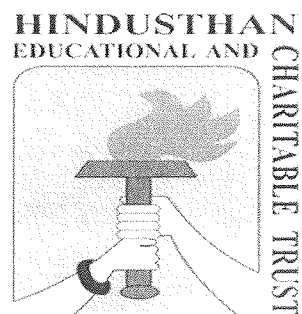


**LEARNING OUTCOMES–BASED
CURRICULUM FRAMEWORK (LOCF)**

in the

B. Sc BIOTECHNOLOGY DEGREE

**FOR THE STUDENTS ADMITTED FROM
THE ACADEMIC YEAR 2022 - 2023 AND
ONWARDS**



HICAS

**HINDUSTHAN COLLEGE OF ARTS AND SCIENCE
(AUTONOMOUS)**

**(Affiliated to Bharathiar University and Accredited by
NAAC) COIMBATORE-641028**

TAMILNADU, INDIA.

Phone: 0422-4440555

Website: www.hindusthan.net/hicas

PREAMBLE

Learning Outcome Based Curriculum Framework for Undergraduate education in Biotechnology is intended to promote tutoring and exploration in Biotechnology and afford academic and professional distinction for instantaneous productivity in manufacturing, governmental or clinical sectors for decisive benefit of society and environment.

VISION

To produce Biotechnology Professionals with the knowledge to excel in Scientific and Industrial Research career and to nurture Entrepreneurship Skills

MISSION

➤ To structure the Curriculum with Program Specific Outcomes that produce sound knowledge in different traits of Biotechnology which include Nanotechnology, Agriculture Biotechnology, Forensic Science and Biosafety. To impart the Scientific Knowledge to the student community by conducting Interaction Sessions with Eminent Scientists and Industrialists through Department Association and Clubs. To produce Biotechnology Personnel with Critical Thinking Capability and promote Multidisciplinary Research. To inculcate creativity and innovation in the young minds and make them skillful to deal with social and ethical claims

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO 1: To update, encompass and extend students 'knowledge through a flexible, research-intensive program similar to academia and industry requirements.

PEO 2: To enhance career opportunities in research and industry globally or as a preparation for further higher education through state of the art laboratory exposures and outbound dissertation activities fostering Global Competencies among Students.

PEO 3: To promote critical thinking and full-fledged grasp of essential aspects of bioethics inculcating a Value System among Students.

PEO 4: To enrich the global think-tank with right mixes of innovative ability, existing policies in generating and safeguarding the product of their intellect, equipped with entrepreneurship abilities contributing to self and national development.

PEO 5: To train the students for industrial need and to pursue further education and inculcate entrepreneurship among the students so as to start their own ventures in the field of biotechnology

PROGRAMME OUTCOME (PO)

- PO1** - Understand and comprehend the fundamental and advanced knowledge on various domains of Biotechnology.
- PO 2** - Develop an independent thinking ability, design and conduct experiments as well as to analyze and interpret scientific data.
- PO 3** - Understanding of professional and ethical responsibility
- PO 4** - Equip the students with the laboratory skills in biotechnology and usage of modern tools for promoting life science research
- PO 5** - Ability to communicate effectively and promote team working ability
- PO 6** - Awareness of the impact of bio-solutions in a global, economic, environmental, and societal context.
- PO 7** – Facilitate to assimilate technologies through an inter-disciplinary learning habit

PROGRAMME SPECIFIC OUTCOME (PSO)

- PSO1:** Understand the basic knowledge and concepts of biotechnology, and related areas.
- PSO2:** Understand the ability to apply their knowledge for practical which they can conduct independently.
- PSO3:** Apply the knowledge in other advanced Course areas like Nano-biotechnology, Immunotechnology, Animal and Plant biotechnology for the betterment and advancement of their professional career.
- PSO4:** Utilize practical exposure and incorporate entrepreneur skills by embracing biotechnology
- PSO5:** Adopt to become an eminent researcher or scientist in the field of biotechnology to discover/innovate unique products for societal need with proper ethical statute.

HINDUSTHAN COLLEGE OF ARTS & SCIENCE (AUTONOMOUS),

COIMBATORE-641028

SCHEME OF EXAMINATIONS - CBCS & LOCF PATTERN

(For the Students admitted from the Academic year 2022-2023 and Onwards)

UG PROGRAMME

Programme: B. Sc

Branch: BIOTECHNOLOGY

Part	Course Code	Course Type	Course Title	Credit points	Lecture Hours/ Week		Exam Duration (hours)	MAX. MARKS		
					Theory	Practical		I.E.	E.E	Total
Semester - I										
I	22LAT01/ 22LAH01/ 22LAM01/ 22LAF01	MIL	Tamil-I/ Hindi-I/ Malayalam – I/ French-I	4	6		3	50	50	100
II	22ENG01	AECC	English – I	4	6		3	50	50	100
III	22BTU01	DSC	Core I - Cell Biology and Genetics	5	5		3	50	50	100
III	22BTU02	GE	ALLIED I -Chemistry	4	4		3	50	50	100
III	22BTU03	DSC	Core II- Practical I- Cell Biology and Genetics	2		4	5	50	50	100
III	22BTU04	GE	ALLIED II -Practical II - Chemistry	2		4	3	50	50	100
IV	22BTUE01	AEE	Open Elective – I	2	3		3	100		100
IV	22GSU01	AECC	Environmental Studies	1	2		2	50	-	50
IV	22BTUV01	SEC	VAC-I/Life Skills-I @ / - Communicative English	1*	2		2	50	-	50**
IV	-	SEC	SDR- Student Development Report	Assessment will be in the Fifth Semester						
V	-	AECC	Extension Activities NSS/NCC/SPORTS/YRC/SIS/SA	Assessment will be in the Fourth Semester						
Total				24	28	8		450	300	750
Semester – II										
I	22LAT02/ 22LAH02/ 22LAM02/ 22LAF02	MIL	Tamil-II/ Hindi-II/ Malayalam-II/ French-II	4	6		3	50	50	100
II	22ENG02	AECC	English – II	4	6		3	50	50	100
III	22BTU05 T	DSC	Core III – Bioinstrumentation - Theory	2	3		3	25	25	100
III	22BTU05 P	DSC	Bioinstrumentation- Practical - III	2		3	5	50	-	

III	22BTU06	DSC	Core IV - Microbiology	4	4		3	50	50	100
III	22BTU07	GE	ALLIED III - Biochemistry	4	4		3	50	50	100
III	22BTU08	DSC	Core V -Practical IV - Microbiology	2		3	5	50	50	100
III	22BTU09	GE	ALLIED IV -Practical V - Biochemistry	2		3	5	50	50	100
III	22BTU10	SEC	Internship / Industrial Visit / Mini Project	1	-	-		100		100
IV	22BTUV02	SEC	VAC-II/Life Skills-II @ / Language	1*	2		2	50	-	50**
IV	22BTUJ01	SEC	Aptitude / Placement Training	Grade *	2		3	50		50**
Total				25	27	9		475	325	800
Semester – III										
III	22BTU11	DSC	Core VI -Immunology	5	5		3	50	50	100
III	22BTU12	DSC	Core VII -Molecular Biology	5	5		3	50	50	100
III	22BTU13	GE	ALLIED V- Biomathematics	4	4		3	50	50	100
III	22BTU14	DSC	Core VIII -Practical VI - Immunology	2	-	4	5	50	50	100
III	22BTU15	DSC	Core IX -Practical VII- Molecular Biology	2	-	4	5	50	50	100
III	22BTU16	GE	ALLIED VI -Practical VIII - Biomathematics	2	-	3	3	50	50	100
III	22BTU17	DSE	Elective I/ DSE - I	3	3		3	50	50	100
IV	22BTUE02	AEE	Open Elective-II	2	3		3	100	-	100
IV	22GSU02	AECC	Human Rights	1	2		2	50		50
IV	22BTUJ02	SEC	Aptitude / Placement Training	Grade *	2		2	50		50**
IV	22BTUJ03	SEC	Online Course	-	1			-	-	C/NC
Total				26	25	11		500	350	850
Semester – IV										
III	22BTU18	DSC	Core X -Environmental Biotechnology	5	5		3	50	50	100
III	22BTU19	DSC	Core XI-Fermentation Technology	5	5		3	50	50	100
III	22BTU20	GE	ALLIED VII -Python Programming	4	4		3	50	50	100
III	22BTU21	DSC	Core XII-Practical IX - Environmental Biotechnology	2	-	4	5	50	50	100
III	22BTU22	DSC	Core XIII-Practical X- Fermentation Technology	2	-	5	5	50	50	100
III	22BTU23	GE	ALLIED VIII -Practical XI - Python Programming	2	-	3	3	50	50	100
III	22BTU24	DSE	Elective II/ DSE - II	3	3		3	50	50	100
III	22BTU25	SEC	Internship / Institutional Training / Mini-Project	1	-			100	-	100

IV	22BTUV03	ACC	VAC-III	1*	2		2	50	-	50**
IV	22BTUJ04	SEC	Aptitude / Placement Training	Grade *	2		2	50		50**
IV	22BTUJ05	SEC	Online Course	-	1		-	-	-	C/NC [‡]
IV	22GSU03	AECC	Internet Security	1	2		2	50	-	50
V	22GSU04	AECC	Extension Activities NSS/NCC/SPORTS/YRC/SIS/SA #	2	-		-	-	-	C/NC [‡]
Total				27	24	12		500	350	850
Semester - V										
III	22BTU26 T	DSC	Core XIV -Basics in Forensic Science – Theory	2	3	-	3	25	25	100
III	22BTU26 P	DSC	Core XIV -Basics in Forensic Science – Practical – XII	2	-	2	5	50	-	
III	22BTU27	DSC	Core XV-Recombinant DNA Technology	4	4		3	50	50	100
III	22BTU28	DSC	Core XVI -Plant Biotechnology	4	4		3	50	50	100
III	22BTU29	DSC	Core XVII-Animal Biotechnology	4	4		3	50	50	100
III	22BTU30	DSC	Core XVIII-Practical XIII - Recombinant DNA Technology	2	-	4	5	50	50	100
III	22BTU31	DSC	Core XIX -Practical XIV- Plant Biotechnology	2	-	4	5	50	50	100
III	22BTU32	DSC	Core XX-Practical XV - Animal Biotechnology	2	-	3	5	50	50	100
IV	22BTUE03	AEE	Open Elective-III	2	3		3	100	-	100
IV	22GSU05	AECC	General Awareness	1	-		2	50	-	50
IV	22GSU06	AECC	Law of Ethics	1	-		2	50	-	50
IV	22BTUV04	ACC	VAC-IV	1*	2		2	50	-	50**
IV	22BTUJ06	SEC	Aptitude / Placement Training	Grade *	2		2	50	-	50**
IV	22BTUJ07	SEC	Online Course	-	1		-	-		C/NC
IV	22BTUJ08	SEC	SDR- Student Development Report	2*	-	-	-	-	-	-
Total				26	23	13		575	325	900
Semester – VI										
III	22BTU33	DSE	Elective III/ DSE – III	4	4		3	50	50	100
III	22BTU34	DSE	Elective IV/ DSE – IV	4	4		3	50	50	100
III	22BTU35	DSC	Self-Study Course	3	-	-	3	50	50	100
III	22BTU36	SEC	Project Work /Student Research / Paper	6	6			50	50	100
Total				17	14			200	200	400
Grand Total				145+ 6*				2700	1850	4550

- * denotes Extra credits which are not added with total credits.
- **denotes Extra marks which are not added with total marks.
- VAC-Value Added Course(Extra Credit Courses)
- *Grades depends on the marks obtained
- †C-Completed/ NC- Not Completed

Range of Marks	Equivalent remarks
80 and above	Exemplary
70-79	Very Good
60-69	Good
50-59	Fair
40-49	Satisfactory
Below 40	Not Satisfactory = Not Completed

- Part IV& V not included in total marks and CGPA calculation.
- I.E-Internal Exam
- E.E-External Exam
- J-Job Oriented Course
- E-Open Elective Papers

ABSTRACT FOR SCHEME OF EXAMINATION

(For the candidates admitted during the academic year 2022 - 2023 and onwards)

Part	Course	Papers	Credit	Total Credits	Marks	Total Marks
Part I	Languages/ (MIL)	2	4	8	100	200
Part II	English/AECC-I	2	4	8	100	200
	Core /DSC	20	2/4/5	67	100	2000
	Self-Study Course /DSC	1	3	3	100	100
Part III	Allied /GE	8	2/4	24	100	800
	Electives/DSE	4	3/4	14	100	400
	Project SEC	1	6	6	100	100
	Internship/Institutional Training/Mini-Project /SEC	2	1	2	100	200
	Open Electives /AEE	3	2	6	100	300
Part IV	AECC –EVS/ HR/IS/GA/LE	5	1	5	50	250
	Value Added Course	4	1	4*	50	200**
	Aptitude /Placement Training/ SEC	4	Grade*	Grade*	50	200**
	Online courses / SEC	3	-	-	-	C/NC
	Life Skills / SEC	-	-	-	-	-
	SDR- Student Development Report /SEC	1	2	2*	-	-
	Extension Activities NSS / NCC/Sports/YRC / SIS / SA - AECC	1	2	2	-	C/NC
	Total			145 (6 Extra Credits)		4550 + (400**)

List of Open Elective Papers	
Open Electives	Yoga for Human Excellence Human Health & Hygiene Indian Culture and Heritage Indian Constitution and Political System Consumer Awareness and Protection Professional Ethics and Human Values Human Rights, Women's Rights & Gender Equality Disaster Management Green Farming Corporate Relations How to start a Business? Research Methodology and IPR General Studies for Competitive Examinations IIT JAM Examination (for Science only) CUCET Examination
VAC Papers	Quality Control and Assurance Apiculture Nanotechnology and its Applications Organic farming Biological Databases and Tools Food nutrition and safety Herbal Technology Alternative medicine Clinical laboratory Technology Biosafety and Its Clinical Applications Food safety and Regulation
Courses offered by the Departments to other Programmes	-

Note: VAC / JOC courses can be added along with the above open electives

List of Elective Papers/ DSE (Can choose any one of the paper as electives)		
	Course Code	Title
Elective / DSE-I	22BTU17A	Plant Physiology
	22BTU17B	Dairy process Biotechnology
Elective / DSE-II	22BTU24A	Research Methodology
	22BTU24B	Pharmaceutical Biotechnology
Elective / DSE-III	22BTU33A	Intellectual Property Rights and Competition Law
	22BTU33B	Analytical Technologies in Biotechnology
Elective / DSE-IV	22BTU34A	Introduction to Proteomics
	22BTU34B	Nanotechnology, Science and Applications

Self Study Course

22BTU36	DSC	Core XXI- Self-Study Course – Ecology and Environment
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Dairy

Syllabus Co-ordinator

Dairy

BOS – Chairman / Chairperson

Dr. G. RAJALAKSHMI
M.Sc., M.Phil., PGDBI., Ph.D., SET.,
Associate Professor and Head
PG & Research Dept. of Biotechnology
Hindusthan College of Arts and Science
Coimbatore - 641 028

Baharaul

Academic Council – Member Secretary

[Signature]

PRINCIPAL

PRINCIPAL

Hindusthan College of Arts & Science (Autonomous),
Hindusthan Gardens, Behind Nava India,
Coimbatore - 641 028.

UG - Scheme of Evaluation (Internal & External Components)

(For the students admitted during the academic year 2022-2023 and onwards)

1. Internal Marks for all UG

Components	Marks
Test I	10
Test II	10
Model Exam	10
Assignment	5
Attendance*	5
Internal Assessment components **	10
TOTAL	50

***Split-up of Attendance Marks**

- ♣ 75-79 - 1 marks
- ♣ 80-84 - 2 marks
- ♣ 85-89 - 3 marks
- ♣ 90-94 - 4 marks
- ♣ 95-100 - 5 marks

**** List of components for Internal Assessment (MCQ Compulsory)**

S.No	Components
1	Multiple choice questions
2	Club activities
3	Assignment
4	Seminar

(Any two components from the above list with five marks each will be calculated .2x5=10 marks)

2. a) Components for Practical I.E.

Components	Marks
Test -I	15
Test - II	15
Observation	10
Application*	10
Total	50

b) Components for Practical E.E.

Components	Marks
Experiments/Exercise	40
Record	5
Viva	5
Total	50

3. Institutional/ Industrial Training, Mini Project and Major Project Work

Institutional /Industrial Training (I.E)		Mini Project (I.E)	Major Project Work		
Component	Marks	Marks	Component	Marks	Total Marks
Work diary	25	-	I.E: a)Attendance	20	50
Report	50	50	b)Review/Work diary*	30	
Viva-voce	25	50			
Total	100	100	E.E:** a) Evaluation	30	50
			b)Viva-voce	20	
			Total	100	

*Review is for Individual Project and Work Diary is for Group Projects (group consisting of minimum 3 and maximum 5)

**Evaluation of report and conduct of viva voce will be done jointly by Internal and External Examiners

4. Guidelines for Internet Security/Human Rights/ Law of Ethics/ Environmental Studies (Part IV)

Components	Marks
Two Tests (each 2 hours) of 20 marks each [4 out of 7 descriptive type questions 4 x 5 = 20 Marks]	40
Two assignments (2 x 5)	10
Total	50

5. Guidelines for General Awareness (Part IV)

Components	Marks
Two Tests (each 2 hours) of 25 marks each [50 objective type questions 50 x 1/2 = 25 Marks]	50

6. Guidelines for open Elective (Part IV)

Components	Marks
Two Tests (each 2 hours) of 50 marks each [5 out of 8 descriptive type questions 5 x 10 = 50 Marks]	100

7. Value Added Courses and Aptitude/Placement courses:

Components	Marks
Two Test (each 1 hour) of 25 marks each QP is objective pattern (25x1=25)	50
Total	50

Guidelines:

1. The passing minimum for these items should be 40%
2. If the candidate fails to secure 40% passing minimum, he / she may have to reappear for the same in the subsequent Semesters
3. Item No's:4,5,6 and 7 are to be treated as 100% Internal papers.
4. For item No.7, Tests conducted through online modules (Google Form/any other)
5. Item No.2: * - Application should be from the relevant practical subject other than the Listed programmes. It must be enclosed in the practical record.

UG PATTERN

QUESTION PAPER PATTERN FOR CIA I and CIA II EXAM

Reg.No:----- Q.P.CODE:

HINDUSTHAN COLLEGE OF ARTS & SCIENCE (AUTONOMOUS)

----- DEGREE CIA-I/CIA-II EXAMINATIONS -----20---

(----- SEMESTER)

BRANCH: -----

SUBJECT NAME: -----

Time: Two Hours

Maximum:50 Marks

SECTION - A (6 x 1 = 6 Marks)

Answer ALL Questions

ALL Questions Carry EQUAL Marks

(Q.No: 1 to 6: Multiple choice/Fill up the blanks /True or False questions)

SECTION - B (4x 6 = 24 marks)

Answer ALL Questions

ALL Questions Carry EQUAL Marks

(Q.No: 7 to 10 Either Or type)

SECTION - C (2x10 = 20 marks)

Answer any TWO Questions out of THREE Questions

ALL Questions Carry EQUAL Marks

(Q.No: 11 to 13)

QUESTION PAPER PATTERN FOR MODEL/END SEMESTER EXAMINATION

Reg.No:-----

Q.P.CODE:

HINDUSTHAN COLLEGE OF ARTS & SCIENCE (AUTONOMOUS)

----- DEGREE MODEL EXAMINATIONS -----20-----

(-----SEMESTER)

BRANCH: -----

SUBJECT NAME:-----

Duration: Three Hours

Maximum: 70 Marks

SECTION - A (10x1=10 Marks)

Answer ALL Questions

ALL Questions Carry EQUAL Marks

(Q.No 1 to 10 Multiple choice/Fill up the blanks /True or False questions)

(Two questions from each unit)

SECTION - B (5x6=30 Marks)

Answer ALL Questions

ALL Questions Carry EQUAL Marks

(Q.No 11 to 15 Either or type)

(One question from each Unit)

SECTION- C (3x10=30 Marks)

Answer any THREE Questions out of FIVE Questions

ALL Questions carry EQUAL Marks

(Q.No 16 to 20) (One question from each Unit)

Blue Print of Question Paper for all UG Programmes

(For the academic year 2021-22, 2022-23)

FOR CIA I, CIA II - QUESTION PATTERN

Max. Marks: 50

Sec	Question No	Type	No of Question	Questions to be answered	Mark per question	K-level
A	1 to 6	MCQ/ True or False/ Fill up	6	6	1 (6x1=6)	All Questions will be K1
B	7 to 10	Either or Type (a or b)	8	4	6 (4x6=24)	4 Questions will be in K2 4 Questions will be in K3
C	11 to 13	Open choice	3	2	10 (2x10=20)	1 Question will be in K3 2 Question will be in K4

FOR MODEL/ESE - QUESTION PATTERN

Max. Marks:70

Sec	Question No	Type	No of Question	Questions to be answered	Mark per question	K-level
A	1 to 10	MCQ/ True or False/ Fill up	10	10	1 (10x1=10)	All Questions will be K1
B	11 to 15	Either or Type (a or b)	10	5	6 (5x6=30)	6 Questions will be in K2 4 Questions will be in K3
C	16 to 20	Open choice	5	3	10 (3x10=30)	2 Question will be in K3 3 Question will be in K4

(For the academic year 2020-21)

FOR CIA I, CIA II - QUESTION PATTERN

Max. Marks:50

Sec	Question No	Type	No of Question	Questions to be answered	Mark per question	K-level
A	1 to 6	MCQ/ True or False/ Fill up	6	6	1 (6x1=6)	All Questions will be K1
B	7 to 10	Either or Type (a or b)	8	4	5 (4x5=20)	4 Questions will be in K2 4 Questions will be in K3
C	11 to 13	Either or Type (a or b)	6	3	8 (3x8=24)	3 Question will be in K3 3 Question will be in K4

FOR MODEL/ESE - QUESTION PATTERN

Max. Marks:70

Sec	Question No	Type	No of Question	Questions to be answered	Mark per question	K-level
A	1 to 10	MCQ/ True or False/ Fill up	10	10	1 (10x1=10)	All Questions will be K1
B	11 to 15	Either or Type (a or b)	10	5	4 (5x4=20)	6 Questions will be in K2 4 Questions will be in K3
C	16 to 20	Either or Type (a or b)	10	5	8 (5x8=40)	5 Question will be in K3 5 Question will be in K4

Blue Print of Question Paper

Distribution of section-wise marks with K levels for UG 2021-22, 2022-23

CIA							
Sec.	K1	K2	K3	K4	Total questions	Questions to be answered	Total marks
A -MCQ/T or F / Fill up	6				6	6	6x1=6
B - Either or type		4	4		8	4	4x6=24
C - Open choice			1	2	3	2	2x10=20
Total Marks	6	24	34	20			84
% of marks without choice	7.14	28.57	40.48	23.81			100

Model Exam							
Sec.	K1	K2	K3	K4	Total questions	Questions to be answered	Total marks
A- MCQ/T or F/ Fill up	10				10	10	10x1=10
B - Either or type		6	4		10	5	5x6=30
C - Open choice			2	3	5	3	3x10=30
Total Marks	10	36	44	30			120
% of marks without choice	8.33	30	36.67	25			100

Distribution of section-wise marks with K levels for UG (2020-21)

CIA							
Sec.	K1	K2	K3	K4	Total questions	Questions to be answered	Total marks
A MCQ/T or F/ Fill up	6				6	6	6x1=6
B - Either or type		4	4		8	4	4x5=20
C - Either or type			3	3	6	3	3x8=24
Total Marks	6	20	54	24			104
% of marks without choice	5.77	19.23	51.92	23.08			100

Model Exam							
Sec.	K1	K2	K3	K4	Total questions	Questions to be answered	Total marks
A MCQ/True or False/ Fill up	10				10	10	10x1=10
B - Either or type		6	4		10	5	5x4=20
C - Either or type			5	5	10	5	5x8=40
Total Marks	10	24	56	40			130
% of marks without choice	7.69	18.46	43.08	30.77			100

UG Programme Regulations for the academic year 2022-2023

1. Internal marks components for the candidates admitted from the academic year 2022-2023 and onwards is as follows.

For Theory courses

Components	Marks
Test I	10
Test II	10
Model Exam	10
Assignment	5
Attendance	5
Internal Assessment components	10
TOTAL	50

For Practical courses

Components	Marks
Test –I	15
Test – II	15
Observation/Exercise	10
Application*	10
TOTAL	50

2. The pattern of the question paper for External Examination will be maximum of 70 marks for theory courses, the marks obtained will be converted into 50 as per the scheme.
3. Passing minimum for all UG programme is 40% in Internal and 40 % in External and the composition of total 40 marks out of 100 marks.
4. Internship / Institutional Training / Mini-Project is related to the discipline. The students can be permitted to complete the Internship / Institutional Training / Mini-Project before the end of First year (end of II semester) and before the end of the second year (end of IV semester) and submit a report.

Internship / Institutional Training	Duration: Not more than seven days
Mini project	During the course of study for not more than seven days.

5. Project work is considered as a special course involving application of knowledge in problem solving/analyzing/exploring a real-life situation. A Project work may be given in lieu of a discipline specific elective paper. Distribution of marks for major project for all UG programme will be 50:50 pattern for both Internal and External in total of 100/200 marks.
6. Two tests for fully internal subjects should be conducted during CIA-I and CIA –II by the department.
7. Retest for the failure candidates in CIA I or CIA II or Part IV or Part V or Extra credit courses should be conducted during the model examination after getting approval from the COE office. The candidates who are not able to complete the minimum pass mark in internal components even getting chance of reappearance, will be treated as arrear candidates.
8. For the Theory cum Practical blended courses, 50:50 Internal and External pattern will be followed for theory examination and Fully internal pattern will be followed for Practical examination. For theory part. External examination will be conducted as regular pattern (max of 70 marks) and it will be converted into 25 marks.

Course	Internal Marks		External marks		Total marks (Max. marks 50)	
	Min.	Max.	Min.	Max.	Min.	Max.
Theory	10	25	10	25	20	50
Practical	20	50	-		20	50

For Practical components for Theory cum Practical courses (Fully Internal)

Components	Marks
Test I	10
Test II	10
Experiment/Excercise	20
Record	5
Viva	5
Total	50

The Internal mark 50 will be converted into 25.

9. For the candidates admitted under the Fast Track System (FTS) must register their names to their concerned department heads and get approval from the COE office at the beginning of the III semester.
10. Students who are not willing to select the Project/Research work in Semester VI, can chose the theory papers offered by their departments as per the prescribed theory pattern.
11. Self Study will be a Core Paper of the department for which the examination pattern will be as like part III courses is followed.
12. NSS / NCC/Sports/YRC / SIS / SA is mandatory for all students as per New Education Policy and the students must attend the allocated hours within two years and complete the programme. They will be evaluated during the end of second year (Fourth Semester) and also a certificate will be issued.
13. SDR – Student Development Report to be received by the department from the students till end of the fifth semester. (Evidences of Curricular activities and Co-curricular activities)
14. For online courses minimum of 2 certificates in any of the online platform is mandatory.
15. Open elective courses:
Departments can offer list of subjects which teaches moral ethics to the young community for the better future. The topics relevant to Indian ethics, Culture, Women rights, Yoga, Green farming, Indian constitution etc., as an open elective courses. These courses can be offered by the department or other department as inter department courses. Marks earned for this courses will not be included for CGPA calculations.

Extension Activities

- NSS – National Service Scheme, as enrolled member with the College Unit.
NCC – National Credit Corps, as enrolled member with the College Unit.
SPORTS – Sports & Games Participation with College Team
YRC/RRC–Youth Red Cross / Red Ribbon Club, as enrolled member with the College Unit.
Rotaract Club - Rotaract Club, as enrolled member with the College Unit.
SIS – Special Interest Subjects, as approved by the Academic Council
SA – Social Activity for not less than 50 hours with NGGO like Aram Foundation / Shanthi Social Service /Siruthuli /Kulangal Pathukappu Amaipu /Old age Home / Nature Foundation / etc.

Regulations of Fast Track System (FTS)

- From the academic year 2021-22, our college is offering Fast Track System (FTS) for all UG and PG programmes. In this system, we are offering two courses under the course type of Discipline Specific Elective (DSE) in the sixth semester for all UG programmes and fourth semester for all PG programmes, which are equivalent and related with **National Programme on Technology Enhanced Learning/Study Webs of Active-Learning for Young Aspiring Minds (NPTEL/SWAYAM)** courses.
- The students have the option of taking two subjects of the sixth semester of their programme through NPTEL/SWAYAM portal from the list given by NPTEL and can complete the online course before fifth semester and submit the received original certificates to the COE office for getting approval. If the student completes these courses before the beginning of the sixth semester (UG)/fourth semester (PG), the candidate can be considered and exempted to write the examination from the assigned DSE courses in the sixth semester/fourth semester. They should complete only the self study course and project work during the VI/IV semester as assigned in the scheme. The candidate who completes the online courses and submits the successful course completion credentials, the credit transfer will be considered as per our Scheme of Examination for qualifying the degree. **The minimum duration of the registered online course must be 12 weeks.** Course duration of less than 12 weeks will not be considered.
- For all PG programmes, the candidates who were admitted during the academic year 2021-2022 under the Fast track system, for the self study course, the internal mark component will be as follows. For others regular internal pattern follows.

TEST	Max. Marks	Mode
CIA I	50 (50x1=50)	Online objective type
Model Exam.	50 (50x1=50)	Online objective type

Out of these two tests, the total marks will be converted into 40 marks as Internal.

- For all UG programmes, the candidates who were admitted during the academic year 2021-2022 under the Fast track system, for the self study course, the internal mark component will be as follows. For others regular internal pattern follows.

TEST	Max. Marks	Mode
CIA I	50 (50x1=50)	Online objective type
CIA II	50 (50x1=50)	Online objective type
Model Exam.	50 (50x1=50)	Online objective type

Out of three tests, the total mark will be converted into 30 marks as Internal.

- For the students admitted in Fast Track System, must enroll their names to the concerned department heads and get approval from the COE office at the beginning of III semester for all UG Programmes and at the beginning of II semester for all PG programmes.
- The students who cleared and got certified for online courses under the fast track system, the grade obtained will be converted into average marks of range. The received certificates must be submitted to the COE office for approval of the Controller and the Principal. The FTS courses will be treated as fully external.

DEPARTMENT OF BIOTECHNOLOGY				CLASS: I B. Sc.,				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
I	DSC	22BTU01	CORE I - CELL BIOLOGY AND GENETICS	5	5	50	50	100

Nature of Course		
Knowledge and Skill Oriented	Employability Oriented	✓
	Entrepreneurship Oriented	✓
	Skill Development	✓

Course Objectives			
<ol style="list-style-type: none"> To provide an overview of theory of origin, structural and functional aspects of cells, crossing over and inheritance, gene pool and gene frequency. To understand the concept of characteristics and functional aspects of cell organelle, cell cycle and cell division, membrane transport mechanisms, different crosses and on different hypothesis. To explore the cell structures, history, laws of Mendelian genetics and fundamental phenomenon of Mendelian genetics and pedigree analysis. To gain insights on cell theory, Epistasis, important concept of genetics in breeding, and chromosomal mutations. To learn about microbial cells, cell senescence, Mendel's work, underlying mechanism of population and human genetics with respect to various disease. 			
Unit	Course Contents	Hours	K Level
I	Introduction to Cell biology Definition of cell biology, history of cell biology from 6 th century to 20 th century, cell theory, protoplasm theory and organismal theory, unit of measurement of cell, Prokaryotic cell structure and function, eukaryotic cell structure and function, comparison and characteristics of plant cell, animal cell and microbial cells.	12	Upto K4
II	Cytoplasmic Matrix and Cell Division Structure and function of cell organelles – cell wall, plasma membrane – different models of plasma membrane, Membrane transport, Cell Junction, Cell adhesion. Golgi apparatus, mitochondria, nucleus, chromosomes and ribosomes. Microtubules, microfilaments and intermediate filaments. Cell cycle and Cell Division –mitosis, meiosis –Cell Senescence & Programmed cell death.	12	Upto K4
III	Introduction to Genetics History of genetics – vapour and fluid theories, preformation theories – rediscovery of Mendel's work, Mendel's selection of experimental plant – phenomenon of dominance, incomplete dominance and codominance. Monohybrid and dihybrid cross, Law of segregation, law	12	Upto K4

	of independent assortment. Dihybrid cross in <i>Drosophila</i> . Epistasis- Back cross and test cross.		
IV	Concepts in genetics Inbreeding, Outbreeding and Hybrid vigour – linkage – crossing over – sex- linked inheritance – multiple alleles -fine structure of gene - chromosomal mutation – changes in structure of chromosome – changes in number of chromosomes; – cytoplasmic or extra nuclear inheritance – Kappa particles in <i>Paramecium</i> .	12	Upto K4
V	Population Genetics and Human genetics Gene pool and gene frequency – two models of gene pool structure – classical hypothesis, balance hypothesis and chance mating or panmixis – Hardy Weinberg law – calculating gene frequency in a population with an example. Human genetics – pedigree analysis – inborn errors of metabolism – Phenylketonuria, alkaptonuria, albinism, sickle cell anaemia, human cytogenetics, eugenics, eupinics and euthenics.	12	Upto K4

Book for Study

P. S. Verma and V. K. Agarwal., 2020, Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, Reprint Colour Edition, S. Chand and Company.

Books for Reference

1. *Alberts Bruce, 2015, Molecular Biology of Cell, 8th Edition, Garland Science, New York.*
1. *Cooper G. M., 2016, The Cell: A Molecular Approach, 2nd Edition, ASM Press.*
2. *Helena M. Christoffersen, 2020, Gene Mutations – Causes & Effects, 1st Edition, NOVA Publishers.*
3. *Gardner and Simmons, 2006, Principles of Genetics, 8th Edition, Snustad, Wiley Publisher.*
4. *Wilson and Walker's, 2017. Principles and Techniques of Biochemistry and Molecular Biology. 8th Edition, Andreas Hofmann, Samuel Clokie. Cambridge University.*

Web Resources

1. <https://nptel.ac.in/courses/102/106/102106025/>
2. <https://www.coursera.org/learn/genetics>

Pedagogy: Lecturing, PowerPoint Projection through LCD, Videos, Assignment, Discussion and Activity.

Rationale for Nature of the Course: Cell Biology and Genetics is used to understand the concept, characteristics and functional aspects of cell and Cell organelles, cell cycle and division, membrane transport mechanisms, laws of Mendelian genetics and fundamental phenomenon of Mendelian genetics and pedigree analysis.

Activities to be given

1. Preparing students to learn Cell organelles in functional point of view which helps them to explore molecular techniques.
2. Creating models on Cell organelles to know better about cell structure, function and their characteristics.

Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K - Level
CLO 1	Describe the origin, unit of measurement, structure and function of cells, Mendel's History of crossing over and inheritance and about the gene pool and gene frequency.	K1
CLO 2	Outline the morphological and functional characteristic cell organelle, underlying mechanism of cell cycle, membrane transport, different crosses, sex-linked inheritance and also on different types of hypothesis.	K2
CLO 3	Illustrate on the different cell structure, history, theories and various laws of Mendelian' genetics, Human Genetics and Pedigree analysis.	K3
CLO 4	Examine about the cell theory, Cell division, Epitasis, breeding concepts, structural characteristic of gene and chromosomal mutation.	K4
CLO 5	Defend on the microbial cells, cell senescence, Mendel's work, the different hypothesis and laws, Inborn metabolic errors in human population.	K4



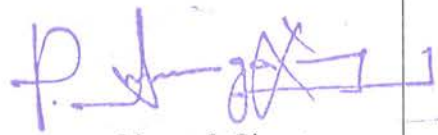
Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

CLOs	Programme Outcomes (with Graduate Attributes)						
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CLO 1	2	1	1	2	2	2	2
CLO 2	2	1	1	2	2	2	2
CLO 3	2	1	2	2	2	2	2
CLO 4	1	2	1	2	2	2	2
CLO 5	2	2	1	2	2	2	2

3 – Advance Application

2 – Intermediate Level

1 – Basic Level

Course Designed by	Verified by HOD	Approved by CDC Co-ordinator
 Dr. A. MANJU Name & Signature of the Staff	 Dr. G. RAJALAKSHMI Name & Signature	 Name & Signature

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 PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY
 HINDUSTHAN COLLEGE OF ARTS AND SCIENCE
 COIMBATORE - 641 028.

Co-ordinator
 Curriculum Development Cell
 Hindusthan College of Arts & Science,
 Coimbatore-641 028.

DEPARTMENT OF BIOTECHNOLOGY				CLASS: I B.Sc				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
I	GE	22BTU02	ALLIED I - CHEMISTRY	4	4	50	50	100

Nature of Course			
Knowledge and Skill Oriented	✓	Employability Oriented	✓
		Entrepreneurship Oriented	✓
		Skill Development	✓

Course Objectives

1. To acquire comprehensive knowledge on the principles of chemical bonding
2. To gain knowledge about stereoisomerism, inter-halogen compounds and chemistry of heterocyclic compounds
3. To explore chemical kinetics with respect to different orders of reactions.
4. To obtain basic knowledge on preparation and properties of Aromatic and Heterocyclic compounds.
5. To enlighten the properties of different dyes and its industrial applications

Unit	Course Contents	Hours	K Level
I	Chemical bonding Molecular Orbital Theory - MO diagram of H ₂ , He ₂ , N ₂ and O ₂ Molecules. Inter-halogen Compounds – Preparation, Properties, Structure and uses of ICl, BrF ₃ . Diborane – Preparation, Properties and Structure.	09	Upto K4
II	Hybridization and Stereoisomerism Orbital Overlap - Geometry of Organic Molecules – Methane, Ethylene and Acetylene. Inductive Effect, Electromeric Effect, Mesomeric Effect - Effects in Properties of Compounds. Stereoisomerism - Optical Isomerism, Symmetry - Elements of Symmetry, Cause of Optical Activity - Optical Activity in Lactic and Tartaric acid. Racemization and Resolution - Geometric Isomerism exhibited by Maleic and Fumaric acid.	10	Upto K4
III	Chemical Kinetics Introduction - Rate of a Reaction - Order and Molecularity of a Reaction - Examples. Various Order of a Reaction - Zero, First, Second Order Reactions - Pseudo First Order Reaction - Methods of Determining Order of a Reaction - Effect of Temperature on Reaction Rate – Energy of Activation.	10	Upto K4
IV	Aromatic compounds Electrophilic substitution in benzene - Mechanism of nitration, halogenation, alkylation, acylation, sulphonation - Preparation and properties of naphthalene. Heterocyclic's : Preparation and properties of furan and pyrrole.	10	Upto K4
V	Dye chemistry Definition of Terms – Chromophore – Auxochrome-	09	Upto K4

Bathochromic Shift - Hypsochromic Shift - Hyperchromic Effect - Hypochromic Effect. Synthesis of Azo Dyes - Methyl Red, Methyl Orange, Aniline Yellow, Triphenylmethane Dyes - Preparation of Malachite Green.		
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Note: The Questions should be asked in the 20% Problems and 80% Theory

Book for Study

1. *Text book of Allied Chemistry, Dr. Veeraiyan V, Highmount Publishing House, Chennai-14, 2006.*

Books for Reference

1. *Text book of Physical Chemistry, P.L.Soni, D.B.Dharmarke, Sultan Chand & Sons. 2009*
2. *Principles of Physical Chemistry, Puri B.R., Sharma L.R and Pathania M. S., 33rd Edn., Vishal Publishing Co., 2020, New Delhi.*
3. *Essentials of Physical Chemistry, B.S.Bahl and G.D.Tuli, S.Chand & Co., 2014.*
4. *Advanced organic Chemistry, Arun Bahl and B.S. Bahl, S.Chand & Co, 2005*
5. *Chemistry for Degree Students, R.L. Madan, S.Chand & Co, 2019.*

Web Resources

<https://www.nios.ac.in/media/documents/313courseE/L5.pdf>

<https://ncert.nic.in/textbook/pdf/kech104.pdf>

https://www.vssut.ac.in/lecture_notes/lecture1425072667.pdf

<https://www.saplinglearning.com/media/loudon/loudon5ech16sec04.pdf>

<https://ddu.collegedu.ac.in/Datafiles/cms/ecourse%20content/DYES.pdf>

Pedagogy :

Lecturing, PowerPoint Projection through LCD, Assignment, Discussion and Activity.

Rationale for Nature of the Course

Students can able to infer the chemical reactions and rate of reaction for a formation of molecules and compounds.

Activities to be given

Assignments, Seminars and Model Making

Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K - Level
CLO1	Describe the impact of various chemical bonding in structural and functional aspects of different compounds	K1
CLO2	Discuss the hybridization and geometrics of organic molecule using stereoisomerism	K2
CLO3	Illustrate experimentally the concept of chemical kinetics to ascertain zero, first and second order reactions	K3
CLO4	Analyze the knowledge on preparation, properties of aromatic and heterocyclic compounds	K4
CLO5	Explain the procedure for preparation and properties of different dye compounds and their industrial applications	K4




Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

CLOs	Programme Outcomes (with Graduate Attributes)						
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CLO 1	2	3	2	2	2	1	2
CLO 2	3	2	2	2	3	2	3
CLO 3	3	3	2	3	2	2	1
CLO 4	2	3	2	2	1	2	2
CLO 5	2	3	3	2	3	3	2

3 – Advance Application

2 – Intermediate Level

1 – Basic Level

Course Designed by	Verified by HOD	Approved by CDC Co-ordinator
 Dr. D. MAHALAKSHMI Name & Signature of the Staff	 Dr. G. RAJALAKSHMI Name & Signature	 Name & Signature

HEAD OF THE DEPARTMENT
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 COIMBATORE - 641 028.

Co-ordinator
 Curriculum Development Cell
 Hindusthan College of Arts & Science,
 Coimbatore-641 028.

DEPARTMENT OF BIOTECHNOLOGY				CLASS: I B. Sc.,				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
1	DSC	22BTU03	CORE II- PRACTICAL I - CELL BIOLOGY AND GENETICS	2	4	50	50	100

Nature of Course		
Knowledge and Skill Oriented	Employability Oriented	✓
	Entrepreneurship Oriented	
	Skill Development	✓

Course Objectives

1. To understand the basic laboratory procedures and microscopic techniques.
2. To explore distinguished feature of cells, cellular fractionization and stages of cell division.
3. To determine permeability of cell membrane and changes in chromosomes.
4. To demonstrate morphology of Drosophila and Mendelian crosses.
5. To identify different mutants, types and structure of chromosomes.

Unit	Course Contents	Hours
1	Cell Biology: Laboratory Rules and Regulations.	3
2	Microscopy – Light Microscope – Compound Microscope – Dark – Field Microscope and Bright Field Microscope.	5
3	Observation of distinguishing features of prokaryotic and eukaryotic cells.	4
4	Fractionation of Cellular components - Chloroplast and Mitochondria.	5
5	Study of divisional stages in Mitosis using onion root tip.	5
6	Cell Permeability.	4
7	Karyotyping.	5
8	Genetics: Drosophila – Morphology, Section Culture and Maintenance-Demo.	4
9	Monohybrid and Dihybrid Cross Using Plants – Demo.	4
10	Identification of Barr Bodies.	5
11	Mounting of Polytene Chromosome from Chironomus Larvae.	4
Total		48

Book for Study

K.V. Chaitanya, 2013, Cell and Molecular biology – A lab Manual Kindle Edition, PHI Publishing.

Books for Reference

1. Alberts Bruce, 2015, *Molecular Biology of Cell, 8th Edition, Garland Science, New York.*
1. Cooper G. M., 2016, *The Cell: A Molecular Approach, 2nd Edition, ASM Press.*
2. Helena M. Christoffersen, 2020, *Gene Mutations – Causes & Effects, 1st Edition, NOVA Publishers.*

- Gardner and Simmons, 2006, *Principles of Genetics*, 8th Edition, Snustad, Wiley Publisher.
- Wilson and Walker's, 2017. *Principles and Techniques of Biochemistry and Molecular Biology*. 8th Edition, Cambridge University.

Web Resources

- <https://www.easybiologyclass.com/molecular-biology-video-lectures-interactive-online-classes/>
- <https://www.khanacademy.org/science/high-school-biology/hs-cells/hs-basic-cell-structures/v/introduction-to-the-cell>

Pedagogy: Chalk & Talk, Exercise, Assignments & PPTs.

Rationale for Nature of the Course: Cell Biology and Genetics is used to understand the concept, characteristics and functional aspects of cell and Cell organelles, cell cycle and division, membrane transport mechanisms, laws of Mendelian genetics and fundamental phenomenon of Mendelian genetics and pedigree analysis. Chromosome banding helps to find Chromosomal Aberrations.

Activities to be given

- Preparing students to learn Cell organelles in functional point of view which helps them to explore molecular techniques.
- On demonstration of Monohybrid and dihybrid cross, they can able to understand the Mendelian genetics and explore in genetics.
- Identification of Barr bodies will have applications in forensic studies.

Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K - Level
CLO 1	Recall the basic laboratory guidelines and working principle of different microscopy.	K1
CLO 2	Compare the characteristics of cell types, fractionization of cellular components and stages of cell division.	K2
CLO 3	Examine the permeability of cell membrane and morphological characteristics of chromosomes.	K3
CLO 4	Compare and contrast Drosophila morphology, and types of Mendelian cross.	K4
CLO 5	Investigate the practical approach for mutant identification and structural changes of chromosome.	K4

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

CLOs	Programme Outcomes (with Graduate Attributes)						
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CLO 1	2	2	1	2	2	2	2
CLO 2	2	1	1	2	2	2	2
CLO 3	2	2	2	2	2	2	1
CLO 4	1	2	1	2	2	2	3
CLO 5	2	2	2	2	2	2	2

3 – Advance Application

2 – Intermediate Level

1 – Basic Level

Course Designed by	Verified by HOD	Approved by CDC Co-ordinator
 Mrs. FLORY SHOBANA Name & Signature of the Staff	 Dr. G. RAJALAKSHMI Name & Signature	 Name & Signature

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 COIMBATORE - 641 028.

Co-ordinator
 Curriculum Development Cell
 Hindusthan College of Arts & Science,
 Coimbatore-641 028.

DEPARTMENT OF BIOTECHNOLOGY				CLASS: I B.Sc				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
I	GE	22BTU04	ALLIED II - PRACTICAL II - CHEMISTRY	2	4	50	50	100

Nature of Course		
Knowledge and Skill Oriented	Employability Oriented	✓
	Entrepreneurship Oriented	
	Skill Development	✓

Course Objectives

1. To understand the basic concepts of volumetric analysis.
2. To enlighten basic mechanism of detection of elements.
3. To learn the distinguishing characteristics of aliphatic and aromatic compounds.
4. To explore saturated and unsaturated properties of chemical compounds
5. To give insights about qualitative and quantitative test for functional groups.

Unit	Course Contents	Hours	K Level
1	Volumetric Analysis: Estimation of Hydrochloric Acid- Standard Oxalic Acid.	4	Upto K4
2	Estimation of Ferrous Sulphate- Standard Mohr Salt Solution.	4	UptoK4
3	Estimation of Potassium Permanganate - Standard Sodium Hydroxide	4	UptoK4
4	Organic Analysis: Detection of Elements (N, S, Halogens).	36	UptoK4
5	To distinguish between Aliphatic and Aromatic		UptoK4
6	To distinguish between Saturated and Unsaturated.		UptoK4
7	Functional group tests for Phenols, Dicarboxylic Acids, Aromatic Primary Amine, Diamide, and Carbohydrate.		UptoK4
8	Functional groups characterized by Confirmatory Test		UptoK4

Book for Study

1. G H Jeffery, J Bassett, J. Mendham, R C Denney, Vogel's "Textbook of Quantitative Chemical Analysis", 5th Edition, 2009.

Books for Reference

1. Venkateswaran, V. Veeraswamy R. and Kulandaivelu. A.R, "Basic Principles of Practical Chemistry", Revised Edn., Sultan Chand and Sons, 2017, New Delhi.
2. B.S. Furniss, A.J. Hannaford, P.W.G. Smith, A.R. Tatchell, Vogel's Textbook of practical organic chemistry, including qualitative organic analysis, 5th edition, 1989.
3. Raj K.Bansal, Laboratory manual of Organic Chemistry, III Edn., New Age International (P)Ltd.1996.

- Gnanaprasadam, Ramamurthy, Organic lab Manual, Viswanathan, S., Printers & Publishers Pvt Ltd, 2009.
- B.Viswanathan & P.S. Raghavan, Practical Physical Chemistry, Viva Books, 3rd Edition, 2009.

Web Resources

<https://ncert.nic.in/pdf/publication/sciencelaboratorymanuals/classXI/chemistry/kelm206.pdf>
https://iscnagpur.ac.in/study_material/dept_chemistry/3.1_MIS_and_NJS_Manual_for_Organic_Qualitative_Analysis.pdf

Pedagogy:

Hands on Experiments.

Rationale for Nature of the Course

Students can able to analyze the compound quantitatively and qualitatively

Activities to be given




Preparation of standard solutions for volumetric and salt analysis

Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K - Level
CLO1	Remember the concepts of volumetric analysis; molarity, molality, normality and concentration.	K1
CLO2	Explain the concept for estimation of Nitrogen, Halogen, and Sulphur	Upto K2
CLO3	Illustrate the standardization of protocol for aliphatic and aromatic compounds	Upto K3
CLO4	Identify the various experimental methods for exploring saturated and unsaturated compounds	Upto K4
CLO5	Categorize the underlying mechanism of qualitative and quantitative analysis of functional groups	Upto K4

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

CLOs	Programme Outcomes (with Graduate Attributes)						
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CLO 1	3	3	2	3	2	3	3
CLO 2	3	3	2	2	3	2	3
CLO 3	3	3	2	3	2	3	2
CLO 4	3	3	2	3	2	3	2
CLO 5	3	3	2	3	2	3	2

Course Designed by	Verified by HOD	Approved by CDC Co-ordinator
 Dr. D. MAHALAKSHMI Name & Signature of the Staff	 Dr. G. RAJALAKSHMI Name & Signature	 Name & Signature

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DEPARTMENT OF BIOTECHNOLOGY				CLASS: I B. Sc.,				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
II	DSC	22BTU05	CORE III – BIOINSTRUMENTATION	2	3	25	25	50

Nature of Course		
Knowledge and Skill Oriented	Employability Oriented	✓
	Entrepreneurship Oriented	
	Skill Development	✓

Course Objectives

1. To gain insights on laboratory safety, unit measurement and ionizing radiations.
2. To familiarize knowledge on handling analytical balance and pH meter.
3. To give acumens on analytical equipment's like chromatography, centrifugation and osmometry.
4. To learn about the working principle of advanced optical and molecular separation techniques.
5. To enlighten the experimental knowledge on separation and purification of compounds.

Unit	Course Contents	Hours	K Level
I	Laboratory Safety and Units in Measurement Safe use of Laboratory equipment – Electrical equipment – Science lab equipment's and their general uses, Personal Protection – Hazardous and corrosive substance in laboratory, Ionizing radiation, waste disposal and first aid. The Metric systems – Conversion of units – Units used in Preparation of solutions – Units used in laboratory calculations – Ratios and dilutions.	9	Upto K4
II	Analytical Balance and pH meter Analytical balance – Single pan and Double pan analytical balance – Physical balance – Triple beam single pan balance and Double Pan balance. pH – Bra lowry concept of acids and bases and Buffers – Hendreson-Hasselbach equation & biological buffer systems. pH meter – Principle, Calomel electrode, glass electrode, combined electrode – operation and applications of pH meter.	9	Upto K4
III	Centrifugation, chromatography, Osmometry Basic Principles of Sedimentation – sedimentation coefficient -types of centrifuges – bench, high speed and ultra centrifuges – analytical and preparative. Chromatography – Principle and Applications and Types, Paper, Thin layer, Column, Ion exchange chromatography, HPLC and HPTLC. Osmometry – Vant Hoff's law of osmotic pressure – Determination of osmotic pressure – Types of Simple osmometers – Applications of osmometry.	9	Upto K4
IV	Colorimetry, Spectroscopy & Electrophoresis	9	Upto K4

	Colorimetry – Beer Lamberts law – applications. Spectrophotometry – Principle and applications of UV-Visible spectroscopy; Atomic Absorption Spectroscopy (AAS); Flame photometry and Fluorimetry. Mass Spectroscopy - principle and applications of GC MS. Electrophoresis – Basic Principle – Application of Electrophoresis in analyzing Macromolecules.		
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Book for Study

Veerakumari, L., 2015, Bioinstrumentation, 1st Edition, MJP Publishers, Chennai.

Books for Reference

1. *Abhilasha Shourie, Shilpa S., Chapadgaonkar. 2017, Bioanalytical Techniques. 1st Edition, The Energy and Resources Institute, TERI.*
2. *Christos P. Kitsos, Konstantinos G. Kolovos, 2010, Optimal Calibration Procedure for Calibrating the pH meters: Chemical and Statistical Approach for the pH Calibration Procedure, 1st Edition, LAP LAMBERT Academic Publishing.*
3. *Boyer Rodney F., 2020, Modern Experimental Biochemistry, 2nd Edition, Benjamin Cummings Publication, Sydney.*
4. *Wilson and Walkers, 2017, Principles and Techniques of Biochemistry and Molecular Biology, 8th Edition., Andreas Hofmann, Samuel Clokie. Cambridge University Press.*
5. *S. M. Khopar, 2016, Instrumental Methods in Bioanalytical Chemistry, 1st Edition., New Age International Private Limited.*

Web Resources

1. <https://automationforum.in/t/free-online-instrumentation-courses/4783>
2. <https://www.coursera.org/learn/spectroscopy>

Pedagogy: Chalk & Talk, Exercise, Assignments & PPTs.

Rationale for Nature of the Course: Can be able to understand the basic principle and working mechanism of all basic instruments used in the laboratories and can inculcate this knowledge in research field.

Activities to be given

1. Assignments can be given on preparing buffer solutions and calibrate the pH.
1. Preparing the students to have hands on experience on column packing and purify the compounds using chromatography.
2. Assignments can be given on metric systems, conversion of units and ratios and dilutions.

Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K - Level
CLO 1	Describe the basic concept of laboratory safety, metric system and ionising radiations.	K1
CLO 2	Outline the application and handling of analytical balance and pH meter in field of biological sciences.	K2
CLO 3	Examine the application of analytical techniques like centrifugation, chromatography and osmometry in separation and monitoring of biological compound and process.	K3
CLO 4	Investigate the importance of advanced analytical tools like calorimetry, spectroscopy and electrophoretic instruments in biological laboratory.	K4
CLO 5	Investigate the analytical principle and procedure for separation and purification of biological compounds.	K4




Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

CLOs	Programme Outcomes (with Graduate Attributes)						
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CLO 1	1	2	1	1	1	1	2
CLO 2	2	2	1	2	2	3	3
CLO 3	3	3	2	3	3	3	1
CLO 4	3	3	3	2	2	3	2
CLO 5	3	3	3	3	2	3	3

3 – Advance Application

2 – Intermediate Level

1 – Basic Level

Course Designed by	Verified by HOD	Approved by CDC Co-ordinator
 Dr. D. BHARATHI Name & Signature of the Staff	 Dr. G. RAJALAKSHMI Name & Signature	 Name & Signature

HEAD OF THE DEPARTMENT
 PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY
 HINDUSTHAN COLLEGE OF ARTS AND SCIENCE,
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Co-ordinator
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 Hindusthan College of Arts & Science,
 Coimbatore-641 028.

DEPARTMENT OF BIOTECHNOLOGY				CLASS: I B.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CI A	Ext	Total
II	DSC	22BTU05	CORE – III BIOINSTRUMENTATION- PRACTICAL - III	2	3	25	25	50

Nature of Course		
Knowledge and Skill Oriented	Employability Oriented	✓
	Entrepreneurship Oriented	
	Skill Development	✓

Course Objectives

1. To gain insights on Calibration and determination and usage of pH meter.
2. To familiarize knowledge on importance of buffer preparation.
3. To learn about the working principle of advanced optical and molecular separation techniques.
4. To give acumens on analytical equipment's like chromatography, centrifugation and osmometry.
5. To enlighten the experimental knowledge on separation and purification of compounds.

Unit	Course Contents	Hours
1	Calculation of Molar and Normal solution.	4
2	Buffer preparation, Determination of pH.	6
3	Determine the characteristics of a medium using Spectrophotometry method of light absorption.	6
4	Separation of Plant Pigments using Column chromatography.	6
5	Working principle and determination of sedimentation in a Revolutionary Centrifuge.	6
6	Separation of Nucleic acids with different size and charges using Gel Electrophoresis.	8
Total		36

Book for Study

Veerakumari, L., 2015, Bioinstrumentation, 1st Edition, MJP Publishers, Chennai.

Books for Reference

1. *Abhilasha Shourie, Shilpa S., Chapadgaonkar. 2017, Bioanalytical Techniques. 1st Edition, The Energy and Resources Institute, TERI.*
2. *Christos P. Kitsos, Konstantinos G. Kolovos, 2010, Optimal Calibration Procedure for Calibrating the pH meters: Chemical and Statistical Approach for the pH Calibration Procedure, 1st Edition, LAP LAMBERT Academic Publishing.*
3. *Boyer Rodney F., 2020, Modern Experimental Biochemistry, 2nd Edition, Benjamin Cummings Publication, Sydney.*
4. *Wilson and Walkers, 2017, Principles and Techniques of Biochemistry and Molecular Biology, 8th Edition., Andreas Hofmann, Samuel Clokie. Cambridge University Press.*

5. S. M. Khopar, 2016, *Instrumental Methods in Bioanalytical Chemistry*, 1st Edition., New Age International Private Limited.

Web Resources

1. <https://automationforum.in/t/free-online-instrumentation-courses/4783>
2. <https://www.coursera.org/learn/spectroscopy>

Pedagogy: Chalk & Talk, Exercise, Assignments & PPTs.

Rationale for Nature of the Course: Can be able to understand the basic principle and working mechanism of all basic instruments used in the laboratories.

Activities to be given:

1. Assignments can be given on preparing buffer solutions and calibrate the pH.
2. Preparing the students to have hands on experience on column packing and purify the compounds using chromatography.

Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K - Level
CLO 1	Recall the basic handling involved in the usage of pH meter.	K1
CLO 2	Outline the importance buffers in Biological system.	K2
CLO 3	Examine the basic working principle of molecular separation techniques.	K3
CLO 4	Practice the analytical techniques available to separate macro and micro molecules.	K4
CLO 5	Deduce the experimental methods for the separation and purification of biological compounds.	K4



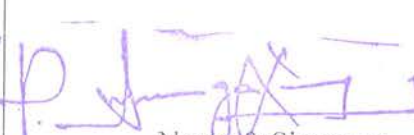
Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

CLOs	Programme Outcomes (with Graduate Attributes)						
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CLO 1	1	2	1	1	1	1	2
CLO 2	2	2	1	2	2	3	3
CLO 3	3	3	2	3	3	3	2
CLO 4	3	3	3	2	2	3	3
CLO 5	3	3	3	3	2	3	2

3 – Advance Application

2 – Intermediate Level

1 – Basic Level

Course Designed by	Verified by HOD	Approved by CDC Co-ordinator
 Dr. D. BHARATHI Name & Signature of the Staff	 Dr. G. RAJALAKSHMI Name & Signature	 Name & Signature

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 Coimbatore-641 028.

DEPARTMENT OF BIOTECHNOLOGY				CLASS: I B. Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
II	DSC	22BTU06	CORE IV - MICROBIOLOGY	4	4	50	50	100

Nature of Course		
Knowledge and Skill Oriented	Employability Oriented	✓
	Entrepreneurship Oriented	✓
	Skill Development	✓

Course Objectives

1. To remember the concepts of basic principle of microscopy and cultivation of microorganisms, its staining protocols, their classification and its pathology.
2. To understand the composition of different cellular components of various microorganisms and their growth kinetics.
3. To provide insights on viral replication, its cultivation assays and the various factors affecting the growth of microorganisms.
4. To learn the concept of structural studies using electron microscopy, nutritional classification of microbes and microbial pathogenesis caused in humans and plants.
5. To infer about the types of microscopes, bacterial structure, viral cultivation, microbial growth kinetics and assay, microbial nutrition and pathology.

Unit	Course Contents	Hours	K Level
I	Fundamentals of Microbiology History and scope of Microbiology –Five-kingdom and three-kingdom classification, Bergeys' Molecular and Phylogenetic classifications. Bright field, dark field, phase contrast, Confocal Scanning Laser Microscope (CSLM) and Electron Microscopes - Scanning tunneling Microscope – Atomic force Microscope.	9	Upto K4
II	Structure, Replication, and functions of Microbes Bacteria - Shape and Structure, Composition –Gram-Negative and Gram-Positive Cell Wall; Flagella: Structure – Types – Functions. Virus structures and Morphology- animal and plant viruses. Viral multiplication, Attachment, entry, un-coating, replication, assembly, release, Cell transformations, Cultivation of viruses-Assay techniques.	9	Upto K4
III	Microbial Growth Kinetics and Identification Growth phases - Generation time. Kinetics of growth, Batch culture. Continuous culture. Synchronous culture. Physical factors influencing growth – Temperature, pH, osmotic pressure, salt concentration. Staining of cells - Auxochrome and Chromophores; Classification of stains - Acidic and Basic dyes; Simple and differential staining procedures - Gram staining, acid fast staining, endospore staining, negative staining, capsule staining; and flagella staining.	10	Upto K4

IV	Microbial Nutrition and Culturing Techniques Microbial Nutrition-macro and micronutrients- nutrition uptake by cells. Nutritional types- Photoautotrophs, Photo- organotrophs, Chemo-organotrophs Chemo-lithotrophs. Effects of oxygen on growth, Classification on the basis of oxygen requirement and tolerance. Culture media and its types. Pure Culture Techniques – plating methods Preservation of microbes. Control of growth of Microbes. Sterilization-Physical and Chemical Methods.	10	Upto K4
V	Diseases in Human and Plants Disease caused by bacteria to humans- <i>Salmonella typhi</i> - <i>Mycobacterium tuberculosis</i> - <i>Streptococcus pneumoniae</i> – <i>Yersinia pestis</i> - <i>Clostridium tetani</i> . Disease caused by virus to humans and Plants – <i>HIV</i> , <i>HSV-TMV</i> , <i>Gemini virus</i> . Disease caused by fungus to humans and plants – <i>Candida albicans</i> - <i>Phytophthora infestans</i> . Plant Diseases - i) Citrus Canker ii) Tikka disease of groundnut iii) Bacterial Blight of Pomegranate: Common symptoms produced by plant pathogens, Modes of transmission of plant diseases.	10	Upto K4

Book for Study

Presscott L.M, Harley J. P. and Klein D. A., 2008, Microbiology, 7th Edition, McGraw-Hill Education.

Books for Reference

1. S. Rajan and R. Selvi Christy, 2016, *Experiments in Microbiology, 1st Edition, Anjanaa Book House.*
2. Ananthanarayan and Panicker, 2009, *Text Book of Microbiology, 8th Edition, Universities Press.*
3. Madigan, Bender, Buckley, Sattley, Stahl, 2019, *Brock Biology of Microorganisms, 15th Edition, Pearsons Education.*
4. Michael J. Pelczar, J.R.E.C.S. Chan, Noel. R. Krieg., 2016, *Microbiology, 5th Edition, McGraw Hill Education.*
5. Anthony Har C. and Paul Shears, 2004, 2nd Edition, Mosby Publisher.

Web Resources

1. <https://www.futurelearn.com/courses/introduction-to-microbiology>
2. <https://nptel.ac.in/courses/102103015>

Pedagogy: Chalk & Talk, Exercise, Assignments & PPTs.

Rationale for Nature of the Course

Microbiology provides the knowledge on the characteristics of microorganisms and their interactions with each other, with a host or with an environment, or with their societal significance. Moreover, making it possible to identify how some of these organisms cause diseases, discover cures for such diseases and even use some microbes for industrial purposes.

Activities to be given

1. Students will explore the classification of microorganisms and their culturing techniques.

2. Assignments on microbial characteristics and identification of microorganisms.
3. Preparing students to assess the microbial and plant pathology and to analyze the common symptoms and transmission.

Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K - Level
CLO 1	Recognize the basic principle of microbiology like microscopy, cultivation of microorganisms, staining, classification and its pathology.	K1
CLO 2	Predict the different components of microbial cells, its structure, functions and also the growth kinetics.	K2
CLO 3	Explain viral replication and cultivational assays, various culture systems and the factors affecting the growth of the microorganisms.	K3
CLO 4	Evaluate the microbial structures in electron microscopy and diseases caused by them to humans and plants and the way to control them.	K4
CLO 5	Deduce the working of various microscopes, structure of bacteria, viral assays, pure culture techniques, microbial pathology.	K4




Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

CLOs	Programme Outcomes (with Graduate Attributes)						
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CLO 1	1	2	2	2	2	2	2
CLO 2	2	2	2	2	2	3	3
CLO 3	2	2	2	3	2	3	2
CLO 4	2	2	2	2	3	3	3
CLO 5	2	2	3	3	3	3	2

3 – Advance Application

2 – Intermediate Level

1 – Basic Level

Course Designed by	Verified by HOD	Approved by CDC Co-ordinator
 Dr. SHARMY SAIMON Name & Signature of the Staff	 Dr. G. RAJALAKSHMI Name & Signature	 Name & Signature

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 COIMBATORE - 641 028.

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 Coimbatore-641 028.

DEPARTMENT OF BIOTECHNOLOGY				CLASS: I B. Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
II	GE	22BTU07	ALLIED III - BIOCHEMISTRY	4	4	50	50	100

Nature of Course		
Knowledge and Skill Oriented	Employability Oriented	
	Entrepreneurship Oriented	
	Skill Development	✓

Course Objectives

1. To understand the basic concepts of Atoms, Chemical bonding and Buffers.
2. To learn about classification, structural characteristics and functional importance of Carbohydrate and Protein.
3. To acquire knowledge on structural features, and biological properties of Enzymes and Nucleic acids.
4. To gain aware of structural elucidation. physical properties and functional role of Lipids and vitamins.
5. To explore the various metabolic pathways and biosynthetic pathways of Nucleotides.

Unit	Course Contents	Hours	K Level
I	Atoms and Chemical bonds Atomic theory – Valency – Atomic weight – Molecular weight - Molarity. Chemical Bonding – Le theory & Kos theory. Types of chemical bonding: Ionic, Covalent, Hydrogen and Polar bond, Van der Waals interactions. Physical properties of water. Structure of Water Molecules, Role of water in life - Properties and Ionization of Water, Bioenergetics – Concept of free energy in living organisms.	10	Upto K4
II	Carbohydrates and Proteins Carbohydrates: Classification-Simple & Complex. Structure and Biological Functions - Physical and Chemical Properties. Proteins: General Structure and Classification of Amino Acids & Peptides - Classification Proteins –Structure of Proteins Primary – Secondary - Tertiary and Quaternary – Physical and Chemical properties of proteins.	10	Upto K4
III	Enzymes and Nucleic Acid IUB Classification and Nomenclature of Enzymes –Characteristics and Three Dimensional structure. Mechanism of enzyme action. Modifiers of enzyme activity, Allosteric enzymes. Nucleic Acids: DNA -Structure, Denaturation & Renaturation, RNA-Structure & Types, Informosome. Functions of nucleic acid.	10	Upto K4
IV	Organic Compounds-Lipids and Vitamins Lipids –General Structure, Classification-Simple, Compound & Derived lipids, Physical properties of fats & Oils, Quantitative tests. Functions of lipids in biological system. Vitamins – Physical Properties – types – water soluble and fat soluble –significance.	9	Upto K4
V	Metabolism & Biosynthesis Metabolism-Definition, Metabolic Pathways-Catabolic & Anabolic pathways, Difference between catabolism &anabolism, Anaplerotic pathway. Regulation of metabolic pathways. Biosynthesis-of purines & pyrimidines – De novo synthesis & Salvage pathway.	9	Upto K4

Book for Study

U. Sathyanarayana and U. Chakrapani, 2021, Biochemistry, 6th Edition, Elsevier.

Books for Reference

1. Christopher K. Mathews, Kensal E. van Holde, Kevin. G. Ahern, 2017, *Biochemistry*, 3rd Edition, Pearson Education.
2. J. M. Berg, J. L. Tymoczko and L. Stryer, 2016, *Biochemistry*, 6th Edition, W. H Freeman and Company.
3. M. Cox, David. L. Nelson, 2011, *Lehninger Principles of Biochemistry*, 4th Edition, W.H. Freeman and Company, New York, USA
4. Smith et al., 2003, *Principles of Biochemistry*, 8th Edition, McGraw– Hill International Book Company.
5. Victor. W. Rodwell, David. A. Bender, Kathleen. M. Botham, Peter. J. Kennelly, P. Anthony Well, 2013, *Harper's Illustrated Biochemistry*, 31st Edition, McGraw- Hill Education.

Web Resources

1. https://onlinecourses.swyam2.ac.in/cec19_bt02/preview
2. https://onlinecourses.nptel.ac.in/noc20_cy10/preview

Pedagogy: Chalk & Talk, Exercise, Assignments & PPTs.

Rationale for Nature of the Course:

Biochemistry helps in understanding the chemical basis that gives rise to the process through biological molecules that are occurring between the living cells and within the cells. This, in turn, relates to the understanding of tissues and organs as well as the structure of the organisms and their functions.

Activities to be given

1. **Assignment:** Have students work with individuals for this activity. Students should prepare a detailed report on a specific topic.
2. **Model Presentation:** Have students work with small groups for this activity. Give each group different colors of yarn, as well as cardboard, glue, scissors, and toothpicks. Their task is to use these materials to create a sculpture or chart that accurately models a metabolic pathway in three dimensions.
3. **Visual Activities:** This section provides activities that will appeal most strongly to your visual learners by using LCD Displays.

Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K - Level
CLO 1	Describe atomic concepts, chemical bonding, general properties of water, and impact of buffers in biological system.	K1
CLO 2	Compare the structural features, properties and biological functions of carbohydrates and protein.	K2
CLO 3	Illustrate the nomenclature and action mechanism of enzyme as well as structural characteristics, types of enzyme and nucleic acids.	K3
CLO 4	Explain the general characteristics, classification, and functions of lipids and Vitamins in biological system.	K4
CLO 5	Classify the various metabolic pathways in biological system and biosynthetic pathways for nucleotides.	K4




Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

CLOs	Programme Outcomes (with Graduate Attributes)						
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CLO 1	1	2	2	2	2	2	2
CLO 2	3	2	3	3	2	3	3
CLO 3	3	3	3	3	3	3	2
CLO 4	3	2	2	3	3	3	1
CLO 5	3	2	2	3	3	3	2

3 – Advance Application

2 – Intermediate Level

1 – Basic Level

Course Designed by	Verified by HOD	Approved by CDC Co-ordinator
 Dr. D. BHARATHI Name & Signature of the Staff	 Dr. G. RAJALAKSHMI Name & Signature	 Name & Signature

HEAD OF THE DEPARTMENT
 PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY
 HINDUSTHAN COLLEGE OF ARTS AND SCIENCE,
 COIMBATORE - 641 028.

Co-ordinator
 Curriculum Development Cell
 Hindusthan College of Arts & Science,
 Coimbatore-641 028.

DEPARTMENT OF BIOTECHNOLOGY				CLASS: I B.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
II	DSC	22BTU08	Core V - Practical IV- Microbiology	2	3	50	50	100

Nature of Course		
Knowledge and Skill Oriented	Employability Oriented	✓
	Entrepreneurship Oriented	✓
	Skill Development	✓

Course Objectives

1. To understand the basic concept of isolation, identification and culture techniques of bacteria.
2. To make them skillful in morphological identification of microbes using different staining techniques.
3. To learn the method and measurement of bacterial growth in different environmental conditions.
4. To enlighten knowledge on biochemical identification and mobility of microorganism.
5. To explore the antibiotic sensitivity of microbes, and cultivation procedure for Bacteriophage.

Unit	Course Contents	Hours
1	Media Preparation and Sterilization.	3
2	Isolation and Enumeration of Bacteria and Fungi from soil, water and food sample.	3
3	Pure Culture Techniques.	3
4	Staining Techniques – Simple Staining, Gram's Staining, Endospore Staining and Lacto phenol Cotton Blue Staining.	7
5	Measurement of Bacterial Growth (by turbidity method) - Effect of temperature and pH on bacterial growth.	5
6	Biochemical Identification using IMVIC test.	4
7	Motility Test by Hanging Drop Method.	3
8	Antibiotic Sensitivity Test by Kirby - Bauer method.	3
9	Cultivation and enumeration of Bacteriophage from Sewage sample.	5
Total		36

Book for Study

J.G. Cappuccino and N. Sherman, 2014, Microbiology: A Laboratory Manual, 10th Edition, Addison-Wesley.

Books for Reference

1. *N. Murugalatha et al., 2012, Microbiological Techniques, 1st Edition., MJP Publishers.*
2. *Jame. G. Cappuccino, Chand Welsh, 2020, Microbiology: A laboratory Manual, 12th Edition, Hoboken, N.J.: Pearson Publisher.*

3. James H. Jorgensen, Karen C. Carroll, Guido Funke, Michael A. Pfaller, Marie Louise Landry, Sandra S. Richter, David W. Warnock, 2015, *Manual of Clinical Microbiology*, 11th Edition, ASM Press.
4. Fawole, M.O. and Oso, B.A. 2001, *Laboratory Manual of Microbiology*. Revised Edition, Spectrum Books, Ibadan.
5. James G. Cappuccino, Natalie Sherman, 2013, *Microbiology: A Laboratory Manual*, 10th Edition, Pearson Benjamin Cummings.

Web Resources

1. <https://nptel.ac.in/courses/104105102>
2. https://onlinecourses.nptel.ac.in/noc22_cy32/preview

Pedagogy: Chalk & Talk, Exercise, Assignments & PPTs.

Rationale for Nature of the Course

Techniques learned by the students are used for various industrial purposes. Microbial isolation, culturing and biochemical characterization techniques are useful to identify and distinguish microbial populations.

Activities to be given:

Workshop conducted on Enumeration and cultivation of bacteriophage from sewage sample.



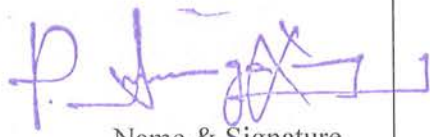
Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K - Level
CLO 1	Recall the basic microbiological laboratory techniques, isolation, culture techniques of bacteria.	K1
CLO 2	Outline the staining methods for morphological characterization of bacteria.	K2
CLO 3	Illustrate the methods involved in measurement of bacterial growth and its impact on various environment conditions.	K3
CLO 4	Identify the biochemical characteristics to distinguish microbial population and methods to determine their mobility.	K4
CLO 5	Examine the practical approaches for antibiotic sensitivity of bacteria and cultivation procedure for Bacteriophage.	K4

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

CLOs	Programme Outcomes (with Graduate Attributes)						
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CLO 1	3	3	2	3	2	2	3
CLO 2	2	2	2	2	2	3	3
CLO 3	2	2	3	3	2	2	2
CLO 4	3	3	2	3	2	3	3
CLO 5	1	3	2	3	2	3	1

3 – Advance Application
2 – Intermediate Level
1 – Basic Level

Course Designed by	Verified by HOD	Approved by CDC Co-ordinator
 Dr. SHARMY SAIMON Name & Signature of the Staff	 Dr. G. RAJALAKSHMI Name & Signature	 Name & Signature

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DEPARTMENT OF BIOTECHNOLOGY				CLASS: I B. Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
II	GE	22BTU09	ALLIED IV - Practical V - Biochemistry	2	3	50	50	100

Nature of Course		
Knowledge and Skill Oriented	Employability Oriented	✓
	Entrepreneurship Oriented	✓
	Skill Development	✓

Course Objectives

1. To understand the basic techniques involved in estimation of Amino acids and Proteins.
2. To learn the basic principle for quantitative estimation of Nucleic acids.
3. To comprehend the methods involved in estimation of sugar and analysis of oil.
4. To gain insights on the estimation of macro elements i.e. calcium and inorganic phosphate.
5. To explore key role of analytical separation techniques in biological experiments.

Unit	Course Contents	Hours
1	Estimation of Protein by Lowry's method.	3
2	Estimation of amino acids by Ninhydrin method.	3
3	Estimation of DNA by DPA Method.	4
4	Estimation of RNA by Orcinol method.	4
5	Estimation of Sugars by Anthrone method.	3
6	Analysis of Oils- Iodine Number - Saponification Value - Acid Number.	5
7	Estimation of Calcium.	3
8	Estimation of inorganic phosphate by Subbarow method.	3
9	Separation of Aminoacids using Paper Chromatography.	4
10	Separation of Xanthophyll using Thin Layer Chromatography.	4
Total		36

Book for Study

Shivaraja Shankara. Y.M, 2013, Laboratory Manual for Practical Biochemistry, 2nd Edition, Jaypee Brothers Medical Publishers.

Books for Reference

1. Jayaraman, 2011, Laboratory Manual in Biochemistry. Willy Eastern.
2. S. Sadasivam, A. Manickam, 2009, Biochemical Methods. 3rd Edition, New Age International Publisher.
3. Kaushik, G. G, Neha Sharma, Sabira Dabeer, Ruchi Jindal, 2020, Practical Manual of Biochemistry, 1st Edition, CBS Publisher.
4. S. Shanmugam, T. Sathish Kumar, K. Paneer Selvam, 2020, Laboratory Handbook On Biochemistry, 2nd Edition, PHI Learning Pvt. Ltd.
5. Soundravally Rajendiran, Pooja Dhiman, 2019, Biochemistry Practical Manual, 1st Edition, Elsevier India.

Web Resources

1. <https://nptel.ac.in/courses/104105102>
2. https://onlinecourses.nptel.ac.in/noc22_cy32/preview

Pedagogy: Chalk & Talk, Exercise, Assignments & PPTs.

Rationale for Nature of the Course

Techniques learned by the students are used for various Industrial purposes. Various estimations are used for finding out the percentages of each compound present in each substance.

Activities to be given:

1. **Assignment:** Have students work with individuals for this activity. Students should prepare a detailed report on a specific topic.
2. **Model Presentation:** Have students work with small groups for this activity. Give each group different colors of yarn, as well as cardboard, glue, scissors, and toothpicks. Their task is to use these materials to create a sculpture or chart that accurately models a metabolic pathway in three dimensions.
3. **Visual Activities:** This section provides activities that will appeal most strongly to your visual learners by using LCD Displays.

Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K - Level
CLO 1	Understand the basic techniques involved in estimation of Amino acids and Proteins.	K1
CLO 2	Learn the basic principle for quantitative estimation of Nucleic acids.	K3
CLO 3	Comprehend the methods involved in estimation of sugar and analysis of oil.	K3
CLO 4	Gain insights on the estimation of macro elements i.e. calcium and inorganic phosphate.	K1
CLO 5	Explore key role of analytical separation techniques in biological experiments.	K4




Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

CLOs	Programme Outcomes (with Graduate Attributes)						
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CLO 1	2	3	2	2	3	3	2
CLO 2	3	2	2	3	2	2	2
CLO 3	2	2	3	2	3	1	3
CLO 4	1	3	2	3	2	3	2
CLO 5	3	3	2	2	3	2	1

3 – Advance Application

2 – Intermediate Level

1 – Basic Level

Course Designed by	Verified by HOD	Approved by CDC Co-ordinator
 Dr. D. BHARATHI Name & Signature of the Staff	 Dr. G. RAJALAKSHMI Name & Signature	 Name & Signature

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