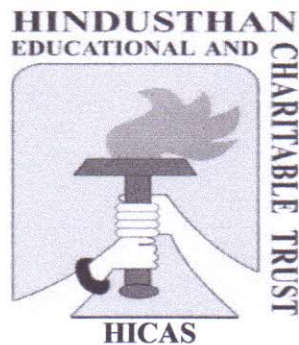


**CURRICULUM FRAMEWORK AND SYLLABUS  
FOR OUTCOME BASED EDUCATION IN  
(CBCS & LOCF PATTERN)**

**MASTER OF SCIENCE IN BIOTECHNOLOGY DEGREE PROGRAM**

**FOR THE STUDENTS ADMITTED FROM THE ACADEMIC YEAR**

**2020 - 2021 and ONWARDS**



**HINDUSTHAN COLLEGE OF ARTS AND SCIENCE (AUTONOMOUS)  
(Affiliated to Bharathiar University and Accredited by NAAC)  
COIMBATORE-641028 TAMILNADU, INDIA.**

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HINDUSTHAN COLLEGE OF ARTS AND SCIENCE (AUTONOMOUS) COIMBATORE – 641 028

M.Sc., BIOTECHNOLOGY SCHEME OF EXAMINATIONS – CBCS PATTERN

(For the Students Admitted from the Academic Year 2020 -2021 and onwards)

PG PROGRAMME

Programme: Master of Science in Biotechnology

CODE NO.	COURSE TYPE	SUBJECT	LECTURE HOURS / WEEK	EXAM DURATION (HOURS)	MAX. MARKS			CREDIT POINTS
					IE	EE	TOT	
<b>First Semester</b>								
20BTP01	DSC	Cell and Molecular Biology	4	3	30	70	100	4
20BTP02	DSC	Applied Microbiology	5	3	30	70	100	5
20BTP03	DSC	Biochemistry	5	3	30	70	100	5
20BTP04A	DSE	<b>Elective I</b> Plant and Animal System Physiology	4	3	30	70	100	3
20BTP04B		<b>Elective I</b> Occupational Health and Industrial Safety						
20BTP05	DSC	<b>Practical I</b> - Cell and Molecular Biology	4	6	40	60	100	2
20BTP06	DSC	<b>Practical II</b> - Applied Microbiology	4	6	40	60	100	2
20BTP07	DSC	<b>Practical III</b> – Biochemistry	4	6	40	60	100	2
20BTPV01	ACC	VAC-I	2	1	50	-	50	1
20BTPJ01	AEE	Aptitude / Placement Training	2	1	50	-	50	Grade*
20BTPJ02	AEE	Online Classes	2	1	-	-	-	C/NC**
<b>Credits</b>								<b>24</b>
<b>Second Semester</b>								
20BTP08	DSC	Genetic Engineering	5	3	30	70	100	5
20BTP09	DSC	Research Methodology and Biostatistics	5	3	30	70	100	5
20BTP10	DSC	Bioprocess Technology	5	3	30	70	100	5
20BTP11A	DSE	<b>Elective II</b> Bioethics, Biosafety and IPR	5	3	30	70	100	3
20BTP11B		<b>Elective II</b> Genomics and Proteomics						
20BTP11C		<b>Elective II</b> Molecular Diagnostics and Clinical Testing						
20BTP12	DSC	<b>Practical IV</b> - Genetic Engineering	4	6	40	60	100	2
20BTP13	DSC	<b>Practical V</b> - Bioprocess Technology	4	6	40	60	100	2
20BTP14	DSC	<b>Self-Supportive Course:</b> Biodiversity and Conservation Biology	-	3	30	70	100	3



20GSP01	AECC	Skill based subject: Cyber security	2	2	100	--	100	2
20BTPV02	ACC	VAC-II	2	1	50	-	50	1
20BTPJ03	AEE	Aptitude / Placement Training	2	1	50	-	50	Grade*
20BTPJ04	AEE	Online Classes	2	1	-	-	-	C/NC**
<b>Credits</b>								<b>28</b>
<b>Students should complete Online course, Mini project, News review/Poster Presentation at the End of the First Year</b>								
<b>Third Semester</b>								
20BTP15	DSC	Immunology and Immunotechnology	5	3	30	70	100	5
20BTP16	DSC	Animal and Pharmaceutical Biotechnology	5	3	30	70	100	5
20BTP17	DSC	Plant Biotechnology	4	3	30	70	100	4
20BTP18A	DSE	<b>Elective III</b> Developmental Biology and Behavioural Studies	4	3	30	70	100	3
20BTP18B		<b>Elective III</b> Biotechniques						
20BTP18C		<b>Elective III</b> Stem Cell Biology						
20BTP19	SEC	Institutional Training	-	-	100	-	100	3
20BTP20	DSC	<b>Practical VI</b> - Immunology and Immunotechnology	4	6	40	60	100	2
20BTP21	DSC	<b>Practical VII</b> - Animal and Pharmaceutical Biotechnology	4	6	40	60	100	2
20BTP22	DSC	<b>Practical VIII</b> - Plant Biotechnology	4	6	40	60	100	2
20BTPV03	ACC	VAC-III	2	1	50	-	50	1
20BTPJ05	SEC	Aptitude / Placement Training	2	1	50	-	-	Grade*
20BTPJ06	SEC	Online Classes	2	1	-	-	-	C/NC**
<b>Credits</b>								<b>27</b>
<b>Fourth Semester</b>								
20BTP23	DSC	Environmental Biotechnology and Nanotechnology	5	3	30	70	100	5
20BTP24A	DSE	<b>Elective IV</b> Bioinstrumentation	4	3	30	70	100	3
20BTP24B		<b>Elective IV</b> Tools in Biotechnology						
20BTP24C		<b>Elective IV</b> Medical Biotechnology						
20BTP25	DSC	<b>Practical IX</b> - Environmental Biotechnology and Nanotechnology	5	6	40	60	100	2
20BTP26	SEC	Project Work	16	-	50	150	200	6
20BTPV04	ACC	VAC-IV	2	1	50	-	50	1

20BTPJ07	SEC	Aptitude / Placement Training	2	1	50	-	-	Grade*
20BTPJ08	SEC	Online Classes	2	1	-	-	-	C/NC**
<b>Credits</b>								<b>17</b>
<b>Students should complete Online course, Case study Analysis/Research Article Review/Paper Presentation at the End of the Year</b>								
*Actual credit=92, Extra credit =04 (for value added course)								<b>96*</b>

- VAC-Value Added Course (Extra Credit Courses)
- JOC- Job Oriented course
- C/NC\*\* -Completed/ Not Completed
- I.E-Internal Exam
- E.E-External Exam
- \* Grades depends on the marks obtained

Range of marks	Equivalent remarks
80 and above	Exemplary
70 – 79	Very good
60 – 69	Good
50 – 59	Fair
40 – 49	Satisfactory
Below 39	Not Satisfactory = Not completed

#### **PASSING MINIMUM**

- Passing Minimum for UG 40% and for PG 50 %
- For UG: 35 % (25 marks) in EE and 40 % in Total Marks
- For PG 50 % (35 marks) in EE and 50 in Total Marks



## PG Courses- Scheme of Evaluation (Internal & External Components)

(For the students admitted during the academic year 2020-2021 and onwards)

### 1. Internal Marks for all PG

Components	Marks
Test	5
Model Exam	10
Assignment	5
Attendance*	5
Seminar	5#
<b>TOTAL</b>	<b>30</b>

### \*Split-up of Attendance Marks for UG

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

(# (3+2)-3 for External & 2 for (Internal paper presentation or poster design)

### 2. a) Components for Practical I.E.                      b) Components for Practical E.E.

Components	Marks
Test - I	20
Test - II	20
<b>Total</b>	<b>40</b>

Components	Marks
Experiments	50
Record	5
Viva	5
<b>Total</b>	<b>60</b>

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

Institutional /Industrial Training (I.E)		Mini Project (I.E)	Major Project Work		
Component	Marks	Marks	Component	Marks	Total Marks
Work diary	25	-	I.E a)Attendance	20	50
Report	50	50	b)Review	30	
Viva-voce	25	50			
<b>Total</b>	<b>100</b>	<b>100</b>	E.E* a) Final report	120	150
			b)Viva-voce	30	
			<b>Total</b>	<b>200</b>	

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

### 4. Components for Cyber Security Paper

Components	Marks
Two Tests (each 2 hours) of 40marks each [4 out of 7 descriptive type questions 4 x 10 = 40 Marks]	80
Two assignments (2 x 10)	20

### 5. 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>

#### Guidelines:

- The passing minimum for these items should be 50%
- If the candidate fails to secure 50% passing minimum, he / she may have to reappear for the same in the subsequent semesters
- Item No's:4,5, are to be treated as 100% Internal papers.
- For item No.5, Tests conducted through online modules (Google Form/any other)

**PG PATTERN**  
**QUESTION PAPER PATTERN FOR CIA EXAM**

Reg.No:-----

Q.P.CODE:

**HINDUSTHAN COLLEGE OF ARTS AND SCIENCE (AUTONOMOUS)**  
**----- DEGREE CIA EXAMINATIONS -----20-----**

(-----Semester)

BRANCH: -----

Subject Name: -----

Time: Two Hours

Maximum: 50 Marks

**Section-A (3 x 6=18 Marks)**

Answer ALL Questions

ALL questions carry EQUAL Marks

(Q.No: 1 to 3 Either Or type)

**Section-B (4 x 8=32 Marks)**

Answer ALL Questions

ALL questions carry EQUAL Marks

(Q.No: 4 to 7 Either Or type)

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

Reg.No:-----

Q.P.CODE:

**HINDUSTHAN COLLEGE OF ARTS AND SCIENCE (AUTONOMOUS)**  
**-----DEGREE MODEL EXAMINATIONS -----20-----**

(-----Semester)

BRANCH: -----

Subject Name: -----

Time: Three Hours

Maximum: 70 Marks

**SECTION – A (5x6=30 marks)**

Answer ALL Questions

ALL Questions carry EQUAL Marks

(Q.No 1 to 5 Either Or type)

(One question from each Unit)

**SECTION – B (5x8=40 Marks)**

Answer ALL Questions

ALL Questions carry EQUAL Marks

(Q.No 6 to 10 Either Or type)

(One question from each Unit)

(For the Candidates admitted during the academic year 2020 - 2021 )

<b>List of Open Elective Papers</b>	
Open Electives	Courses offered by the Departments (Additional credit Course)
	Fisheries Technology
	Apiculture
	Clinical Laboratory Technology
	Cheminformatics
	Medico Botany
	Bioentrepreneurship

<b>List of Elective Papers/ DSE</b>		
<b>(Can choose any one of the papers as electives)</b>		
	<b>Course Code</b>	<b>Title</b>
Electives/ <b>DSE-I</b>	20BTP04A	<b>Elective I</b> Plant and Animal System Physiology
	20BTP04B	<b>Elective I</b> Occupational Health and Industrial Safety
Electives/ <b>DSE-II</b>	20BTP11A	<b>Elective II</b> Bioethics, Biosafety and IPR
	20BTP11B	<b>Elective II</b> Genomics and Proteomics
	20BTP11C	<b>Elective II</b> Molecular Diagnostics and Clinical Testing
Electives/ <b>DSE-III</b>	20BTP18A	<b>Elective III</b> Developmental Biology and Behavioural Studies
	20BTP18 B	<b>Elective III</b> Biotechniques
	20BTP18 C	<b>Elective III</b> Stem Cell Biology
Electives/ <b>DSE-IV</b>	20BTP24 A	<b>Elective IV</b> Bioinstrumentation
	20BTP24 A	<b>Elective IV</b> Tools in Biotechnology
	20BTP24 A	<b>Elective IV</b> Medical Biotechnology



**ABSTRACT FOR SCHEME OF EXAMINATIONS**

<b>S. No.</b>	<b>Course (AEE/DSC/DSE/GE/ACC/SEC)</b>	<b>Papers</b>	<b>Credit</b>	<b>Total Credits</b>	<b>Marks</b>	<b>Total Marks</b>
1	DSC	8	5 per paper	40	100	800
2	DSC	2	4 per paper	8	100	200
3	DSC	1	3 per paper	3	100	100
4	DSC	9	2 per paper	18	100	900
5	DSE	04	3 per paper	12	100	400
6	SEC(Institutional training)	1	3 per paper	3	100	100
7	SEC (Project)	1	6 per paper	6	200	200
8	SEC (Aptitude/ Placement Training)	2	Grade	Grade	50	100
9	SEC (Online classes)	2	Grade	Grade	Grade	Grade
10	ACC	04	1 per paper	4	50	200
11	AEE (Placement Training)	02	Grade	Grade	50	100
12	AEE (Online classes)	2	Grade	Grade	Grade	Grade
13	AECC	01	2 per paper	2	100	100
	<b>Total</b>	<b>39</b>	<b>29</b>	<b>96</b>	<b>1050</b>	<b>3200</b>

<b>Programme Code:</b>	<b>DSC</b>	<b>Programme Title: Master of Science in Biotechnology</b>					
<b>Course Code:</b>	<b>20BTP01</b>	<b>Course Title</b>				<b>Batch:</b>	<b>2020-2021 onwards</b>
		<b>CELL AND MOLECULAR BIOLOGY</b>				<b>Semester:</b>	<b>I</b>
<b>Hrs/Week:</b>	<b>4</b>	<b>L</b>	<b>4</b>	<b>T</b>	<b>-</b>	<b>P</b>	<b>-</b>
						<b>Credits:</b>	<b>4</b>

#### **COURSE OBJECTIVE**

1. To understand cell structures, functions, cellular organelles and various metabolic processes will help students to design experiments with appropriate understanding and leads to conduct genuine research.
2. To discuss the properties and biological significance of the major classes of molecules found in living organisms and the relationship between molecular structure and biological function.
3. To know the structural organization of genes and the control of gene expression, replication and photosynthesis.
4. To explore the processes that control eukaryotic cell cycle and cell death and link the rapid advances in cell and molecular biology to a better understanding of diseases.

#### **COURSE OUTCOMES (CO)**

<b>S. No</b>	<b>COURSE OUTCOME</b>	<b>BLOOMS LEVEL</b>
CO1	Describe the knowledge of cell structures, functions, cellular organelles and various metabolic processes will help students to design experiments with appropriate understanding and leads to conduct genuine research.	K1
CO2	Understand and discuss the properties and biological significance of the major classes of molecules found in living organisms and the relationship between molecular structure and biological function.	K2
CO3	Apply the structural organization of genes and the control of gene expression, replication and photosynthesis.	K3
CO4	Represent and illustrate the processes that control eukaryotic cell cycle and cell death and link the rapid advances in cell and molecular biology to a better understanding of diseases.	K4
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse.</b>		

## SYLLABUS

Code	Subject Name	Semester
20BTP01	<b>CELL AND MOLECULAR BIOLOGY</b>	<b>I</b>
Unit No.	Topics	Hours
<b>I</b>	<b>Introduction to Different Types of Cells</b> Types of Cells - Prokaryotic and Eukaryotic Cell Structure and Intracellular Organelles – Nucleus, Mitochondria, Chloroplast, Ribosomes, golgi complex, Endoplasmic reticulum, Peroxysomes and Microbodies; Fractionation and Purification of Subcellular Organelles.	9
<b>II</b>	<b>Cell Division, Cell Cycle and Cytoskeleton</b> Events of Mitosis and Meiosis. Cell Cycle and its regulation. Cytoskeleton - Cell Motility and Cellular Movements – Microtubules – Microfilament Specialized Cell Structure and Function (Muscle Cell, Nerve Cell and Motile Cell).	9
<b>III</b>	<b>Cell Signaling</b> Structure and Functions of Plasma Membrane – Cell Recognition, Cell to Cell Signaling – Receptor and Receptor – Response Mechanisms G protein coupled receptors – Jak/STAT Pathway, Receptor Tyrosine Kinase pathways	11
<b>IV</b>	<b>Central Dogma of Cell</b> DNA Replication, RNA Transcription and Processing, Interaction of mRNA, rRNA and tRNA on Protein Synthesis. Mitochondrial Electron Transport System – Oxidative Reactions in Microbodies– Pathways of Photosynthesis – Light and Dark Reactions.	10
<b>V</b>	<b>Gene transfer, Gene Regulation, Genetic recombination</b> DNA as a genetic material – Conjugation, Transformation and Transduction. Mutation – Spontaneous and Induced; Operon concept – lac, trp and ara operons Recombination – Holliday model;	9
<b>Total</b>		<b>48</b>

**Distribution of marks for Theory:(IE 30; EE 70)**

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

### TEXT BOOKS:

1. Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Anthony Bretscher, HiddePloegh, Angelika Amon, Kelsey C. Martin. 2016, *Molecular Cell Biology*, 8<sup>th</sup> Edition, W. H. Freeman and Company, New York.
2. Ajoy Paul, 2015, *Cell and Molecular Biology*, New Edition, Books and Allied.



**REFERENCE BOOKS:**

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 Edition.

**WEB RESOURCES: NPTEL, COURSEERA, SWAYAM****WEB LINK:**

1. <https://nptel.ac.in/courses/102/106/102106025/>
2. <https://nptel.ac.in/courses/102/103/102103012/>
3. <https://www.coursera.org/learn/cancer>
4. [https://onlinecourses.swayam2.ac.in/cec20\\_ma14/preview](https://onlinecourses.swayam2.ac.in/cec20_ma14/preview)




**MAPPING WITH PROGRAM OUTCOMES:**

CO \ PO	PO1	PO2	PO3	PO4
CO1	S	S	S	S
CO2	S	S	M	L
CO3	S	M	L	M
CO4	S	S	L	M

S - Strong; M-Medium; L-Low.

**ASSESSMENT PATTERN (if deviation from common pattern)**

Follows common pattern of Internal and External assessment, suggested in the Regulations.

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

BOS meeting approved

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.

Approved in 6<sup>th</sup> Academic Council meeting on: 04.08.2020

<b>Programme Code:</b>	<b>DSC</b>	<b>Programme Title: Master of Science in Biotechnology</b>							
<b>Course Code:</b>	<b>20BTP02</b>	<b>Course Title</b>						<b>Batch:</b>	<b>2020-2021 onwards</b>
		<b>APPLIED MICROBIOLOGY</b>						<b>Semester:</b>	<b>I</b>
<b>Hrs/Week:</b>	<b>5</b>	<b>L</b>	<b>5</b>	<b>T</b>	<b>-</b>	<b>P</b>	<b>-</b>	<b>Credits:</b>	<b>5</b>

#### **COURSE OBJECTIVE**

1. To explore microbial biotechnology its product and its application in various fields on microbiology
2. To understand the various techniques involved in pharmaceutical microbiology and its product and characterizations
3. To apply the various roles of microorganism in waste water and drinking water, fuel cells and biodegradation
4. To analyse the appropriate tools in Medicine and Human health having understood pathogen and human interactions and their significance.

#### **COURSE OUTCOMES (CO)**

<b>S.No</b>	<b>COURSE OUTCOME</b>	<b>BLOOMS LEVEL</b>
CO1	Explain microbial biotechnology its product and its application in various fields on microbiology	K1
CO2	Understand various techniques involved in pharmaceutical microbiology and its product and characterizations	K2
CO3	Apply the various roles of microorganism in waste water and drinking water, fuel cells and biodegradation	K3
CO4	Analyse the appropriate tools in Medicine and Human health having understood pathogen and human interactions and their significance	K4
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse</b>		



## SYLLABUS

Code	Subject Name	Semester
20BTP02	<b>APPLIED MICROBIOLOGY</b>	<b>I</b>
Unit No.	Topics	Hours
<b>I</b>	<b>Introduction to Applied Microbiology</b> Microbial Diversity -Microbial Biotechnology: Scope, Techniques, Examples Production of Proteins in Bacteria and Yeast- Recombinant and Synthetic Vaccines- Plant-Microbe Interactions- Microbial Polysaccharides and Polyesters- Primary Metabolites: Organic Acids and Amino Acids- Secondary Metabolites: Antibiotics- Biocatalysis, Biomass and Ethanol	<b>12</b>
<b>II</b>	<b>Pharmaceutical Microbiology:</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. Preservation and maintenance of Microbial cultures- Lyophilizers, Deep freezer Microbial Genetics and Variations and control- Sterility Testing: Pharmaceutical Products- Microbial Assays: Antibiotics- Vitamins-Amino Acids	<b>12</b>
<b>III</b>	<b>Environmental Microbiology</b> Purification and sanitary analysis-Ensure safe drinking water- fate and toxicity of chemicals in Wastewater treatment plants, Microbial fuel cells: Batteries Powered by Microbes, biodegradation and bioremediation harness microbes to clean the environment.	<b>12</b>
<b>IV</b>	<b>Food Microbiology</b> History and Development -Characteristics of Food-Source, Microorganisms - Microbial Growth Characteristics-Factors Influences -Microbial Metabolism of Food Components- Microorganisms Used in Food Fermentation-Microbiology of Fermented Food Production-Intestinal Beneficial Bacteria-Food Bio preservatives of Microbial Origin-Microbial Food Spoilage-Food Spoilage by Microbial Enzymes- Microbial Foodborne Diseases- Control of Microorganisms in Foods-Microbial Detection and Food Safety	<b>12</b>
<b>V</b>	<b>Medical Microbiology:</b> Host-Pathogen Interactions-General Epidemiology- Principles of Sterilization and Disinfection-Basic Principles of Immunology-The Morphology, Physiology of Metabolism and Growth-Principles of Antibiotic Therapy-Pathogenicity and laboratory diagnosis of <i>Corynebacterium diphtheriae</i> , <i>Streptococcus pyogenes</i> <i>E.coli</i> <i>Salmonella</i> sp, viral infections – Hepatitis, Dengue virus, HIV and Ebola virus, and <i>Entamoeba histolytica</i> , <i>Taenia solium</i> , <i>Plasmodium</i> <i>vivax</i> ,	<b>12</b>
<b>Total</b>		<b>60</b>

**Distribution of marks for Theory:(IE 30; EE 70)**

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

BOS meeting approved

Approved in 6<sup>th</sup> Academic Council meeting on: 04.08.2020



**TEXT BOOK:**

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

**REFERENCE BOOKS:**

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. Pelczar & Kreig, 2006, Microbiology, 5<sup>th</sup> Edition. Tata McGraw Hill, New Delhi

**WEB RESOURCES:** COURSEERA, EDX, MOOC, NPTEL, SWAYAM**WEB LINK:**

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://www.scienceprofonline.com/virtual-micro-main.html>
5. <https://nptel.ac.in/courses/105/107/105107173/>
6. <https://nptel.ac.in/content/storage2/courses/105104102/Lecture%2023.htm>
7. [https://onlinecourses.swayam2.ac.in/cec19\\_ag03/preview](https://onlinecourses.swayam2.ac.in/cec19_ag03/preview)

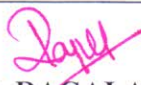
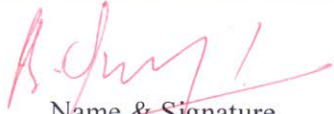
**MAPPING WITH PROGRAM OUTCOMES:**

CO \ PO	PO1	PO2	PO3	PO4
CO1	S	S	S	S
CO2	S	S	M	L
CO3	S	M	L	M
CO4	S	S	L	M

S - Strong; M-Medium; L-Low.

**ASSESSMENT PATTERN (if deviation from common pattern)**

Follows common pattern of Internal and External assessment, suggested in the Regulations.

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. RAGALAKSHMI</b> Name & Signature	 Name & Signature

BOS meeting approved

Approved in 6<sup>th</sup> Academic Council meeting on: 04.08.2020

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.

<b>Programme Code:</b>	<b>DSC</b>	<b>Programme Title: Master of Science in Biotechnology</b>							
<b>Course Code:</b>	<b>20BTP03</b>	<b>Course Title</b>					<b>Batch:</b>	<b>2020-2021 onwards</b>	
		<b>BIOCHEMISTRY</b>					<b>Semester:</b>	<b>I</b>	
<b>Hrs/Week:</b>	<b>5</b>	<b>L</b>	<b>5</b>	<b>T</b>	<b>-</b>	<b>P</b>	<b>-</b>	<b>Credits:</b>	<b>5</b>

### Course Objective

1. To acquire knowledge on the building blocks of the macromolecules, their chemical properties, their modification and their importance in normal functioning of living organisms.
2. To understand various biochemical reactions- thermodynamics - energy production through biochemical process responsible for the manifestation of life disease and metabolic errors.
3. To identify how the genetic abnormalities disturb the normal homeostasis and link with pathological conditions
4. To analyse the various applications of biochemistry in medicine, agriculture, and pharmaceuticals

### Course Outcomes (CO)

<b>S. No</b>	<b>COURSE OUTCOME</b>	<b>BLOOMS LEVEL</b>
CO1	Acquire knowledge on the building blocks of the macromolecules, their chemical properties and their modification and their importance in normal functioning of living organisms.	K1
CO2	Understand a thorough various biochemical reactions- thermodynamics - energy production through biochemical process responsible for the manifestation of life disease and metabolic errors.	K2
CO3	Apply the metabolic pathways and identify how the genetic abnormalities disturb the normal homeostasis and link with pathological conditions	K3
CO4	Analyse the various applications of biochemistry in medicine, agriculture, and pharmaceuticals	K4
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse</b>		



## SYLLABUS

Code	Subject Name	Semester
20BTP03	BIOCHEMISTRY	I
Unit No.	Topics	Hours
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; Respiration and Photosynthesis. Energy Metabolism (concept of free energy); Principles of Thermodynamics; Kinetics, Dissociation and Association Constants; Bioenergetics.	12
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. Glycolysis and TCA Cycle; Glycogen Breakdown and Synthesis; Gluconeogenesis; Interconversion of Hexoses and Pentoses.	12
III	<b>Proteins and Lipids</b> Proteins: Classification– Primary Structure of Proteins – Structural Comparison at Secondary and Tertiary levels (Ramchandran Map) – Conformation of Proteins and Polypeptides (Secondary, Tertiary, Quaternary and Domain Structure) – Protein Folding - Biophysical and Cellular Aspects. Lipids: Structure and Classification – Properties – Oxidation of Fatty acids – Biosynthesis of Fatty acids – Triglycerides.	12
IV	<b>Nucleic Acids</b> Classification – Structure and Properties – Biological Significance of Double Strand – Sequence Dependent Variation in the Shape of DNA. Physical Properties of Double Stranded DNA, Structure of Double Stranded DNA (B, A, C, D, T and Z DNA) - Types of RNAs and their Biological Significance - DNA Bending – DNA Supercoiling, Secondary and Tertiary Structural Features and their Analysis - Biosynthesis of Purines and Pyrimidines	12
V	<b>Enzymes</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).	12
<b>Total</b>		60

**Distribution of marks for Theory: (IE 30; EE 70)**

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

**TEXT BOOKS:**

1. Michael.M.Cox, David.L.Nelson, 2012, *Leninger Principles of Biochemistry*, 6<sup>th</sup> Edition, W.H. Freeman and Company, NY, USA.
2. Donald Voet, Judith G. Voet, 2010, *Biochemistry*, 4<sup>th</sup> Edition, J. Wiley & Sons.



**REFERENCE BOOKS:**

1. Christopher K. Mathews, Kensal E. van Holde, Kevin G. Ahern, 2008, *Biochemistry*, 6<sup>th</sup> Edition Pearson Education.
2. Smith et al., 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: SWAYAM, NPTEL, HARVARD, COURSERA****WEB LINK:**

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.edx.org/learn/biochemistry>
5. <https://www.coursera.org/learn/chemicals-health>




**MAPPING WITH PROGRAM OUTCOMES**

CO \ PO	PO1	PO2	PO3	PO4
CO1	S	L	M	L
CO2	S	S	S	L
CO3	M	S	M	S
CO4	S	S	S	S

S - Strong; M-Medium; L-Low.

**ASSESSMENT PATTERN (if deviation from common pattern)**

Follows common pattern of Internal and External assessment, suggested in the Regulations.

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

BOS meeting approved

**HEAD OF THE DEPARTMENT**  
 Approved in 6<sup>th</sup> Academic Council meeting on: 04.08.2020  
**PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY**  
**HINDUSTHAN COLLEGE OF ARTS AND SCIENCE**  
 COIMBATORE - 641 028. **Curriculum Development Cell**  
**Hindusthan College of Arts & Science,**  
 Coimbatore-641 028.

<b>Programme Code:</b>	<b>DSE</b>	<b>Programme Title: Master of Science in Biotechnology</b>							
<b>Course Code:</b>	<b>20BTP04A</b>	<b>Course Title</b>					<b>Batch:</b>	<b>2020-2021 onwards</b>	
		<b>Elective I: PLANT AND ANIMAL SYSTEM PHYSIOLOGY</b>					<b>Semester:</b>	<b>I</b>	
<b>Hrs/Week:</b>	<b>4</b>	<b>L</b>	<b>4</b>	<b>T</b>	<b>-</b>	<b>P</b>	<b>-</b>	<b>Credits:</b>	<b>3</b>

### COURSE OBJECTIVE

1. To recall about biosynthesis of secondary metabolite, biotic and abiotic stress
2. To understand about blood and cardiovascular system with their anatomy, specialized tissues.
3. To explore the anatomy, structure and function of lungs, nervous system and sense organs.
4. To analyse the inventory thoughts on excretory system, endocrinology and reproduction in regulation of body

### COURSE OUTCOMES (CO)

S. No	COURSE OUTCOME	BLOOMS LEVEL
CO1	Remember about biosynthesis of secondary metabolite, biotic and abiotic stress.	K1
CO2	Understand about blood and cardiovascular system with their anatomy, specialized tissues.	K2
CO3	Apply the anatomy, structure and function of lungs, Nervous system and sense organs.	K3
CO4	Analyse the inventory thoughts on Excretory system, endocrinology and reproduction in regulation of body	K4
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse</b>		

BOS meeting approved

Approved in 6<sup>th</sup> Academic Council meeting on: 04.08.2020



## SYLLABUS

Code	Subject Name	Semester
20BTP04A	<b>PLANT AND ANIMAL SYSTEM PHYSIOLOGY</b>	<b>I</b>
Unit No.	Topics	Hours
<b>I</b>	<b>Plant Metabolism</b> Photosynthesis - Electron Transport - CO <sub>2</sub> fixation- C <sub>3</sub> , C <sub>4</sub> and CAM pathways - Solute Translocation through Xylem and Phloem. Biosynthesis – Storage - Breakdown and Transport - Physiological Effects and Mechanisms of Action of cytokinin and auxins Structure, Function–of Cryptochromes and Phytotropins; - Photoperiodism and Biological Clocks.	10
<b>II</b>	<b>Secondary Metabolites and Stress physiology</b> Biosynthesis of Terpenoids – Steroids – Alkaloids - Flavonoids and Phenolic Compounds and their roles. Responses of Plants to Biotic (Pathogen and Insects) and Abiotic (Water, Temperature and Salt) Stresses	9
<b>III</b>	<b>Muscular System:</b> Classification – Structure and Function. Blood Cardiovascular System: Blood Corpuscles - Blood Groups – Haemoglobin - haemostasis. Comparative Anatomy of Heart Structure, Myogenic Heart - Specialized Tissue - Cardiac Cycle - Heart as a Pump - Blood Pressure.	10
<b>IV</b>	<b>Respiratory System:</b> Anatomy and Structure of Lungs - Transport of Gases - Exchange of Gases – Waste Elimination - Neural and Chemical Regulation of Respiration. Nervous System: Types -Neurons – Synapse. Sense organs: Vision - hearing and tactile response.	9
<b>V</b>	<b>Excretory System:</b> Anatomy and Structure of Urinary System – Micturition - regulation of electrolyte balance and acid-base balance. Endocrinology and Reproduction: Endocrine glands - basic mechanism of Hormone Action - Hormones and Diseases. Reproductive Processes - Neuroendocrine Regulation.	10
<b>Total</b>		48

**Distribution of marks for Theory:(IE 30; EE 70)**

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

**TEXT BOOK:**

1. Frank B Salisbury and Cleon Wross, "Plant Physiology", 3<sup>rd</sup> Edn., CBS Publishers and Distributors, New Delhi, 2001
2. Neilson K.S, "Animal Physiology", 3<sup>rd</sup> Edn., New Delhi Prentice Hall, 2005



### REFERENCE BOOKS

1. Roy G. Noggle and George J. Fritz, "Introductory Plant physiology", 1<sup>st</sup> Edn., Prentice-Hall of India Pvt.Ltd, New Delhi, 2013
2. Verma, V. 2007. Text book of Plant Physiology. 1<sup>st</sup> Edn., Ane books pvt. Ltd, 2015
3. Malick, C. P. Text book of Plant Physiology. 2<sup>nd</sup> Edn., Kalyani publisher, 2015
4. Mukherji, S. 1995. Text book of Plant Physiology. 1<sup>st</sup> Edn., Tata McGraw-hill education private Ltd.

WEB RESOURCES: ALISON, NPTEL, CLASSCENTRAL

### WEB LINK:

1. <https://alison.com/course/advanced-biology-1>
2. [https://onlinecourses.nptel.ac.in/noc20\\_bt42/preview](https://onlinecourses.nptel.ac.in/noc20_bt42/preview)
3. <https://www.classcentral.com/course/swayam-plant-physiology-and-plant-tissue-culture-14238>




### MAPPING WITH PROGRAM OUTCOMES

CO \ PO	PO1	PO2	PO3	PO4
CO1	S	M	M	L
CO2	S	M	L	M
CO3	S	M	L	M
CO4	S	S	M	M

S - Strong; M-Medium; L-Low.

### ASSESSMENT PATTERN (if deviation from common pattern)

Follows common pattern of Internal and External assessment, suggested in the Regulations.

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

BOS meeting approved

Approved in 6<sup>th</sup> Academic Council meeting on: 04.08.2020

<b>Programme Code:</b>	<b>DSE</b>	<b>Programme Title: Master of Science in Biotechnology</b>							
<b>Course Code:</b>	<b>20BTP04 B</b>	<b>Course Title</b>						<b>Batch:</b>	<b>2020-2021 onwards</b>
		<b>Elective I: OCCUPATIONAL HEALTH AND INDUSTRIAL SAFETY</b>						<b>Semester:</b>	<b>I</b>
<b>Hrs/Week:</b>	<b>4</b>	<b>L</b>	<b>4</b>	<b>T</b>	<b>-</b>	<b>P</b>	<b>-</b>	<b>Credits:</b>	<b>3</b>

### **COURSE OBJECTIVE**

1. To know how to identify hazards in the home or workplace that poses a danger or threat to their safety or health, or that of others.
2. To understand the control unsafe or unhealthy hazards and propose methods to eliminate the hazard
3. To apply and discuss the role of health and safety in the workplace pertaining to the responsibilities of workers, managers, supervisors and explain a comprehension of the changes created by WHMIS legislation in everyday life
4. To analyse and create a decisive making required to maintain protection of the environment, workplace as well as personal health and safety.

### **COURSE OUTCOMES (CO)**

<b>S. No</b>	<b>COURSE OUTCOME</b>	<b>BLOOMS LEVEL</b>
CO1	Know how to identify hazards in the home or workplace that poses a danger or threat to their safety or health, or that of others.	K1
CO2	Understand the control unsafe or unhealthy hazards and propose methods to eliminate the hazard	K2
CO3	Apply and discuss the role of health and safety in the workplace pertaining to the responsibilities of workers, managers, supervisors. To explain a comprehension of the changes created by WHMIS legislation in everyday life.	K3
CO4	Analyse and create a decisive making required to maintain protection of the environment, home and workplace as well as personal health and safety.	K4
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse</b>		



## SYLLABUS

Code	Subject Name	Semester
20BTP04 B	<b>OCCUPATIONAL HEALTH AND INDUSTRIAL SAFETY</b>	<b>I</b>
Unit No.	Topics	Hours
<b>I</b>	<b>Parameters of safety</b> Concept of safety organization and Management - Safety Regulations. Definition and Role of Ergonomics in Designing Work-Place. Factors affecting the conditions of occupational and Industrial safety.	9
<b>II</b>	<b>Work Environment</b> Effects of Light -Ventilation – Vibration – Noise. The Work Physiology and their Relevance to Safety - Performance Evaluation of Man - Environment systems.	9
<b>III</b>	<b>Occupational Health and Safety</b> Occupational Health and Hazards – Physical, Chemical and Biological hazards. Occupational Diseases, their Prevention and Control. Health Protection Measures for Workers. Principles of Arthropod Control.	10
<b>IV</b>	<b>Health Education Medical First-Aid and Management of Medical Emergencies Industrial Safety Management Techniques</b> Industrial Safety Standards. Accidents-Definition, Frequency Rate, Prevention and Control. Types of accidents -Work Study - Method of Study and Measurement. Measurement of Skills. Safety - Cost of Expenses.	10
<b>V</b>	<b>Case Study.</b> Principles of Functions in Safety Management - Case Study - Visit to an Industry - Preparation of report on safety measures followed in Airport/Industry -. Distillery, Paper, Tannery, Pharmaceutical Industries.	10
<b>Total</b>		<b>48</b>

**Distribution of marks for Theory:(IE 30; EE 70)**

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

**TEXT BOOK:**

1. Kolluru R.V, "Environmental Strategies–Hand Book", 1<sup>st</sup> Edn., Mc Graw Hill Inc., New York.(1994)

**REFERENCE BOOKS:**

1. Walsh W and Russell L, "A B C of Industrial Safety", 1<sup>st</sup> Edn., Pitma Publishing, United Kingdom. (1974)
2. Hommedi A.H, "Environmental and Industrial Safety", 1<sup>st</sup> Edn., I.B.B Publication, New Delhi.(1989)

BOS meeting approved

Approved in 6<sup>th</sup> Academic Council meeting on: 04.08.2020

3. *Risk assessment- A Practical Guide, 1993, Institution of Occupational Safety and Health, 2<sup>nd</sup> Edn., United Kingdom*

**WEB RESOURCES:** CLASSCENTRAL, NPTEL, ALISON

**WEBLINK:**

1. <https://www.classcentral.com/course/swayam-industrial-safety-engineering-14124>
2. [https://onlinecourses.nptel.ac.in/noc20\\_mg43/preview](https://onlinecourses.nptel.ac.in/noc20_mg43/preview)
3. <https://nptel.ac.in/courses/110/105/110105094/>
4. <https://alison.com/courses/health-and-safety>

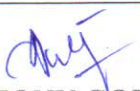

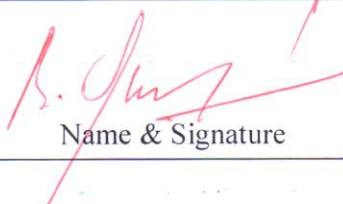
**MAPPING WITH PROGRAM OUTCOMES**

CO \ PO	PO1	PO2	PO3	PO4
CO1	S	S	M	S
CO2	S	L	S	L
CO3	S	M	S	M
CO4	M	S	S	S

S - Strong; M-Medium; L-Low.

**ASSESSMENT PATTERN (if deviation from common pattern)**

Follows common pattern of Internal and External assessment, suggested in the Regulations.

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

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.

BOS meeting approved

Approved in 6<sup>th</sup> Academic Council meeting on: 04.08.2020



<b>Programme Code:</b>	<b>DSC</b>	<b>Programme Title: Master of Science in Biotechnology</b>							
<b>Course Code:</b>	<b>20BTP05</b>	<b>Course Title</b>						<b>Batch:</b>	<b>2020-2021 onwards</b>
		<b>PRACTICAL I - CELL AND MOLECULAR BIOLOGY</b>						<b>Semester:</b>	<b>I</b>
<b>Hrs/Week:</b>	<b>4</b>	<b>L</b>	<b>-</b>	<b>T</b>	<b>1</b>	<b>P</b>	<b>3</b>	<b>Credits:</b>	<b>2</b>

### **COURSE OBJECTIVE**

1. To know basic concept, principle and application of cell and molecular biology
2. To understand the cells of various living organisms and get awareness of physiological processes of cell e.g. cell divisions.
3. To identify different cell types, cellular structures using different microscopic techniques.
4. To execute a laboratory experiment using the standard methods and techniques in molecular biology

### **COURSE OUTCOMES (CO)**

<b>S. No</b>	<b>COURSE OUTCOME</b>	<b>BLOOMS LEVEL</b>
CO1	Observe to know basic Concept principle and application of cell and molecular biology	K1
CO2	Understand the cells of various living organisms and get awareness of physiological processes of cell e.g. cell divisions.	K2
CO3	Identify different cell types, cellular structures using different microscopic techniques.	K3
CO4	Analyse and execute a laboratory experiment using the standard methods and techniques in molecular biology	K4
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse</b>		

## SYLLABUS

Code	Subject Name	Semester
19BTU05	PRACTICAL I -CELL AND MOLECULAR BIOLOGY	I
Experiment No.	Topics	Hours
1. 2. 3. 4. 5. 6. 7. 8. 9.	Microscopy – Working principle of Bright Field Microscope Identification of Cell Types – Plant, Animal and Microbes. Fractionation of Cellular components – Nucleus, Mitochondria, Chloroplast. Mitotic Preparation - Onion Root Tip. Identification of Barr Bodies. Mounting of Polytene Chromosome from Chironomus Larvae. Identification of Mutants - Physical and Chemical Methods Auxotrophic selection of mutants by replica plating technique Sucrose Fractionation of Castor Bean Lipid Solubility of Membranes	48

**Distribution of marks for Practical: (IE 40; EE 60)**

**Teaching methods:** Demonstration, Lecturing, PowerPoint Projection through LCD, Discussion and Activity.

### 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:** EASYBIOLOGYCALSS, KHAN ACADEMY

### WEBLINK:

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





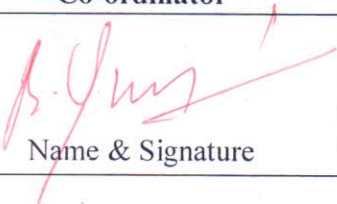
## MAPPING WITH PROGRAM OUTCOMES

CO \ PO	PO1	PO2	PO3	PO4
CO1	S	M	L	L
CO2	M	S	M	M
CO3	S	M	S	M
CO4	M	S	M	S

S - Strong; M-Medium; L-Low.

### ASSESSMENT PATTERN (if deviation from common pattern)

Follows common pattern of Internal and External assessment, suggested in the Regulations.

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

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.

BOS meeting approved

Approved in 6<sup>th</sup> Academic Council meeting on: 04.08.2020

<b>Programme Code:</b>	<b>DSC</b>	<b>Programme Title: Master of Science in Biotechnology</b>					
<b>Course Code:</b>	<b>20BTP06</b>	<b>Course Title</b>				<b>Batch:</b>	<b>2020-2021 onwards</b>
		<b>PRACTICAL II - APPLIED MICROBIOLOGY</b>				<b>Semester:</b>	<b>I</b>
<b>Hrs/Week:</b>	<b>4</b>	<b>L</b>	<b>-</b>	<b>T</b>	<b>1</b>	<b>P</b>	<b>3</b>
						<b>Credits:</b>	<b>2</b>

#### **COURSE OBJECTIVE**

1. To understand the microscopic techniques and methods for laboratory management and handling
2. To standardise the protocol for the isolation of microbes from various sources and staining methods
3. To conduct biochemical tests to identify various pathogenic organisms for environmental pollution monitoring
4. To explore various diagnoses test for human pathogen upon culturing and assessing from human sample

#### **COURSE OUTCOMES (CO)**

<b>S. No</b>	<b>COURSE OUTCOME</b>	<b>BLOOMS LEVEL</b>
CO1	Understand the microscopic techniques and methods for laboratory management and handling	K1
CO2	Standardise the protocol for the isolation of microbes from various sources and staining methods	K2
CO3	Apply and conduct biochemical tests to identify various pathogenic organisms for environmental pollution monitoring	K3
CO4	Analyse various diagnoses test for human pathogen upon culturing and assessing from human sample	K4
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse</b>		

## SYLLABUS

Code	Subject Name	Semester
20BTP06	<b>PRACTICAL II - APPLIED MICROBIOLOGY</b>	<b>I</b>
Experiment No.	Topics	Hours
1.	<b>Basic Laboratory Techniques for Isolation, Cultivation, and Cultural Characterization of Microorganisms</b> Effectiveness of Hand Washing, Culture Transfer Techniques, Techniques for Isolation of Pure Cultures, Cultural Characteristics of Microorganisms	<b>48</b>
2.	<b>Microscopy</b> Microscopic Examination of Stained Cell Preparations, living Microorganisms Using a Hanging-Drop Preparation or a Wet Mount, The Microscopic Measurement of Microorganisms	
3.	<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	
4.	Isolation of Microbes from Soil, Water and Contaminated Food.	
5.	Pure culture Techniques- Streak plate, pour plate, Spread plate, decimal dilution.	
6.	IMVIC Test, Hydrogen sulphide test, Oxidase test, Catalase Test. Urease test, TSI test, Carbohydrate fermentation.	
7.	Bacterial Growth curve, effect of pH and Temperature on Bacterial Growth by Turbidity method	
8.	MPN test (presumptive, confirmed and completed tests)	
9.	Antibiotic sensitivity test.	
10	<b>Medical Microbiology</b> Microbial Flora of the Mouth: Determination of Susceptibility to Dental Caries	
11.	Normal Microbial Flora of the Throat and Skin	
12.	Microbiological Analysis of Urine Specimens	
13.	Microbiological Analysis of Blood Specimens	

**Distribution of marks for Practical: (IE 40; EE 60)**

**Teaching methods:** Demonstration, Lecturing, PowerPoint Projection through LCD, Discussion and Activity.

**REFERENCE BOOKS**

1. Cappucino James., Sherman. N. 2014. *Microbiology; A laboratory Manual (3<sup>rd</sup> Edition)*. Pearson Education, Inc, 2005



2. Subbarao N. S. 2006. Soil Microbiology. (4th Edition of Soil microbiology and Plant growth). Oxford & IBH, New Delhi, 2018

**WEB RESOURCES: MICRORAO**

**WEB LINK:**

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

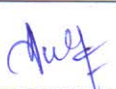
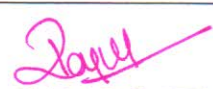
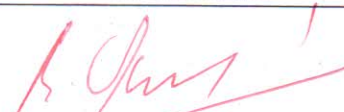
**MAPPING WITH PROGRAM OUTCOMES**

CO \ PO	PO1	PO2	PO3	PO4
CO1	S	S	M	S
CO2	S	M	S	L
CO3	S	S	M	M
CO4	S	S	S	S

S - Strong; M-Medium; L-Low.

**ASSESSMENT PATTERN (if deviation from common pattern)**

Follows common pattern of Internal and External assessment, suggested in the Regulations.

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

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.

BOS meeting approved

Approved in 6<sup>th</sup> Academic Council meeting on: 04.08.2020

<b>Programme Code:</b>	<b>DSC</b>	<b>Programme Title: Master of Science in Biotechnology</b>							
<b>Course Code:</b>	<b>20BTP07</b>	<b>Course Title</b>					<b>Batch:</b>	<b>2020-2021 onwards</b>	
		<b>PRACTICAL III - BIOCHEMISTRY</b>					<b>Semester:</b>	<b>I</b>	
<b>Hrs/Week:</b>	<b>4</b>	<b>L</b>	<b>-</b>	<b>T</b>	<b>1</b>	<b>P</b>	<b>3</b>	<b>Credits:</b>	<b>2</b>

### **COURSE OBJECTIVE**

1. To know the importance of biomolecules in living organisms
2. To understand a protocol for the isolation of microbes and staining methods
3. To know the analytical quality solutions, buffers and dilution series its calibration and principles of calibration.
4. To optimize media for maximum production of microbial metabolites.

### **COURSE OUTCOMES (CO)**

<b>S. No</b>	<b>COURSE OUTCOME</b>	<b>BLOOMS LEVEL</b>
CO1	Know the importance of Biomolecules in Living organisms	K1
CO2	Understand a protocol for the isolation of microbes and staining methods	K2
CO3	Apply the analytical quality solutions, buffers and dilution series and know it calibration, understand principles of calibration.	K3
CO4	Analyse and select and optimize media for maximum production of microbial metabolites.	K4
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse</b>		

## SYLLABUS

Code	Subject Name	Semester
20BTP07	PRACTICAL III -BIOCHEMISTRY	I
Experiment No.	Topics	Hours
1	Estimation of Carbohydrates by Anthrone method.	48
2	Estimation of Acid Value, Saponification value, Iodine number of fats.	
3	Estimation of Amino Acids by Ninhydrin Method	
4	Protein Estimation by Lowry's Method and Bradford method.	
5	Separation of LDH Isozymes from Serum by SDS-PAGE.	
6	Extraction and purification of peroxidase from soy bean seeds	
7	Assay of amylase activity and determination of enzyme kinetic parameters - Km, Vmax and Kcat	
8	Paper Chromatography - Separation of Plant Pigments.	
9	Thin Layer Chromatography - Separation of Amino Acids.	
10	Ion Exchange Chromatography.	
11	Gel permeation Chromatography.	
12	Estimation of Ascorbic Acid.	
13	Estimation of Calcium and Iron	

**Distribution of marks for Practical:(IE 40; EE 60)**

**Teaching methods:** Demonstration, Lecturing, PowerPoint Projection through LCD, Assignment, Discussion and Activity

### REFERENCE BOOKS:

1. *Laboratory Manual of Biochemistry* by J. Jayaraman, Published by Willy Eastern. 1981. Edition: 2.
2. *Protein Methods* by Daniel M. Bollag et al. Published by Wiley-Liss, Inc. 1996. Edition: 2.
3. *Biochemical Methods* by S. Sadasivam and A. Manickam, Published by Reprint New age international (P) Ltd. 1996. Edition: 2.

### WEB RESOURCES: NPTEL

BOS meeting approved

Approved in 6<sup>th</sup> Academic Council meeting on: 04.08.2020



**WEBLINK:**

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



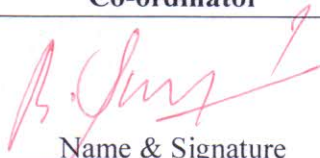
**MAPPING WITH PROGRAM OUTCOMES**

CO \ PO	PO1	PO2	PO3	PO4
CO1	S	S	S	S
CO2	S	M	S	S
CO3	S	S	S	M
CO4	M	S	S	S

S - Strong; M-Medium; L-Low.

**ASSESSMENT PATTERN (if deviation from common pattern)**

Follows common pattern of Internal and External assessment, suggested in the Regulations.

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.

BOS meeting approved

Approved in 6<sup>th</sup> Academic Council meeting on: 04.08.2020

<b>Programme Code:</b>	<b>DSC</b>	<b>Programme Title: Master of Science in Biotechnology</b>							
<b>Course Code:</b>	<b>20BTP08</b>	<b>Course Title</b>						<b>Batch:</b>	<b>2020-2021 onwards</b>
		<b>GENETIC ENGINEERING</b>						<b>Semester:</b>	<b>II</b>
<b>Hrs/Week:</b>	<b>5</b>	<b>L</b>	<b>5</b>	<b>T</b>	<b>-</b>	<b>P</b>	<b>-</b>	<b>Credits:</b>	<b>5</b>

#### **COURSE OBJECTIVE**

1. To know the structure of gene, genome organization and expression in prokaryotes and eukaryotes.
2. To understand the types and functions of enzymes in genetic engineering
3. To explain the key aspect of plant and animal vectors as a tool in genetic engineering
4. To explore advanced molecular techniques in biotechnological experiments

#### **COURSE OUTCOMES (CO)**

<b>S. No</b>	<b>COURSE OUTCOME</b>	<b>BLOOMS LEVEL</b>
CO1	Remember the structure of gene and genome organization and expression in prokaryotes and eukaryotes.	K1
CO2	Understand the types and functions of enzymes in genetic engineering	K2
CO3	Apply the knowledge of plant and animal vectors as a tool in genetic engineering.	K3
CO4	Analyse and explore about advanced molecular techniques in biotechnology.	K4
K1- Remember; K2- Understand; K3-Apply; K4-Analyse		

## SYLLABUS

Code	Subject Name	Semester
20BTP08	<b>GENETIC ENGINEERING</b>	<b>II</b>
Unit No.	Topics	Hours
<b>I</b>	<b>Gene and Genome</b> Genome Organization - C - Value Paradox; Human Genome Project and Genome Sequencing Methods - Maxam and Gilbert, Sanger's method, Pyrosequencing, Automated DNA sequencing, N	12
<b>II</b>	<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, E.coli 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
<b>III</b>	<b>Vectors</b> Steps in Gene Cloning – Host Cell Types – Prokaryotic Hosts, Eukaryotic Hosts – Vectors - Plasmid Vectors – pBR322 – pUC vectors – Bacteriophage Vectors – Lambda and M13 vectors; Hybrid Vectors – Cosmids – Phagemids. Eukaryotic Vectors – Yeast Vectors – YAC and BAC. Plant Vectors – CaMV– TMV –Animal Vectors – SV40 – Retrovirus – Adenovirus.	12
<b>IV</b>	<b>Advanced Molecular Techniques</b> Genomic Library Construction – cDNA Library Construction – Chromosome Walking and Jumping. Screening of Recombinants –. Blotting Techniques - PCR – Real time PCR - Genome editing – ZFN, TALENs, CRISPR Tool Site Directed Mutagenesis and Protein Engineering – in situ hybridization and site directed mutagenesis.	12
<b>V</b>	<b>Gene therapy</b> Gene Therapy – Germline, Somatic Cell Line – <i>In vivo</i> – <i>Ex vivo</i> – Anti-Sense Gene Therapy and Embryo Gene Therapy –RNA interference (RNAi). Gene knockout Genetic Counseling.	12
<b>Total</b>		60

*Distribution of marks for Theory: (IE 30; EE 70)*

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

**TEXT BOOK:**

1. Primrose, S.B. and Twyman, R., 2013, *Principles of gene manipulation and genomics*. 7<sup>th</sup> Edition., Blackwell publishing Ltd. UK

**REFERENCE BOOKS:**

1. Micklos D. A. and Freyer G. A., 2003, "DNA Science: A First Course in Recombinant Technology", Revised Edition, Cold Spring Harbor Laboratory Press, New York.

BOS meeting approved

Approved in 6<sup>th</sup> Academic Council meeting on: 04.08.2020



2. Mark Walker and Ralph Rapley, 2018, "Route Maps in Gene Technology", Revised Edition, Wiley Blackwell.
3. Nicholl D.S.T., 2008. An Introduction to Genetic Engineering, 3rd Edition. Cambridge University Press.
4. Brown T.A., 2016, Gene Cloning and DNA Analysis – An Introduction, 7<sup>th</sup> Edition, Wiley-Blackwell.
5. Watson J.D. Gann A., Baker T.A., Levine M., Bell S.P. and Losick R., 2014, Molecular Biology of Gene, 7th Edition, Pearson Publishers.

**WEB RESOURCES:** NPTEL, CLASSCENTRAL, EDX, STANFORD, MOOC, COURSERA

**WEBLINK:**

1. <https://nptel.ac.in/courses/102/103/102103013/>
2. [https://onlinecourses.nptel.ac.in/noc19\\_bt15/preview](https://onlinecourses.nptel.ac.in/noc19_bt15/preview)
3. <https://www.classcentral.com/course/swayam-genetic-engineering-theory-and-application-14090>
4. <https://www.edx.org/course/dna-biologys-genetic-code>
5. <https://online.stanford.edu/courses/xgen203-genetic-engineering-and-biotechnology>
6. <https://www.mooc-list.com/course/genes-and-human-condition-behavior-biotechnology-coursera>
7. <https://www.coursera.org/lecture/dna-decoded/genetic-engineering-KIROE>



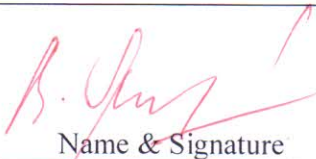
**MAPPING WITH PROGRAM OUTCOMES**

PO \ CO	PO1	PO2	PO3	PO4
CO1	S	M	S	L
CO2	S	S	M	L
CO3	S	S	S	M
CO4	M	S	M	S

S - Strong; M-Medium; L-Low.

**ASSESSMENT PATTERN (if deviation from common pattern)**

Follows common pattern of Internal and External assessment, suggested in the Regulations.

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

BOS meeting approved

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

Approved in 6<sup>th</sup> Academic Council meeting on 04.08.2020  
**Co-ordinator**  
**Curriculum Development Cell**  
**Hindusthan College of Arts & Science,**  
**Coimbatore-641 028.**

<b>Programme Code:</b>	<b>DSC</b>	<b>Programme Title: Master of Science in Biotechnology</b>							
<b>Course Code:</b>	<b>20BTP09</b>	<b>Course Title</b>					<b>Batch:</b>	<b>2020-2021 onwards</b>	
		<b>RESEARCH METHODOLOGY AND BIOSTATISTICS</b>					<b>Semester:</b>	<b>II</b>	
<b>Hrs/Week:</b>	<b>5</b>	<b>L</b>	<b>5</b>	<b>T</b>	<b>-</b>	<b>P</b>	<b>-</b>	<b>Credits:</b>	<b>5</b>

#### **COURSE OBJECTIVE**

1. To learn the basis of collection of data's, data characteristics and thesis writing
2. To understand the exact method of data analysis for the problem under investigation - about publication of manuscript- databases, journal information and impact factor
3. To know how to use and interpret results of descriptive statistical methods
4. To explore the principal methods of statistical interference and design for effective use in analysing biotechnological results

#### **COURSE OUTCOMES (CO)**

<b>S. No</b>	<b>COURSE OUTCOME</b>	<b>BLOOMS LEVEL</b>
CO1	Know the research, collection of data's, data characteristics, and thesis writing	K1
CO2	Understand the exact method of data analysis for the problem under investigation - about publication of manuscript- databases, journal information and impact factor	K2
CO3	Apply know-how to use and interpret results of descriptive statistical methods	K3
CO4	Analyse the principal methods of statistical interference and design for effective use in analysing biotechnological results	K4
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse</b>		



**SYLLABUS**

Code	Subject Name	Semester
20BTP09	<b>RESEARCH METHODOLOGY AND BIOSTATISTICS</b>	<b>II</b>
Unit No.	Topics	Hours
<b>I</b>	<b>Introduction to research methodology</b> What is Research? Basic and Applied Research - Essential steps in Research - 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. Significance of Research, Teaching Learning, Evaluation and Monitoring Process.	12
<b>II</b>	<b>Databases and Information Retrieval</b> Journals - Standard of Research Journals – Plagiarism – Copyrights - Impact Factor - Citation Index – Bibliometrics – Google Scholar Citation. Access to Archives and Databases – Science Direct – Sciverse– Pubmed - National Informatics Center Network Services – Online Data Base Library.	12
<b>III</b>	<b>Biostatistics</b> Definitions - Scope of Biostatistics – Classification and Tabulation of Data – Graphical and Diagrammatic Representation – Scale Diagrams – Histograms – Frequency Polygon - Frequency Curves. <b>Measures of Central Tendency</b> – Arithmetic Mean – Median and Mode. Calculation of Mean – Median – Mode in Series of Individual Observation Discrete Series – Continuous Open-End Classes.	12
<b>IV</b>	<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: Completely Randomized Design – Factorial Design – Plackett Burman Designs – Response Surface Methodology: Central Composite Designs (adapted from Montgomery) and Box-Behnken design – Taguchi statistical method.	12
<b>V</b>	<b>Proportion Data and Analysis</b> Examples of Proportion data - MPM-sterility testing of medicines - animal toxicity infection and immunization studies (e.g., LD <sub>50</sub> , ED <sub>50</sub> , PD <sub>50</sub> ) –statistical treatment to proportion data. 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.	12
<b>Total</b>		60

**Distribution of marks for Theory: (IE 30; EE 70)**

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

**TEXT BOOKS:**

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.

BOS meeting approved

Approved in 6<sup>th</sup> Academic Council meeting on: 04.08.2020



2. Kothari C. R., 2019, "Research Methodology Methods & Techniques", Second Edition, New Age International publishers, New Delhi.
3. Duncary P, 2003, "Authoring a PhD, Thesis: How to Plan, Draft, Write and Finish a Doctoral Dissertation", 3<sup>rd</sup> Edition, Palgrave Macmillan, Australia.
4. G. Nageswara Rao, 2018, "Biostatistics and Research Methodology" 1<sup>st</sup> Edition, B.S. Publication.

**REFERENCE BOOKS:**

1. Robert A. Day and Barbara Gastel, 2006, How to Write and Publish a Scientific Paper? 8<sup>th</sup> Edition, Cambridge, Cambridge University.
2. Ranjit Kumar, 2004, Research Methodology: A step by step guide for beginners, 3<sup>rd</sup> Edition, University of Western Australia, SAGE Publications Ltd.
3. P. S. S. Sundar Rao & J. Richard, 2012, Introduction to Bio-statistics and Research methods, 5<sup>th</sup> Edition, PHI Learning Publisher.
4. J. H. Abramson and Z. H. Abramson, 2002, Research Methods in Community Medicine: Surveys, Epidemiological Research, Programme Evaluation, Clinical Trials, 6<sup>th</sup> Edition, Wiley Publication.

**WEB RESOURCES:** MICHENER, COURSERA, NPTEL, SWAYAM

**WEBLINK:**

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




**MAPPING WITH PROGRAM OUTCOMES**

CO \ PO	PO1	PO2	PO3	PO4
CO1	S	M	S	M
CO2	S	S	S	S
CO3	S	S	M	S
CO4	S	S	S	S

**S - Strong; M-Medium; L-Low.**

**ASSESSMENT PATTERN (if deviation from common pattern)**

Follows common pattern of Internal and External assessment, suggested in the Regulations.

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

BOS meeting approved

Approved in 6<sup>th</sup> Academic Council meeting on: 04.08.2020

**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.

<b>Programme Code:</b>	<b>DSC</b>	<b>Programme Title: Master of Science in Biotechnology</b>							
<b>Course Code:</b>	<b>20BTP10</b>	<b>Course Title</b>					<b>Batch:</b>	<b>2020-2021 onwards</b>	
		<b>BIOPROCESS TECHNOLOGY</b>					<b>Semester:</b>	<b>II</b>	
<b>Hrs/Week:</b>	<b>5</b>	<b>L</b>	<b>5</b>	<b>T</b>	<b>-</b>	<b>P</b>	<b>-</b>	<b>Credits:</b>	<b>5</b>

### COURSE OBJECTIVE

1. To understand the fermentation and usage of microorganisms in the production of fermented products
2. To explore various media and its compositions for fermentation with various microbes and its sterilization process
3. To learn the features, instrumentation and control of various bioreactors, modes of fermentation operations and kinetics
4. To utilize the downstream processing in the product recovery

### COURSE OUTCOMES (CO)

<b>S.No</b>	<b>COURSE OUTCOME</b>	<b>BLOOMS LEVEL</b>
CO1	Remember the fermentation and usage of microorganisms in the production of fermented products.	K1
CO2	Understand and explore various media and its compositions for fermentation with various microbes and sterilization process	K2
CO3	Apply and evaluate and design the features and the instrumentation and control of bioreactors and types and modes of fermentation operations and kinetics	K3
CO4	Analyse and elucidate the downstream processing in the product recovery	K4
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse</b>		



## SYLLABUS

Code	Subject Name	Semester
20BTP10	<b>BIOPROCESS TECHNOLOGY</b>	<b>II</b>
Unit No.	Topics	Hours
<b>I</b>	<b>Introduction to Bioprocess Engineering</b> <b>Interaction between biochemical engineering;</b> Microbiology and Biochemistry; Introduction to fermentation processes; Microbial culture; Screening and selection for fermentation processes; Preservation and improvement of industrially important microorganisms; Inoculum production for bacterial and fungal processes	12
<b>II</b>	<b>Media for industrial fermentations:</b> Media ingredients, medium formulation, oxygen requirements, antifoams, medium optimization, Ingredients for mammalian cell culture and plant cell culture. Inoculum production for bacterial and fungal processes. Media sterilization, Batch Process (thermal death kinetics), continuous sterilization process; sterilization of fermenter and other ancillaries, filter sterilization of air and media.	12
<b>III</b>	<b>Design and control of bioreactors:</b> Basic objective of fermenter design, aseptic operation & containment, body construction, agitator and sparger design, baffles, stirrer glands and bearings. Process parameters and measurement techniques: measurement of temperature, pressure and pH, DO, foam etc.; flow rate of liquid and gases; Automation (processes computerization). Validation of Fermentor	12
<b>IV</b>	<b>Bioreactor configurations, types and kinetics:</b> Bubble column, airlift reactor, packed bed, and fluidized bed, trickle bed, Membrane reactor, Photobioreactor, Solid state fermenter, Animal and plant cell bioreactors. Scale up and Scale down studies of bioreactors. Heat and Mass transfer in Bioprocess, Relationship in between heat transfer, cell concentrations and stirring conditions, Measurement of KLa, Rheological properties of fermentation broths, Factors affecting broth viscosity, Mixing in Fermenters.	12
<b>V</b>	<b>Downstream Processing</b> Filtration – Removal of Microbial Cells – Cell Disruption: Enzymatic, Chemical and Physical Methods; Purification of Fermentation Products - Precipitation Methods, Membrane Process. Centrifugation – Ultracentrifugation; Chromatography - Ion Exchange and Gel Permeation Chromatography – HPLC. Crystallization – Drying – Lyophilisation.	12
<b>Total</b>		<b>60</b>

**Distribution of marks for Theory:(IE 30; EE 70)**

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

**TEXT BOOK:**

1. Michael L. Shuler and Fikret Kargi, "Bioprocess Engineering Basic concepts", 2<sup>nd</sup> Edn., Prenticeall International services, New Jersey, 2005
2. El-Mansi E.M.T and Bryce C.F.A, "Fermentation Microbiology and Biotechnology", 1<sup>st</sup> Edn., Taylor & Francis, London, 2011



3. Wulf Crueger and Anneliese Crueger, "Biotechnology-A Textbook of Industrial Microbiology", 3<sup>rd</sup> Edn., Panima Publishing Corporation, New Delhi 2009
4. Principles of fermentation technology by P.F. Stanbury and A. Whitaker, Pergamon press. Second edition. 2005.

**REFERENCE BOOKS:**

1. Fermentation microbiology and Biotechnology. Second edition, edited by El-. Mansi, C.F.A. Bryce, A.L. Demain, A.R. Allman. Taylor and Francis, 2007.
2. Introduction to Biochemical engineering by D.G.Rao, McGraw-Hill publications, 1 edition, 2007.
3. Industrial Microbiology by Prescott and Dunns 4th edition edited by Gerald Reed, Chapman & Hall publications 2007.

**WEB RESOURCES: CLASSCENTRAL, COURSERA, ITSLIGO, TUDELFT, NPTEL. WEBLINK:**

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/>




**MAPPING WITH PROGRAM OUTCOMES**

PO \ CO	PO1	PO2	PO3	PO4
CO1	S	S	M	L
CO2	S	M	L	S
CO3	S	S	S	M
CO4	S	S	M	L

**S - Strong; M-Medium; L-Low.**

**ASSESSMENT PATTERN (if deviation from common pattern)**

Follows common pattern of Internal and External assessment, suggested in the Regulations.

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

BOS meeting approved

Approved in 6<sup>th</sup> Academic Council meeting on: 04.08.2020  
**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.**

<b>Programme Code:</b>	<b>DSE</b>	<b>Programme Title: Master of Science in Biotechnology</b>							
<b>Course Code:</b>	<b>20BTP11 A</b>	<b>Course Title</b>						<b>Batch:</b>	<b>2020-2021 onwards</b>
		<b>Elective II: BIOETHICS, BIOSAFETY AND IPR</b>						<b>Semester:</b>	<b>II</b>
<b>Hrs/Week:</b>	<b>5</b>	<b>L</b>	<b>5</b>	<b>T</b>	<b>-</b>	<b>P</b>	<b>-</b>	<b>Credits:</b>	<b>3</b>

### COURSE OBJECTIVE

1. To know the rationale for and against IPR and especially patents
2. To understand to why India has adopted an IPR Policy and be familiar with broad outline of patent regulations
3. To create a different types of intellectual property rights in general and protection of products derived from biotechnology research and issues related to application and obtaining patents
4. To learn risk assessment of products derived from recombinant DNA research and environmental release of genetically modified organisms, national and international regulations

### COURSE OUTCOMES (CO)

<b>S.No</b>	<b>COURSE OUTCOME</b>	<b>BLOOMS LEVEL</b>
CO1	Remember the rationale for and against IPR and especially patents	K1
CO2	Understand to why India has adopted an IPR Policy and be familiar with broad outline of patent regulations	K2
CO3	Apply and create a different types of intellectual property rights in general and protection of products derived from biotechnology research and issues related to application and obtaining patents	K3
CO4	Analyse the biosafety and risk assessment of products derived from recombinant DNA research and environmental release of genetically modified organisms, national and international regulations	K4
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse</b>		



## SYLLABUS

Code	Subject Name	Semester
20BTP11 A	<b>BIOETHICS, BIOSAFETY AND IPR</b>	<b>II</b>
Unit No.	Topics	Hours
<b>I</b>	<b>Introduction to Bioethics in Biotechnology</b> Biotechnology and Ethics –Benefits and Risks of Genetic Engineering – Ethical Aspects of Genetic Testing and Genetic counselling - Ethical Implications of Cloning: Reproductive Cloning, Therapeutic Cloning; Ethical, Legal and socioeconomic aspects of Gene Therapy (ELSI), Germ Line, Somatic, Embryonic and Adult Stem Cell Research.	12
<b>II</b>	<b>Biosafety Regulations</b> Guidelines and Regulations (National and International) - Cartagena Protocol on Biosafety –The Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA). GMO's and LMO's, RCGM, GEAC etc for GMO application in food and agriculture; Environmental release of GMO's	12
<b>III</b>	<b>Biosafety and Institutional Biosafety Committees</b> Introduction to Biosafety its Issues in Biotechnology – Risk Assessment and Risk Management – Safety Protocols: Risk Groups – Biosafety Levels –Biosafety Containment.	12
<b>IV</b>	<b>Intellectual Property Rights</b> IPR and its Different types Patents, Trade Mark, Trade Secret, Copy Rights, Designs Geographic Indications, Plant breeders' rights - IP relevance to biotechnology Protection of New GMO's.	12
<b>V</b>	<b>Patent</b> What can and what cannot be patented? -- Patent Application -- International Patenting and Patent co-operation treaty – Revocation of Patent – Patenting of biological material Patenting in India - FlavrSavr™ Tomato as a Model Case - Biopiracy and Case Studies on Patents (Basmati Rice, Turmeric, and Neem).	12
<b>Total</b>		<b>60</b>

**Distribution of marks for Theory: (IE 30; EE 70)**

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

**TEXT BOOK:**

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

**REFERENCE BOOKS:**

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.

BOS meeting approved

Approved in 6<sup>th</sup> Academic Council meeting on: 04.08.2020



**WEB RESOURCES: NPTEL, SWAYAM, MARISSTELLAELEARNING  
WEBLINK:**

1. [https://onlinecourses.nptel.ac.in/noc20\\_hs18/preview](https://onlinecourses.nptel.ac.in/noc20_hs18/preview)
2. [https://onlinecourses.swayam2.ac.in/cec20\\_ge04/preview](https://onlinecourses.swayam2.ac.in/cec20_ge04/preview)
3. <https://nptel.ac.in/courses/109/106/109106092/>
4. <https://marisstellalearning.gnomio.com/enrol/index.php?id=46>



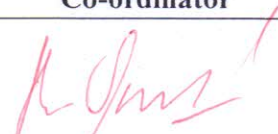
**MAPPING WITH PROGRAM OUTCOMES**

CO \ PO	PO1	PO2	PO3	PO4
CO1	S	S	M	M
CO2	S	S	M	M
CO3	S	S	S	S
CO4	S	S	M	M

**S - Strong; M-Medium; L-Low.**

**ASSESSMENT PATTERN (if deviation from common pattern)**

Follows common pattern of Internal and External assessment, suggested in the Regulations.

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

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.

BOS meeting approved

Approved in 6<sup>th</sup> Academic Council meeting on: 04.08.2020

<b>Programme Code:</b>	<b>DSE</b>	<b>Programme Title: Master of Science in Biotechnology</b>							
<b>Course Code:</b>	<b>20BTP11 B</b>	<b>Course Title</b>					<b>Batch:</b>	<b>2020-2021 onwards</b>	
		<b>Elective II: GENOMICS AND PROTEOMICS</b>					<b>Semester:</b>	<b>II</b>	
<b>Hrs/Week:</b>	<b>5</b>	<b>L</b>	<b>5</b>	<b>T</b>	<b>-</b>	<b>P</b>	<b>-</b>	<b>Credits:</b>	<b>3</b>

### **COURSE OBJECTIVE**

1. To explain the importance of bioinformatics in systems biology
2. To understand and discuss the use of genes and genomes data in systems biology
3. To learn and integrate the omics data for networking
4. To identify the appropriate tools in systems biology for modelling

### **COURSE OUTCOMES (CO)**

<b>S.No</b>	<b>COURSE OUTCOME</b>	<b>BLOOMS LEVEL</b>
CO1	Remember and explain the importance of bioinformatics in systems biology	K1
CO2	Understand and discuss the use of genes and genomes data in systems biology	K2
CO3	Apply and integrate the omics data for networking	K3
CO4	Analyse the appropriate tools in systems biology for modelling	K4
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse</b>		

## SYLLBUS

Code	Subject Name	Semester
20BTP11 B	<b>GENOMICS AND PROTEOMICS</b>	<b>II</b>
Unit No.	Topics	Hours
<b>I</b>	Genome Mapping – Mapping Genomes, Genetic and Physical Maps, Sequencing Genomes, Methodology for DNA Sequencing, Assembly of a Contiguous DNA Sequence, Genome Analysis DNA Sequencing databases, Sequence analysis programs, Pairwise sequence alignment, Multiple sequence alignment, DNA sequencing, Genomic sequencing, Sequencing cDNA Libraries of expressed genes	12
<b>II</b>	<b>Gene Prediction and Genome Rearrangement</b> Introduction, gene prediction methods and tools, Applications to Complex Genomes <b>Comparative Genomics</b> – Completed genomes, Sequence assembly and gene identification, functional classification of genes.	12
<b>III</b>	<b>Protein classification</b> Principles of classification: Based on structural features, Phylogenetic relationship. <b>Protein structure prediction</b> Use of sequence pattern, leucine zipper, coiled coil, transmembrane, signal peptide, cleavage site. Secondary structure prediction: Chou – Fasman / GOR method, Neural network, nearest neighbor method, tertiary structure prediction, threading profile, contact potential, modeling.	12
<b>IV</b>	<b>Bioanalysis of protein and peptides</b> Complex protein and peptide mixtures, Extracting proteins from biological samples, Protein separation before digestion: 1D and 2 D Electrophoresis, Immobilized pH gradient, Sample preparation, First dimension criteria, second dimension criteria, Stabilization, Detecting protein on gel: Electro blot, Image analysis, Digital imaging, Spot detection and quantification, Gel matching. Data Analysis – Database for 2D gel	12
<b>V</b>	<b>Tool of Proteomics</b> Mass Spectrometry for protein and peptide analysis: MALDI-TOF Analyzers, ESI Tandem MS instrument, Tandem Mass Analyzers, The Triple Quadrupole Mass Analyzer, The Ion Trap Mass Analyzer, Q-TOF & Fourier Transform-Ion Cyclotron Resonance, MS Instrument.	12
<b>Total</b>		<b>60</b>

**Distribution of marks for Theory: (IE 30; EE 70)**

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

**TEXT BOOK:**

1. S.B. Primrose and R.M. Twyman, 2006. *Principles of Gene Manipulation and Genomics*, 6<sup>th</sup> Edn., Blackwell Publishing
2. Devarajan Thangadurai and Jeyabalan Sangeetha, 2015. *Genomics and Proteomics Principles, Technologies, and Applications*, 1<sup>st</sup> Edn., Apple Academic Press

**REFERENCE:**

1. Pevsner, J. A., 2009. *Bioinformatics and Functional Genomics* by John Wiley & Sons, Inc.



2. Ideker et al. *A new approach to decoding life: Systems Biology. Annual Review on Genomics and Human Genetics* 2001, 2: 343-372, 2017
3. Ideker et al. *Integrated Genomic and Proteomic Analyses of a Systematically Perturbed Metabolic Network. Science*, 2001, 292: 929-934, 2015

**WEB RESOURCES:** CLASSCENTRAL, COURSERA, NPTEL, EDX

**WEBLINK:**

1. <https://www.classcentral.com/course/swayam-applications-of-interactomics-using-genomics-and-proteomics-technologies-12897>
2. <https://www.coursera.org/learn/comparing-genomes>
3. [https://onlinecourses.nptel.ac.in/noc20\\_bt19/preview](https://onlinecourses.nptel.ac.in/noc20_bt19/preview)
4. <https://courses.lumenlearning.com/boundless-biology/chapter/genomics-and-proteomics/>
5. <https://www.edx.org/learn/bioinformatics>
6. <https://nptel.ac.in/courses/102/103/102103017/>

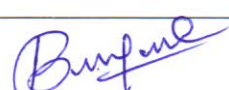

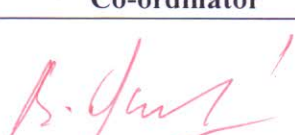
**MAPPING WITH PROGRAM OUTCOMES**

**ASSESSMENT PATTERN (if deviation from common pattern)**

Follows common pattern of Internal and External assessment, suggested in the Regulations.

CO \ PO	PO1	PO2	PO3	PO4
CO1	S	S	M	M
CO2	S	S	M	L
CO3	S	S	S	S
CO4	S	S	S	S

S - Strong; M-Medium; L-Low.

Course Designed by	Verified by HOD	Approved by CDC Co-ordinator
 <b>Mrs. G. BRINDHA</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.

BOS meeting approved

Approved in 6<sup>th</sup> Academic Council meeting on: 04.08.2020

<b>Programme Code:</b>	<b>DSE</b>	<b>Programme Title: Master of Science in Biotechnology</b>							
<b>Course Code:</b>	<b>20BTP11C</b>	<b>Course Title</b>						<b>Batch:</b>	<b>2020-2021 onwards</b>
		<b>Elective II: MOLECULAR DIAGNOSTICS AND CLINICAL TESTING</b>						<b>Semester:</b>	<b>II</b>
<b>Hrs/Week:</b>	<b>5</b>	<b>L</b>	<b>5</b>	<b>T</b>	<b>-</b>	<b>P</b>	<b>-</b>	<b>Credits:</b>	<b>3</b>

### **COURSE OBJECTIVE**

1. To be familiar with the basis of molecular diagnostics with reference to clinical diagnostics
2. To understand the DNA based molecular diagnostics with reference to sequencing using PCR
3. To elucidate different types of proteomic analysis and characterization
4. To gain the knowledge on types of molecular diseases and its diagnostics

### **COURSE OUTCOMES (CO)**

<b>S. No</b>	<b>COURSE OUTCOME</b>	<b>BLOOMS LEVEL</b>
CO1	Know the rationale molecular diagnostics with reference to clinical diagnostics	K1
CO2	Understand the DNA based molecular diagnostics with reference to sequencing using PCR	K2
CO3	Apply and elucidate different types of Proteomic analysis and characterization	K3
CO4	Analyse and gain applied knowledge on types of molecular diseases and its diagnostics	K4
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse</b>		



## SYLLABUS

Code	Subject Name	Semester
20BTP11C	MOLECULAR DIAGNOSTICS AND CLINICAL TESTING	II
Unit No.	Topics	Hours
I	<b>Introduction to molecular diagnostics</b> Definition - History – Diseases- infectious, physiological and metabolic errors, and inherited diseases. Biomarkers- types, potential uses and limitations. Diagnostics – types and importance in clinical decision making. Benefits of molecular diagnostics over conventional diagnostics. Ethical issues related to molecular diagnostics.	12
II	<b>DNA based molecular techniques for diagnosis</b> DNA based molecular techniques: DNA sequencing: Next generation sequencing methods in diagnosis- whole genomic sequencing (WGS), whole transcriptomic sequencing (WTS), exome sequencing, SNP chromosomal microarrays, relative-quantitative PCR, methylation analysis, MLPA, mutation screening panels (xTAG, Luminex)	12
III	<b>Proteomic assays for diagnostics</b> Proteomics- introduction to clinical proteomics. Gel based techniques: 1D and 2D PAGE. High throughput multidimensional protein identification technology: Protein microarray, LC-MS, MALDI-TOF, Isotope coated affinity tag (ICAT), SILAC, i-TRAQ, Multiple Reaction Monitoring (MRM), Shotgun proteomics, 2D-DIGE. Immunoassays –Immunohistochemistry.	12
IV	<b>Applications of molecular diagnostics</b> Major Histocompatibility Complex (MHC), HLA typing- RFLP, PCR based methods, SSO, SSP and SBT methods. Role of Molecular diagnostics in bone marrow transplantation and organ transplantation. Bone marrow transplant engraftment analysis.	12
V	<b>Molecular diagnosis of degenerative diseases and infectious disorders</b> Muscular Dystrophy, Cardiovascular diseases: CVD gene mutations- LDL and LDL receptor, Lecithin cholesterol acyl transferase (LCAT), Hepatic triglyceride lipase (HTGL), Cholesterol ester transfer protein (CETP). Circulating tumour cell testing (CTC). Molecular diagnostic of various viral diseases: Dengue, Chickungunya, Ebola and Influenza (H1N1).	12
<b>Total</b>		60

**Distribution of marks for Theory: (IE 30; EE 70)**

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

### TEXT BOOKS:

1. Kanai L. Mukherjee, 2017, "Medical Laboratory Technology", 3<sup>rd</sup> Edn., Tata Mc Graw Hill publications, Chennai.
2. John Bernard and Henry M. D., 2001, "Clinical Diagnosis and Management by Laboratory Methods" Hardcover, 20<sup>th</sup> Edn., Saunders Publication.
3. Connie R. Mahon and Donald C. Lehman, 2018, "Text Books of Diagnostic Microbiology", 6<sup>th</sup> Edn., Elsevier Publication.



**REFERENCE BOOKS:**

1. Talib V. H, 2015, "Handbook of Medical Lab Technology", 2<sup>nd</sup> Edn., CBS publication, New Delhi.
2. Allen Gaw, Robert A.Cowan, 2013, "An Illustrated color text of Clinical Biochemistry", 5<sup>th</sup> Edn., Churchill Living stone press, Scotland.
3. Yi-Wei Tang, Charles W. Stratton 2006, "Advanced Techniques in Diagnostic Microbiology" 1<sup>st</sup> Edn., Springer Publications.

**WEB RESOURCES: CLASSCENTRAL, SWAYAM, NPTEL****WEBLINK:**

1. <https://www.classcentral.com/course/molecular-techniques-6338>
2. [https://onlinecourses.swayam2.ac.in/cec20\\_ma13/preview](https://onlinecourses.swayam2.ac.in/cec20_ma13/preview)  
[https://onlinecourses.swayam2.ac.in/cec20\\_bt10/preview](https://onlinecourses.swayam2.ac.in/cec20_bt10/preview)
3. [https://onlinecourses.swayam2.ac.in/cec20\\_ag01/preview](https://onlinecourses.swayam2.ac.in/cec20_ag01/preview)
4. <https://nptel.ac.in/courses/102/101/102101040/>



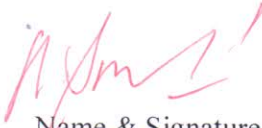
**MAPPING WITH PROGRAM OUTCOMES**

CO \ PO	PO1	PO2	PO3	PO4
CO1	S	S	M	M
CO2	S	S	M	M
CO3	S	S	S	S
CO4	S	S	M	M

S - Strong; M-Medium; L-Low.

**ASSESSMENT PATTERN (if deviation from common pattern)**

Follows common pattern of Internal and External assessment, suggested in the Regulations.

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

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.

BOS meeting approved

Approved in 6<sup>th</sup> Academic Council meeting on: 04.08.2020

<b>Programme Code:</b>	<b>DSC</b>	<b>Programme Title: Master of Science in Biotechnology</b>							
<b>Course Code:</b>	<b>20BTP12</b>	<b>Course Title</b>						<b>Batch:</b>	<b>2020-2021 onwards</b>
		<b>PRACTICAL IV- GENETIC ENGINEERING</b>						<b>Semester:</b>	<b>II</b>
<b>Hrs/Week:</b>	<b>4</b>	<b>L</b>	<b>-</b>	<b>T</b>	<b>1</b>	<b>P</b>	<b>3</b>	<b>Credits:</b>	<b>2</b>

#### **COURSE OBJECTIVE**

1. To understand the basic of rDNA technology, concept and principle and application of genetic engineering
2. To learn the detailed mechanism of gel electrophoresis and explore different aspects of analysis
3. To explain principles, material and methodology of techniques involved in rDNA technology, blotting techniques, sequencing methods, PCR. DNA fingerprinting and reporter gene assays
4. To execute a laboratory experiment using the standard methods and techniques in molecular biology, with the appropriate analysis and interpretation of results obtained

#### **COURSE OUTCOMES (CO)**

<b>S. No</b>	<b>COURSE OUTCOME</b>	<b>BLOOMS LEVEL</b>
CO1	Remember the basic of rDNA technology, Concept and principle and application of genetic engineering.	K1
CO2	Understand and observe Gel electrophoresis and detailed mechanism and explore different aspects of learning	K2
CO3	Apply and explain principles, material and methodology of techniques involved in rDNA technology, blotting techniques, sequencing methods, PCR. DNA fingerprinting and Reporter gene assays	K3
CO4	Analyse independently execute a laboratory experiment using the standard methods and techniques in molecular biology, with the appropriate analysis and interpretation of results obtained.	K4
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse;</b>		

## SYLLABUS

Code	Subject Name	Semester
20BTP12	PRACTICAL IV - GENETIC ENGINEERING	II
Unit No.	Topics	Hours
1.	Isolation of Genomic DNA from Plant Tissue	48
2.	Isolation of Genomic DNA from Bacteria	
3.	Isolation of Genomic DNA from Animal Tissue	
4.	Isolation of Genomic DNA from Human blood	
5.	Isolation of Plasmid DNA from Bacteria	
6.	Restriction Digestion	
7.	Ligation	
8.	Transformation in <i>E. coli</i>	
9.	Polymerase Chain Reaction	
10.	Southern Hybridization using Non-Radioactive Detection	
11.	Western Blotting	
12.	Reporter gene assay - GUS gene	

**Distribution of marks for Practical: (IE 40; EE 60)**

**Teaching methods:** Demonstration, Lecturing, PowerPoint Projection through LCD, Assignment, Discussion and Activity.

### REFERENCE BOOKS:

1. John Vennison, 2009, "Laboratory manual for Genetic Engineering", 1<sup>st</sup> Edition, PHI Learning.
2. Aksan Kurnaz, 2015 "Techniques in Genetic Engineering" 1<sup>st</sup> Edition, CRC Press.
3. Dubey, R. C. & Maheswari, D. K., 2012, Practical Microbiology, 5<sup>th</sup> Edition, S. Chand & Co, New Delhi.
4. Chitanya K.V., 2016, "Cell and Molecular Biology – Lab manual, Revised Edition, PHI Learning Pvt. Ltd. 2016
5. Green and Sambrook, 2018, Molecular Cloning-Lab Manual, 4<sup>th</sup> Edition, Cold Spring Harbor Laboratory Press.

### WEB RESOURCES: KHANACADEMY

#### WEBLINK:

1. <https://www.khanacademy.org/science/high-school-biology/hs-molecular-genetics/hs-biotechnology/v/introduction-to-genetic-engineering>






### MAPPING WITH PROGRAM OUTCOMES:

CO \ PO	PO1	PO2	PO3	PO4
CO1	S	S	S	S
CO2	S	S	S	S
CO3	S	M	S	S
CO4	S	S	M	S

S - Strong; M-Medium; L-Low.

#### ASSESSMENT PATTERN (if deviation from common pattern)

Follows common pattern of Internal and External assessment, suggested in the Regulations.

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

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

BOS meeting approved

Approved in 6<sup>th</sup> Academic Council meeting on: 04.08.2020

<b>Programme Code:</b>	<b>DSC</b>	<b>Programme Title: Master of Science in Biotechnology</b>							
<b>Course Code:</b>	<b>20BTP13</b>	<b>Course Title</b>						<b>Batch:</b>	<b>2020-2021 onwards</b>
		<b>PRACTICAL V - BIOPROCESS TECHNOLOGY</b>						<b>Semester:</b>	<b>II</b>
<b>Hrs/Week:</b>	<b>4</b>	<b>L</b>	<b>-</b>	<b>T</b>	<b>1</b>	<b>P</b>	<b>3</b>	<b>Credits:</b>	<b>2</b>

#### **COURSE OBJECTIVE**

1. To study the basis of fermentation technology, concept, principle and application of bioprocesses technology
2. To understand the working principles mechanism and importance of Fermentor
3. To explore the principles, material and methodology of citric acid production, enzyme production, wine production, antibiotic production.
4. To optimize the protocol for isolation and secondary screening of industrially important microbes in fermentation technology field

#### **COURSE OUTCOMES (CO)**

<b>S. No</b>	<b>COURSE OUTCOME</b>	<b>BLOOMS LEVEL</b>
CO1	Remember basic of fermentation technology, Concept, principle and application of bioprocesses technology.	K1
CO2	Understand Fermentor and working principles and mechanism and importance	K2
CO3	Apply principles, material and methodology of citric Acid Production, enzyme production, wine production, antibiotic Production. Isolation and secondary screening of industrially	K3
CO4	Analyse independently execute the isolation and secondary screening of industrially important microbes in fermentation technology field.	K4
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse</b>		

## SYLLABUS

Code	Subject Name	Semester
20BTP13	PRACTICAL V - BIOPROCESS TECHNOLOGY	II
Unit No.	Topics	Hours
1.	Fermentor – Design and Working Principle	48
2.	Citric Acid Production	
3.	Amylase Production	
4.	Wine Production	
5.	Antibiotic Production and its Bioassay	
6.	Culture optimization (pH, Temperature, Carbon & Nitrogen sources)	
7.	Bioassay of Antibiotics	
8.	Immobilization of cells for enzyme production	
9.	Purification of enzymes by salting, dialysis and column chromatography technique	

**Distribution of marks for practical: (IE 40; EE 60)**

**Teaching methods:** Demonstration, Lecturing, PowerPoint Projection through LCD, Assignment, Discussion and Activity.

**REFERENCE BOOKS:**

1. *Fermentation microbiology and Biotechnology. Second edition, edited by El-. Mansi, C.F.A. Bryce, A.L. Demain, A.R. Allman. Taylor and Francis, 2007.*
2. *Introduction to Biochemical engineering by D.G.Rao, McGraw-Hill publications, 1 edition, 2007.*
3. *Industrial Microbiology by Prescott and Dunns 4th edition edited by Gerald Reed, Chapman & Hall publications 2007.*

**WEB RESOURCES: NIL**





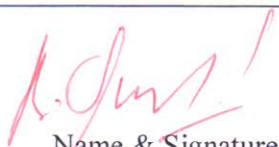
### MAPPING WITH PROGRAM OUTCOMES

CO \ PO	PO1	PO2	PO3	PO4
CO1	S	M	S	S
CO2	S	S	S	S
CO3	S	S	S	S
CO4	S	S	S	S

S - Strong; M-Medium; L-Low.

### ASSESSMENT PATTERN (if deviation from common pattern)

Follows common pattern of Internal and External assessment, suggested in the Regulations.

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

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.

BOS meeting approved

Approved in 6<sup>th</sup> Academic Council meeting on: 04.08.2020

<b>Programme Code:</b>	<b>DSC</b>	<b>Programme Title: Master of science in Biotechnology</b>							
<b>Course Code:</b>	<b>20BTP14</b>	<b>Course Title</b>						<b>Batch:</b>	<b>2020-2021 onwards</b>
		<b>Self-supportive course: BIODIVERSITY AND CONSERVATION BIOLOGY</b>						<b>Semester:</b>	<b>II</b>
<b>Hrs/Week:</b>	<b>-</b>	<b>L</b>	<b>-</b>	<b>T</b>	<b>-</b>	<b>P</b>	<b>-</b>	<b>Credits:</b>	<b>3</b>

#### **COURSE OBJECTIVE**

1. To recollect the basic biodiversity and their distribution in Western Ghats.
2. To understand the reason for decreases of animal diversity and species extinction
3. To learn about various methods of biodiversity conservation using *in situ* and *ex situ* tools
4. To solve biological problems using laws and policy in India and know about the role of different organization in conservation

#### **COURSE OUTCOMES (CO)**

<b>S. No</b>	<b>COURSE OUTCOME</b>	<b>BLOOMS LEVEL</b>
CO1	Remember the basic biodiversity and their distribution in Western Ghats.	K4
CO2	Understand the decreases of animal diversity and species extinction.	K1
CO3	Apply about conservation biology by In-situ and Ex-situ tools.	K2
CO4	Analyse and solve biological problems, by laws and policy in India. And to understand about role of different organization in conservation.	K4
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse;</b>		

## SYLLABUS

Code	Subject Name	Semester
20BTP14	<b>BIODIVERSITY AND CONSERVATION BIOLOGY</b>	<b>II</b>
Unit No.	Topics	
I	<b>Biodiversity; Species Concepts; Animal Diversity</b> What is Biodiversity - Components of Biodiversity (Ecosystem, Genetic and Species diversity) - Assigning values to biodiversity - Species concepts - Animal diversity: (Distribution, inventory, species richness) - Biodiversity Hotspots (Western Ghats, Indo-Burma region).	-
II	<b>Loss of Animal Diversity, Status of Species Extinctions</b> Past rates of Extinctions - Concepts of Island biogeography and extinction rates on Islands - Human induced, Modern and local extinctions - Population reduction - threats to wildlife (examples) - Habitat loss, degradation and fragmentation. Threats to animal diversity in India - Status of species: Rare - endemic and threatened species - Measuring status of species in the wild - IUCN Red list (Assessments and methodologies) - Status of Indian animals.	-
III	<b>Conservation: Tools In Animal Conservation</b> What is conservation biology? - In situ and Ex situ conservation of Indian animals (Case studies) - Population management - Project Tiger and Elephant - Captive breeding programme - peoples participation in conservation - Successes and failures of conservation actions in India (Case study) - Tools in Conservation: Interpretation of various data on wildlife - GIS - Remote sensing - Landscape model – PVA and CAMP processes.	-
IV	<b>Animal Laws and Policies In India; Economics of Biodiversity Conservation</b> Wildlife Protection Act of India (1972) - Protected Area network - forest policy - Prevention of cruelty to Animal Act - Convention on Biological diversity - International Trade in endangered species - Zoo policy - Laws and their applications in Zoological parks - wildlife sanctuaries and biosphere reserves - Economics of biodiversity conservation.	-
V	<b>Conservation Education and Awareness</b> Wildlife / Animal magazines, Journals- How to write popular and Scientific articles - Magazine and Journal information – Wildlife – nature - environment games (examples) – Role of NGO's and Government organizations in wildlife conservation - Wildlife celebration days in India - Biotechnology in conservation.	-

*Distribution of marks for Theory: (IE 30; EE 70)*

**Teaching methods: -**

**Text Book:**

1. Primack R.B, "Essentials of Conservation Biology", 2<sup>nd</sup> Edn., Sinauer Associates, USA, 2015



- Richard B. Primack. 2002. *Essentials of Conservation Biology*. 3rd edition, Sinauer Associates, Inc. Publishers. 698 pp. ISBN 0-87893-719-6.

**REFERENCE BOOKS:**

- Meffe G.K and Carroll C.R, "Principles of Conservation Biology", 2<sup>nd</sup> Edn., Sinauer Associates, USA, 2006
- Peter J. Bryant, *Biodiversity and Conservation*, 1<sup>st</sup> Edn., School of Biological Sciences, University of California, 2016
- E.O. Wilson, Frances M. Peter, *Biodiversity*, 3<sup>rd</sup> Edn., National Academic Press, Washington, D.C., 2015

**WEB RESOURCES:** ALISON, MOOC, NPTEL, SWAYAM

**WEBLINK:**

- [HTTPS://ALISON.COM/COURSE/ECOLOGY-STUDIES-CONSERVATION-BIOLOGY-AND-BIODIVERSITY](https://alison.com/course/ecology-studies-conservation-biology-and-biodiversity)
- [HTTPS://WWW.MOOC-LIST.COM/COURSE/SUSTAINABLE-SOIL-MANAGEMENT-SOIL-LIFE-EDX](https://www.mooc-list.com/course/sustainable-soil-management-soil-life-edx)
- [HTTPS://NPTEL.AC.IN/COURSES/102/104/102104068/](https://nptel.ac.in/courses/102/104/102104068/)
- [HTTPS://ONLINECOURSES.SWAYAM2.AC.IN/NOU20 BT02/PREVIEW](https://onlinecourses.swayam2.ac.in/nou20_bt02/preview)



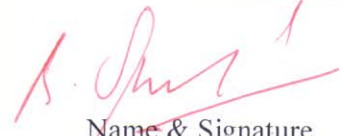
**MAPPING WITH PROGRAM OUTCOMES**

CO \ PO	PO1	PO2	PO3	PO4
CO1	S	M	S	S
CO2	S	S	S	S
CO3	S	S	S	S
CO4	S	S	S	S

**S - Strong; M-Medium; L-Low.**

**ASSESSMENT PATTERN (if deviation from common pattern)**

Follows common pattern of Internal and External assessment, suggested in the Regulations.

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

BOS meeting approved

Approved in 6<sup>th</sup> Academic Council meeting on: 04/08/2020  
 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.

<b>Programme Code:</b>	<b>DSC</b>	<b>Programme Title: Master of Science in Biotechnology</b>							
<b>Course Code:</b>	<b>20BTP15</b>	<b>Course Title</b>						<b>Batch:</b>	<b>2020-2021 onwards</b>
		<b>IMMUNOLOGY AND IMMUNOTECHNOLOGY</b>						<b>Semester:</b>	<b>III</b>
<b>Hrs/Week:</b>	<b>5</b>	<b>L</b>	<b>5</b>	<b>T</b>	<b>-</b>	<b>P</b>	<b>-</b>	<b>Credits:</b>	<b>5</b>

### COURSE OBJECTIVES

1. To apply the acquired knowledge about immunity, organs of immunity and cells involved; Types of antigens and properties; immunoglobulin – types; MHC and its significance; hypersensitivity reactions.
2. To understand the various cell development and tissues of the human immune system and to know the differences between and necessary integration of innate and adaptive immunity.
3. To evaluate the molecular level, focusing in gene rearrangement of immunoglobulin genes and T-cell receptor genes, additionally, antigen processing and presentation, cellular response and tolerance mechanism.
4. To acquire knowledge about application of antigen, the design of recombinant vaccine, strategies for immune intervention in the medicine for therapeutics and diagnostics.
5. To analyze and evaluate information related to immunotechnologies and learn about the dysfunction of the immune system during the development of various diseases, such as allergy, autoimmunity and immune deficiencies as well as the technologies that are used for diagnosis and treatment of these diseases as well as cancer.

### COURSE OUTCOMES (CO)

S. No	COURSE OUTCOME	BLOOMS LEVEL
CO1	Describe the roles of the immune system in both maintaining health and contributing to disease and get deep knowledge about the features and mechanisms of innate and adaptive immune responses	K1
CO2	Classify the cells and organs of immune system; antibodies and complement system and mechanisms involved in initiation of specific immune responses; describe the types of autoimmune disorders and vaccine development against infectious diseases	K2
CO3	Develop knowledge about cells involved in innate and acquired immunity; antigen-antibody interactions; immunologic processes governing graft rejection and therapeutic modalities for immunosuppression in transplantation	K3
CO4	Evaluate the functions of cells and organs of immune system; antibody production, principles of autoimmune disease and immune response against the infectious disease	K4
CO5	Distinguish the basic knowledge about the functioning of the immune system, inflammation, immune response against infectious agents and against cancer, the causes and pathogenesis of major alterations in the immune response, vaccines, and immunotherapy.	K5
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5- Evaluate</b>		



## SYLLABUS

Code	Subject Name	Semester
20BTP15	<b>IMMUNOLOGY AND IMMUNOTECHNOLOGY</b>	<b>III</b>
Unit No.	Topics	Hours
<b>I</b>	<b>Introduction to Immunology</b> History and Scope of Immunology; Humoral and Cell Mediated Immunity; Cells & organs of immune system - lymphoid cells, B and T lymphocytes, null cells. Mononuclear cells - phagocytosis, antimicrobial and cytotoxic activities. Structure and Functions of Granulocytes and Agranulocytes - neutrophils, eosinophils, basophils, Mast cells, Dendritic cells. Structure and Functions of primary and secondary lymphoid organs. – Thymus, Bone marrow, Bursa of fabricius, Spleen, Lymph Node	13
<b>II</b>	<b>Antigen, Antibody and Monoclonal Antibodies</b> <b>Antigen</b> –Structure, Properties; Haptens and adjuvants. <b>Immunoglobulins:</b> Structure and function-basic and fine structures of immunoglobulins. Isotypes, allotypes and idiotypes. Classification of immunoglobulins. Genetic control of antibody response. Generation of antibody diversity. <b>Monoclonal antibodies-</b> production, role and advantages of monoclonal antibodies. Detailed account on the application and uses of monoclonal antibodies. Humanization of antibodies	12
<b>III</b>	<b>Antigen- antibody interactions, Complements and MHC molecules</b> <b>Antigen-antibody interactions</b> - strength of antigen-antibody interaction, cross reactivity, precipitin reactions. Radioimmunoassays (RIA). Enzyme linked immunosorbent assay (ELISA). Western blotting. immunoelectron microscopy. <b>Complement proteins;</b> classical, alternative and lectin pathways. <b>Major histocompatibility complex (MHC):</b> Structure and its significance. Antigen presentation via Class I and Class II pathways. Th1/ Th2 polarities, NK Effector Mechanism.	14
<b>IV</b>	<b>Autoimmunity and Transplantation Immunology</b> <b>Autoimmunity:</b> Basis of autoimmune disorders, mechanism for the induction of autoimmunity. Organ Specific Autoimmune Disease – mediated by direct cellular damage – Systemic Autoimmune disease – Multiple Sclerosis. Treatment of autoimmune diseases. <b>Transplantation immunology-</b> immunological basis of graft rejection, Xenotransplantation. Clinical transplantation. Hypersensitivity – Types – Gel and Combs reaction – Mechanisms underlying the types – Examples of Hypersensitive reactions.	13
<b>V</b>	<b>Immune Response to Infectious Diseases and Vaccine Development</b> <b>Infectious disease:</b> Viral infections – Avian H5N1; Bacterial infection – Mycobacterium tuberculosis; Parasitic infections – Leishmaniasis; Emerging infectious disease – SARS. Tumors of immune system - Tumor antigens. Cancer immunotherapy – cytokine therapy <b>Vaccine</b> – Active and Passive immunization. Development of Conjugate and DNA vaccines for infectious diseases.	13
<b>Total</b>		<b>65</b>

*Distribution of marks for Theory: (IE 30; EE 70)*

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



**TEXT BOOK:**

1. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby, 2007, "Kuby Immunology", 6<sup>th</sup> Edn., W. H. Freeman.

**REFERENCE BOOKS:**

1. Ivan Riot, 2016, "Essentials of Immunology", 13<sup>th</sup> Edn., Wiley-Blackwell Scientific Publications.
2. Abul K. Abbas, Andrew Lichtman and Shiv Pillai, 2016, Cellular and Molecular Immunology, 9<sup>th</sup> Edn., Elsevier
3. David K. Male, Jonathan Brostoff, David E. Roth, and Ivan M Roitt, 2008, Immunology, 8<sup>th</sup> Edn., Elsevier.

**WEB RESOURCES: Coursera****WEB LINK:**

1. <https://www.coursera.org/specializations/immunology>



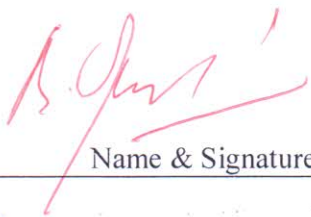
**MAPPING WITH PROGRAM OUTCOMES:**

CO \ PO	PO1	PO2	PO3	PO4
CO1	S	S	S	S
CO2	S	S	M	M
CO3	S	S	S	S
CO4	S	S	M	S
CO5	S	S	S	S

S – Strong; M – Medium

**ASSESSMENT PATTERN (if deviation from common pattern)**

Follows common pattern of Internal and External assessment, suggested in the Regulations.

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

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.

BOS meeting approved:

Approved in 7<sup>th</sup> Academic Council meeting on: 24.08.2021

<b>Programme Code:</b>	<b>DSC</b>	<b>Programme Title: Master of Science in Biotechnology</b>							
<b>Course Code:</b>	<b>20BTP16</b>	<b>Course Title</b>					<b>Batch:</b>	<b>2020-2021 onwards</b>	
		<b>ANIMAL AND PHARMACEUTICAL BIOECHOLOGY</b>					<b>Semester:</b>	<b>III</b>	
<b>Hrs/Week:</b>	<b>5</b>	<b>L</b>	<b>5</b>	<b>T</b>	<b>-</b>	<b>P</b>	<b>-</b>	<b>Credits:</b>	<b>5</b>

### COURSE OBJECTIVES

1. To explain the basic concept of Animal cell culture techniques concerning characterization, contaminations, stem cell biology and pharmaceutical drug properties
2. To explore the characterization of media preparation, cell surface markers, stem cell characteristics and drugs sources and evaluation.
3. To understand and provide knowledge on characterization of cell line like qualitative analysis of chromosome and DNA, embryo transfer and ADME and pharmacodynamics as well as toxicity studies
4. To enable students to gain a comprehensive information and insights on LEAP culture, tissue engineering aspects and drug properties
5. To explore about three-dimensional culture, bioartificial organ regeneration and drug discovery and receptor system

### COURSE OUTCOMES (CO)

S. No	COURSE OUTCOME	BLOOMS LEVEL
CO1	Recall the fundamentals of Animal cell culture, cell line characterization and contaminations, stem cell biology and tissue engineering, Pharmaceuticals and drug delivery and development.	K1
CO2	Discuss properties and functions of different media, antigenic cell surface markers for different cell lines and its fidelity, different stem cells, its culture, niche and markers, different drugs from various sources, its isolation and evaluation, structural genomics and proteomics.	K2
CO3	Examine the features of cell line characteristics, requirement and generation, different staining, banding and painting the chromosomes, DNA analysis, different embryo transfer methods and stem cell banking, ADME and pharmacodynamics, clinical and toxicity and carcinogen and mutagenic studies.	K3
CO4	Explain methodology of LEAP culture and transfection, differentiation, tissue engineering its biomaterial, bioreactors, drug action and properties, and drug delivery systems	K4
CO5	Assess the methods governing three-dimensional culture, organ culture, different contamination and aspects, bioartificial organ regeneration, drug discovery, receptor, and delivery.	K5
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5- Evaluate</b>		



## SYLLABUS

Code	Subject Name	Semester
20BTP16	ANIMAL AND PHARMACEUTICAL BIOTECHNOLOGY	III
Unit No.	Topics	Hours
I	<p><b>Basics of Animal Cell Culture</b> Culture Media; Serum and protein free defined media and their applications. Balanced salt solutions and simple growth medium: Physical, Chemical and Metabolic functions of different constituents of culture medium. Primary cell culture, Cell lines, Cell Strain, Continuous cell culture, Finite cell culture, Features of cell line, Characteristics of Cell lines, Requirement of cell lines, Generation of cell lines: LEAP, culture condition, Transfection method. Organ culture and three-dimensional culture feeder layers; cell synchronization.</p>	13
II	<p><b>Cell Line Characterization &amp; Contamination:</b> Parameters of Characterization: Tissue markers, Cell surface antigen, Intermediate filament proteins, Differentiated products and functions, Enzymes, Lineage fidelity, Unique Markers, Transformation: Cell morphology, Staining. Chromosome content, Chromosome banding, Chromosome painting. Chromosome Analysis, DNA analysis, DNA hybridization, DNA fingerprinting, Antigenic markers, Immunostaining, Differentiation. Source of contamination, Monitoring, visible microbial contamination, ways of disposal of contaminated culture, eradication, cross contamination.</p>	13
III	<p><b>Stem Cell Biology and Tissue Engineering</b> Stem cells: characteristics and classification; stem cell niche; stem cell culture; stem cell markers. ES cells, EG cells; Adult stem cells: HSC, MSC, NSC, UCBS cells, iPS cells. Embryo transfer, IVF, Microinjection and Electroporation, Stem cell banking. Tissue Engineering: Principles of tissue engineering; biomaterials in tissue engineering; tissue engineering bioreactors. Applications: bio artificial organs-regeneration of bone, liver, epidermis and bladder. Case study: Uses of Human embryonic stem cell in different types of treatment process.</p>	15
IV	<p><b>Introduction to Pharmaceuticals</b> Biopharmaceuticals and pharmaceutical biotechnology. Source of drugs – plant, animals, microbes and minerals. Drug isolation and evaluation. Drug metabolism – Pharmacokinetics – Absorption, Distribution, Metabolism and Excretion (ADME), Pharmacodynamics – Mechanism of drug action. Physico – chemical properties of the drugs. Drug receptors. Drug Discovery of biopharmaceuticals. Case study: Biopharmaceutical in Clinical and medical trails.</p>	10
V	<p><b>Drug Development and Delivery</b> Impact of genomics and related technologies upon drug discovery. Initial product characterization. Gene chips – proteomics - structural genomics - pharmacogenetics. Pre-clinical studies. Toxicity studies – reproductive toxicity and teratogenicity, mutagenicity, carcinogenicity and other tests, clinical trials, clinical trial design, trial size design and study population. Delivery of biopharmaceuticals – oral delivery systems, pulmonary delivery, nasal, transmucosal and transdermal delivery system. Case study: Genomics and proteomics in drug delivery system.</p>	14
<b>Total</b>		<b>65</b>

*Distribution of marks for Theory: (IE 30; EE 70)*

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

BOS meeting approved:

Approved in 7<sup>th</sup> Academic Council meeting on: 24.08.2021



**TEXT BOOKS:**

1. DaanCrommelin and Robert D. Sindelar, 2008, "Pharmaceutical Biotechnology", 3<sup>rd</sup> Edn., Taylor andFrancis Publications, London.
2. Fresheny, I., 2021, "Culture of animal cell – A manual of basic technique and specialized application" Characterization, 4<sup>th</sup> Edn., Wiley Blackwell Publications.
3. Saurabh Bhatia, Tanveer Naved and Satish Sardana, 2019, Introduction to animal tissue culture science, 1<sup>st</sup> Edn., IOP Publishing Ltd.

**REFERENCE BOOKS:**

1. Leon Lachman, Herbert A. Lieberman, Joseph L.Kanig, 2010, "The Theory and Practice of Industrial Pharmacy", 1<sup>st</sup> Edn., Lea&Febiger, Philadelphia, USA.
2. Allen Loyd V, 2012, "Remington: The Science and Practice of Pharmacy", 21<sup>st</sup> Edn., Pharmaceutical Press,Great Britain.
3. Sudha Gangal, 2007, Principles and Practice of Animal Tissue Culture. 2<sup>nd</sup> Edn., Universities Press.
4. John M. Davis, 2011, Animal Cell Culture: Essential Methods. 1<sup>st</sup> Edn., John Wiley & Sons, Ltd.
5. Michael Butler, 2003, Animal cell culture and Technology, 2<sup>nd</sup> Edn., Taylor & Francis.

**WEB RESOURCES: NPTEL, ONLINE BIOLOGY, COURSERA****WEB LINK:**

1. <https://nptel.ac.in/courses/102/104/102104059/>
2. <https://www.onlinebiologynotes.com/animal-cell-culture/>
3. <https://www.coursera.org/lecture/extracellular-vesicles/cell-culture-media-QIRQ1>



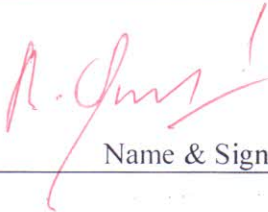
**MAPPING WITH PROGRAM OUTCOMES:**

PO \ CO	PO1	PO2	PO3	PO4
CO1	S	M	S	M
CO2	S	S	M	S
CO3	S	S	S	S
CO4	S	S	S	S
CO5	M	S	S	S

S- Strong; M – Medium

**ASSESSMENT PATTERN (if deviation from common pattern)**

Follows common pattern of Internal and External assessment, suggested in the Regulations.

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

BOS meeting approved:

HEAD OF THE DEPARTMENT  
 PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY  
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 Curriculum Development Cell  
 Hindusthan College of Arts & Science,  
 Coimbatore-641 028.

Approved by Academic Council meeting on 24.08.2021

<b>Programme Code:</b>	<b>DSC</b>	<b>Programme Title: Master of Science in Biotechnology</b>							
<b>Course Code:</b>	<b>20BTP17</b>	<b>Course Title</b>					<b>Batch:</b>	<b>2020-2021 onwards</b>	
		<b>PLANT BIOTECHNOLOGY</b>					<b>Semester:</b>	<b>III</b>	
<b>Hrs/Week:</b>	<b>4</b>	<b>L</b>	<b>4</b>	<b>T</b>	<b>-</b>	<b>P</b>	<b>-</b>	<b>Credits:</b>	<b>4</b>

### **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

### **COURSE OUTCOMES (CO)**

<b>S. No.</b>	<b>COURSE OUTCOME</b>	<b>BLOOMS LEVEL</b>
CO1	Recall the fundamentals of tissue culture, hybrid production, rDNA concepts in plant transformation and basic applications	K1
CO2	Review the proper techniques/ procedures for the maintenance of sterile condition, proper plant growth, gene transfer, molecular pharming and secondary metabolites production	K2
CO3	Transfer the learned techniques in new or improve the existing similar situations	K3
CO4	Focus the concepts in future studies and debate on the issue related to newly evolved species/products and evaluate its significances	K4
CO5	Prioritize the concerns over modern plant biotechnology and assess them according to the regulatory frame works	K5
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5 – Evaluate</b>		



## SYLLABUS

Code	Subject Name	Semester
20BTP17	PLANT BIOTECHNOLOGY	III
Unit No.	Topics	Hours
Unit 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
Unit 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
Unit 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
Unit 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 Factories, Medical Pharming, Pharmaceuticals, Plantibodies, Edible Vaccines, Non medical Pharming, Industrial enzymes.	10
Unit 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
	<b>Total</b>	<b>52</b>

**Distribution of marks for Theory: (IE 30; EE 70)**

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

**Text Book:**

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

**Reference Books:**

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.

## WEB RESOURCES: SWAYAM, NPTEL, HARVARD, COURSERA

### WEB LINK:

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>



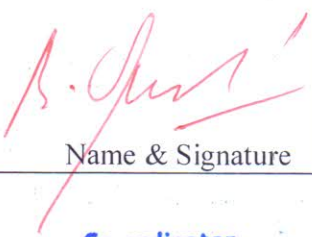
### MAPPING WITH PROGRAM OUTCOMES

PO \ CO	PO1	PO2	PO3	PO4
CO1	S	S	S	M
CO2	S	S	S	S
CO3	S	S	S	S
CO4	M	S	S	S
CO5	S	S	S	S

S – Strong; M – Medium

### ASSESSMENT PATTERN (if deviation from common pattern)

Follows common pattern of Internal and External assessment, suggested in the Regulations.

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

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.



<b>Programme Code:</b>	<b>DSE</b>	<b>Programme Title: Master of Science in Biotechnology</b>							
<b>Course Code:</b>	<b>20BTP18A</b>	<b>Course Title</b>						<b>Batch:</b>	<b>2020-2021 onwards</b>
		<b>Elective III DEVELOPMENTAL BIOLOGY AND BEHAVIORAL STUDIES</b>						<b>Semester:</b>	<b>III</b>
<b>Hrs/Week:</b>	<b>4</b>	<b>L</b>	<b>4</b>	<b>T</b>	<b>-</b>	<b>P</b>	<b>-</b>	<b>Credits:</b>	<b>3</b>

### 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

### COURSE OUTCOMES (CO)

<b>S. No</b>	<b>COURSE OUTCOME</b>	<b>BLOOMS LEVEL</b>
CO1	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
CO2	Discuss the detailed mechanism of early development of plant and animal cell, and classify the evidences of chemical evolution	K2
CO3	Illustrate the morphogenic and organogenic pattern of animal cell development and cellular degeneration mechanism and insight the experimental evidences for evolution.	K3
CO4	Compare and correlate the basic concepts of developmental biology evolutionary theory of basic biological molecules and animal relationships	K4
CO5	Evaluate the approaches and methods of morphogenesis, organogenesis and study the behavioral relationship in animal	K5
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5 - Evaluate</b>		

Code No.	Subject Name	Semester
20BTP18A	Elective III- DEVELOPMENTAL BIOLOGY AND BEHAVIORAL STUDIES	III
Unit No.	Topics	Hrs
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 - mutants and transgenics in analysis of development.	10
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> and <i>Antirrhinum</i> .	12
III	<b>Morphogenesis and Organogenesis in Animal</b> Axes and pattern formation in amphibia and chick. 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
IV	<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 & 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.	10
V	<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.	10
<b>Total</b>		<b>52</b>

**Distribution of marks for Theory: (IE 30; EE 70)**

**Teaching methods:** Demonstration, Lecturing, PowerPoint Projection through LCD, Assignment, Discussion and Activity

**Text Book:**

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

**Reference Books:**

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, Limited



**WEB RESOURCES: NPTEL, MOOC**

**WEBLINK:**

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



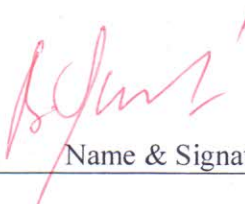
**MAPPING WITH PROGRAM OUTCOMES**

CO \ PO	PO1	PO2	PO3	PO4
CO1	S	M	M	M
CO2	S	S	-	M
CO3	M	S	M	M
CO4	S	S	M	M
CO5	S	M	S	S

S-Strong; M- Medium

**ASSESSMENT PATTERN (if deviation from common pattern)**

Follows common pattern of Internal and External assessment, suggested in the Regulations.

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.**

<b>Programme Code:</b>	<b>DSE</b>	<b>Programme Title: Master of Science in Biotechnology</b>							
<b>Course Code:</b>	<b>20BTP18B</b>	<b>Course Title</b>					<b>Batch:</b>	<b>2020-2021 onwards</b>	
		<b>Elective III BIOTECHNIQUES</b>					<b>Semester:</b>	<b>III</b>	
<b>Hrs/Week:</b>	<b>4</b>	<b>L</b>	<b>4</b>	<b>T</b>	<b>-</b>	<b>P</b>	<b>-</b>	<b>Credits:</b>	<b>3</b>

### COURSE OBJECTIVE

1. To gain insights on the basics in safe use of laboratory equipment's and their working principles
2. To familiarize with metric system in laboratory calculations and usage of analytical balance, pH meter, chromatography
3. To give acumens on various waste disposal methodologies and able to analyses physical, spectral characteristics and purification of the components and basic microscopic techniques
4. To Experiment on the analysis of different biomolecules using advanced high-end techniques like confocal microscopy, ultracentrifugation, AAS and biosensors.
5. To evaluate application and usage of various analytical techniques in healthcare and environment.

### COURSE OUTCOMES (CO)

S. No	COURSE OUTCOME	BLOOMS LEVEL
CO1	State the basics in safe use of laboratory equipment's and their working principles	K1
CO2	Understand the concepts of metric system in laboratory calculations and usage of analytical balance, pH meter, chromatography, electrophoresis and radioisotopes in molecule identification.	K2
CO3	Discover the various waste disposal methodologies and able to analyses physical, spectral characteristics and purification of the components and basic microscopic techniques, spectroscopy and centrifugation methods.	K3
CO4	Experiment on the analysis of different biomolecules using advanced high-end techniques like confocal microscopy, ultracentrifugation, AAS and biosensors.	K4
CO5	Asses the application and usage of various analytical techniques in healthcare and environment.	K5
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5-Evaluate</b>		



## SYLLABUS

Code	Subject Name	Semester
20BTP18B	Elective III -BIOTECHNIQUES	III
Unit No.	Topics	Hours
I	<b>Laboratory Safety and Units in Measurement</b> Safe Use of Laboratory equipment – Electrical equipment – Science lab equipment's & their general uses, Personal protection – Hazards and Corrosive substances in laboratory, Ionising radiation, Waste disposal and First Aid, The Metric systems – Conversion of Units – Units used in Preparation of Solutions – Units used in laboratory calculations – Ratios and dilution	10
II	<b>Microscopy, Analytical Balance and pH meter</b> Historical Development of Microscope – Components of a microscope – Working principle of bright field microscope, polarizing microscope and confocal microscope & their Applications. Analytical Balance – Single Pan and Double Pan analytical balance – Physical Balance – Triple Beam Single Pan Balance and Double Pan Balance. pH meter – Principle, calomel electrode, glass electrode, combined electrode – operation and applications of pH meter	10
III	<b>Centrifugation, Chromatography, Osmometry</b> Basic principles of Sedimentation – sedimentation coefficient – types of centrifuges – bench, high speed and ultracentrifuges – types of centrifugation – analytical and Centrifugation. Chromatography – Principle and applications of Paper, Thin layer, Column and Ion Ex Chromatography, HPLC and HPTLC. Osmometry – Vant Hoff's law of osmotic pressure – Determination of osmotic pressure – Types of Simple osmometers – Applications of osmometry.	12
-IV	<b>Calorimetry, Spectroscopy &amp; Electrophoresis</b> Calorimetry – Beer Lamberts law – applications. Spectrophotometry – Principle and applications of UV- Visible spectroscopy; Atomic Absorption Spectroscopy (AAS); Flame photometry and Fluorimetry. Mass Spectroscopy - principle and applications of GC MS. Electrophoresis – Basic Principle – Application of Electrophoresis in analysing Macromolecules.	10
V	<b>Manometry, Radio – isotope Techniques and Biosensors</b> Manometry – Types of manometers – manometers used for measurement of oxygen in tissue or animal – Warburg manometer. Radioisotopes – applications of radioisotopes – radio techniques – detection and measurement of radio. Biosensors – components of biosensors – types of biosensors – applications in healthcare and environmental issues.	10
<b>Total</b>		<b>52</b>

*Distribution of marks for Theory: (IE 30; EE 70)*

**Teaching methods:** Lecturing, PowerPoint Projection through LCD, Videos, Assignment, Discussion and Activity.

### TEXT BOOKS:

1. Veerakumari. L, 2015, "Bioinstrumentation", 1<sup>st</sup> Edn., MJP Publishers, Chennai
2. Abhilasha Shourie and Shilpa S Chapadgaonkar, 2015, Bioanalytical Techniques. The Energy and Resources Institute, 1<sup>st</sup> Edn., TERI Press.

BOS meeting approved:

Approved in 7<sup>th</sup> Academic Council meeting on: 24.08.2021

## REFERENCE BOOKS:

1. Sawhney S. K. and Randhir Singh, 2014, "Introductory to Practical Biochemistry", 5<sup>th</sup> Edn., Narosa Publishing House, New Delhi.
2. Rodney F. Boyer, 2000, "Modern Experimental Biochemistry", 3<sup>rd</sup> Edn., Pearson
3. Sabari Ghosal, Anupama Sharma Awasthi, 2018, Fundamentals of Bioanalytical Techniques and Instrumentation. 2<sup>nd</sup> Edn., PHI Learning
4. Andreas Hofmann and Samuel Clokie, 2017, Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology, 8<sup>th</sup> Edn., Cambridge University Press.
5. S. M. Khopkar, 2016, Instrumental Methods in Bioanalytical Chemistry, 1<sup>st</sup> Edn., New Age International Private Limited.

**WEB RESOURCES:** Automation forum, Courseera, lab training.

### WEB LINK:

1. <https://automationforum.in/t/free-online-instrumentation-courses/4783>
2. <https://www.coursera.org/learn/spectroscopy>
3. <https://lab-training.com/2011/12/20/free-e-courses/>
4. <https://www.coursera.org/lecture/forensic-science/week-2b-1-introduction-to-chromatography-MSip0>




## MAPPING WITH PROGRAM OUTCOMES

PO CO	PO1	PO2	PO3	PO4
CO1	S	S	-	-
CO2	S	S	-	M
CO3	S	S	S	M
CO4	S	S	S	M
CO5	M	S	M	M

S-Strong; M-Medium

## ASSESSMENT PATTERN (if deviation from common pattern)

Follows common pattern of Internal and External assessment, suggested in the Regulations.

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

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.



<b>Programme Code:</b>	<b>DSE</b>	<b>Programme Title: Master of Science in Biotechnology</b>							
<b>Course Code:</b>	<b>20BTP18C</b>	<b>Course Title</b>						<b>Batch:</b>	<b>2020-2021 onwards</b>
		<b>Elective III STEM CELL BIOLOGY</b>						<b>Semester:</b>	<b>III</b>
<b>Hrs/Week:</b>	<b>4</b>	<b>L</b>	<b>4</b>	<b>T</b>	<b>-</b>	<b>P</b>	<b>-</b>	<b>Credits:</b>	<b>3</b>

### Course Objective

1. To familiarize the basics of stem cell biology, its types along with gene therapy, its attributes and ethical, legal issue concerning to it
2. To give a broad view of stem cell and gene therapy from its historic point for their application and limitation in regenerative medicine
3. To comprehend the role of stem cells in gene therapy, regulatory and ethics consideration in regard stem cell-based disease management.
4. To understand the culture techniques of stem cells and gene therapy based on genetically modified organism as well as different treatment
5. To enlighten legal issues, potential benefits of stem cell culture and vector-based gene delivery in medical sector

### Course Outcomes (CO)

S. No	COURSE OUTCOME	BLOOMS LEVEL
CO1	Relate the fundamental concept of stem cell biology with regards to basics, types, gene therapy and delivery methods, ethical issues and application.	K1
CO2	Discuss the stem cell and gene therapy from its historical perspectives, adult stem cell such as hematopoietic and mesenchymal stem cells, regenerative medicine, ethical issue pertained to regenerative medicine, and neurodegenerative diseases	K2
CO3	Illustrate the diverse role of various stem cells and its properties, Neural stem cells, disease target and failure and success of gene therapy, Ethical and regulatory consideration and stem cell safety and stem cell management with heart disease, diabetes, muscular dystrophy	K4
CO4	Examine the culture of stem cells for medical applications, Epithelial, embryonic stem cell types, gene therapy perspective on genetically modified organism and orthopedic application of stem cell therapy	K4
CO5	Rate the stem cell in legal issues, culture methods and potential benefits, different vectors on gene delivery approaches for gene therapies experimentation purpose and overall regulatory issues in medical sector	K5
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5-Evaluate</b>		

Code	Subject Name	Semester
20BTP18C	Elective III- STEM CELL BIOLOGY	III
Unit No.	Topics	Hours
I	<b>Introduction to stem cells</b> History of stem cell use, importance, Pros and Cons of Using Various Stem Cells, properties, proliferation, culture of stem cells, medical applications of stem cells, legal issues in use of stem cells.	9
II	<b>Types of stem cells.</b> Stem Cell biology and therapy, Adult stem cell: Hematopoietic Stem Cells (Blood Stem Cells) Mesenchymal Stem Cells, Neural Stem Cells, Epithelial Stem Cells, Skin Stem Cells. Embryonic Stem Cells and types, culture and the potential benefits of stem cell Technology	9
III	<b>Gene therapy and Gene delivery methods</b> Gene Therapy: Introduction, History and evolution of Gene therapy, optimal disease targets, Failures and successes with gene therapy and future prospects, Genetic Perspectives for Gene Therapy, <b>Gene Delivery methods:</b> Viral vectors and Non-viral Vectors	12
IV	<b>Ethical Issues</b> associated with stem cell-based regenerative medicine field Regulatory and Ethical Considerations of stem cell and Gene Therapy, Assessing Human Stem Cell Safety, Use of Genetically Modified Stem Cells in Experimental Gene Therapies	10
V	<b>Applications of stem cells:</b> Neurodegenerative diseases, spinal cord injury, heart disease, diabetes, burns and skin ulcers, muscular dystrophy, orthopedic applications, eye diseases, stem cells and genetherapy.. Regulatory issues in medical sector	12
<b>Total</b>		<b>52</b>

**Distribution of marks for Theory: (IE 30; EE 70)**

**Teaching methods:** Demonstration, Lecturing, PowerPoint Projection through LCD, Assignment, Discussion and Activity

**TEXT BOOKS:**

1. Daniel Marshak, Richard L. Gardener and David Gottlieb, 2001, *Stem Cell Biology*, 1<sup>st</sup> Edn., Cold Spring Harbour Laboratory Press.
2. Alexander Battler, Jonathan Leo, 2018, *Stem Cell and Gene-Based Therapy: Frontiers in Regenerative Medicine*, 1<sup>st</sup> Edn., Springer.

**REFERENCE BOOKS:**

1. Anthony Atala and Robert Lanza, 2012, "Handbook of Stem Cells" 2<sup>nd</sup> Edn., Academic Press.
2. Sell and Stewart, 2013, "Stem Cells Handbook" 2<sup>nd</sup> Edn., Springer Archives.
3. Gary S. Stein, Maria Borowski, Mai X. Luong, Meng-Jiao Shi, Kelly P. Smith, Priscilla Vazquez, 2011, "Human Stem Cell Technology and Biology: A Research Guide and Laboratory Manual" 2011, 5<sup>th</sup> Edn., Wiley-Blackwell publication
4. Stephen Sullivan, Chad A Cowan and Kevin Eggan, 2007, "Human Stem Cell Technology and Biology: A Research Guide and Laboratory Manual", 3<sup>rd</sup> Edn., Wiley publication.



**WEB RESOURCES: NPTEL, CLASSCENTRAL, EDX, STANFORD, MOOC, COURSERA**

**WEBLINK:**

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

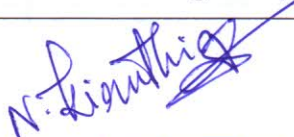

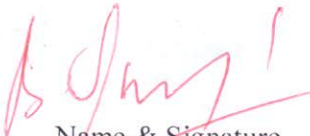
**MAPPING WITH PROGRAM OUTCOMES**

CO \ PO	PO1	PO2	PO3	PO4
CO1	S	M	S	S
CO2	S	S	M	M
CO3	S	S	S	S
CO4	M	M	S	S
CO5	S	S	S	S

S-Strong; M- Medium

**ASSESSMENT PATTERN (if deviation from common pattern)**

Follows common pattern of Internal and External assessment, suggested in the Regulations.

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

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

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

<b>Programme Code:</b>	<b>DSC</b>	<b>Programme Title: Master of Science in Biotechnology</b>							
<b>Course Code:</b>	<b>20BTP20</b>	<b>Course Title</b>						<b>Batch:</b>	<b>2020-2021 onwards</b>
		<b>PRACTICAL VI – IMMUNOLOGY AND IMMUNOTECHNOLOGY</b>						<b>Semester:</b>	<b>III</b>
<b>Hrs/Week:</b>	<b>4</b>	<b>L</b>	<b>-</b>	<b>T</b>	<b>1</b>	<b>P</b>	<b>3</b>	<b>Credits:</b>	<b>2</b>

### **COURSE OBJECTIVES**

1. To develop practical skills on basic principles of immunization and animal handling techniques.
2. To learn the modern chromatographic technique for separation of immunoglobulins
3. To provide hands on training on qualitative and quantitative detection of antigen-antibody interactions
4. To equip the students in various electrophoresis and blotting techniques
5. To give hands on experience in separating blood cells from human

### **COURSE OUTCOMES (CO)**

<b>S. No</b>	<b>COURSE OUTCOME</b>	<b>BLOOMS LEVEL</b>
CO1	Describe a detail procedure for immunization and various handling techniques of animals	K1
CO2	Outline the mechanism for molecular separation of immunoglobulins using chromatographic techniques	K2
CO3	Use an advance immunological assays such as double diffusion, radial Immunodiffusion, ELISA for studying antigen-antibody interaction	K3
CO4	Investigate the scientific and technological aspects on the use of blotting and electrophoresis techniques for diagnosis	K4
CO5	Evaluate the components of human sera by performing density gradient separation procedure	K5
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5- Evaluate</b>		



## SYLLABUS

Code	Subject Name	Semester
20BTP20	PRACTICAL VI – IMMUNOLOGY AND IMMUNOTECHNOLOGY	III
Topics		Hours
1. Demonstration of animal handling cervical dislocation, dissection of mice, cardiac puncture, blood sample preparation and its handling.		10
2. Separation of IgG using affinity chromatography.		7
3. Antigen-Antibody Interactions: Radial Immunodiffusion, Ouchterlony Double Diffusion Precipitin Ring Test.		5
4. Rocket Immunoelectrophoresis.		8
5. Antibody titre by using ELISA reader		7
6. Immunoblotting.		7
7. Separation of mononuclear cells from Human peripheral blood		8
<b>Total</b>		<b>52</b>

**Distribution of marks for Practical: (IE 40; EE 60)**

**Teaching methods:** Demonstration, Lecturing, PowerPoint Projection through LCD, Discussion and Activity and Hands on training.

### REFERENCE BOOKS:

1. Hannah D. Zane, 2001, *Immunology: Theoretical and practical concepts in Laboratory Medicine, 1<sup>st</sup> Edn., Saunders.*
2. Christine Dorresteyn Stevens, 2009, *Clinical Immunology and Serology: A Laboratory Perspective 2<sup>nd</sup> Revised Edn., F.A.Davis Company.*

**WEB RESOURCES:** EASYBIOLOGYCALSS, KHAN ACADEMY

### WEBLINK:

1. <https://www.easybiologyclass.com/tag/immunology-short-notes/>
2. <https://www.khanacademy.org/science/high-school-biology/hs-human-body-systems/hs-the-immune-system/a/hs-the-immune-system-review>




## MAPPING WITH PROGRAM OUTCOMES

CO \ PO	PO1	PO2	PO3	PO4
CO1	S	S	S	M
CO2	M	S	S	M
CO3	S	S	M	M
CO4	S	S	S	S
CO5	M	S	S	M

S-Strong, M- Medium

### ASSESSMENT PATTERN (if deviation from common pattern)

Follows common pattern of Internal and External assessment, suggested in the Regulations.

Course Designed by	Verified by HOD	Approved by CDC Co-ordinator
 <b>Dr. S. GANESH</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  
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 Curriculum Development Cell  
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 Coimbatore-641 028.



<b>Programme Code:</b>	<b>DSC</b>	<b>Programme Title: Master of Science in Biotechnology</b>							
<b>Course Code:</b>	<b>20BTP21</b>	<b>Course Title</b>					<b>Batch:</b>	<b>2020-2021 onwards</b>	
		<b>PRACTICAL VII – ANIMAL AND PHARMACEUTICAL BIOTECHNOLOGY</b>					<b>Semester:</b>	<b>III</b>	
<b>Hrs/Week:</b>	<b>4</b>	<b>L</b>	<b>-</b>	<b>T</b>	<b>1</b>	<b>P</b>	<b>3</b>	<b>Credits:</b>	<b>2</b>

### COURSE OBJECTIVES

1. To impart the fundamental concepts of animal cell culture media preparation and sterilization
2. To provide insights on preparation cells for primary culture and establishment of cell line
3. To determine the cell viability by underlying various assays like MTT and plating efficiency
4. To enlighten about various modes of drug administration, analgesic, anti-inflammatory and antibiotic/microbial testing of drugs
5. To learn the basic mechanism of antioxidant properties of various drugs

### COURSE OUTCOMES (CO)

<b>S. No</b>	<b>COURSE OUTCOME</b>	<b>BLOOMS LEVEL</b>
CO1	List the foundational knowledge on competence in laboratory techniques, media preparation and sterilization.	K1
CO2	Compare the protocol for various primary cell culture and establishment of cell line	K2
CO3	Examine the cell viability of cultured cell using various assays	K3
CO4	Compare and contrast the procedure for drug administration, and pharmaceutical analysis of drugs	K4
CO5	Asses the Spectrophotometric based Antioxidant assays for drug testing	K5
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5-Evaluate</b>		

**SYLLABUS**

Code	Subject Name	Semester
20BTP21	PRACTICAL VII- ANIMAL AND PHARMACEUTICAL BIOTECHNOLOGY	III
Topics		Hours
<b>Animal Biotechnology</b>		
1. Sterilization techniques and culture media preparation		4
2. Preparation of primary cell culture		5
3. Preparation of established cell lines		5
4. Determining cell number and viability with a Hemocytometer and Trypan blue staining		5
5. MTT assay		5
6. Colony formation or plating efficiency		5
<b>Pharmaceutical Biotechnology</b>		
7. Various modes of administration of drugs: Intravenous, Intramuscular, Intraperitoneal, Intradermal		3
8. Determination of analgesic and anti-inflammatory activity of a compound		5
9. UV Spectrophotometric determination of Allantoin and Griseofulvin		5
10. Microbial analysis of Pharmaceuticals (syrops)		5
11. DPPH and SOD - Antioxidant Assay		5
<b>Total</b>		<b>52</b>

**Distribution of marks for Practical :( IE 40; EE 60)**

**Teaching methods:** Demonstration, Lecturing, PowerPoint Projection through LCD, Discussion and Activity, Hands on training.

**REFERENCE BOOKS**

1. Masters, J. R.W., 2000, *Animal Cell Culture*, 3<sup>rd</sup> Edn., Oxford.
2. Ranga, M.M., 2007, *Animal Biotechnology*, 2<sup>nd</sup> Edn., Agrobios.
3. Freshney, 2000, *Animal cell culture – a practical approach*, 3<sup>rd</sup> Edn., Oxford University Press.
4. Parul Patel, Vivek Narayan, Upasani M. G., 2019, *Lab Manual in Pharmaceutical Microbiology & Biotechnology-1<sup>st</sup> Edn.*, Nirav and Roopal Prakashan publisher, Ahmedabad

**WEB RESOURCES: NIL**

**WEB LINK: NIL**



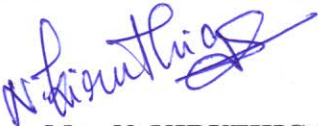

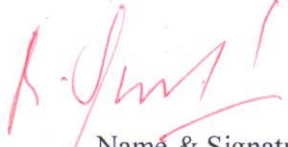
## MAPPING WITH PROGRAM OUTCOMES

CO \ PO	PO1	PO2	PO3	PO4
CO1	S	S	M	M
CO2	S	M	S	S
CO3	M	S	M	M
CO4	M	M	S	M
CO5	M	S	S	S

S-Strong; M- Medium

### ASSESSMENT PATTERN (if deviation from common pattern)

Follows common pattern of Internal and External assessment, suggested in the Regulations.

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  
 HINDUSTHAN COLLEGE OF ARTS AND SCIENCE  
 COIMBATORE - 641 028.

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

BOS meeting approved:

Approved in 7 Academic Council meeting on: 24.08.2021

<b>Programme Code:</b>	<b>DSC</b>	<b>Programme Title: Master of Science in Biotechnology</b>							
<b>Course Code:</b>	<b>20BTP22</b>	<b>Course Title</b>						<b>Batch:</b>	<b>2020-2021 onwards</b>
		<b>PRACTICAL VIII – PLANT BIOTECHNOLOGY</b>						<b>Semester:</b>	<b>III</b>
<b>Hrs/Week:</b>	<b>4</b>	<b>L</b>	<b>-</b>	<b>T</b>	<b>1</b>	<b>P</b>	<b>3</b>	<b>Credits:</b>	<b>2</b>

### COURSE OBJECTIVES

1. To acquire knowledge about layout of plant tissue culture lab, and culture environment,
2. To impart knowledge on media preparation and various sterilization techniques
3. To learn the principles behind the establishment of various cultures
4. To gain knowledge on basic principles and mechanism of Haploid plant, Somatic hybrid production
5. To explore procedure for establishment of virus free plant, artificial seeds and isolation of genomic DNA

### COURSE OUTCOMES (CO)

S. No	COURSE OUTCOME	BLOOMS LEVEL
CO1	List the knowledge about the Lab organization & measures adopted for aseptic manipulation and nutritional requirements of cultured tissues.	K1
CO2	Explain the protocol for media preparation, explant sterilization and apply knowledge for large scale clonal propagation of plants through various Micropropagation techniques	K2
CO3	Use principles, technical requirement, scientific and commercial applications of various culture system in Plant Biotechnology	K3
CO4	Identify procedure for production of homozygous lines and somatic hybrids	K4
CO5	Prioritize the methods of protocols to develop meristematic culture, synthetic seed preparation and DNA analysis	K5
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5 - Evaluate</b>		



## SYLLABUS

Code	Subject Name	Semester
20BTP22	PRACTICAL VIII – PLANT BIOTECHNOLOGY	III
Topics		Hours
1. Plant Tissue Culture Laboratory Organization		2
2. Preparation of MS nutrient Medium and sterilization		4
3. Surface sterilization and establishment of Callus Culture		5
4. <i>In vitro</i> Germination of Seeds		3
5. Isolation and Culture of Embryos		5
6. Anther Culture		5
7. Establishment of suspension culture		5
8. Protoplast isolation and protoplast fusion		5
9. Artificial seeds production and stability testing of sodium alginate		3
10. Production of Virus Free Plants		5
11. Axillary bud culture		5
12. Isolation of genomic DNA from plant tissue		5
<b>Total</b>		<b>52</b>

**Distribution of marks for Practical: (IE 40; EE 60)**

**Teaching methods:** Demonstration, Lecturing, PowerPoint Projection through LCD, Assignment, Discussion and Activity and Hands on training.

### REFERENCE BOOK:

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

**WEB RESOURCES:** NIL

**WEBLINK:** NIL




### MAPPING WITH PROGRAM OUTCOMES

CO \ PO	PO1	PO2	PO3	PO4
CO1	S	S	M	M
CO2	S	S	S	M
CO3	S	S	S	M
CO4	S	S	S	S
CO5	M	M	S	M

S-Strong, M- Medium

**ASSESSMENT PATTERN (if deviation from common pattern)**

Follows common pattern of Internal and External assessment, suggested in the Regulations.

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

BOS meeting approved:

Approved in 7<sup>th</sup> Academic Council meeting on: 24.08.2021



<b>Programme Code:</b>	<b>DSC</b>	<b>Programme Title: Master of Science in Biotechnology</b>							
<b>Course Code:</b>	<b>20BTP23</b>	<b>Course Title</b>						<b>Batch:</b>	<b>2020-2021 onwards</b>
		<b>ENVIRONMENTAL BIOTECHNOLOGY AND NANOTECHNOLOGY</b>						<b>Semester:</b>	<b>IV</b>
<b>Hrs/Week:</b>	<b>5</b>	<b>L</b>	<b>5</b>	<b>T</b>	<b>-</b>	<b>P</b>	<b>-</b>	<b>Credits:</b>	<b>5</b>

### COURSE OBJECTIVES

1. To learn the universal issues of environment with respect to pollution, its control and monitoring and new technologies.
2. To provide insights on source, biotechnological approaches for measurement and management of pollution and synthesis and key aspects of nanoparticles.
3. To understand the biotechnological methods for solid and hazardous waste management with reference to nanotechnology and modern techniques for characterization of nanoparticles.
4. To acquire knowledge on applications of biotechnology in various fields includes global environmental issues, biomonitoring and waste management with specific emerging technologies.
5. To explore the current status and future prospects of environmental issues and applications of nano-materials in environmental management.

### COURSE OUTCOMES (CO)

<b>S. No</b>	<b>COURSE OUTCOME</b>	<b>BLOOMS LEVEL</b>
CO1	Recognize the various global and regional environmental concerns due to natural causes and/or human activities and the role of nanotechnology in environment concerns	K1
CO2	Infer the different types of environmental pollution and their impacts, key aspects of pollution management, synthesis, characterization and basic application of nanoparticles	K2
CO3	Relate the diverse concepts for disposal and management of solid, liquid, hazardous wastes with reference to nanotechnology and modern techniques for characterization of nanoparticles	K3
CO4	Categorize the applications in various fields includes global environmental issues, biomonitoring, waste management with specific emerging technologies.	K4
CO5	Appraise an awareness of emerging concerns such as climate change, waste management or management of effluent toxicity and key aspect of new technologies addressing for these.	K5
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5- Evaluate</b>		

## SYLLABUS

Code	Subject Name	Semester
20BTP23	ENVIRONMENTAL BIOTECHNOLOGY AND NANOTECHNOLOGY	IV
Unit No.	Topics	Hours
I	<b>Introduction to Pollution</b> Introduction - Types of pollution – Air, water, sound & Soil Pollution. Measurement of pollution – Air Quality Standards; Water Quality Standards; Noise Standards/Rules – CPCB Guidelines. Global environmental problems - ozone depletion, green house effect and acid rain. Control of pollution through Biotechnology – Pollution Monitoring through Biosensors.	11
II	<b>Water Pollution</b> Water management, measurement and sources of water pollution. Biotechnological approaches for industrial waste water treatment - dairy, tannery, and pharmaceutical industries. Biodegradation of inorganic and organic wastes - lignin, tannin. Bioremediation of oil spills – Case studies in India. Biomonitoring of water pollution using algae, bacteria, macrophytes, invertebrates, fishes (Bio indicators). Management for effluent toxicity, heavy metal pollution, thermal and radioactive pollution	13
III	<b>Waste management</b> Types of solid wastes. Solid waste characteristics and its impact on environment. Non toxic- composting, mushroom farming, Vermiculture, biogas production coir wastes and myco-straw wastes. Toxic - Solid waste disposal - land filling, incineration, Processing of sugar factory wastes, residential and municipal wastes. Biodegradation of xenobiotics compounds. Biotechnological methods for hazardous waste management.	13
IV	<b>Synthesis of Nano Materials &amp; Characterization</b> Definition of a nano system - dimensionality and size dependent phenomena, Quantum dots, Nanowires and Nanotubes, 2D films. Methods for synthesis of Nanoscale Materials. UV-Spectroscopy, X-ray diffraction, Energy dispersive X-ray Analysis. Scanning electron microscopes, transmission electron microscopes, atomic force microscopy, scanning tunneling microscope Nuclear Magnetic Resonance Spectroscopy, Electron Spin Resonance Spectroscopy, IR & Raman Spectroscopy.	13
V	<b>Applications of nanotechnology</b> <b>Nano remediation:</b> Identification and characterization of Hazardous waste, Nano Pollution, Air- Water - Soil Contaminants, Identification and Characterization of Organic and inorganics, Environmental cleanup technologies <b>Nano Remediation Technologies:</b> Environmental Nano Remediation Technology - Thermal, Physico-Chemical and Biological Methods, Nano Filtration for treatment of waste – removal of organics & inorganics and pathogens, Nanotechnology for waste water remediation and purification. Treatment of hi-tech industrial waste waters using Nano particles/ modified structures/devices. Environmental Benefits of nanomaterials.	15
<b>Total</b>		65

**Distribution of marks for Theory: (IE 30; EE 70)**

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

**TEXT BOOKS:**

1. Dash and Dash, 2009, *Fundamentals of Ecology*, 3<sup>rd</sup> Edn., TMH Education.
2. Mohapatra, 2007, *Text Book of Environmental Biotechnology*, 1<sup>st</sup> Edn., I K International Publishing House Pvt.Ltd.

BOS meeting approved:

Approved in 7<sup>th</sup> Academic Council meeting on: 24.08.2021



## REFERENCE BOOK

1. Niemeyer and Mirkin, 2004, *Nanobiotechnology: concepts, applications & perspectives*, 1<sup>st</sup> Edn., Wiley and Sons
2. Jain, K. K., 2005, *Nanobiotechnology in molecular diagnostics: current techniques and applications*, 1<sup>st</sup> Edn., CRC Press.

## WEB RESOURCES: NPTEL, MOOC

### WEBLINK:

1. <https://nptel.ac.in/courses/118/107/118107015/>
2. <https://www.mooc-list.com/tags/nanotechnology>


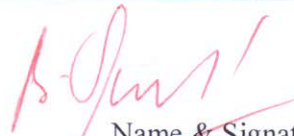
## MAPPING WITH PROGRAM OUTCOMES

PO \ CO	PO1	PO2	PO3	PO4
CO1	M	S	S	M
CO2	S	S	S	M
CO3	S	S	S	M
CO4	S	S	S	M
CO5	M	S	S	M

S- Strong; M – Medium

## ASSESSMENT PATTERN (if deviation from common pattern)

Follows common pattern of Internal and External assessment, suggested in the Regulations.

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

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

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



<b>Programme Code:</b>	<b>DSE</b>	<b>Programme Title: Master of SCIENCE IN BIOTECHNOLOGY</b>		
<b>Course Code:</b>	<b>20BTP24A</b>	<b>Course Title</b>	<b>Batch:</b>	<b>2020-2021 onwards</b>
<b>Hrs/Week:</b>	<b>4</b>	<b>Elective IV- BIOINSTRUMENTATION</b>	<b>Semester:</b>	<b>IV</b>
			<b>Credits:</b>	<b>3</b>

### Course Objective

1. To understand the basic analytical instruments in the field of Biotechnology.
2. To learn the working principles of advanced spectroscopic and chromatographic techniques used for separation of biological compounds.
3. To impart technical information on MALDI TOF IR and Image fluorescent techniques for gene and protein expression studies.
4. To obtain knowledge on instrumentation used for detection of radio isotopes.
5. To provide insights on Electrophoresis, flow cytometry and Radioisotope Techniques

### Course Outcomes (CO)

<b>S. No</b>	<b>COURSE OUTCOME</b>	<b>BLOOMS LEVEL</b>
CO1	Describe the importance of basic analytical instruments in biological Laboratory	K1
CO2	Explain the working principle of advanced spectroscopic and chromatographic techniques used for the separation of biological compounds	K2
CO3	Determine protein expression using MALDI TOF IR spectroscopy and image fluorescent techniques for gene expression studies.	K3
CO4	Categorize the instrumentation and application of various bio-medical equipment and explain on autoradiography	K4
CO5	Justify the working principle of electrophoretic techniques used for separation and bio instruments used in detection of radioisotopes	K5
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5-Evaluate</b>		

## Syllabus

Code	Subject Name	Semester
20BTP24A	Elective IV- BIOINSTRUMENTATION	IV
Unit No.	Topics	Hours
I	<b>Basics instruments</b> pH meter, Buffer of biological importance, Centrifuge- Preparative, Analytical and Ultra, Laminar Air Flow, Autoclave, Hot Air Oven and Incubator, Colorimeter	9
II	<b>Spectroscopic Techniques</b> Spectrophotometry: Principles, types and applications, UV-VIS double beam spectrophotometry, Spectrofluometry, Mass spectroscopy, MALDI TOF IR spectroscopy, Flame photometry. NMR Spectroscopy, Circular Dichroism and X-ray diffraction studies	10
III	<b>Chromatographic Techniques</b> Principles, types and applications of chromatography, Paper chromatography, Thin layer chromatography (TLC), size exclusion, Ion Exchange chromatography, affinity chromatography. High performance liquid chromatography (HPLC), Gas chromatography (GC),	12
IV	<b>Imaging Fluorescence and radiation based techniques</b> Principle, Instrumentation and application of ECG, EEG, EMG, MRI, CT and PET scan radioisotopes, Flame photometer, Scintillation counter, Geiger Muller counter, Autoradiography	9
V	<b>Electrophoresis and Radioisotope Techniques</b> Principles, types and applications of Electrophoresis. Agarose gel electrophoresis PAGE (SDS/Native), Gradient gel, Isoelectric focusing, 2-D gel electrophoresis (2-D PAGE), cellulose, Capillary electrophoresis. Flow cytometry Nature & detection of radio isotopes; Applications of Radio isotope techniques.	12
	<b>Total</b>	<b>52</b>

**Distribution of marks for Theory: (IE 30; EE 70)**

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

### Text Books:

1. Geddes L. A. and L. E. Baker, 2008, *Principles of Applied Biomedical Instrumentation 3<sup>rd</sup> Edn.*, John Wiley and Sons.
2. Rodney F. Boyer, 2000, *"Modern Experimental Biochemistry"*, 3<sup>rd</sup> Edn., Pearson

### Reference Books:

1. Sawhney S. K. and Randhir Singh, 2014, *"Introductory to Practical Biochemistry"*, 5<sup>th</sup> Edn., Narosa Publishing House, New Delhi.
2. Rodney F. Boyer, 2012, *Biochemistry Laboratory: Modern Theory and techniques 2<sup>nd</sup> Edn.*, Prentice Hall.



**WEB RESOURCES: NPTEL**

**WEB LINK:**

1. [https://onlinecourses.nptel.ac.in/noc20\\_bt28/preview](https://onlinecourses.nptel.ac.in/noc20_bt28/preview)

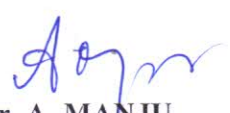


**MAPPING OF OUTCOMES**

CO \ PO	PO1	PO2	PO3	PO4
CO1	M	M	M	-
CO2	S	M	S	M
CO3	M	S	S	M
CO4	S	S	S	M
CO5	S	S	M	S

**S - Strong; M-Medium**

**ASSESSMENT PATTERN (if deviation from common pattern)**

Follows common pattern of Internal and External assessment, suggested in the Regulations.

Course Designed by	Verified by HOD	Approved by CDC Co-ordinator
 <b>Dr. A. MANJU</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.

<b>Programme Code:</b>	<b>DSE</b>	<b>Programme Title: Master of SCIENCE IN BIOTECHNOLOGY</b>		
<b>Course Code:</b>	<b>20BTP24B</b>	<b>Course Title</b>	<b>Batch:</b>	<b>2020-2021 onwards</b>
		<b>Elective IV- TOOLS IN BIOTECHNOLOGY</b>	<b>Semester:</b>	<b>IV</b>
<b>Hrs/Week:</b>	<b>4</b>		<b>Credits:</b>	<b>3</b>

### Course Objective

1. To understand the procedure for laboratory safety measures and routine clinical tests for different samples like blood, body fluids cancer and malignant cells.
2. To give students a solid foundation in diagnostic methods and different types of examining procedures for all types of samples with its microbial and pathological identification of several diseases with the help of advanced equipment.
3. To gain insights on microbial, pathological and immunological diagnostic methodology for analyzing various specimens based on the symptoms and causes of the disease.
4. To develop analytical and clinical skills in hematology, serology, microbiology and pathological study and banking system
5. To explore various applications of diagnostic and medical equipment for assessment to treat the disease related with the hematological, clinical pathology and microbial samples and treatment methods.

### Course Outcomes (CO)

S. No	COURSE OUTCOME	BLOOMS LEVEL
CO1	Describe the basics of clinical laboratory safety measures, and routine clinical tests for different samples like blood, body fluids cancer and malignant cells.	K1
CO2	Extend the knowledge on different types of examining procedures for all types of samples with its microbial and pathological identification of several diseases with various modern and updated clinical diagnostic tests to examining the disease for human welfare	K2
CO3	Relate the biochemical, microbial and metabolic problems by examining diagnostic methodology for analyzing various specimen based on the symptoms and causes of the disease	K3
CO4	Examine the Hematology, serology and clinical pathology specimen with various laboratory procedures and for analytical methods along with banking procedures.	K4
CO5	Assess the importance of sophisticated medical equipment for assessment to treat the disease related with the hematological, clinical pathology and microbial samples and treatment methods	K5
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5- Evaluate</b>		



Code	Subject Name	Semester
20BTP24B	Elective IV- TOOLS IN BIOTECHNOLOGY	IV
Unit No.	Topics	Hours
I	<b>Haematology</b> Laboratory Safety and First Aid - Routine Haematological Tests – Special Haematological Tests – Blood Banking and Blood Transfusion Therapy.	9
II	<b>Serology</b> Basic Serodiagnostics tests – Agglutination Test for Serodiagnostics – Serodiagnostics for Streptococcal Infection. – Immunological Test for Pregnancy.	10
III	<b>Clinical Pathology</b> Urine analysis – Collection – Physical, Chemical and Microscopic Examination of Urine – Laboratory evaluation of Body Fluids like CSF – Synovial Fluid – Vaginal Discharge – Gastric Juices - Semen Analysis – Stool Examination.	11
IV	<b>Diagnostic Microbiology</b> Laboratory Procedures in Microbiology – Quality Control in Microbiology – Identification of Pathogenic Microbes – Diagnosis of Sputum Specimen – Faecal Specimen – Urine Specimen – Body Exudates – CSF – Laboratory Diagnosis of Leprosy. Fungal Diagnosis – Dermatormycosis – Subcutaneous Mycosis.	10
V	<b>Other Diagnosis and Diagnostic equipment's</b> Parasitic Examination of Stool Specimen – Histology and Cytology – Tissue Preparation – Staining of Tissues – Identifying Characteristics of Benign and Malignant Cells. <b>Diathermy:</b> Clinical applications of electrotherapy, short wave diathermy, ultrasonic diathermy, microwave diathermy, surgical diathermy unit, IR lamps, UV lamps, endoscopy. Laproscopy	12
	<b>Total</b>	<b>52</b>

**Distribution of marks for Theory: (IE 30; EE 70)**

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

**Text Books:**

1. Kanai L. Mukherjee, 2013, "Medical Laboratory Technology", 3<sup>rd</sup> Edn., Tata Mc Graw Hill publications, Chennai.
2. Khandpur R.S, 2014, "Handbook of Biomedical Instrumentation", 3<sup>rd</sup> Edn., Tata McGraw-Hill, New Delhi.

**Reference Books:**

1. Talib V.H, 2015, "Handbook of Medical Lab Technology", 2<sup>nd</sup> Edn., CBS publication, New Delhi.
2. Allen Gaw, Robert A.Cowan, 2016, "An Illustrated color text of Clinical Biochemistry", 5<sup>th</sup> Edn., ChurchillLiving stone press, Scotland.

WEB RESOURCES: MOOC, SWAYAM, NPTEL

WEB LINK:

1. <https://online-learning.tudelft.nl/courses/industrial-biotechnology/>
2. [https://onlinecourses.nptel.ac.in/noc20\\_bt32/preview](https://onlinecourses.nptel.ac.in/noc20_bt32/preview)
3. <https://nptel.ac.in/courses/102/103/102103013/>

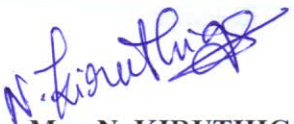

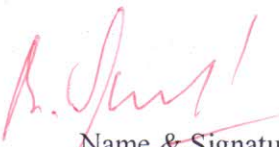
Mapping of Outcomes

CO \ PO	PO1	PO2	PO3	PO4
CO1	S	M	M	M
CO2	S	S	S	M
CO3	M	S	S	M
CO4	S	S	M	M
CO5	M	M	S	S

S - Strong; M-Medium

ASSESSMENT PATTERN (if deviation from common pattern)

Follows common pattern of Internal and External assessment, suggested in the Regulations.

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

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

BOS meeting approved:

Approved in 7 Academic Council meeting on: 24.08.2021



<b>Programme Code:</b>	<b>DSE</b>	<b>Programme Title: Master of SCIENCE IN BIOTECHNOLOGY</b>		
<b>Course Code:</b>	<b>20BTP24C</b>	<b>Course Title</b>	<b>Batch:</b>	<b>2020-2021 onwards</b>
		<b>ELECTIVE IV- MEDICAL BIOTECHNOLOGY</b>	<b>Semester:</b>	<b>IV</b>
<b>Hrs/Week:</b>	<b>4</b>		<b>Credits:</b>	<b>3</b>

### Course Objective

1. Possess knowledge and comprehension of the core and basic knowledge associated with the profession of Medical, genetic and pathological disorders in human body and safety levels.
2. To learn about morphology of different pathogens with the mode of infection and genetic health with its etiology bacterial, viral, fungal and parasitic infections.
3. To explore knowledge on toxins of bacterial, viral, fungal and parasitic infections based on the different species and its treatment methods.
4. To understand the basis of infectious symptoms and preventive measures of various microbial and parasitic infection along with therapeutic approaches like gene therapy, chemotherapy, etc.
5. To provide insights on various infections, causative agents, diagnostic methods and control mechanism of various microbial flora and its treatment methods.

### Course Outcomes (CO)

S. No	COURSE OUTCOME	BLOOMS LEVEL
CO1	Describe the basic knowledge on medical, genetic and microbial population of human body and its Pathogenicity with its safety level.	K1
CO2	Predict the morphology, pathogenesis, symptoms, laboratory diagnosis, and preventive measures of bacterial diseases etiology bacterial, viral, fungal and parasitic infections.	K2
CO3	Illustrate the worldwide exploration of microbes in human and its morphological identification and diagnosis related with therapeutic intervention of genetic disorders	K3
CO4	Identify the diagnostic procedure and remedial measures for various microbial and parasitic infection along with therapeutic approaches	K4
CO5	Justify the causative agents, and control mechanism for various bacterial, viral, fungal and protozoan infections	K5
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5-Evaluate</b>		

Code	Subject Name	Semester
20BTP24C	ELECTIVE IV- MEDICAL BIOTECHNOLOGY	IV
Unit No.	Topics	Hours
I	<b>Introduction:</b> Normal microflora of human body, nosocomial infections, carriers, septic shock, septicemia, pathogenicity, virulence factors, toxins, biosafety levels.	9
II	<b>Genetic disorders:</b> Genetic disease, type of inheritance, single-gene and multifactorial inheritance, example of genetic diseases. Therapeutic intervention in blood disorder by stem cell transplantation/gene therapy	12
III	<b>Etiology of bacterial diseases:</b> Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy caused by Gram negative bacteria ( <i>E. coli</i> , <i>N. gonorrhoea</i> , <i>N. meningitidis</i> , <i>P. aeruginosa</i> , <i>S. typhi</i> , <i>S. dysenteriae</i> , <i>Y. pestis</i> , <i>H. influenzae</i> ,) and Gram positive bacteria ( <i>S. aureus</i> , <i>S. pyogenes</i> , <i>B. anthracis</i> , <i>C. perferinges</i> , <i>C. tetani</i> , <i>C. botulinum</i> ):	10
IV	<b>Viral diseases:</b> Diseases caused by viruses- Picornavirus, Orthomyxoviruses, Paramyxoviruses, Rhabdoviruses, Reoviruses, Pox virus, Herpes virus, Papova virus, Retro viruses (including HIV/AIDS) and Hepatitis viruses. Antigenic shift and drift	9
V	<b>Fungal and Protozoan infections.</b> Dermatophytoses Subcutaneous infection ( <i>Sporothrix</i> , <i>Cryptococcus</i> ), systemic infection ( <i>Histoplasma</i> , <i>Coccidoides</i> ) and opportunistic fungal infections ( <i>Candidiasis</i> , <i>Aspergillosis</i> ), Gastrointestinal infections ( <i>Amoebiasis</i> , <i>Giardiasis</i> ), Blood-borne infections ( <i>Leishmaniasis</i> , <i>Malaria</i> )	12
	<b>Total</b>	<b>52</b>

**Distribution of marks for Theory:(IE 30; EE 70)**

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

#### TEXT BOOKS

1. Presscott L.M, Harley J. P. and Klein D. A., 2008, "Microbiology", 7<sup>th</sup> Edn., McGraw-Hill Education.

#### REFERENCE BOOKS

1. Brooks, G. F., Carroll, K. C., Butel, J. S., and Morse, S. A., 2007, *Medical Microbiology*, 2<sup>4</sup><sup>th</sup> Edn., McGraw Hill Publication.
2. Goering, R., Dockrell, H., Zuckerman, M. and Wakelin D. 2007, *Mims' Medical Microbiology*. 4<sup>th</sup> Edn., Elsevier.

WEB RESOURCES: NPTEL

WEB LINK: 1. <https://nptel.ac.in/courses/102/106/102106057/>




Mapping of Outcomes

CO \ PO	PO1	PO2	PO3	PO4
CO1	M	M	S	M
CO2	S	S	M	M
CO3	M	S	S	S
CO4	M	S	S	M
CO5	M	S	S	M

S - Strong; M-Medium

ASSESSMENT PATTERN (if deviation from common pattern)

Follows common pattern of Internal and External assessment, suggested in the Regulations.

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

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.

BOS meeting approved:

Approved in 7 Academic Council meeting on: 24.08.2021



<b>Programme Code:</b>	<b>DSC</b>	<b>Programme Title: Master of Science in Biotechnology</b>								
<b>Course Code:</b>	<b>20BTP25</b>	<b>Course Title</b>						<b>Batch:</b>	<b>2020-2021 onwards</b>	
		<b>PRACTICAL IX – ENVIRONMENTAL BIOTECHNOLOGY AND NANOTECHNOLOGY</b>						<b>Semester:</b>	<b>IV</b>	
<b>Hrs/Week:</b>	<b>5</b>	<b>L</b>	<b>-</b>	<b>T</b>	<b>1</b>	<b>P</b>	<b>4</b>	<b>Credits:</b>	<b>2</b>	

### COURSE OBJECTIVES

1. To analyse the various physico-chemical properties of waste water samples
2. To offer hands on training on isolating microorganism from polluted environment
3. To ascertain microbes in varied sources of water sample
4. To provide experimental learning on green mediated synthesis of nanoparticles and characterisation
5. To gain insights on the phenomena of nanotechnology in bioremediation of industrial wastewaters.

### COURSE OUTCOMES (CO)

<b>S. No</b>	<b>COURSE OUTCOME</b>	<b>BLOOMS LEVEL</b>
CO1	Recall to design and execute experimental protocol for physico-chemical properties wastewater	K1
CO2	Explain the isolation method for microbial population in polluted environment	K2
CO3	Examine the potability water using qualitative and quantitative analysis	K3
CO4	Investigate the green synthesis and characterization of nanoparticles	K4
CO5	Asses the phenomena of nanotechnology in bioremediation of industrial waste waters.	K5
<b>K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5-Evaluate</b>		

## SYLLABUS

Code	Subject Name	Semester
20BTP25	<b>PRACTICAL IX - ENVIRONMENTAL BIOTECHNOLOGY AND NANOTECHNOLOGY</b>	<b>IV</b>
<b>Topics</b>		<b>Hours</b>
1. Sampling techniques: Waste water analysis for physico - chemical characteristics such as pH, conductivity, DO, BOD, COD, alkalinity, chlorides and fluorides, nitrates, hardness, settle ability of solids.		33
2. Isolation of microorganisms (Bacteria and Fungi) from polluted environment		5
3. MPN test		5
4. Synthesis of green nanoparticles (silve) and characterization using UV Spectrophotometer		10
5. Bioremediation of industrial wastewater using synthesized nanoparticles		12
<b>Total</b>		<b>65</b>

*Distribution of marks for practical: (IE 40; EE 60)*

**Teaching methods:** Demonstration, Lecturing, PowerPoint Projection through LCD, Assignment, Discussion and Activity and Hands on training.

**REFERENCE:**

1. G. Murugesan and C. Rajakumari, 2005, *Environmental Science and Biotechnology – Theory and Techniques*, 1<sup>st</sup> Edn., MJP Publishers.
2. Christon J Hurst, 2002, *Manual of Environmental Microbiology*, 2nd Edn., American Society for Microbiology, Washington.
3. Gerrard Eddy and Jai Poinern, 2014, *Laboratory Course in Nanoscience and Nantechnology*, 1<sup>st</sup> Edn., CRC Press.

**WEB RESOURCES:** NIL

**WEB LINK:** NIL



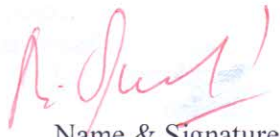
**MAPPING WITH PROGRAM OUTCOMES**

CO \ PO	PO1	PO2	PO3	PO4
CO1	S	M	S	M
CO2	S	S	S	M
CO3	M	S	S	-
CO4	S	S	S	M
CO5	S	S	S	M

S - Strong; M-Medium

**ASSESSMENT PATTERN (if deviation from common pattern)**

Follows common pattern of Internal and External assessment, suggested in the Regulations.

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

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.**

BOS meeting approved:

Approved in 7<sup>th</sup> Academic Council meeting on: 24.08.2021