques/15683
5. https://iopscience.iop.org/book/978-0-7503-1347-6/chapter/bk978-0-7503-1347-6ch1
6. https://www.slideshare.net/zeal_eagle/fermentation-technology
7. https://www.slideshare.net/zeal_eagle/fermentation-technology
8. https://www.slideshare.net/Chepkitwai/blotting-techniques-6129300

Course Code 23UBCE61	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1.a	**PSO 1.b**	**PSO 2**	**PSO 3.a**	**PSO 3.b**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO 1	3	3	2	2	3	2	2	2	3	2
CO 2	3	2	2	1	3	2	2	2	2	3
CO 3	2	2	3	3	2	2	2	2	2	2
CO 4	2	3	2	2	2	2	1	2	2	2
CO 5	2	3	2	3	2	2	2	2	2	2

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

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Semester VI	**MOLECULAR BIOPHYSICS**	Hours/Week: 5	
DSEC -3		Credits: 4	
Course Code 23UBCE62		Internal 25	External 75

COURSE OUTCOMES

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

CO1 : Remember different atomic system, different coupling schemes and their interactions with magnetic and electric field , and learn the Laws and functions and their relations of thermodynamics in Bioenergetics in biological systems. [K1]

CO2 : Understand the Fundamentals of physical phenomenon associated with biological reactions with the basic laws and explore the concept of Biophysics. [K2]

CO3 : outline the principles of Bio physics in analytical determination of biomolecules and life processes , theoretical modelling techniques involved in biomolecular system. [K2]

CO4 : apply the Structural and molecular properties of biomolecules in Biological process and various methods in the Biophysical analysis and Contemporary issues on atomic and Molecular physics. [K3]

CO5 : relate the applications of physics in biological sciences needed to develop the new approach in the academic and Industrial Research [K3]

UNIT I: Structure of atom-Models & theories, Periodic table, Concept of bonding; valence of carbon; hybridizations of carbon; hybridizations of nitrogen & oxygen; molecular orbital theories, polar & non polar molecules; inductive effect; Secondary bonding: weak interactions, hydrogen bonding; dipole-dipole & dipole induced dipole interactions; London dispersion forces. Bonds within molecules-Ionic, covalent, Hydrogen, Electrostatic, Disulphide & peptide bonds, Van-der Waals forces, Bond lengths & Bond energies, Bond angles, Structural isomerism; optical isomerism & optical activity. (15 Hours)

UNIT II: Biophysics of Water: Physicochemical properties of water, Molecular structure, Nature of hydrophobic interactions, Water Structure. Small-Molecule Solutes: Hydrophiles, Hydrophobes, Large Hydrophobic Solutes and Surfaces, Aqueous Environment of the Cell, State of water in bio- structures & its significance, Protein Hydration-Nonspecific Effects, The Hydration Shell. Acid & Bases: Acid-Base theories, Mole concept, Molarity, Molality & Normality, Ampholyte, concept of pH, measurements of pH , Henderson–Hasselbatch equation , Titration curve & pK values, Buffers & Stability of their pH , numerical problems. Redox potential : Oxidation –Reduction, examples of redox potential in biological system.

(15 Hours)

UNIT III: Thermodynamics of Biological system: First and second laws of thermodynamics, activation energy. Biological systems as open, non-equilibrium systems, Concept of free energy, unavailable energy and entropy, heat content of food, bomb calorimetry, Enthalpy, Negative entropy as applicable to biological systems. thermodynamics of passive and active transport, glycolytic oscillations, biological clocks. (15 Hours)

UNIT IV: Bioenergetics: Concept of energy coupling in biological processors, Energy requirements in cell metabolism, structure and role of mitochondria, high energy phosphate bond, energy currency of cell, Biological oxidation, Electron-transport chain, Oxidative Phosphorylation including chemi osmotic hypothesis. Thermodynamic analysis of TCA cycle and oxidative phosphorylation. (15 Hours)

UNIT V: Nucleic acids: Purine and Pyrimidine bases, nucleosides, nucleotides, basic differences in structure and function of RNA and DNA Amino acids & Proteins: Amino acid general structure & types, peptide bond, Structure of Proteins - primary, secondary, tertiary and quarternary , Carbohydrates : Structure and function of mono, di ,oligo and polysaccharides, Structure of D-glucose & D-fructose; formation of glucosides & the cyclic structure of D glucose; Structure and conformation of disaccharides and polysaccharides-cellulose, amylopectin & glycogen, Chitin. Lipids : Definition: Types of lipids; Triglycerides , fatty acids, Fats & oils ,Phospholipids, Glycolipids; lipoproteins, Structure, Function and Localization Vitamins & hormones: Structure, classification & function. (15 Hours)

Textbooks

1. Lehninger, A. L., Nelson, D. L., & Cox, M. M. (1993). *Principles of biochemistry* (2nd ed.). CBS Publishers.
2. Stryer, L. (2002). *Biochemistry* (5th ed.). W.H. Freeman Co.
3. Rao, V. S. R., Qasba, P. K., Balaji, P. V., & Chandrasekaran, R. (1998). *Conformation of carbohydrates* (1st ed.). Harwood Academic Publishers.
4. Stoddart, J. F. (1971). *Stereochemistry of carbohydrates* (1st ed.). John Wiley & Sons.

Reference Books

1. Sharon, N. (1978). *Complex carbohydrates: Their chemistry, biosynthesis and functions* (1st ed.). Amsterdam-Don Mills.
2. Kennedy, J. F., & White, C. A. (1983). *Bioactive carbohydrates in chemistry, biochemistry and biology* (1st ed.). Ellis Harwood Limited.
3. Schulz, G., & Schirmer, R. H. (1984). *Principles of protein structure* (1st ed.). Springer-Verlag.

Course Code (23UBCE62)	**PO1**	**PO2**	**PO3**		**PO4**		**PO5**		**PO6**	**PO7**
	PSO 1	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4a**	**PSO 4b**	**PSO 5a**	**PSO 5b**	**PSO 6**	**PSO 7**
CO 1	3	3	3	3	3	2	2	3	-	-
CO 2	3	3	3	3	3	2	3	3	2	1
CO 3	3	3	2	2	2	3	3	2	2	2
CO 4	3	3	3	3	3	3	2	3	1	2
CO 5	3	2	3	2	2	2	2	2	1	2

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

Dr.P. Annapoorani
Head of the Department

Dr. Sinthia Ganeshan
Course Designer

V.V.VANNIAPERUMAL COLLEGE FOR WOMEN
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Semester VI	**BIOCHEMICAL PHARMACOLOGY**	Hours/Week: 5	
DSEC-4		Credits: 3	
Course Code 23UBCE63		Internal 25	External 75

COURSE OUTCOMES

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

CO1 : recall the drug classification, administration, metabolism, excretion and therapeutics drugs. [K1]

CO2 : explain the drug absorption, metabolism, resistance and therapeutic applications [K2]

CO3 : discuss the drug distribution, drug reactions, drug interactions, tolerance, addiction, biochemical drug actions, therapeutics of drugs and antibiotics. [K2]

CO4 : identify the drug applications, drug mechanisms, drug allergy and therapeutic effects and biochemical mode of antibiotics. [K3]

CO5 : apply the knowledge of drug excretions, metabolism of drugs, antibiotic activity, biochemical mechanism and therapeutic drugs. [K3]

UNIT I: Drugs – classification based on sources, routes of drug administration - Oral/Enteral, Parenteral and Local application. Absorption of drugs, factors influencing drug absorption, distribution and excretion of drugs. (15hours)

UNIT II: Drug metabolism - Phase I and Phase II reactions, role of cytochrome P_{450}, non-microsomal reactions of drug metabolism. Factors influencing drug metabolism. Therapeutic index. (15 hours)

UNIT III: Drug allergy, Drug tolerance - IC 50, LD50 of a drug, Drug intolerance, Drug addiction, Drug abuses and their biological effects. Drug resistance - biochemical mechanism. (15 hours)

UNIT IV: Therapeutic Drugs - Analgesics and Non-steroidal anti-inflammatory drugs (NSAIDs) – Aspirin and Acetaminophen. Insulin, Oral antidiabetic drugs - Sulfonylureas, Biguanides. Antihypertensive drugs - ACE inhibitors, Calcium channel blockers. Anti-cancer agents –Antimetabolites. (15 hours)

UNIT V: Antibiotics - Definition, Examples and Biochemical mode of action of penicillin, streptomycin, tetracyclines and chloramphenicol. (15 hours)

Textbooks

1. Murugesh, N. (2022). *A concise textbook of pharmacology*. Sathya Publishers.
2. Ghosh, J. (2015). *A textbook of pharmaceutical chemistry*. S. Chand & Company Ltd.
3. Mehta, S. C., & Kar, A. (2009). *Pharmaceutical pharmacology*. New Age International (P) Limited Publishers.

Reference Books

1. Mycek, M. J., Harvey, R. A., & Champe, P. C. (2009). *Lippincott's illustrated reviews: Pharmacology*. Lippincott-Raven Publishers.
2. Golan, D. E. (2016). *Principles of pharmacology*. Wolters Kluwer (India) Pvt. Ltd.
3. Satoskar, R. S., & Bhandarkar, S. D. (2017). *Pharmacology and pharmacotherapy*. Elsevier. https://doi.org/ISBN-13: 978-8131248867
4. Tripathi, K. D. (2018). *Essentials of medical pharmacology* (7th ed.). Jaypee Publishers.

Web Resources

1. https://slideplayer.com/slide/3728296/64/video/What+is+bioremediation%3F.mp4

Course Code (23UBCE63)	**PO1**	**PO2**	**PO3**		**PO4**		**PO5**		**PO6**	**PO7**
	PSO 1	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4a**	**PSO 4b**	**PSO 5a**	**PSO 5b**	**PSO 6**	**PSO 7**
CO 1	3	3	2	3	3	3	3	3	2	3
CO 2	3	3	2	3	3	3	3	3	2	3
CO 3	3	3	2	3	3	3	3	3	2	3
CO 4	3	3	2	3	3	3	3	3	2	3
CO 5	3	3	2	3	3	3	3	3	2	3

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

Dr.P.Annapoorani
Head of the Department

Dr. R. Sreebha
Course Designer

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Semester VI	**BIOFERTILIZERS AND BIOPESTICIDES**	Hours/Week: 5	
DSEC -4		Credits: 3	
Course Code 23UBCE64		Internal 25	External 75

COURSE OUTCOMES

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

CO1 : recall the role of the microorganisms as biofertilizers and biopesticides. [K1]

CO2 : explain the biofertilizer and biopesticides preparation process. [K2]

CO3 : Identify the importance of microbial inoculants for the preparation of biofertilizer and biopesticides . [K2]

CO4 : apply the concept of biofertilizers and biopesticides in sustainable agricultural practices. [K3]

CO5 : relate the importance of biofertilizers and biopesticide preparation in sustainable agriculture. [K3]

UNIT I : Biofertilizer : Introduction and benefits from biofertilizers. Blue Green Algae (BGA) : Isolation and methods applied for mass culture of BGA. Mass cultivation and field application of *Anabeena* and *Nostoc*. (15 hours)

UNIT II : Symbiotic bacterial biofertilizer: *Rhizobium* and *Azospirillum* - isolation, identification, mass culture, carrier based inoculant, field application and its advantages. (15 hours)

UNIT III : Nonsymbiotic bacterial biofertilizer – *Azotobacter* and *Clostridium* characteristics, isolation, mass production of inoculants, field application and its beneficial role. (15 hours)

UNIT IV: Mycorrhizal fungi: types of mycorrhizae. Vesicular - Arbuscular Mycorrhizal Fungi (VAM) - morphology, isolation, mass production, importance on growth and yield of crop plants. Phosphate solubilizing organisms: Isolation and mass cultivation. (15 hours)

UNIT V: Biopesticides: Biological pest control agents - Predators and microbial pesticides. Methods applied for control of plant pathogens. Biological control of weeds: mycoherbicide. Insects as weed killer. Plant extracts as insecticides. (15 hours)

TEXT BOOKS

1. Dubey, R. C. (2006). *A Text book of Biotechnology*. New Delhi: S. Chand & company Ltd. Albert, F. Hill.

2. John Jothi Prakash, E. (2004). *Outlines of Plant Biotechnology*. New Delhi: Emkay Publication.

REFERENCE BOOKS

1. Gupta, P.K.(1994). *Elements of Biotechnology*. Meerut: Rastogi & company.

2. Subha Rao, NS. (2000). *Soil Microbiology*, New Delhi: Oxford &IBH Publishers.

Course Code (23UBCE64)	PO1	PO2	PO3		PO4		PO5		PO6	PO7
	PSO 1	PSO 2	PSO 3a	PSO 3b	PSO 4a	PSO 4b	PSO 5a	PSO 5b	PSO 6	PSO 7
CO 1	3	3	2	2	2	3	3	3	-	1
CO 2	3	3	3	2	2	2	3	2	-	1
CO 3	3	3	3	2	2	2	2	2	1	1
CO 4	3	3	3	2	2	3	3	3	1	1
CO 5	3	2	3	2	3	2	2	2	2	-

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

Dr.R.Salini
Dr.P. Annapoorani Dr.R.Sreebha
Head of the Department **Course Designer**

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Semester VI	**MEDICAL CODING**	Hours/Week: 2	
SEC-7		Credits:2	
Course Code 23UBCS61		Internal 25	External 75

COURSE OUTCOMES

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

CO1 : define the fundamental concepts of human anatomy and medical coding. [K1]

CO2 : explain the types of coding including CPT and ICD-10- CM classification system. [K1]

CO3 : describe the use of diagnostic codes and CPT codes. [K2]

CO4 : discuss the significance of CPR, CPT and medical records. [K2]

CO5 : evaluate the legal and ethical aspects of medical coding. [K3]

UNIT I: Introduction to Medical coding, coding theory, Healthcare Common Procedure Coding, First Aid and CPR. (6 Hours)

UNIT II: Introduction to Medical Terminology, specialization I & II, Diagnostic coding, factors affecting diagnostic coding. (6 Hours)

UNIT III: Documenting medical records- Importance of Documentation, Types of dictation formats. (6 Hours)

UNIT IV: Introduction to Human Anatomy and Coding, ICD-10- CM classification system. (6 Hours)

UNIT V: Introduction to CPT coding, types of CPT coding Medical Law and Ethics. (6 Hours)

Textbooks

1. Johnson, S. L., & Linker, R. (2015). *Understanding medical coding: A comprehensive guide*. CENGAGE Learning Custom Publishing.
2. Buck, C. (2016). *Buck's step-by-step medical coding*. 4th Edition, Elsevier.

Course Code (23UBCS61)	PO1	PO2	PO3		PO4		PO5		PO6	PO7
	PSO 1	PSO 2	PSO 3.a	PSO 3.b	PSO 4a	PSO 4b	PSO 5a	PSO 5b	PSO 6	PSO 7
CO 1	3	3	2	3	3	3	3	3	2	3
CO 2	3	3	2	3	3	3	3	3	2	3
CO 3	3	3	2	3	3	3	3	3	2	3
CO 4	3	3	2	3	3	3	3	3	2	3
CO 5	3	3	2	3	3	3	3	3	2	3

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

Dr.P.Annapoorani
Head of the Department

Mrs. P.Ramalakshmi
Course Designer