

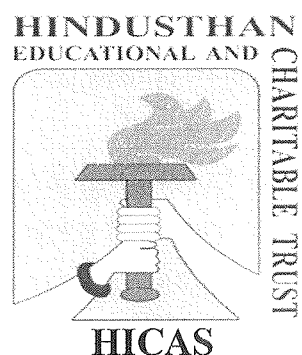
**LEARNING OUTCOMES–BASED CURRICULUM FRAMEWORK (LOCF)**

**in the**

**POST GRADUATE PROGRAMME IN BIOTECHNOLOGY**

**FOR THE STUDENTS ADMITTED FROM THE ACADEMIC**

**YEAR 2022 - 2023 AND ONWARDS**



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

**(Affiliated to Bharathiar University and Accredited by**

**NAAC) COIMBATORE-641028**

**TAMILNADU, INDIA.**

**Phone: 0422-4440555**

***Website: [www.hindusthan.net/hicas](http://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 at 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 OUTCOMES**

- PO1:** To engage loyal students in areas not qualified in their former academic lives and to

take them to a reference point that will permit them to conduct translational research, from intangible design through in vivo testing with an eye towards clinical execution

**PO2:** To provide interdisciplinary research and enlightening opportunities to explain problems that will progress the quality of life for those misery from health-related ailments and conditions.

**PO3:** To provide moral grounds for social guidelines aimed at shielding the Earth's environment and improving environmental degradation

**PO4:** To employ tools for Genetic resourcefulness in Fermentation, Selection and Breeding, Genetic analysis, Tissue culturing, Genetic Engineering/Recombinant DNA, and DNA analysis towards viability in economic and environmental features, and user friendly.

**PO5:** To impart skill for successful business start-ups and for building associations by persuading communications either positively or negatively

**PO6:** To provide students with the opening to teach themselves the most indispensable skill to become alltime learners: knowledge of how to learn and to not teach students how to learn, rather than what to learn.

**PO7:** To promote organization's tactic to research veracity – the formal and informal ethics, ideals, protocols and guidelines researchers trail in their environment to become more gratifying and successful environment.

#### **PROGRAMME SPECIFIC OUTCOMES (PSO)**

**PSO1:** Understand the basic knowledge and concepts of biotechnology and other related areas.

**PSO2:** Understand develop skills to verbalize accountable questions/hypotheses, predict expected results.

**PSO3:** Apply their knowledge in other advanced Course area like Nano biotechnology, Immunotechnology, and animal and plant biotechnology for the betterment and advancement of their professional career.

**PSO4:** Learn the theoretical and practical exposure to the basic and the advanced fields of biotechnology and validate respectable lab citizenry and the capability to work with others

**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)*

**PG PROGRAMME**

Programme: M.Sc.

Branch: Biotechnology

Course Code	Course Type	Course Title	Credit points	Lecture Hours/ Week		Exam Duration (hours)	MAX. MARKS		
				Theory	Practical		I.E.	E.E	Total
<b>Semester - I</b>									
22BTP01	DSC	Cell and Molecular Biology	4	4		3	50	50	100
22BTP02	DSC	Applied Microbiology	4	4		3	50	50	100
22BTP03	DSC	Biochemistry and Metabolism	4	4		3	50	50	100
22BTP04	DSC	Practical I-Cell and Molecular Biology	2		4	6	50	50	100
22BTP05	DSC	Practical II-Applied Microbiology	3		5	6	50	50	100
22BTP06	DSC	Practical III-Biochemistry and Metabolism	2		4	6	50	50	100
22BTP07	DSE	Elective I/ DSE-I	3	4		3	50	50	100
22BTP08	SEC	Internship/Institutional Training/ Mini-Project	2	-		-	100	-	100
22BTPJ01	SEC	Aptitude/ Placement Training	Grade *	2		-	50		50**
22BTPE01	AEE	Open Elective-I	2	3		-	100		100
22BTPV01	ACC	VAC-I	1*	2		-	50	-	50**
-	SEC	SDR – Student Development Record	Assessment will be done in the end of III semester						
<b>Total</b>			<b>26</b>	<b>23</b>	<b>13</b>		<b>550</b>	<b>350</b>	<b>900</b>
<b>Semester –II</b>									
22BTP09	DSC	Genetic Engineering	4	4		3	50	50	100
22BTP10	DSC	Plant Biotechnology	4	4		3	50	50	100
22BTP11	DSC	Research Methodology and Biostatistics	4	4		3	50	50	100
22BTP12	DSC	Bioprocess Technology	4	4		3	50	50	100
22BTP13	DSC	Practical IV – Genetic Engineering	3		5	6	50	50	100
22BTP14	DSC	Practical V- Plant Biotechnology	3		5	6	50	50	100
22BTP15	DSC	Practical VI - Bioprocess Technology	2		3		50	50	100
22BTP16	SEC	Internship/Institutional Training/ Mini-Project/Extension Activity	2	-		-	100	-	100
22BTPE02	AEE	Open Elective-II	2	3		3	100		100
22BTPJ02	SEC	Online Courses	Grade*	-	-	-	-	-	C/NC
22BTPJ03	SEC	Aptitude/ Placement Training	Grade*	2		-	50		50**

22BTPV02	ACC	VAC-II	1*	2		-	50	-	50**
		<b>Total</b>	<b>28</b>	<b>23</b>	<b>13</b>	<b>-</b>	<b>550</b>	<b>350</b>	<b>900</b>
		<b>Semester –III</b>							
22BTP17	DSC	Immunology and Immunotechnology	4	4		3	50	50	100
22BTP18	DSC	Animal and Pharmaceutical biotechnology	4	4		3	50	50	100
22BTP19	DSC	Environmental Biotechnology and Bionanotechnology	4	4		3	50	50	100
22BTP20 T	DSC	R Programming for Biologists	2	2		3	25	25	50
22BTP20 P	DSC	Practical VII - R Programming for Biologists	2		2	-	50	-	50
22BTP21	DSC	Practical VIII – Immunology and Immunotechnology	2		3	6	50	50	100
22BTP22	DSC	Practical IX – Animal Biotechnology and Pharmaceutical Biotechnology	2		4	6	50	50	100
22BTP23	DSC	Practical X-Environmental Biotechnology and Bionanotechnology	2		3	6	50	50	100
22BTP24	DSE	Elective II / DSE - II	3	3		3	50	50	100
22BTP25	SEC	Internship/Institutional Training/ Mini-Project/Extension Activity	2	-		-	100	-	100
22BTPE03	AEE	Open Elective-III	2	3		3	100	-	100
22BTPJ04	SEC	Aptitude/ Placement Training	Grade *	2		-	50		50**
22BTPJ05	SEC	OnlineCourses	Grade *	-	-	-	-	-	C/NC
22BTPV03	ACC	VAC-III	1*	2		-	50	-	50**
22BTPJ06	SEC	SDR – Student Development Record	2*	-	-	-	-	-	-
		<b>Total</b>	<b>29</b>	<b>24</b>	<b>12</b>		<b>625</b>	<b>375</b>	<b>1000</b>
		<b>Semester –IV</b>							
22BTP26	DSE	ElectiveIII/DSE-III	3	5		3	50	50	100
22BTP27	DSE	ElectiveIV /DSE- IV	3	5		3	50	50	100
22BTP28	DSC	Self-StudyCourse	3	-	-	3	50	50	100
22BTP29	SEC	Project Work/Student Research	6	-		-	100	100	200
		<b>Total</b>	<b>15</b>	<b>10</b>	<b>-</b>		<b>250</b>	<b>250</b>	<b>500</b>
<b>Grand Total</b>			<b>98+5*</b>				<b>1975</b>	<b>1325</b>	<b>3300</b>

\* - Extra Credits

- 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

Range of marks	Equivalent remarks
80 and above	Exemplary
70 – 79	Very good
60 – 69	Good
50 – 59	Satisfactory
Below 50	Not Satisfactory = Not Completed

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

#### **PASSING MINIMUM**

- Passing Minimum for PG 50%

**Abstract for Scheme of Examination**  
(For the students admitted during the academic year 2022 - 2023 and onwards)

Course	Papers	Credit	Total Credits	Marks	Total Marks
Core /DSC	11	4	44	100	1100
Self Study Course/DSC	1	3	3	100	100
Electives/DSE	4	3	12	100	400
Practical DSC	6/3	2/3	21	100	900
Project SEC	1	6	6	200	200
Internship/Institutional Training/Mini-Project / Extension Activity	3	2	6	100	300
Open Electives /AEE	3	2	6	100	300
Value Added Course	3	1*	3*	50	150**
Aptitude /Placement Training/ SEC	3	Grade*	Grade*	50	150**
Online courses	2	Grade*	Grade*	-	C/NC
SDR - SEC	1	2*	2*	-	-
<b>Total</b>			<b>98+ (5 Extra Credits)</b>		<b>3300 + (300**)</b>

<b>List of Open Elective Papers</b>	
<b>Open Electives</b>	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 Start a Business? Research Methodology and IPR General Studies for Competitive Examinations IIT JAM Examination (for Science only) CUCET Examination
<b>VAC Papers</b>	Mushroom Technology Medicobotany Fisheries Technology Intellectual Property Rights
<b>Courses offered by the Departments to other Programmes</b>	-

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)		
Electives/ DSE-I	Course Code	Title
	22BTP07 A	Bioethics and Biosafety
	22BTP07 B	Developmental Biology and Behavioural Studies
Electives/ DSE-II	22BTP24 A	IPR and Patents
	22BTP24 B	Bio-entrepreneurship
Electives/ DSE-III	22BTP26 A	Nanotechnology in Agriculture
	22BTP 26 B	Proteomics and Genomics
Electives/ DSE-IV	22BTP27 A	Introduction to mechanobiology
	22BTP27 B	Downstream Processing

22BTP28	DSC	Self-Study Course – Cell culture technologies
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Syllabus Coordinator

  
Academic Council – Member Secretary

  
BOS-Chairman/Chairperson

**Dr. G. RAJALAKSHMI**  
M.Sc., M.Phil., PGDBI., Ph.D., SET.,  
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Coimbatore - 641 028.

**PG Scheme of Evaluation (Internal & External Components)**

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

**1. Internal Marks**

**# List of components for Internal Assessment**

Components	Marks
Test	15
Model Exam	15
Internal Assessment components	20 #
<b>TOTAL</b>	<b>50</b>

S.No	Components
1	Multiple choice questions
2	Video teach
3	Co-operative or Collaborative Learning
4	Mini Project/Assignment
5	Case study
6	Seminar
7	Role Play
8	Management Games

(Any four components from the above list with five marks each will be calculated .4x5=20 marks)

**2. a) Components for Practical I.E.**

Components	Marks
Test - I	15
Test - II	15
Observation	10
Application*	10
<b>Total</b>	<b>50</b>

**b) Components for Practical E.E.**

Components	Marks
Experiments/Exercise	40
Record	5
Viva	5
<b>Total</b>	<b>50</b>

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

Internships/Industrial Training (I.E)		Mini Project (I.E)	Major Project Work		
Component	Marks		Component	Marks	Total Marks
Work diary	25	-	I.E a)Attendance	20	100
Report	50	50	b)Review	30	
Viva-voce	25	50	c) Report	25	
			d)MocViva-Voce/ Presentation	25	
<b>Total</b>	<b>100</b>	<b>100</b>	<b>E.E*</b>		
			a) Final report	60	100
			b)Viva-voce	40	
			<b>Total</b>		<b>200</b>

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

**4. 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
<b>Total</b>	<b>50</b>

### 5. Guideline for Open Elective

Two tests(each 2 hours) of 50 marks each	Marks
15 out of 8 descriptive type questions 5x10=50 Marks	
	100

#### Guidelines:

1. The passing minimum for these items should be 50%
2. If the candidate fails to secure 50% passing minimum, he / she may have to reappear for the same in the Subsequent semesters
3. Item No's:4 is to be treated as 100% Internals and evaluation through online.
4. Item No.2: \* - Application should be from the relevant practical subject other than the listed programmes. It must be enclosed in the practical record.

*For all PG/MBA/MCA Programmes (2022-2023 Regulations)*

**QUESTION PAPER PATTERN FOR CIA EXAM**

Reg.No:----- Q.P.CODE:  
HINDUSTHAN COLLEGE OF ARTS & SCIENCE (AUTONOMOUS)  
PG/MBA/MCA DEGREE CIA EXAMINATIONS -----20-----  
(-----Semester)  
BRANCH: -----  
Subject Name: -----

Time: Two Hours

Maximum: 50 Marks

**Section-A (4 x 4=16 Marks)**

Answer ALL Questions

ALL questions carry EQUAL Marks

(Q.No: 1 to 4 Either Or type)

**Section-B (3 x 8=24 Marks)**

Answer any THREE Questions out of FIVE Questions

ALL questions carry EQUAL Marks

(Q.No: 5 to 9)

**Section-C (1 x 10=10 Marks)**

(Compulsory Question: It should be a Case study/Application oriented/Critical analysis from any of the units)

(Q.No: 10)

**QUESTION PAPER PATTERN FOR MODEL / END SEMESTER EXAM**

Reg.No:----- Q.P.CODE:  
HINDUSTHAN COLLEGE OF ARTS & SCIENCE (AUTONOMOUS)  
PG/MBA/MCA DEGREE MODEL EXAMINATIONS -----20-----  
(-----Semester)  
BRANCH: -----  
Subject Name: -----

Time: Three Hours

Maximum: 60 Marks

**SECTION – A (5x4=20 marks)**

Answer ALL Questions

ALL Questions carry EQUAL Marks

(Q.No 1 to 5 Either Or type)

(One question from each Unit)

**SECTION – B (3x10=30 Marks)**

Answer any THREE Questions Out of FIVE Questions

ALL Questions carry EQUAL Marks

(Q.No 6 to 10)

(One question from each Unit)

**SECTION – C (1x10=10Marks)**

(Compulsory Question: It should be a Case study/Application oriented/Critical analysis from any of the units)

(Q.No: 11)

**Blue Print of Question Paper for all PG Programmes**  
(For the academic year 2021-22, 2022-23)

**FOR CIA I - QUESTION PATTERN**

Max. Marks:50

Sec	Question No	Type	No of Question	Questions to be answered	Mark per question	K-level
A	1 to 4	Either or Type (a or b)	8	4	4 (4x4=16)	2 Questions will be in K1 4 Questions will be in K2 2 Questions will be in K3
B	5 to 9	Open choice	5	3	8 (3x8=24)	2 Questions will be in K3 2 Questions will be in K4 1 Questions will be in K5
C	10	Compulsory	1	1	10 (1x10=10)	1 Question will be in K5

**FOR MODEL/ESE - QUESTION PATTERN**

Max. Marks:60

Sec	Question No	Type	No of Questions	Questions to be answered	Mark per question	K-level
A	1 to 5	Either or Type (a or b)	10	5	4 (5x4=20)	2 Questions will be in K1 4 Questions will be in K2 4 Questions will be in K3
B	6 to 10	Open choice	5	3	10 (3x10=30)	2 Questions will be in K3 2 Questions will be in K4 1 Questions will be in K5
C	11	Compulsory	1	1	1 (1x10=10)	1 Question will be in K5

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

CIA - PG								
Sec.	K1	K2	K3	K4	K5	Total questions	Questions to be answered	Total marks
A- Either or type	2	4	2			8	4	4x4=16
B - Open choice			2	2	1	5	3	3x8=24
C- Compulsory Question					1	1	1	1x10=10
Total Marks	8	16	16	16	18			84
% of marks without choice	9.52	19.05	19.05	119.05	21.43			100

Model Exam - PG								
Sec.	K1	K2	K3	K4	K5	Total questions	Questions to be answered	Total marks
A- Either or type	2	4	4			10	5	5x4=20
B - Either or type			2	2	1	5	3	3x10=30
C - Compulsory Question					1	1	1	1x10=10
Total Marks	8	16	36	20	20			100
% of marks without choice	8	16	36	20	20			100

**PG Programme Regulations for the academic year 2022-2023**

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

**For Theory courses**

Components	Marks
Test	15
Model Exam	15
Internal Assessment components	20
<b>TOTAL</b>	<b>50</b>

**For Practical courses**

Components	Marks
Test-I	15
Test-II	15
Observation/Exercise	10
Application*	10
<b>TOTAL</b>	<b>50</b>

2. Pattern of question paper for External Examination will be maximum of 60 marks for all theory courses. The marks obtained will be converted into 50 marks as per the scheme.
3. Passing minimum marks for all PG programme is 50 % in internal and 50% in External and the composition of total 50 marks out of 100 marks.
4. 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 work for all PG Programmes will be of 50:50 pattern for both Internal and External in total of 200 marks.
5. Internship / Institutional Training / Mini-Project/ Extension Activity is related to the discipline. The students can be permitted to complete the Internship / Institutional Training / Mini-Project/ Extension Activity before the end of respective semesters (end of I, II and III semester) and submit a report.

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

6. For fully internal subjects, Two test will be conducted one at the time of CIA I and the other will be during Model Examinations.
7. Retest for the failure candidates in the above case should be conducted immediately before the End Semester Examinations.
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	12.5	25	12.5	25	25	50
Practical	25	50	-	-	25	50

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

Components	Marks
Test I	10
Test II	10
Experiment/Exercise	20
Record	5
Viva	5
<b>Total</b>	<b>50</b>

The Internal mark 50 will be converted into 25.

11. 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 II semester.
12. Self Study will be a Core Paper of the department for which the examination pattern of other theory subjects is followed.
13. Online courses is incorporated as a non-credit skill enhancement course for the III and IV semesters and Grades will be assessed based on the certificates produced by the students. It is compulsory to produce one online course certificate for each semester to avail grades for the students. (2 certificates in any of the online platform is mandatory).
14. SDR – Student Development Report to be received by the department from the students till end of the **Third** semester. (Evidences of Curriculum activities and Co-curriculum activities).
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 subject will not be included for the CGPA calculation.

## 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 M. Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
I	DSC	22BTP01	CELL AND MOLECULAR BIOLOGY	4	4	50	50	100

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

Course Objectives			
<ul style="list-style-type: none"> <li>To impart knowledge on different types of cells in regard to structure and function of different organelles, cell cycles and signaling process</li> <li>To provide insights on various aspects of Intracellular organelles, cell division and gene regulation which give foundation in basic cell and molecular biology</li> <li>To make familiar with mechanism in cell adhesion, cell signaling pathways, prokaryotic and eukaryotic replication</li> <li>To make students understand the phenomenon of specialized cell, cytoskeleton, central dogma and genetic recombination</li> <li>To enlighten the concepts of purification of cellular organelles, connections between cell adhesion and cytoskeleton, receptor response mechanisms and gene regulation</li> </ul>			
Unit	Course Contents	Hours	K Level
I	<b>Introduction to Different Types of Cells:</b> Cell and Intracellular Organelles – Nucleus, Mitochondria, Chloroplast, Ribosomes, Golgi complex, Endoplasmic reticulum, Fractionation and Purification of Subcellular Organelles. Structure of Chromosomes – Giant and Polytene Chromosomes. Specialized Cell Structure and Function - Muscle Cell, Nerve Cell and Sperm Cell.	10	Upto K5
II	<b>Cell Division, Cell Cycle and Cytoskeleton:</b> Events of Mitosis, Events of Meiosis. Cell Cycle and its regulation. Cytoskeleton - Cell Motility and Cellular Movements – Microtubules – Microfilament, Connections between cell cycle, cell adhesion and cytoskeleton.	10	Upto K5
III	<b>Cell Signaling</b> Structure and Functions of Plasma Membrane – Cell Recognition, Membrane Transport, Cell junction, Cell Adhesion, Cell to Cell Signaling – Receptors and Receptor Response Mechanisms - G protein coupled receptors – Jak/STAT Pathway, Receptor Tyrosine Kinase pathways	11	Upto K5

IV	<b>Central Dogma of Cell</b> DNA Replication – Prokaryotic and Eukaryotic replication – mode of replication. Transcription and Post transcriptional Modification – Genetic code – Wobbling hypothesis – Translation and post translational modification.	12	Upto K5
V	<b>Gene transfer, Gene Regulation, Genetic recombination</b> DNA as a genetic material – Conjugation, Transformation and Transduction. Mutation – Spontaneous and Induced-DNA Repair Mechanisms. Operon concept – trp and ara operons Recombination – Holliday model and Transposons –IS elements and Tn in Maize.	9	Upto K5

### Book for Study

1. Ajoy Paul, 2015, *Cell and Molecular Biology, New Edition, Books and Allied.*

### Books for Reference

1. Alberts Bruce, 2002, *Molecular Biology of Cell, 4<sup>th</sup> Edition, Garland Science, New York.*
2. Cooper G. M. and Hausman R. E., 2013, *The Cell: A Molecular Approach, 6<sup>th</sup> Edition, Sinauer Associates Inc.*
3. Krebs J. E., Kilpatrick S. T., Goldstein E. S., 2013, *Lewin' GENES XI, 11<sup>th</sup> Edition, Jones & Bartlett Publishers, Boston.*
4. Berg J. M., Tymoczko J. L., Gatto G. J. and Stryer L., 2015, *Biochemistry, 8<sup>th</sup> Edition, W H Freeman & Co., New York.*
5. Gerald Karp, Janet Iwasa, Wallace Marshall, 2018, *Karp's Cell Biology, 8<sup>th</sup> Edition, Global Publishing.*

### Web Resources

1. <https://www.coursera.org/courses?query=molecular%20biology>
2. <https://www.khanacademy.org/science/biology/x324d1dcc:metabolism>

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

**Rationale for Nature of the Course:** Useful and making it possible to identify some of genetic manipulation using the molecular biology tools to discover cures for genetic disorders.

### Activities to be given

1. Students will explore and learn how advances in science are allowing increasingly specific tools in molecular biology studies
2. Assignments on advancement in Gene regulation and recombination
3. Preparing Students to explore the risks and benefits of molecular biology studies.

### Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K - Level
CLO 1	Relate the knowledge of cell structures, functions, of cellular organelles, cell cycles and signaling processes will help students to design experiments	K1
CLO 2	Outline the properties and biological significance of Cell division, and cytoskeleton found in living organisms and gene regulation which give foundation in molecular biology	K2
CLO 3	Illustrate the structure and functions and mechanisms of various cell signaling pathways, mechanism in cell adhesion and replication	K3
CLO 4	Explain the processes of central dogma, specialized cell, cytoskeleton and genetic recombination	K4
CLO 5	Justify the methods of purification process, Gene transfer, mutation, trc concepts and IS elements	K5

### 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	2	2	2	2	2	3
CLO 2	3	2	2	2	2	3	2
CLO 3	3	2	2	3	2	3	2
CLO 4	3	2	2	2	3	3	3
CLO 5	3	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
 <b>Dr. P. KARTHIGA</b> Name & Signature of the Staff	 <b>Dr. G. RAJALAKSHMI</b> Name & Signature	 Name & Signature

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

DEPARTMENT OF BIOTECHNOLOGY				CLASS: I M. Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
I	DSC	22BTP02	<b>CORE II - APPLIED MICROBIOLOGY</b>	4	4	50	50	100

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

### Course Objectives

1. To provide knowledge on the fundamentals of Applied microbiology in terms of microbial physiology and metabolism, Agriculture and environmental, and food and medical microbiology.
2. To impart thoughts on the evolutionary theories, methods of pure culture, bio fertilizers preparation, theories in food microbiology, and host-pathogen interactions.
3. To give insights on types of classification of microorganism, staining and sterilization methods, column-based culturing, food characteristics, and antibiotic therapy
4. To gain knowledge on the principle of Light microscopes, quality control, biogeochemical cycles, food preservatives and pathogenicity bacterial infections
5. To explore the principle of electron microscopes, nutritional classification, growth of culture, pollution management, food safety methods, and pathogenicity of viral infections.

Unit	Course Contents	Hours	K Level
I	<b>Introduction to Applied Microbiology</b> History and Scope of Microbiology – Biogenesis vs Abiogenesis - Microbial Diversity:- Classification of Bacteria, Algae, Fungi and Protozoa – Bergey’s Molecular and Phylogenetic Classification. Microscopy – Principle and Applications of Bright Field, Dark Field, Phase Contrast, Confocal Scanning Laser Microscope and Fluorescent Microscope. Electron Microscope – SEM and TEM.	11	Upto K5
II	<b>Microbial Physiology and Metabolism</b> Microbial cultures: Methods of pure culture technique- Staining Techniques-Methods of sterilization- physical methods-Dry heat, moist heat, radiation methods, filtration methods, chemical methods & their application. Quality control. - Lyophilizers, Deep freezer. Nutritional Classification of Microbes – Autotrophs, Heterotrophs, oxygen requirements and carbon source – Growth Curve - Preservation and maintenance of Microbial cultures	12	Upto K5
III	<b>Agricultural and Environmental Microbiology</b> Biofertilisers – Azolla, Anabena – Winogradsky Column – Biogeochemical Cycles – Carbon, Nitrogen, Sulphur, Phosphorus. Microbial fuel cells: Batteries Powered by Microbes, Role of Microorganisms in pollution management through Biodegradation and Bioremediation process (Oil spills).	09	Upto K5
IV	<b>Food Microbiology</b>	10	Upto K5

	History and Development -Characteristics of Food-Source, Microorganisms - Factors Influencing Microbial Growth Characteristics; Food Bio preservatives of Microbial Origin-Food Spoilage by Microbial Enzymes-Salmonellosis, Campylobacteriosis- Control of Microorganisms like Physical and chemical methods-Microbial Detection and Food Safety		
V	<b>Medical Microbiology:</b> Host–Pathogen Interactions-General Epidemiology- Principles of Antibiotic Therapy- Pathogenicity and laboratory diagnosis of bacterial infections - <i>Corynebacterium diptheriae</i> , <i>Streptococcus pyogenes</i> , Viral infections – Dengue virus, HIV, Ebola virus, CoVID Protozoan Infections - <i>Entamoeba histolytica</i> , <i>Taenia solium</i> and <i>Plasmodium vivax</i>	10	Upto K5

#### Book for Study

1. Prescott L. M., Harley J.P. and Klein D. A., 2003, *Microbiology*, 5<sup>th</sup> Edition, Tata Mc Graw Hill, New Delhi.

#### Books for Reference

1. Frazier W.C. and West Hoff D.C., 2003, *Food Microbiology*, 18<sup>th</sup> Edition, Tata McGraw Hill Ltd, New Delhi.
2. Oladele A Ogunseitan, 2008, *Microbial Diversity Form and Function in Prokaryotes*, 1<sup>st</sup> Edition, Wiley-Blackwell.
3. Dubey R. C. and Maheswari D. K., 2005, *A text book of Microbiology*, Revised Multi colour Edition, S. Chand Publishers, New Delhi.
4. Pelezar & Kreig, 2006, *Microbiology*, 5<sup>th</sup> Edition, Tata McGraw Hill, New Delhi

#### Web Resources

1. <https://www.coursera.org/courses?query=microbiology>
2. <https://www.edx.org/learn/microbiology>
3. <https://www.mooc-list.com/course/stories-infection-coursera>
4. <https://nptel.ac.in/courses/105/107/105107173/>
5. <https://nptel.ac.in/content/storage2/courses/105104102/Lecture%2023.htm>
6. [https://onlinecourses.swayam2.ac.in/cec19\\_ag03/preview](https://onlinecourses.swayam2.ac.in/cec19_ag03/preview)

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

#### Rationale for Nature of the Course

Students can be master in a set of techniques, which make them to explore many opportunities in higher studies, research and entrepreneur.

#### Activities to be given

1. Assignment on specific topics with their own ideas
2. Discussion on importance topics as their own views

#### Course Learning Outcomes




CLOs	On Completion of the Course, the students should be able to	K - Level
CLO 1	Describe the fundamentals of Applied microbiology in terms of microbial physiology and metabolism, Agriculture and environmental, and food and medical microbiology	K1
CLO 2	Examine the evolutionary theories, methods of pure culture, biofertilizers preparation, theories in food microbiology and development, and host pathogen interactions.	K2
CLO 3	Illustrate the types of classification of microorganism, staining and sterilization methods, column-based culturing, food characteristics and influencing factors, and epidemiology and antibiotic therapy	K3
CLO 4	Experiment the principle of Light and compound microscopes,	K4

	instrumentation of quality control methods, biogeochemical cycles, food preservatives and pathogenicity of bacterial infections	
CLO 5	Justify the principle of electron and laser microscopes, nutritional classification, growth and maintenance of culture, techniques involved in pollution management, food safety methods, and pathogenicity of viral infections.	K5

**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	3	2	3	3	2
CLO 2	2	3	3	3	2	3	3
CLO 3	2	2	3	3	2	3	2
CLO 4	3	3	3	3	2	3	2
CLO 5	3	3	3	3	3	3	3

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

Course Designed by	Verified by HOD	Approved by CDC Co-ordinator
 <b>Dr. S. G. ANTONY GODSON</b> Name & Signature of the Staff	 <b>Dr. G. RAJALAKSHMI</b> 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 M.Sc.,				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
I	DSC	22BTP03	BIOCHEMISTRY AND METABOLISM	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, biomolecules and metabolism.
2.	To learn about structural features of atoms, various biomolecules and classification of biological metabolisms
3.	To acquire knowledge on physico-chemical, and biological properties of bonding systems, micro and macromolecules and metabolic energetics.
4.	To understand the energetics in living systems and also biomolecules such as carbohydrates, proteins, enzymes, nucleic acids, vitamins and lipids.
5.	To explore the role of various biomolecules in living systems to generate energy.

Unit	Course Contents	Hours	K Level
I	<b>Atoms, Molecules and Chemical Bonds</b> Classes of Organic Compounds and Functional Groups. Covalent and Non-covalent Interactions - Vander Waal's – Electrostatic – Hydrogen Bonding and Hydrophobic Interactions; Energy Metabolism (concept of free energy); Principles of Thermodynamics; Kinetics, Dissociation and Association Constants; Bioenergetics.	10	Upto K5
II	<b>Carbohydrates</b> Structure and Classification of Mono, Di and Polysaccharides – Occurrence – Isolation – Purification – Properties and Biological Reactions. Structural Features of Homoglycans, Heteroglycans and Complex Carbohydrates. Carbohydrate Metabolism: Glycolysis and TCA Cycle; Glycogen Breakdown and Synthesis; Gluconeogenesis; Interconversion of Hexoses and Pentoses.	10	Upto K5
III	<b>Proteins and Lipids</b> Proteins: Classification–Primary Structure of Proteins–Structural Comparison at Secondary and Tertiary levels–Conformation of Proteins (Ramchandran Map) and Polypeptides (Secondary, Tertiary, Quaternary and Domain Structure) – Protein Folding –Biophysical and Cellular Aspects. Amino acids: Metabolism of aromatic amino acids.-tyrosine, tryptophan and phenylalanine.	11	Upto K5

	Lipids: Structure and Classification–Properties–Oxidation of Fatty acids–Biosynthesis of Fatty acids–Triglycerides.		
IV	<b>Nucleic Acids</b> Classification – Structure and Properties – Biological Significance of Double Strand –Sequence Dependent Variation in the Shape of DNA. Structure of Double Stranded DNA (B, A, C, D, T and Z DNA) - Types of RNAs and their Biological Significance - DNA Bending – DNA Super coiling, Secondary and Tertiary Structural Features and their Analysis-Biosynthesis of Purines and Pyrimidines.	11	Upto K5
V	<b>Enzymes and Vitamins</b> Classification–Regulation of Enzymatic Activity-Enzyme Kinetics-Active Sites; Coenzymes–Coenzymes Interactions, Activators and Inhibitors–Isoenzymes–Allosteric Enzymes–Ribozyme–Hammer Head–Hair Pin and other Ribozymes– Abzyme: Structure and Drug Targets (Enzymes and Receptors).Vitamins–Classification–Fat soluble and Water Soluble vitamins and their significance	10	Upto K5

#### Book for Study

1. Michael.M.Cox, David.L.Nelson, 2012, *Lehninger Principles of Biochemistry*, 6<sup>th</sup> Edition, W.H. Freeman and Company, NY, USA.

#### Books for Reference

1. Christopher K. Mathews, Kensal E. van Holde, Kevin G. Ahern, 2008, *Biochemistry*, 6<sup>th</sup> Edition Pearson Education.
2. Smithetal., 2006, *Principles of Biochemistry*, 8<sup>th</sup> Edition, McGraw–Hill International book Company.
3. Zubay, 2016, *Biochemistry*, 6<sup>th</sup> Edition, WCB publishers.
4. R. K. Murray, D. K. Granner, P. A. Mayes and V. W., 2009, *Rodwell, Harper's Biochemistry*, 3<sup>rd</sup> Edition, Prentice-Hall International.
5. J. M. Berg, J. L. Tymoczko and L. Stryer, 2011, *Biochemistry*, 6<sup>th</sup> Edition, W H Freeman and Company, NY.

#### Web Resources

1. [https://onlinecourses.swayam2.ac.in/cec19\\_bt02/preview](https://onlinecourses.swayam2.ac.in/cec19_bt02/preview)
2. [https://onlinecourses.nptel.ac.in/noc20\\_cy10/preview](https://onlinecourses.nptel.ac.in/noc20_cy10/preview)
3. <https://online-learning.harvard.edu/course/principles-biochemistry-1?delta=0>
4. <https://www.coursera.org/learn/chemicals-health>

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

**Rationale for Nature of the Course:** Biochemistry and Metabolism is used to understand and provide scientific insights on atoms, molecules, various chemical bonds, macromolecules and energy metabolism, structure of micro and macro molecules, biological importance of thermodynamics, nucleic acids, enzymes, vitamins and proteins, gives knowledge on kinetics, bioenergetics, and regulatory pathways of enzymes



### Activities to be given

1. Creating models on biochemical pathways and the structure of Micro and Macro molecules
2. Assignment and poster presentation on Macro molecules and their functions

### Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K - Level
CLO 1	Gain the knowledge on basic concepts of atoms, chemical bonding, biomolecules and metabolism.	K1
CLO 2	Experienced with structural features of atoms, various biomolecules and classification of biological metabolisms.	K2
CLO 3	Mastered with physio-chemical, and biological properties of bonding systems, micro and macromolecules and metabolic energetics	K3
CLO 4	Proficient to know the energetics in living systems and also biomolecules such as carbohydrates, proteins, enzymes, nucleic acids, vitamins and lipids	K4
CLO 5	Capability to understand role of various biomolecules in living systems to generate energy	K5

### 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	2	3	3	3	2
CLO 2	3	2	3	3	2	3	3
CLO 3	3	2	3	3	2	3	2
CLO 4	2	2	3	3	2	3	3
CLO 5	3	3	3	2	2	2	3

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

Course Designed by	Verified by HOD	Approved by CDC Co-ordinator
 <b>Dr. D. BHARATHI</b> Name & Signature of the Staff	 <b>Dr. G. RAJALAKSHMI</b> 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 M.Sc.,				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
1	DSC	22BTP04	PRACTICAL I - CELL AND MOLECULAR BIOLOGY	2	4	50	50	100

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

#### Course Objectives

1. To learn the working principle of bright field microscope and identification of cellular organelles, cell division and sucrose fractionation
2. To develop practical skills fractionation of cellular components and observation of cell division and selection of mutants
3. To gain insights on XY sex determination using chromosomal study and selection of mutants using different methods
4. To provide knowledge on identification of cell types and mutants by employing plating techniques
5. To impart knowledge on identification of cell types and lipid solubility of membrane

Unit	Course Contents	Hours
1	Microscopy--Working principle of Bright Field Microscope; Identification of Cell Types – Plant, Animal and Microbes.	4
2	Fractionation of Cellular components – Nucleus, Mitochondria, Chloroplast.	5
3	Mitotic Preparation –Onion Root Tip.	4
4	Identification of Barr bodies	4
5	Mounting of Polytene Chromosome from Chironomous larva	5
6	Physical and Chemical Mutagenesis	5
7	Auxotrophic selection of mutants by replica plating technique	10
8	Lipid solubility of membranes	5
9	Isolation of Genomic DNA from Bacteria	5
10	Isolation of plasmid DNA from Bacteria	5
<b>Total</b>		<b>52</b>

#### REFERENCE BOOKS:

1. Cappuccino, P., & Sherman, D., 2009, *Microbiology -A Lab Manual*. 7<sup>th</sup> Edition., Singapore: Pearson Education.
2. Dubey, R., & Maheswari, E., 2012, *Practical Microbiology*, 5<sup>th</sup> Edition, S. Chand & Co., New Delhi
3. Chitanya K. V., 2013, *Cell and Molecular Biology– Lab manual*, Revised Edition, PHI Learning Pvt.Ltd.

### Web Resources

1. <https://www.coursera.org/lecture/introduction-genomics/important-molecules-in-molecular-biology-d2XsC>
2. <https://www.khanacademy.org/science/biology/x324d1dcc:metabolism>

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

**Rationale for Nature of the Course:** Useful and making it possible to identify some of genetic manipulation using the molecular biology tools to discover cures for genetic disorders also it offer a deep understanding of molecular biology.

### Activities to be given

1. Students will explore and learn how advances in science are allowing increasingly specific tools in molecular biology studies
2. Assignments on advancement in Gene regulation and recombination
3. Preparing Students to explore the risks and benefits of molecular biology studies.
4. Assignments on advancement in cell and molecular biology.
5. Seminars on recent updates in cell and molecular biology.

### Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K – Level
CLO 1	Find the basic concepts, principle and application of microscopy for identification different cell types and mutant study	K1
CLO 2	Outline procedure for cellular components fractionation and analyse the cell division and techniques in fractionation	K2
CLO 3	Examine and Identify different chromosomes for the sex determination and fractionation of sucrose	K3
CLO 4	Investigate and execute the principle mechanism involved in cellular organelles and mutant identification using plating study	K4
CLO 5	Assess the mechanism of lipid solubility of membrane system and mutant detection using different methods	K5

### 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	2	3	3	2	3
CLO 2	2	2	2	2	2	3	2
CLO 3	3	3	2	3	3	3	3
CLO 4	3	3	2	2	3	3	2
CLO 5	3	3	3	3	3	3	3

3 – Advance Application

2 – Intermediate Level

1 – Basic Level

Course Designed by	Verified by HOD	Approved by CDC Co-ordinator
 <b>Dr. P. KARTHIGA</b> Name & Signature of the Staff	 <b>Dr. G. RAJALAKSHMI</b> Name & Signature	 Name & Signature

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 COIMBATORE - 641 028.

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

DEPARTMENT OF BIOTECHNOLOGY				CLASS: I M. Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
I	DSC	22BTP05	PRACTICAL II - APPLIED MICROBIOLOGY	3	5	50	50	100

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

### Course Objectives

1. To enable the students to understand the basic techniques and cultural characterization of microorganism
2. To make students aware of cell preparation methods and microscopic measurement
3. To gain insights on isolation of microbes from various sources, their staining and culture techniques
4. To impart knowledge on biochemical characterization, growth pattern, waste water analysis and drug responsive study of microbes.
5. To provide knowledge on microbial flora exploration of various human clinical samples

Unit	Course Contents	Hours
1	Pure culture Techniques- Streak plate, Pour plate and Spread plate	05
2	Isolation of Microbes from Soil, Water and Contaminated Food using Decimal Dilution	05
3	Test for Microbial Motility- Hanging Drop and Wet Mount, Microscopic Measurement of Microorganisms - Micrometry	05
4	<b>Bacterial Staining:</b> Preparation of Bacterial Smears, Simple Staining, Negative Staining, Gram Stain, Acid-Fast Stain, Staining of Fungi - Lacto Phenol Cotton Blue Method	07
5	<b>Biochemical Test:</b> IMVIC Test, Hydrogen sulphide test, Oxidase test, Catalase Test, Urease test, TSI test, Carbohydrate fermentation.	08
6	<b>Bacterial Growth curve:</b> Effect of pH and Temperature on Bacterial Growth by Turbidity method	07
7	<b>Microbial analysis:</b> MPN test (presumptive, confirmed and completed tests)	06
8	Antibiotic sensitivity test by Kirby Bauer test	05
9	<b>Medical Microbiology</b> Microbial Flora of the Mouth: Determination of Susceptibility to Dental Caries	06
10	Normal Microbial Flora of the Throat and Skin	06
11	Microbiological Analysis of Urine Specimens	05
<b>Total</b>		<b>65</b>



**REFERENCE BOOKS:**

1. Cappucino James., Sherman. N., 2014, *Microbiology: A laboratory Manual, 3<sup>rd</sup> Edition*, Pearson Education, Inc.
2. Subbarao, N. S. 2006, *Soil Microbiology, 4<sup>th</sup> Edition of Soil microbiology and Plant growth*, Oxford & IBH, New Delhi.
3. S. Rajan, 2016, *Medical Microbiology, 1<sup>st</sup> Edition*, MJP Publisher

**Web Resources**

1. <https://www.microrao.com/practicals.htm>

**Pedagogy:**Lecturing, PPTs, Demos and Hands on Training.

**Rationale for Nature of the Course**

Students to become a master in all types culture techniques, which support them to exploit it in research studies and entrepreneurship development.

**Activities to be given**

Hands on training, Field Visit, Application studies

**Course Learning Outcomes**

CLOs	On Completion of the Course, the students should be able to	K - Level
CLO 1	Apply the basic techniques of microbiology, isolation of pure culture and characterization of microorganism	K1
CLO 2	Compute the procedure involved in preparation of sample for microscopic examination and measurement	K2
CLO 3	Illustrate the methods for isolation of microbes, various pure culture techniques and preparation of bacterial smears for morphological characterization	K3
CLO 4	Differentiate various test of biochemical characterizations, effect of physical factors on growth of microorganism, microbial counting from wastewaters, and drug response analysis	K4
CLO 5	Assess the procedure for exploration of various microbial flora in human clinical sample	K5

**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	3	2	2	3
CLO 2	2	2	2	2	2	3	3
CLO 3	3	3	3	3	2	3	2
CLO 4	3	3	3	3	3	3	3
CLO 5	3	3	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
 <b>Dr. S.G. ANTONY GODSON</b> Name & Signature of the Staff	 <b>Dr. G. RAJALAKSHMI</b> Name & Signature	 Name & Signature

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

DEPARTMENT OF BIOTECHNOLOGY				CLASS: I M.Sc.,				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
I	DSC	22BTP06	PRACTICAL III BIOCHEMISTRY AND METABOLISM	2	4	50	50	100

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

Course Objectives		
1. To enable the students learn the qualitative and quantitative analysis of biomolecules.		
2. To provide insights on estimation, separation and purification of micro and macromolecules		
3. To gain knowledge on identification macromolecules using various chromatographic methods		
4. To explore key role of chemicals and reagents for the analysis of biomolecules.		
5. To understand the mechanistic reactions between molecules with reagents		
Unit	Course Contents	Hours
1	Estimation of Carbohydrates by Anthrone Method	3
2	Estimation of Acid Value, Saponification value, Iodine number of fats.	5
3	Estimation of Amino Acids by Ninhydrin Method	4
4	Protein Estimation by Lowry's Method and Bradford method	3
5	Separation of LDH Isozymes from Serum by SDS-PAGE	4
6	Extraction and purification of peroxidase from soy bean seeds	4
7	Paper Chromatography - Separation of Plant Pigments	3
8	Thin Layer Chromatography - Separation of Amino Acids	4
9	Separation of Immunoglobulin Using Ion Exchange Chromatography.	4
10	Separation of Colour Proteins Using Gel permeation Chromatography	4
11	Estimation of Ascorbic Acid	4
12	Estimation of Calcium and Iron	5
13	Assay of amylase activity and determination of enzyme kinetic parameters - Km, Vmax and Kcat	5
<b>Total</b>		<b>52</b>

#### REFERENCE BOOKS:

1. J Jayaraman, 2011, Laboratory Manual in Biochemistry, 5<sup>th</sup> Edition, Willy Eastern.
2. S Sadasivam and A Manickam, 2009, Biochemical Methods, 3<sup>rd</sup> Edition, New age Publishers.

3. Kaushik et al., 2020, *Practical Manual of Biochemistry*, CBS Publishers.

#### Web Resources

1. <https://nptel.ac.in/courses/104105102>
2. [https://onlinecourses.nptel.ac.in/noc22\\_cy32/preview](https://onlinecourses.nptel.ac.in/noc22_cy32/preview)

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

#### Rationale for Nature of the Course

1. Used to analyze the micro and macro molecules both qualitatively and Quantitatively
2. Used to learn advanced techniques like chromatography
3. Used to determine the enzyme kinetics

#### Activities to be given

1. Estimation of molecules from various natural sources like seeds, Pulses, etc.
2. Preparing the students to have hands-on experience on the separation of biomolecules by chromatographic techniques

#### Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K - Level
CLO 1	Practiced with qualitative and quantitative analysis of biomolecules	K1
CLO 2	Skilled with the estimation, separation and purification of micro and macromolecules	K2
CLO 3	Can able to identify the macromolecules using various chromatographic methods	K3
CLO 4	Capable to understand the key role of chemicals and reagents for the analysis of biomolecules	K4
CLO 5	Mastered with mechanistic reactions between molecules with reagents	K5

#### 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	2
CLO 2	3	2	2	3	2	3	3
CLO 3	3	2	3	3	2	3	2
CLO 4	3	3	2	3	2	3	3
CLO 5	3	3	2	3	2	3	2

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

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

HEAD OF THE DEPARTMENT  
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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 M.Sc.,				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
I	DSC	22BTP07A	ELECTIVE I BIOETHICS AND BIOSAFETY	3	4	50	50	100

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

Course Objectives			
<ol style="list-style-type: none"> <li>To understand the basic knowledge on bioethics, gene therapy, biosafety regulations, bio-containment and bio-security concepts.</li> <li>To explore the knowledge on ethical issues related to cloning, stem cell research, GMO, microbial risk assessment and biosafety guidelines.</li> <li>To learn the principles behind genetic engineering, germ cell research, convention on biological diversity, biotechnology risk management and health and medical surveillance.</li> <li>To provide insight into ethical implications of genetic testing, <i>in vitro</i> fertilization, animal experiments, and application of GMO in food and release for environmental protection.</li> <li>To analyze on ethical issues of reproductive technology, cartagena protocol, regulatory framework for GMOs.</li> </ol>			
Unit	Course Contents	Hours	K Level
I	<b>Introduction to Bioethics in Cloning</b> Biotechnology and Ethics – Benefits and Risks of Genetic Engineering– Ethical Aspects of Genetic Testing and Genetic counseling–Ethical Implications of Cloning: Reproductive and Therapeutic Cloning.	10	Upto K5
II	<b>Bioethics in Genetic Engineering and Animal Biotechnology</b> Ethical, Legal and socioeconomic aspects of Gene Therapy (ELSI), Germ Line, Somatic, Embryonic and Adult Stem Cell Research. Ethical Issues related to Assisted Reproductive technologies (Artificial Insemination, IVF and embryo transfer)	12	Upto K5
III	<b>Biosafety Regulations</b> Guidelines and Regulations (National and International), Nagoya Protocol – Convention on Biological Diversity–Cartagena Protocol on Biosafety– The Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA).	10	Upto K5
IV	<b>Biosafety Committees and Biosafety Protocols</b> Regulatory framework for GMOs and LMOs in India RCGM, GEAC etc. for GMO application in food and agriculture; Environmental release of GMO's. Introduction to Biosafety and its Issues in Biotechnology – Risk Assessment and Risk Management –Safety Protocols: Risk Groups–Biosafety Levels–Bio-containment.	10	Upto K5
V	<b>Laboratory Biosafety</b> General Principles, Microbiological Risk Assessment, Code of Practice, Laboratory design and facilities, Laboratory equipment, Health and	10	Upto K5



Medical surveillance, Laboratory Animal Facility, Laboratory Bio-security concepts, Safety Equipment, Contingency plans and Emergency Procedures.		
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### Book for Study

1. *Shaleesha A. Stanley, 2008, Bioethics, 1<sup>st</sup> Edition, Wisdom Educational Servive, Chennai.*

### Books for Reference

1. *Jose Cibelli, Ian Wilmut, Rudolf Jaenisch, John Gurdon, Robert Lanza, Michael West and Keith Campbell, 2013, Principles of Cloning, 2<sup>nd</sup> Edition , Academic Press, USA.*
2. *Fleming, Diane O. and Hunt, Debra L., 2006, Biological safety: principles and practices. 4<sup>th</sup> Edition, Washington, ASM Press.*
3. *World Health Organization, Geneva, 2004, Laboratory Biosafety Manual, 3<sup>rd</sup> Edition.*
4. *Deepa Goel and Shomini Parashar, 2013, IPR, Biosafety and Bioethics, 1<sup>st</sup> Edition, Pearson Education, India.*
5. *Alastair V. Campbell, 2013, "Bioethics: The Basics", 1<sup>st</sup> Edition, Routledge, UK.*

### Web Resources

1. <https://www.mooc-list.com/tags/biosafety>
2. <https://www.classcentral.com/course/edx-introduction-to-bioethics-914>

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

**Rationale for Nature of the Course:** Bioethics and biosafety offer a deep understanding of ethical issues in medicine, health and the life sciences responsible for preventing risks to health and to the environment from exposure to biological agents.

### Activities to be given

1. Group discussion on the risks and benefits of ethical issues related to biotechnology and genetic engineering.
2. Students will explore to seminars on national and international guide lines and regulations related to biosafety risk assessment and management.
3. Assignments on advancement in biosafety protocols and biosafety committees and their roles.

### Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K – Level
CLO 1	Define the basic knowledge on bioethics, gene therapy, biosafety regulations, bio-containment and bio-security concepts	K1
CLO 2	Describe the ethical issues related to cloning, stem cell research, GMO, microbial risk assessment and biosafety guidelines	K2
CLO 3	Explain the principles behind genetic engineering, germ cell research, and convention on biological diversity, biotechnology risk management and health and medical surveillance.	K3
CLO 4	Analyze the ethical implications of genetic testing, <i>in vitro</i> fertilization, animal experiments, and application of GMO in food and release for environmental protection.	K4
CLO 5	Appraise various aspects of ethical issues of reproductive technology, cartagena protocol, regulatory framework for GMOs	K5




**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	2	3	3	2	3
CLO 2	2	2	2	2	2	3	2
CLO 3	3	3	2	3	3	3	2
CLO 4	3	3	2	2	3	3	3
CLO 5	3	3	3	3	3	3	3

3 – Advance Application

2 – Intermediate Level

1 – Basic Level

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

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

DEPARTMENT OF BIOTECHNOLOGY				CLASS: I M.Sc.,				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
I	DSC	22BTP07B	<b>ELECTIVE I DEVELOPMENTAL BIOLOGY AND BEHAVIAUORAL STUDIES</b>	3	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 early animal development and evolutionary studies
2. To study the mechanism in development stages of plant, animal cell and insight the evidences of evolution
3. To explore the concept of morphogenic and organogenic differentiation in animals and study the evidences of chemical evolution
4. To gain insight information on concepts of developmental biology and the theory for origin and evolution of cells.
5. To provide knowledge on morphogenesis, organogenesis, origin of cells and brain behaviour relationships among animals.

Unit	Course Contents	Hours	K Level
I	<b>Basic Concepts of Development</b> Potency – commitment – specification – induction – competence - determination and differentiation - morphogenetic gradients - cell fate and cell lineages - stem cells - genomic equivalence and the cytoplasmic determinants – imprinting.	10	Upto K5
II	<b>Gametogenesis, Fertilization and Early Development</b> Production of gametes - cell surface molecules in sperm-egg recognition in animals - zygote formation – cleavage – blastulation - gastrulation and germ layers in animals. <b>Morphogenesis and Organogenesis in Plants:</b> Embryo sac development. Organization of seed germination – shoot - root and leaf development - transition to flowering and floral development in <i>Arabidopsis</i> .	11	Upto K5
III	<b>Morphogenesis and Organogenesis in Animal</b> Organogenesis – eye lens induction - limb development and regeneration in vertebrates; differentiation of neurons. Post embryonic development - larval formation – metamorphosis. Environmental regulation for normal development and sex determination. Mechanism of Apoptosis – Necrosis –Autophagy - aging and senescence.	10	Upto K5

IV	<p><b>Introduction to Evolution and Origin of Cells</b>  Lamarck; Darwin – concepts of variation – struggle - fitness and natural selection - the evolutionary synthesis. Origin of basic biological molecules – Primordial Soup &amp; Coacervates - abiotic synthesis of organic monomers and polymers - concept of Oparin and Haldane - experiment of Miller (1953) - evolution of prokaryotes- (Precambrian period) - evolution of unicellular eukaryotes - Endosymbiotic events.</p>	11	Upto K5
V	<p><b>Brain, Behavior Relationship</b>  Approaches and methods in study of behavior - proximate and ultimate causation- altruism and evolution - group selection, kin selection – Inclusive fitness theory, reciprocal altruism - Social communication – Social Interactions - Social dominance - use of space and territoriality - mating systems - parental investment and reproductive success - parental care - aggressive behavior – migration - orientation and navigation.</p>	10	Upto K5

#### BOOK FOR STUDY

1. Mohan P Arora, 2015, *Evolutionary Biology, Revised Edn., Himalaya Publishing House, Mumbai, India*

#### BOOK FOR REFERENCES

1. Enger Ross, 2008, *Concepts in Biology, 13<sup>th</sup> Edn., WCB McGraw Hill.*
2. S. Chattopadhyay, 2017, *An Introduction to Developmental Biology, 1<sup>st</sup> Edn., Books and Allied Pvt, Ltd*
3. Scott gillbert f, 2016, *Developmental Biology, 11<sup>th</sup> Edn., Sinauer Associates*
4. Elliot A, 1972, *The social Animal, 12<sup>th</sup> Edn., Macmillan*
5. Aubrey M, and Marian S, 2016, *An introduction to Animal Behaviour, 6<sup>th</sup> Edn*

#### WEB RESOURCES

NPTEL, MOOC

#### WEB RESOURCES

1. <https://nptel.ac.in/courses/102/106/102106084/>
2. <https://www.mooc-list.com/course/developmental-biology-saylororg>

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

**Rationale for Nature of the Course:** Useful and making it possible to identify the advancement in Organogenesis and explore the risk and benefits of organelle behavioral studies.

#### Activities to be given

1. Students will explore and learn how evolution in science are allowing increasingly specific tools in evolutionary studies
2. Assignments on advancement in Morphogenesis and Organogenesis
3. Preparing Students to explore the risks and benefits of brain behavioral studies
4. Assignments on advancement in developmental biology and behavioral studies.
5. Seminars on advancement in organelle behavioral studies.

### Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K – Level
CLO 1	Describe the basic concept of embryo development, gametogenesis, morphogenesis in plant and animal cell and list the evidences of evolution in origin of cells	K1
CLO 2	Discuss the detailed mechanism of early development of plant and animal cell, and classify the evidences of chemical evolution	K2
CLO 3	Illustrate the morphogenic and organogenic pattern of animal cell development and cellular degeneration mechanism and insight the experimental evidences for evolution.	K3
CLO 4	Compare and correlate the basic concepts of developmental biology evolutionary theory of basic biological molecules and animal relationships	K4
CLO 5	Evaluate the approaches and methods of morphogenesis, organogenesis and study the behavioral relationship in animal	K5

### 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	2	3	3	2	2
CLO 2	2	2	2	2	2	3	2
CLO 3	3	3	2	3	3	3	3
CLO 4	3	3	2	2	3	3	2
CLO 5	3	3	3	3	3	3	3

3 – Advance Application

2 – Intermediate Level

1 – Basic Level

Course Designed by	Verified by HOD	Approved by CDC Co-ordinator
 <b>Dr. P. KARTHIGA</b> Name & Signature of the Staff	 <b>Dr. G. RAJALAKSHMI</b> 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 M.Sc.,				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
II	DSC	22BTP09	GENETIC ENGINEERING	4	4	50	50	100

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

### Course Objectives

1. To impart knowledge on versatile techniques in genetic engineering for designing and conducting experiments involving genetic manipulation and reconstruction.
2. To gain insights on application of genetic engineering techniques in basic and applied experimental biology
3. To make use of different methods of gene transfer techniques employed in genetic engineering, its function and characterization.
4. To illustrate creative use of modern tools and techniques for manipulation and analysis of genomic sequences by genetic engineering.
5. To train students in strategizing research methodologies employing genetic engineering techniques.

Unit	Course Contents	Hours	K Level
I	<b>Gene and Genome:</b> Genome Organization - C - Value Paradox. Genome Sequencing Methods - Maxam and Gilbert, Sanger's method, Pyrosequencing – Solid Phase and Liquid Phase, Automated DNA sequencing, Next generation sequencing – Basic Principle and Steps involved. Human Genome Project	10	Upto K5
II	<b>Enzymes in Genetic Engineering:</b> Nucleases: Exonucleases and Endonucleases, Restriction Enzymes (Type I, Type II, Type III, Type IV & Type V), RNases; Methylases: CpG Methylase, Dam Methylase, Dcm Methylase, Polymerases: DNA Pol I, Klenow Fragments, Reverse Transcriptase, Taq&Pfu Polymerases; Ligases: T4 DNA Ligase, <i>E. coli</i> DNA Ligase, T4 RNA Ligase; Topoisomerases: Type I(A, B) & Type II(A,B); End Modifying Enzymes: Terminal Transferase, T4 Polynucleotide Kinase, Alkaline Phosphatases	12	Upto K5
III	<b>Vectors:</b> Steps in Gene Cloning – Host Cell Types – Prokaryotic Hosts, Eukaryotic Hosts – Vectors - Plasmid Vectors – pBR322 – pUC vectors, shuttle vectors – Bacteriophage Vectors – Lambda and M13 vectors; Hybrid Vectors – Cosmids – Phagemids.	10	Upto K5

	Eukaryotic Vectors – Yeast Vectors – YAC and BAC. Plant Vectors – Ti plasmids as a vector CaMV– TMV – Animal Vectors – SV40 – Retrovirus – Adenovirus.		
IV	<b>Advanced Molecular Techniques:</b> Genomic Library Construction – cDNA Library Construction – Chromosome Walking and Jumping. Screening of Recombinants –. Blotting Techniques - PCR – Real time PCR – RT-qPCR Genome editing – ZFN, TALENs, CRISPR Tool Site Directed Mutagenesis and Protein Engineering – in situ hybridization	10	Upto K5
V	<b>Gene therapy and Genetic Counselling</b> Gene Therapy – History and Development Germline, Somatic Cell Line – In vivo – Ex vivo – Anti-Sense Gene Therapy and Embryo Gene Therapy – mRNA-based vaccines RNA interference (RNAi). Cancer Gene Therapy. Gene knockout Genetic Counseling – Prospective and retrospective genetic counselling	10	Upto K5

#### Book for Study

1. Primrose S.B., 2006, *Molecular Biotechnology*, Blackwell Scientific Publishers, 2<sup>nd</sup> Edition, Oxford.

#### Books for Reference

1. Senthilkumar Sadasivama and Mohammed Jabir, 2008, *IPR, Biosafety and Biotechnology Management*, 1<sup>st</sup> Edition, Jasen Publications, India
2. Brown, T.A., 2020, *Gene cloning and DNA analysis: an introduction*. 2<sup>nd</sup> Edition, John Wiley & Sons, Oxford, UK.
3. Mickloss D.A and Freyar G.A, 2005, *DNA Science: A First Course in Recombinant Technology*, 2<sup>nd</sup> Edition Cold Spring Harbor Laboratory Press, New York.
4. Walker M.R and Rapley R, 2018, *Route Maps in Gene Technology*. 4<sup>th</sup> Edition, Blackwell Science Ltd, Oxford.
5. Desmond S.T. Nicholl, 2017, *An Introduction to Genetic Engineering*, 3<sup>rd</sup> Edition Cambridge University Press.

#### Web Resources

1. <https://online.stanford.edu/courses/xgen203-genetic-engineering-and-biotechnology>
2. <https://www.mooc-list.com/course/genes-and-human-condition-behavior-biotechnology-coursera>

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

**Rationale for Nature of the Course:** Genetic engineering is an important tool for natural scientists, with the creation of transgenic organisms one of the most important tools for analysis of gene function.

#### Activities to be given

1. Students will explore artificial selection, as well as learn how advances in science are allowing increasingly specific methods of genetic manipulation in organisms
2. Assignments on advancement in genetic engineering and vector system with application of enzymes in construct of vectors.
3. Preparing Students to explore the risks and benefits of genetic engineering and concerns that affect what we eat and wear.



### Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K – Level
CLO 1	Implementing the gene cloning, role of enzymes and vectors for genetic engineering, Gene transfer methods, Techniques and safety measures of genetic engineering, genome mapping and gene therapy	K1
CLO 2	Demonstrate the ability to design recombinant molecules and apply information extracted from a variety of sources and apply learned knowledge to their future research.	K2
CLO 3	Illustrate the knowledge on technology that has been developed based on the principles of genetic engineering and applied in wet lab and dry lab methods.	K3
CLO 4	Evaluate the advanced genetic engineering computational tools for drug development and to enhance the human values.	K4
CLO 5	Explain the advanced application involved in genetic engineering including the techniques, applications and limitations.	K5

### 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	2	3	3	2	2	3
CLO 2	2	3	2	2	3	3	3
CLO 3	3	3	2	3	2	3	2
CLO 4	3	2	2	2	3	3	3
CLO 5	2	2	3	3	3	3	3

3 – Advance Application

2 – Intermediate Level

1 – Basic Level

Course Designed by	Verified by HOD	Approved by CDC Co-ordinator
 <b>Mrs. N. KIRUTHIGA</b> Name & Signature of the Staff	 <b>Dr. G. RAJALAKSHMI</b> Name & Signature	 Name & Signature

HEAD OF THE DEPARTMENT  
 PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY  
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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 M. Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
II	DSC	22BTP10	PLANT BIOTECHNOLOGY	4	4	50	50	100

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

### Course Objectives

1. To give new and widen basic knowledge on fundamentals of tissue culture, hybrid production, rDNA concepts in plant transformation and applications.
2. To impart the basic principles of maintenance of sterile condition, proper plant growth, gene transfer, molecular pharming and secondary metabolites production
3. To apply the learned concepts into new or improve the existing similar situations
4. To gain insights on execution of concepts in future studies, the issue related to newly evolved species/products and evaluate its significances
5. To learn the concerns over modern plant biotechnology and assess them according to the regulatory frame works

Unit	Course Contents	Hours	K Level
I	<b>Plant Tissue Culture</b> Conventional Plant Breeding methods - Selection, Hybridization, Mutation. Plant Tissue Culture Laboratory organization, Nutrient media, Plant growth regulators. Micropropagation, Suspension Culture, Somaclonal Variation, Methods to Eliminate Viruses in Plants, Cryopreservation	11	Upto K5
II	<b>Plant Hybrid Production</b> Protoplast isolation and Somatic Hybridization, Triploid Production, Artificial Seed Technology, Molecular Marker Aided Breeding, RFLP, RAPD, AFLP, CAPS and SCARS, Marker Aided Selection, Arid and Semi Arid Technology, Green House Technology.	10	Upto K5
III	<b>Plant Transformation Technology</b> Plant Mitochondrial DNA, Plastome/Chloroplast DNA, Regulation of Gene Expression, Gene Expression in Eukaryotes, Gene Regulation in Eukaryotes, Viral Vectors and their Applications, Marker genes for plant transformation, Direct DNA Transfer methods in Plants. Vector Mediated gene transfer in plants, Chloroplast Transformation.	11	Upto K5
IV	<b>Plant Recombinant Technology – Molecular Pharming</b> Metabolic Engineering of Carbohydrates and Lipids. Biodegradable Plastics, Expression of the protein product in plants, Genetically Engineered Plants as Protein	10	Upto K5

	Factories, Medical Pharming, Pharmaceuticals, Plantibodies, Edible Vaccines, Non medical Pharming, Industrial enzymes.		
V	<b>Applications</b> Secondary Metabolites in Plant Cultures, Production of Secondary Metabolites, Phytoremediation, Industrial Phytochemical Products from Plants: Alkaloids and Steroids, Therapeutic Proteins, Herbal Drugs, Bioethanol and Biodiesel.	10	Upto K5

#### Book for Study

1. *Chawla H. S., 2009 Introduction to Plant Biotechnology, 3<sup>rd</sup> Edition, CRC Press, New York.*

#### Books for Reference

1. *Sathyanarayana U., 2020, Biotechnology, 12<sup>th</sup> Edition, Books and Allied Ltd, Bangalore, India.*
2. *Harmeet Kaur, 2009. Plant Biotechnology and Genetic Engineering, 1<sup>st</sup> Edition, Anmol Publisher.*
3. *Razdan M K., 2019, Introduction to Plant Tissue Culture, 3<sup>rd</sup> Edition, Science Publishers, Inc, US.*
4. *Umesha S., 2019. Plant Biotechnology, 1<sup>st</sup> Edition, The Energy and Resources Institute (TERI), New Delhi.*
5. *Nirmala G B., Rajalakshmi G and Chandra Karthick, 2013. Plant Biotechnology, 1<sup>st</sup> Edition, MJP Publishers, Chennai.*

#### Web Resources

1. <https://nptel.ac.in/courses/102103016>
2. <https://www.coursera.org/learn/patenting-bio-ipr>

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

#### Rationale for Nature of the Course

Students can be master in a set of techniques, which make them to explore many opportunities in higher studies, research and entrepreneur.

#### Activities to be given

1. Assignment on specific topics with their own ideas
2. Discussion on importance topics as their own views

#### Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K - Level
CLO1	Recall the fundamentals of tissue culture, hybrid production, rDNA concepts in plant transformation and basic applications	K1
CLO 2	Review the proper techniques/ procedures for the maintenance of sterile condition, proper plant growth, gene transfer, molecular pharming and secondary metabolites production	K2
CLO 3	Transfer the learned techniques in new or improve the existing similar situations	K3
CLO 4	Focus the concepts in future studies and debate on the issue related to newly evolved species/products and evaluate its significances	K4
CLO 5	Prioritize the concerns over modern plant biotechnology and assess them according to the regulatory frame works	K5




**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	3	3	2	3	3	3
CLO 2	2	3	3	3	2	3	2
CLO 3	2	2	3	3	2	3	3
CLO 4	3	3	3	3	2	3	3
CLO 5	3	3	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
 <b>Dr. P. SENTHILKUMAR</b> Name & Signature of the Staff	 <b>Dr. G. RAJALAKSHMI</b> Name & Signature	 Name & Signature

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 Hindusthan College of Arts & Science,  
 Coimbatore-641 028.

DEPARTMENT OF BIOTECHNOLOGY				CLASS: I M.Sc.,				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
II	DSC	22BTP11	RESEARCH METHODOLOGY AND BIOSTATISTICS	4	4	50	50	100

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

### Course Objectives

1. To enable the students should know the types of research studies and typically reported with descriptive statistics.
2. To gain insights on sample size is determined in qualitative research with advanced statistical application.
3. To acquire knowledge on fundamentals of statistics, classification and calculations for research interpretation
4. To learn the advanced statistical tools for proportion data analysis methods to enhance the advanced scientific research.
5. To explore available tools to develop a research data, analysis, as well as research proposal preparation.

Unit	Course Contents	Hours	K Level
I	<b>Introduction to research methodology:</b> What is Research? Basic and Applied Research - Essential steps in Research - Significance of Research, Teaching Learning, Evaluation and Monitoring Process. Defining the Research Problem - Research/Experimental Design. Literature Collection - Literature Citation. Research Report – Components – Format of Thesis and Dissertation – Manuscript/Research Article – Review Monographs – Bibliography.	11	Upto K5
II	<b>Databases and Information Retrieval:</b> Journals – Standard of Research Journals – Plagiarism – Copyrights – Impact Factor – Citation Index – Bibliometric – Search engines-Google-Google Scholar Citation. Access to Archives and Databases – Science Direct (Scopus) – Sciverse– PubMed – National Informatics Center Network Services – Online Data Base Library	9	Upto K5
III	<b>Biostatistics:</b> Definitions - Scope of Biostatistics – Classification and Tabulation of Data – Graphical and Diagrammatic Representation – Scale Diagrams – Histograms – Frequency Polygon - Frequency Curves – RDBMS. Arithmetic Mean – Median and Mode. Calculation of Mean – Median – Mode in Series of Individual Observation Discrete Series – Continuous Open-End Classes.	11	Upto K5

IV	<b>Measures of Dispersion:</b> Standard deviation and Range, Chi – Square Test, Student - t Test, Regression, Correlation, One Way and Two Way ANOVA. Experimentation Design-Response Surface Methodology: Proportion Data and Analysis: Examples of Proportion data - MPM-sterility testing of medicines - animal toxicity infection and immunization studies (e.g., LD50, ED50, PD50) –statistical treatment to proportion data.	10	Upto K5
V	<b>Developing a research data and Analysis:</b> Introduction to Count data – Examples (bacterial cell count, radioactivity count, colony and plaque count, etc.). Statistical treatment to count data Poisson distribution - standard error -confidence limits of counts. Application of statistical software for biological research. Developing a research question, Resources for research question, Literature Review: Traditional Qualitative Review, Meta-Analysis—A Quantitative Review Preparation of Research Proposal, The research report paper writing/ thesis writing, Different parts of the research paper	11	Upto K5

Note: The Questions should be asked in 50% theory and 50% problem for Unit III, IV & V.

**Book for Study**

1. Kothari C R, 2019, *Research Methodology Methods & Techniques, 2<sup>nd</sup> Edition, New Age International publishers, New Delhi.*

**Books for Reference**

1. Karthikeyan S, Chaturvedi R M and Bhonsale R M, 2015, *Comprehensive Textbook of Biostatistics and Research Methodology*”, 1<sup>st</sup> Edition, Bhalani Publishing House, New Delhi.
2. Duncary P, *Authoring a PhD. Thesis: 2003. How to Plan, Draft, Write and Finish a Doctoral Dissertation*”, Palgrave Macmillan, Australia.
3. G. Nageswara Rao, 2018, *Biostatistics and Research Methodology, Paperback – 1, B.S. Publication.*
4. J. H. Abramson, Z. H. Abramson, 2002, *Research Methods in Community Medicine: Surveys, Epidemiological Research, Programme Evaluation, Clinical Trials, 6<sup>th</sup> Edition.*
5. P.S.S Sundar Rao & J. Richard, 2012, *Introduction to Bio-statistics and Research methods, 5<sup>th</sup> Edition, PHI Learning.*

**Web Resources**(any two web resources)

1. <https://www.coursera.org/specializations/biostatistics-public-health>
2. <https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-ge01/>
3. [https://michener.ca/ce\\_course/research-methodology-biostatistics-online/](https://michener.ca/ce_course/research-methodology-biostatistics-online/)
4. <https://www.coursera.org/specializations/biostatistics-public-health>
5. <https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-ge01/>
6. [https://onlinecourses.swayam2.ac.in/ugc19\\_ma03/preview](https://onlinecourses.swayam2.ac.in/ugc19_ma03/preview)

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

**Rationale for Nature of the Course:** To enhance the research and advanced analysis techniques by statistical learning

**Activities to be given**

1. Preparing advanced problems for various research analysis.
2. Assignment on advanced research and Biostatistical problems with different experimental design.
3. Preparing the students to appear researcher by giving Advanced Exercise and workout problems on Biostatistics.




### Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K – Level
CLO 1	Describe the basic and applied research, collection of data, experimental design, and report writing with statistical analysis	K1
CLO 2	Outline the indexing parameters and obtaining online information retrieval on qualitative research techniques	K2
CLO 3	Illustrate basics statistical methods for analysis of developing a research and enhance the analytical methods	K3
CLO 4	Examine the principal methods of advanced statistical tools for research design, interpret and effective analysis of experiments.	K4
CLO 5	Prioritize methodology and upgrade tools for developing analysis of research data, research proposal preparation.	K5

### 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	3	3
CLO 2	3	2	3	3	2	3	2
CLO 3	3	3	2	2	3	3	3
CLO 4	3	3	3	2	3	3	3
CLO 5	2	3	2	2	3	3	2

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

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

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

DEPARTMENT OF BIOTECHNOLOGY				CLASS: I M. Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
II	DSC	22BTP12	BIOPROCESS TECHNOLOGY	4	4	50	50	100

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

Course Objectives			
<ol style="list-style-type: none"> <li>To make students aware of fermentation and usage of microorganisms in the production of fermented products</li> <li>To explore various media and its compositions for fermentation with various microbes and sterilization process</li> <li>To learn the design, features of fermentor, modes of fermentation operations and kinetics, the instrumentation and control of bioreactors</li> <li>To analyze the parameters involved in Bioreactor configurations, types and kinetics</li> <li>To assess the downstream processing method in the product recovery using centrifuge and filtration</li> </ol>			
Unit	Course Contents	Hours	K Level
1	Microbial biomass, enzymes, and metabolites. Microbial culture, Screening and selection Preservation and improvement of industrially important microorganisms, Strain development, Stock culture and maintenance. Batch, fed-batch and continuous culture growth kinetics	10	Upto K5
2	Medium formulation: carbon, nitrogen, mineral sources, growth factors, buffers. Oxygen requirements, antifoams, medium optimization, Inoculum preparation and development: bacteria, fungal, and yeast. Media sterilization: Batch sterilization (thermal death kinetics), continuous sterilization process: design and del factor	11	Upto K5
3	Basic objective of fermenter design, aseptic operation, agitator and sparger design, baffles, stirrer glands and bearings. Process parameters and measurement techniques: measurement of temperature, pressure and pH, DO and foam. Flow rate of liquid and gases; Automation (processes computerization).	10	Upto K5
4	Bubble column, airlift reactor, packed bed, fluidized bed, trickle bed, Membrane reactor, Photo bioreactor, Solid state fermenter, Animal and plant cell bioreactors. Heat and Mass transfer in Bioprocess, Measurement of KLa, Rheological properties of fermentation broths, Factors affecting broth viscosity, Mixing in Fermenters.	10	Upto K5
5	Filtration–Removal of Microbial Cells – Cell Disruption: Enzymatic, Chemical and Physical Methods; Purification	11	Upto K5

	of Fermentation Products- Precipitation Methods, Membrane Process. Centrifugation- Ultra centrifugation; Chromatography-Ion Exchange and Gel Permeation Chromatography-HPLC. Crystallization- Drying - Lyophilization.		
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#### Book for Study

1. Stanbury P.F., Whitaker A., 2016, *Principles of fermentation technology*, 3<sup>rd</sup> Edition. Pergamon press.

#### Books for Reference

1. Rao D.G., 2008, *Introduction to Biochemical engineering*, 1<sup>st</sup> Edition, McGraw-Hill Publications.
2. Prescott and Dunns., 2007, *Industrial Microbiology*, 4<sup>th</sup> Edition. Gerald Reed, Chapman & Hall publications.
3. Cassida L. E. J. R., 2019, *Industrial microbiology*, 1<sup>st</sup> Edition, New Age International Private Limited, India.
4. Wulf Crueger and Anneliese Crueger., 2009, *Biotechnology- A Textbook of Industrial Microbiology*, 1<sup>st</sup> Edition, Panima Publishing Corporation, New Delhi.
5. Claire Komives, Weichang Zhou., 2018, *Bioprocessing Technology for production of Biopharmaceuticals and Bioproducts*, 1<sup>st</sup> Edition, Wiley Publications.

#### Web Resources

1. <https://www.classcentral.com/course/swayam-principles-of-downstream-techniques-in-bioprocess-3967>
2. <https://www.coursera.org/lecture/industrial-biotech/introduction-to-biochemical-and-bioprocess-engineering-hoHUU>
3. <https://www.itsligo.ie/courses/certificate-in-bioprocess-engineering/>
4. <https://online-learning.tudelft.nl/courses/industrial-biotechnology/>
5. <https://nptel.ac.in/courses/102/105/102105058/>

**Pedagogy:** Chalk and Board, PPTs, Group Discussion etc.

**Rationale for Nature of the Course:** Application of some basic and advanced techniques which are used for product development in various food and pharmaceutical industries.

**Activities to be given:** Mini projects, Hands-On trainings, Assignments and seminars.






### Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K - Level
CLO 1	Remember the fermentation and usage of microorganisms in the production of fermented products.	K1
CLO 2	Understand and explore various media and its compositions for fermentation with various microbes and sterilization process	K2
CLO 3	Apply and evaluate and design the features and the instrumentation and control of bioreactors and types and modes of fermentation operations and kinetics	K3
CLO 4	Analyze the parameters involved in Bioreactor configurations, types and kinetics	K4
CLO 5	Assess the downstream processing method in the product recovery using centrifuge and filtration	K5

### 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	3	2
CLO 2	3	2	3	3	2	3	2
CLO 3	3	3	2	2	3	3	3
CLO 4	3	3	3	2	3	3	3
CLO 5	2	3	2	2	3	3	2

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

Course Designed by	Verified by HOD	Approved by CDC Co-ordinator
 <b>Ms. R. GNANAMBAL</b> Name & Signature of the Staff	 <b>Dr. G. RAJALAKSHMI</b> 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 M.Sc.,				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
II	DSC	22BTP13	PRACTICAL IV - GENETIC ENGINEERING	3	5	50	50	100

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

#### Course Objectives

1. To impart knowledge on Gene determination for analysis of DNA and other nucleotides.
2. To gain insights on enzymes, its function and characterization governing genetic manipulation.
3. To make use of different vectors employed in genetic engineering, its function and characterization
4. To explore tools required to develop a gene cloning and gene manipulation to enhance the human values
5. To impart knowledge diagnosis methods to detect the nucleic acids from different source.

S. No	Course Contents	Hours
1	Isolation of Genomic DNA from Animal Tissue	5
2	Isolation of Genomic DNA from Human blood	5
3	Restriction Digestion	6
4	Ligation	6
5	Transformation in <i>E.coli</i>	6
6	Polymerase Chain Reaction	5
7	Southern Hybridization using Non-Radioactive Detection.	5
8	Western Blotting	6
9	Reporter gene assay- GUS gene	6
10	Gene Editing Tool	5
11	Primer Designing	5
12	cDNA Library synthesis	5
<b>Total</b>		<b>65</b>

#### Books for Reference

1. John Vennison, 2009, Laboratory manual for Genetic Engineering, 3<sup>rd</sup> Edition, PHI Publisher.
2. Aksan Kurnaz, 2015, Techniques in Genetic Engineering, 2<sup>nd</sup> Edition, CRC Press.
3. Chitanya K.V., 2016, Cell and Molecular Biology –Lab manual. 1<sup>st</sup> Edition, PHI Learning Pvt Ltd.
4. Green and Sam brook, 2018, Molecular Cloning-Lab Manual 4<sup>th</sup> Edition, CSHL Press.

#### Web Resources

- <https://online.stanford.edu/courses/xgen203-genetic-engineering-and-biotechnology>
- <https://www.mooc-list.com/course/genes-and-human-condition-behavior-biotechnology-coursera>

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

**Rationale for Nature of the Course:** Practicing Genetic engineering is important for natural scientists and researcher, with the creation of transgenic organisms.

**Activities to be given**

- Students will explore practical knowledge on artificial selection, as well as learn how advances in science are allowing increasingly specific methods of genetic manipulation in organisms
- Assignments on advancement in genetic engineering and vector system with application of enzymes in construct of vectors to create a new clone
- Preparing Students to explore the risks and benefits of genetic engineering and concerns that affect what we eat and wear with the practical application.




**Course Learning Outcomes**

CLOs	On Completion of the Course, the students should be able to	K – Level
CLO 1	Describe the principle, methodology of genomic DNA isolation, subsequent estimation and quantification from different sources	K1
CLO 2	Restate the role of different restriction enzymes and their involvement in cleavage and ligation for manipulating the foreign DNA	K2
CLO 3	Illustrate the principles, methods, mechanism of Gene Transformation	K3
CLO 4	Investigate and execute molecular tools such as PCR, Blotting and hybridization techniques to detect and asses the nucleic acids and proteins.	K4
CLO 5	Assess the expression mechanism to detect the nucleic acids from different sources.	K5

**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	2	3	3	2	2	2
CLO 2	2	3	2	2	3	3	3
CLO 3	3	3	2	3	2	3	3
CLO 4	3	2	2	2	3	3	2
CLO 5	2	2	3	3	3	3	3

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

Course Designed by	Verified by HOD	Approved by CDC Co-ordinator
 <b>Dr. G. RAJALAKSHMI</b> Name & Signature of the Staff	 <b>Dr. G. RAJALAKSHMI</b> Name & Signature	 Name & Signature

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 Hindusthan College of Arts & Science,  
 Coimbatore-641 028.

DEPARTMENT OF BIOTECHNOLOGY				CLASS: I M. Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
II	DSC	22BTP14	PRACTICAL V – PLANT BIOTECHNOLOGY	3	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"> <li>To acquire knowledge about layout of plant tissue culture lab, and culture environment,</li> <li>To impart knowledge on media preparation and various sterilization techniques</li> <li>To learn the principles behind the establishment of various cultures</li> <li>To gain knowledge on basic principles and mechanism of Haploid plant, Somatic hybrid production</li> <li>To explore procedure for establishment of virus free plant, artificial seeds and confirmation trans gene expression</li> </ol>		
Unit	Course Contents	Hours
1	Plant Tissue Culture Laboratory Organization	02
2	Preparation of MS nutrient Medium and sterilization	05
3	Surface sterilization and establishment of Callus Culture	05
4	<i>In vitro</i> Germination of Seeds	05
5	Isolation and Culture of Embryos	05
6	Anther Culture	05
7	Hairy Root Culture	04
8	Establishment of suspension culture and assay of one secondary metabolite.	05
9	Protoplast isolation and protoplast fusion.	05
10	Artificial seeds production and stability testing of sodium alginate	05
11	Production of Virus Free Plant	05
12	Axillary bud culture	05
13	Reporter gene assay	04
14	Isolation of Genomic DNA from Plant Tissue	05
<b>Total</b>		<b>65</b>

#### Book for Study

- Robert N Trigiano, 2018. *Plant Tissue Culture Concepts and Laboratory Exercises*, 2<sup>nd</sup> Edition CRC Press, London.

#### Books for Reference

- Robert Nicholas Trigiano and Dennis John Gray, 2019, *Plant Tissue Culture Concepts and Laboratory Exercise*, 2<sup>nd</sup> Edition, CRC Press, London.
- Sunghun Park, 2021, *Plant Tissue Culture Techniques and Experiments*, 4<sup>th</sup> Edition, Academic Press



3. Nagar Santosh and Adhav Madhav, 2010, *Practical Book Of Biotechnology & Plant Tissue Culture*, Kindle Edition, S Chand & Company.
4. Hirenkumar Sherathiya, 2013, *Practical manual for Plant Tissue Culture: Basic Techniques of Plant Tissue Culture and Molecular Biology*, 1<sup>st</sup> Edition, GRIN Verlag.

#### Web Resources

1. <https://www.unom.ac.in/webportal/uploads/library/gcl-opac/lifeplantbio.html>
2. <http://aggie-horticulture.tamu.edu/tisscult/biotech/biotech.html>

**Pedagogy:** Lecturing, PPTs, Demos and Hands on Training.

#### Rationale for Nature of the Course

Students to become a master in all types culture techniques, which support them to exploit it in research studies and entrepreneurship development.

#### Activities to be given

Hands on training, Field Visit, Application studies

#### Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K - Level
CLO 1	List the knowledge about the Lab organization & measures adopted for aseptic manipulation and nutritional requirements of cultured tissues	K1
CLO 2	Explain the protocol for media preparation, explant sterilization and apply knowledge for large scale clonal propagation of plants through various Micropropagation techniques	K2
CLO 3	Use principles, technical requirement, scientific and commercial applications of various culture system in Plant Biotechnology	K3
CLO 4	Identify procedure for production of homozygous lines and somatic hybrids	K4
CLO 5	Prioritize the methods of protocols to develop meristematic culture, synthetic seed preparation and confirmation trans gene expression	K5




#### 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	2	3	2	2	2
CLO 2	2	2	2	2	2	3	3
CLO 3	3	3	3	3	2	3	2
CLO 4	3	3	3	3	3	3	3
CLO 5	3	3	3	3	3	3	3

3 – Advance Application

2 – Intermediate Level

1 – Basic Level

Course Designed by	Verified by HOD	Approved by CDC Coordinator
 <b>Dr. P. SENTHILKUMAR</b> Name & Signature of the Staff	 <b>Dr. G. RAJALAKSHMI</b> 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 M. Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
II	DSC	22BTP15	PRACTICAL VI- BIOPROCESS TECHNOLOGY	2	3	50	50	100

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

Course Objectives		
<ol style="list-style-type: none"> <li>To learn the procedure involved in media sterilization, optimization and formulation to achieve fermentation process.</li> <li>To optimize the growth parameters required to carry out the fermentation process for increased biomass and product.</li> <li>To apply the learned techniques for cell fractionation and disruption to isolate the product.</li> <li>To use the effective procedures for isolation and purification of the product.</li> <li>To identify the various procedures for estimation of the desired isolated crude products formed after fermentation</li> </ol>		
Unit	Course Contents	Hours
1	Citric acid Production - Isolation of strain, media sterilization, culture of isolated strain, Upstream processing and Downstream processing.	5
2.	Amylase production- selection and isolation of strain, culture of microorganism, upstream processing, estimation of glucose.	5
3	Wine production – wine processing from fruit source, estimation of the alcohol	4
4	Optimization of culture – parameters such as Temperature and pH- Estimation of increased yield in the biomass.	4
5	Oxygen transfer Coefficient- Determination of KIA (Volumetric Mass Transfer) by volumetric Analysis.	5
6	Cell separation techniques- Centrifugation, filtration. Estimation of protein using Bradford method.	5
7	Cell disruption techniques – physical methods - Homogenization and Ultrasonication and Chemical method - osmotic shock and surfactants. Estimation of Protein using Lowry's method.	5
8	Product isolation and purification – Salting out, Dialysis and Column chromatography.	6
<b>Total</b>		<b>39</b>

#### Book for Study

- Cassida L. E. J. R., 2019, Industrial microbiology, 1<sup>st</sup> Edition, New Age International Private Limited, India.*

### Books for Reference

1. Rao D.G., 2008, *Introduction to Biochemical engineering*, 1<sup>st</sup> Edition, McGraw-Hill Publications.
2. Prescott and Dunns., 2007, *Industrial Microbiology*, 4<sup>th</sup> Edition, Gerald Reed, Chapman & Hall publications.
3. Wulf Crueger and Anneliese Crueger., 2009, *Biotechnology- A Textbook of Industrial Microbiology*, 1<sup>st</sup> Edition, Panima Publishing Corporation, New Delhi.
4. Claire Komives, Weichang Zhou., 2018, *Bioprocessing Technology for production of Biopharmaceuticals and Bioproducts*, 1<sup>st</sup> Edition, Wiley Publications.

### Web Resources

1. <https://bioprocessing.weebly.com/bioprocess-technology.html>
2. <https://www.bioprocessonline.com/doc/best-practices-for-a-successful-bioprocess-technology-transfer-0001>
3. <https://www.ugent.be/fw/pharmaceutics/pharmtech/en>

**Pedagogy:** Lecturing, PPTs, Demos and Hands on Training.

### Rationale for Nature of the Course

Application of techniques which are required to optimize the Culture of cells and to meet the desired product efficacy and yield in industrial level.

### Activities to be given

Hands on training, Field Visit, Application studies

### Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K - Level
CLO 1	Recall the procedure involved in media sterilization, optimization and formulation to achieve fermentation process.	K1
CLO 2	Review and optimize the growth parameters required to carry out the fermentation process for increased biomass and product.	K2
CLO 3	Apply the learned techniques for cell fractionation and disruption to isolate the product.	K3
CLO 4	Use the effective procedures for isolation and purification of the product.	K4
CLO 5	Identify the various procedures for estimation of the desired isolated crude products formed after fermentation	K5




### 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	2	3	2	2	3
CLO 2	2	2	2	2	2	3	2
CLO 3	3	2	3	3	2	3	3
CLO 4	2	3	3	3	3	3	2
CLO 5	3	3	3	3	3	3	3

3 – Advance Application

2 – Intermediate Level

1 – Basic Level

Course Designed by	Verified by HOD	Approved by CDC Coordinator
 <b>Ms. R. GNANAMBAL</b> Name & Signature of the Staff	 <b>Dr. G. RAJALAKSHMI</b> Name & Signature	 Name & Signature

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