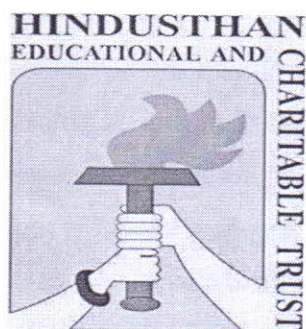


LEARNING OUTCOMES–BASED CURRICULUM FRAMEWORK (LOCF)

in the

POSTGRADUATE PROGRAMME IN BIOTECHNOLOGY

**FOR THE STUDENTS ADMITTED FROM THE ACADEMIC
YEAR 2021 - 2022 AND ONWARDS**



HICAS

HINDUSTHAN COLLEGE OF ARTS AND SCIENCE (AUTONOMOUS)

(Affiliated to Bharathiar University and Accredited by NAAC)

COIMBATORE-641028

TAMILNADU, INDIA.

Phone: 0422-4440555

Website: www.hindusthan.net/hicas/

PREAMBLE

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

VISION

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

MISSION

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

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

- PEO 1:** To update, encompass and extend students 'knowledge through a flexible, research-intensive program similar to academia and industry requirements.
- PEO 2:** To enhance career opportunities in research and industry globally or as a preparation for further higher education through state of the art laboratory exposures and outbound dissertation activities fostering Global Competencies among Students.
- PEO 3:** To promote critical thinking and full-fledged grasp of essential aspects of bioethics inculcating a Value System among Students.
- PEO 4:** To enrich the global think-tank with right mixes of innovative ability, existing policies at generating and safeguarding the product of their intellect, equipped with entrepreneurship abilities contributing to self and national development.
- PEO 5:** To train the students for industrial need and to pursue further education and inculcate entrepreneurship among the students so as to start their own ventures in the field of biotechnology

PROGRAMME OUTCOMES

- PO1:** To engage loyal students in areas not qualified in their former academic lives and to take them to a reference point that will permit them to conduct translational research, from intangible design through in vivo testing with an eye towards clinical execution
- PO2:** To provide interdisciplinary research and enlightening opportunities to explain problems that will progress the quality of life for those misery from health-related ailments and conditions.
- PO3:** To provide moral grounds for social guidelines aimed at shielding the Earth's environment and improving environmental degradation
- PO4:** To employ tools for Genetic resourcefulness in Fermentation, Selection and Breeding, Genetic analysis, Tissue culturing, Genetic Engineering/Recombinant DNA, and DNA analysis towards viability in economic and environmental features, and user friendly.
- PO5:** To impart skill for successful business start-ups and for building associations by persuading communications either positively or negatively
- PO6:** To provide students with the opening to teach themselves the most indispensable skill to become all-time learners: knowledge of how to learn and to not teach students how to learn, rather than what to learn.
- PO7:** To promote organization's tactic to research veracity – the formal and informal ethics, ideals, protocols and guidelines researchers trail in their environment to become more gratifying and successful environment.

PROGRAMME SPECIFIC OUTCOMES (PSO)

- PSO1:** Understand the basic knowledge and concepts of biotechnology and other related areas.
- PSO2:** Understand develop skills to verbalize accountable questions/hypotheses, predict expected results.
- PSO3:** Apply their knowledge in other advanced Course area like Nano biotechnology, Immunotechnology, and animal and plant biotechnology for the betterment and advancement of their professional career.
- PSO4:** Learn the theoretical and practical exposure to the basic and the advanced fields of biotechnology and validate respectable lab citizenry and the capability to work with others
- PSO5:** Adopt to become an eminent researcher or Scientist in the field of biotechnology to discover/innovate unique products for societal need with proper ethical statute.

**HINDUSTHAN COLLEGE OF ARTS & SCIENCE (AUTONOMOUS),
COIMBATORE-641028**

SCHEME OF EXAMINATIONS - CBCS & LOCF PATTERN

(For the Students admitted from the Academic year 2021-2022 and Onwards)

PG PROGRAMME

Programme: M.Sc.

Branch: Biotechnology

Course Code	Course Type	Course Title	Credit points	Lecture Hours/ Week		Exam Duration (hours)	MAX. MARKS		
				Theory	Practical		I.E.	E.E	Total
Semester - I									
21BTP01	DSC	Cell and Molecular Biology	4	4		3	40	60	100
21BTP02	DSC	Applied Microbiology	4	4		3	40	60	100
21BTP03	DSC	Biochemistry and Metabolism	4	4		3	40	60	100
21BTP04	DSC	Practical I - Cell and Molecular Biology	2		4	6	50	50	100
21BTP05	DSC	Practical II - Applied Microbiology	3		5	6	50	50	100
21BTP06	DSC	Practical III - Biochemistry and Metabolism	2		4	6	50	50	100
21BTP07	DSE	Elective I / DSE- I	3	4		3	40	60	100
21BTP08	SEC	Internship / Institutional Training / Mini-Project	2	-		-	100	-	100
21BTPJ01	SEC	Aptitude / Placement Training	Grade *	2		-	50		50**
21BTPE01	AEE	Open Elective - I	2	3		-	100		100
21BTPV01	ACC	VAC-I	1*	2		-	50	-	50**
	SEC	SDR – Student Development Record	Assessment will be done in the end of III semester						
		Total	26	23	13		510	390	900
Semester – II									
21BTP09	DSC	Genetic Engineering	4	4		3	40	60	100
21BTP10	DSC	Plant Biotechnology	4	4		3	40	60	100
21BTP11	DSC	Research Methodology and Biostatistics	4	4		3	50	50	100
21BTP12	DSC	R Programming for Biologists	4	4		3	40	60	100
21BTP13	DSC	Practical IV- Genetic Engineering	3		5	6	50	50	100
21BTP14	DSC	Practical V- Plant Biotechnology	3		5	6	50	50	100
21BTP15	DSC	Practical VI - R Programming for Biologists	2		3		50	50	100
21BTP16	SEC	Internship / Institutional Training / Mini-Project / Extension Activity	2	-		-	100	-	100
21BTPE02	AEE	Open Elective - II	2	3		3	100		100
21BTPJ02	SEC	Online Courses	Grade *	-	-	-	-	-	C/NC
21BTPJ03	SEC	Aptitude / Placement Training	Grade	2		-	50		50**

			*						
21BTPV02	ACC	VAC-II	1*	2		-	50	-	50**
		Total	28	23	13		520	380	900
		Semester – III							
21BTP17	DSC	Immunology and Immunotechnology	4	4		3	40	60	100
21BTP18	DSC	Bioprocess Technology	4	4		3	40	60	100
21BTP19	DSC	Animal and Pharmaceutical biotechnology	4	4		3	40	60	100
21BTP20	DSC	Environmental Biotechnology and Bio nanotechnology	4	4		3	40	60	100
21BTP21	DSC	Practical VII – Immunology and Immunotechnology	2		3	6	50	50	100
21BTP22	DSC	Practical VIII – Animal Biotechnology, Pharmaceutical Biotechnology and Bioprocess Technology	2		4	6	50	50	100
21BTP23	DSC	Practical IX -Environmental Biotechnology and Bio Nanotechnology	2		3	6	50	50	100
21BTP24	DSE	Elective II / DSE- II	3	3		3	40	60	100
21BTP25	SEC	Internship / Institutional Training / Mini-Project / Extension Activity	2	-		-	100	-	100
21BTPE03	AEE	Open Elective-III	2	3		3	100	-	100
21BTPJ04	SEC	Aptitude / Placement Training	Grade *	2		-	50		50**
21BTPJ05	SEC	Online Courses	Grade *	-	-	-	-	-	C/NC
21BTPV03	ACC	VAC-III	1*	2		-	50	-	50**
21BTPJ06	SEC	SDR – Student Development Record	2*	-	-	-	-	-	-
		Total	29	26	10		550	450	1000
		Semester – IV							
21BTP26	DSE	Elective III / DSE- III	3	5		3	40	60	100
21BTP27	DSE	Elective IV / DSE- IV	3	5		3	40	60	100
21BTP28	DSC	Self-Study Course	3	-	-	3	40	60	100
21BTP29	SEC	Project Work /Student Research	6	-		-	50	150	200
		Total	15	10			170	330	500
		Grand Total							

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

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

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

PASSING MINIMUM

- Passing Minimum for PG 50%

Abstract for Scheme of Examination

(For the students admitted during the academic year 2021 - 2022 and onwards)

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

List of Open Elective Papers

Open Electives	Yoga for Human Excellence Human Health & Hygiene Indian Culture and Heritage Indian Constitution and Political System Consumer Awareness and Protection Professional Ethics and Human Values Human Rights, Women's Rights & Gender Equality Disaster Management Green Farming Corporate Relations start a Business? Research Methodology and IPR General Studies for Competitive Examinations IIT JAM Examination (for Science only) CUCET Examination
VAC Papers	-
Courses offered by the Departments to other Programmes	Cheminformatics Organic Farming and Vermitechnology – Mushroom Technology Fisheries Technology Food Safety and Regulations Biosafety in Clinical Applications

List of Elective Papers/ DSE (Can choose any one of the paper as electives)		
	Course Code	Title
Electives/ DSE-I	21BTP07 A	BIOETHICS AND BIOSAFETY
	21BTP07 B	DEVELOPMENTAL BIOLOGY AND BEHAVIORAL STUDIES
Electives/ DSE-II	21BTP24 A	
	21BTP24 B	
Electives/ DSE-III	21BTP26 A	
	21BTP 26 B	
Electives/ DSE-IV	21BTP27 A	
	21BTP27 B	


Syllabus Coordinator


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


Academic Council - Member Secretary


PRINCIPAL

Co-ordinator
Academic Audit Cell
Hindusthan College of Arts & Science,
Coimbatore-641 028.

PRINCIPAL
Hindusthan College of Arts and Science
Hindusthan Gardens, Behind Nava India
Coimbatore - 641 028.

Regulations

1. Internship / Institutional Training / **Mini-Project** is related to the discipline can be permitted to complete during the end of I and III semesters for minimum seven days each and permitted to submit a report.

Internship / Institutional Training	Not more than seven days
Mini project	Depends on the departments

2. Project work is considered as a special course involving application of knowledge in problem solving / analyzing /exploring a real-life situation. A Project work may be given in lieu of a discipline specific elective paper.
3. To fix the practical marks for PG Programme for Internal assessment and External assessment as 50 marks I.E. and 50 marks E.E and to modify the component for Internal assessment as Test-1 = 20, Test-2 = 20 and Observation and concept application = 10.
4. To modify the Internal and External Assessment marks FOR THEORY as 40 and 60 for all the post graduate Programme for the Academic year 2021-2022 and onwards. Subsequently, the Internal component is to be modified as Test -1 = 10, Model = 10 and other component = 20. The Components for internal assessment can be of 5 marks for each 4 components out of 10 components (**10 Components can be fixed by the concern board chairman**) selected by the each Course in charges for their respective courses.
5. To incorporate online courses as a non-credit skill enhancement course for the III and IV th semesters and Grades will be assessed based on the certificates produced by the students. It is compulsory to produce one online course certificate for each semester to avail grades for the students. (2 certificates in any of the online platform is mandatory)
6. **Two Elective courses DSE- III & DSE- IV are the Courses which are to be related with NPTEL courses.**
7. **If the students who are all completed the NPTEL courses before semester -III, they can avail exemption from appearing exams of DSE- III & DSE- IV in Fast track scheme.**
8. SDR – Student Development Report to be received by the department from the students till end of the **Third** semester. (Evidences of Curriculum activities and Co-curriculum activities)

PG/MCA Scheme of Evaluation (Internal & External Components)

(For the students admitted during the academic year 2021-2022 and onwards)

1. Internal Marks

Components	Marks
Test	10
Model Exam	10
Internal Assessment components	20 #
TOTAL	40

List of components for Internal Assessment

S.No	Components
1	Multiple choice questions
2	Quiz
3	Video teach
4	UT – Unannounced test
5	Co-operative or Collaborative Learning
6	Mini Project/Assignment
7	Case study
8	Seminar

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

2. a) Components for Practical I.E.

Components	Marks
Test –I	20
Test - II	20
Application*	10
Total	50

b) Components for Practical E.E.

Components	Marks
Experiments	40
Record	5
Viva	5
* Total	50

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

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

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

4. Value Added Courses / Aptitude/Placement courses:

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

5. Guidelines for Open Elective

No of Activities	Marks
Two Tests (each 3 hours) of 50 marks each [5 out of 8 descriptive type questions 5 x 10 = 50 Marks]	100

Guidelines:

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

For all PG/MBA/MCA Programmes (2021-2022 Regulations)

QUESTION PAPER PATTERN FOR CIA EXAM

Reg.No: _____ Q.P.CODE:

HINDUSTHAN COLLEGE OF ARTS AND SCIENCE (AUTONOMOUS)

PG/MBA/MCA DEGREE CIA EXAMINATIONS _____20_____

(_____Semester)

BRANCH: _____

Subject Name: _____

Time: Two Hours

Maximum: 50 Marks

Section-A (3 x 4=12 Marks)

Answer ALL Questions

ALL questions carry EQUAL Marks

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

Section-B (2 x 12=24 Marks)

Answer any TWO Questions out of THREE Questions

ALL questions carry EQUAL Marks

(Q.No: 4 to 6)

Section-C (1 x 14=14 Marks)

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

(Q.No: 7)

QUESTION PAPER PATTERN FOR MODEL / END SEMESTER EXAM

Reg.No: _____ Q.P.CODE:

HINDUSTHAN COLLEGE OF ARTS AND SCIENCE (AUTONOMOUS)

PG/MBA/MCA DEGREE MODEL EXAMINATIONS _____20_____

(_____Semester)

BRANCH: _____

Subject Name: _____

Time: Three Hours

Maximum: 60 Marks

SECTION - A (5x4=20 marks)

Answer ALL Questions

ALL Questions carry EQUAL Marks

(Q.No 1 to 5 Either Or type)

(One question from each Unit)

SECTION - B (3x10=30 Marks)

Answer any THREE Questions Out of FIVE Questions

ALL Questions carry EQUAL Marks

(Q.No 6 to 10)

(One question from each Unit)

SECTION - C (1x10=10Marks)

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

(Q.No: 11)

Programme Code:	DSC	Programme Title: Master of Science in Biotechnology							
Course Code:	21BTP01	Course Title						Batch:	2021-2022 onwards
		CELL AND MOLECULAR BIOLOGY						Semester:	I
Hrs/Week:	4	L	4	T	-	P	-	Credits:	4

COURSE OBJECTIVES

1. To impart knowledge on different types of cells, cell division and genetic recombination
2. To provide insights on various aspects of cell division, central dogma of cell and cell cycle which give Solid Foundation in Basic Biotechnology
3. To make familiar with cell types, cell cycle, cell signaling pathways in particular G protein STAT pathways and replication mechanisms
4. To make students understand the function of cell types, cell signaling pathways and central dogma
5. To enlighten the concepts of cell structure function, Gene transfer, Gene Regulation, and Genetic recombination techniques

COURSE OUTCOMES (CO)

S. No	COURSE OUTCOME	BLOOMS LEVEL
CO1	Relate the knowledge of different types of cell, cell division and gene transfer regulation processes will help students to design experiments	K1
CO2	Outline the properties and biological significance of Cell division, cell signaling and gene regulation	K2
CO3	Illustrate the structure and functions of plasma membrane, and mechanisms of various cell signaling pathways	K3
CO4	Explain the processes and functions of prokaryotic, eukaryotic cell, genetic recombination and mechanism of cell signal pathways	K4
CO5	Justify the methods of cell types, cell cycle, specialized cell, Gene transfer, operon concepts and Genetic recombination	K5
K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5 - Evaluate		

SYLLABUS

Course Code	Course	Semester No.
21BTP01	CELL AND MOLECULAR BIOLOGY	Sem: I
Unit No.	Topics	Hours
I	Introduction to Different Types of Cells Structure and functions of Prokaryotic and Eukaryotic Cell and Intracellular Organelles – Nucleus, Mitochondria, Chloroplast, Ribosomes, Golgi complex, Endoplasmic reticulum, Peroxisomes and Microbodies; Fractionation and Purification of Subcellular Organelles. Structure of Chromosomes – Giant and Polytene Chromosomes	10
II	Cell Division, Cell Cycle and Cytoskeleton 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 Sperm Cell.	10
III	Cell Signaling Structure and Functions of Plasma Membrane – Cell Recognition, Membrane Transport, Cell junction, Cell Adhesion. Cell to Cell Signaling – Receptors and Receptor Response Mechanisms - G protein coupled receptors – Jak/STAT Pathway, Receptor Tyrosine Kinase pathways	11
IV	Central Dogma of Cell DNA Replication – Prokaryotic and Eukaryotic replication – mode of replication. Transcription and Post transcriptional Modification – Genetic code – Wobbling hypothesis – Translation and post translational modification – Inhibitors of replication, transcription and translation.	12
V	Gene transfer, Gene Regulation, Genetic recombination DNA as a genetic material – Conjugation, Transformation and Transduction. Mutation – Spontaneous and Induced- DNA Repair Mechanisms. Operon concept – lac, trp and ara operons Recombination – Holliday model and Transposons – IS elements and Tn in Maize.	9
Total		52

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

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, Hidde Ploegh, Angelika Amon, Kelsey C. Martin. 2016, *Molecular Cell Biology*, 8th 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", 4th Edition, Garland Science, New York.
2. Cooper G. M. and Hausman R. E., 2013, "The Cell: A Molecular Approach", 6th Edition, Sinauer Associates Inc.
3. Krebs J. E., Kilpatrick S. T., Goldstein E. S., 2013, Lewin' GENES XI, 11th Edition, Jones & Bartlett Publishers, Boston.
4. Berg J. M., Tymoczko J. L., Gatto G. J. and Stryer L., 2015, Biochemistry, 8th Edition, W H Freeman & Co., New York.
5. Gerald Karp, Janet Iwasa, Wallace Marshall, 2018, Karp's Cell Biology, 8th 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


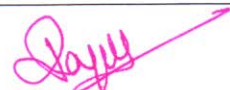

MAPPING WITH PROGRAM OUTCOMES:

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	M	M	S	M
CO2	S	M	-	M	S	S	M
CO3	S	S	M	S	M	M	S
CO4	S	S	M	S	M	-	S
CO5	S	S	S	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
 Dr. P. KARTHIGA Name & Signature of the Staff	 Dr. G. RAJALAKSHMI Name & Signature	 Name & Signature

HEAD OF THE DEPARTMENT
 PG & Research Dept. of Biotechnology
 Hindusthan College of Arts and Science
 Coimbatore - 641 028

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

Programme Code:	DSC	Programme Title: Master of Science in Biotechnology							
Course Code:	21BTP02	Course Title					Batch:	2021-2022 onwards	
		APPLIED MICROBIOLOGY					Semester:	I	
Hrs/Week:	4	L	4	T	-	P	-	Credits:	4

COURSE OBJECTIVES

1. To provide knowledge on the Fundamentals of applied microbiology and its branches.
2. To impart thoughts on history of microbiology, culture techniques, biofertilizers, food sources and host pathogen attributes.
3. To give insights on classifications, biogeochemical cycles, microbial growth, fermentation and antibiotic therapy.
4. To gain knowledge on microscopy, growth phases, microbial fuel cells, food preservation, spoilage and bacterial pathogenicity.
5. To explore different microscopes, culture maintenance, bioremediation, food control and safety, and viral pathogenicity.

COURSE OUTCOMES (CO)

S. No	COURSE OUTCOME	BLOOMS LEVEL
CO1	Describe the basic features of Applied Microbiology in Microbial physiology and metabolism, Agricultural and Environmental Microbiology, Food Microbiology, and Medical Microbiology	K1
CO2	Restate various techniques involved in Scope and history and, biogenesis and abiogenies, pure culture, staining techniques and sterilization methods, Biofertilizers, Food sources and development and host-pathogen interaction.	K2
CO3	Apply the methods of microbiological classifications, using Bergey's, Phylogenetic, nutritional, biogeochemical cycles, microbial growth and metabolism, food fermentation, Antibiotic therapy	K3
CO4	Investigate the effect of microbes and principle of microscopy, growth curve pattern, Microbial fuel cells, food preservatives, spoilage, pathogenicity of bacterial infections	K4
CO5	Justify microbiological tools like sophisticated microscopies, and preservation, maintenance of cultures, bioremediation methods, food control and safety, pathogenicity in viral infections .	K5
K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5 - Evaluate		

SYLLABUS

Course Code	Course	Semester No.
21BTP02	APPLIED MICROBIOLOGY	I
Unit No.	Topics	Hours
I	Introduction to Applied Microbiology History and Scope of Microbiology – Biogenesis vs Abiogenesis - Microbial Diversity -: Classification of Bacteria, Algae, Fungi and Protozoa – Bergey's Molecular and Phylogenetic Classification. Microscopy – Principle and Applications of Bright Fields, Dark Field, Phase Contrast, Confocal Scanning Laser Microscope. Electron Microscope – SEM and TEM	11
II	Microbial Physiology and Metabolism Microbial cultures: Methods of pure culture technique- Staining Techniques- Methods of sterilization- physical methods-Dry heat, moist heat, radiation methods, filtration methods, chemical methods & their application. Quality control. - Lyophilizers, Deep freezer Nutritional Classification of Microbes – Autotrophs, Heterotrophs, oxygen requirements and carbon source – Growth Curve - Preservation and maintenance of Microbial cultures	12
III	Agricultural and Environmental Microbiology Biofertilisers – Azolla, Anabena – Winogradsky Column – Biogeochemical Cycles – Carbon, Nitrogen, Sulphur, Phosphorus. Microbial fuel cells: Batteries Powered by Microbes, Role of Microorganisms in pollution management through Biodegradation and Bioremediation process (Oil spills).	9
IV	Food Microbiology History and Development -Characteristics of Food-Source, Microorganisms - Factors Influencing Microbial Growth Characteristics; Microbial Metabolism of Food Components- -Food Fermentation Technology – Microorganisms employed in food production – GUT Micro flora. Food Bio preservatives of Microbial Origin- Microbial Food Spoilage-Food Spoilage by Microbial Enzymes-Microbial Food borne Diseases- Control of Microorganisms in Foods-Microbial Detection and Food Safety	10
V	Medical Microbiology: Host-Pathogen Interactions-General Epidemiology-Principles of Antibiotic Therapy-Pathogenicity and laboratory diagnosis of bacterial infections - <i>Corynebacterium diphtheriae</i> , <i>Streptococcus pyogenes</i> , Viral infections – Dengue virus, HIV, Ebola virus, CoVID Protozoan Infections - <i>Entamoeba histolytica</i> , <i>Taenia solium</i> and <i>Plasmodium vivax</i>	10
Total		52

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

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

TEXT BOOK:

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

REFERENCE BOOKS:

1. Frazier W.C. and West Hoff D.C., 2003, "Food Microbiology", 18th Edition, Tata McGraw Hill Ltd, NewDelhi.
2. Oladele A Ogunseitan, 2008, Microbial Diversity Form and Function in Prokaryotes, , 1st 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, 5th Edition. Tata McGraw Hill, New Delhi

WEB RESOURCES: Coursera, 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://nptel.ac.in/courses/105/107/105107173/>
5. <https://nptel.ac.in/content/storage2/courses/105104102/Lecture%2023.htm>
6. https://onlinecourses.swayam2.ac.in/cec19_ag03/preview

MAPPING WITH PROGRAM OUTCOMES:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	S	S	M	S
CO2	S	S	M	S	S	-	S
CO3	M	S	S	S	M	M	-
CO4	S	S	M	S	M	M	M
CO5	S	S	S	S	M	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
 Dr. S. G. ANTONY GODSON Name & Signature of the Staff	 Dr. G. RAJALAKSHMI Name & Signature	 Name & Signature

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

BOS meeting approved

Approved in 7th Academic Council meeting on: 24.08.2021

Programme Code:	DSC	Programme Title: Master of Science in Biotechnology							
Course Code:	21BTP03	Course Title					Batch:	2021-2022 onwards	
		BIOCHEMISTRY AND METABOLISM					Semester:	I	
Hrs/Week:	4	L	4	T	-	P	-	Credits:	4

COURSE OBJECTIVES

1. To develop understanding and provide scientific insights on atoms, molecules, various chemical bonds, macromolecules and energy metabolism
2. To explain the structure of micro and macro molecules
3. To provide insights on properties, and classification of macromolecules
4. To explore the biological importance of thermodynamics, nucleic acids, enzymes, vitamins and proteins
5. To give knowledge on kinetics, bioenergetics, and regulatory pathways of enzymes

COURSE OUTCOMES (CO)

S. No	COURSE OUTCOME	BLOOMS LEVEL
CO1	Describing the basis of atoms, various organic compounds with their functional groups, chemical bonds, macromolecules and energy metabolism	K1
CO2	Understanding the structural features of mono, di and polysaccharides, amino acids, nucleotides, fatty acids, enzymes and vitamins	K2
CO3	Illustrating the physio-chemical properties of micro and macro molecules and their biosynthetic pathways	K3
CO4	Explaining the biological significance of thermodynamics, nucleic acids, enzymes, vitamins and proteins	K4
CO5	Evaluating the Ramachandran map, bioenergetics, nucleotides structure and regulatory mechanisms.	K5
K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5 - Evaluate		

SYLLABUS

Course Code	Course	Semester No.
21BTP03	BIOCHEMISTRY AND METABOLISM	I
Unit No.	Topics	Hours
I	Atoms, Molecules and Chemical Bonds Classes of Organic Compounds and Functional Groups. Covalent and Non-covalent Interactions - Vander Waal's – Electrostatic – Hydrogen Bonding and Hydrophobic Interactions; Energy Metabolism (concept of free energy); Principles of Thermodynamics; Kinetics, Dissociation and Association Constants; Bioenergetics.	10
II	Carbohydrates Structure and Classification of Mono, Di and Polysaccharides – Occurrence – Isolation – Purification – Properties and Biological Reactions. Structural Features of Homoglycans, Heteroglycans and Complex Carbohydrates. Carbohydrate Metabolism: Glycolysis and TCA Cycle; Glycogen Breakdown and Synthesis; Gluconeogenesis; Interconversion of Hexoses and Pentoses.	10
III	Proteins and Lipids Proteins: Classification– Primary Structure of Proteins – Structural Comparison at Secondary and Tertiary levels – Conformation of Proteins (Ramchandran Map) and Polypeptides (Secondary, Tertiary, Quaternary and Domain Structure) – Protein Folding - Biophysical and Cellular Aspects. Amino acids: Metabolism of aromatic aminoacids.- tyrosine, tryptophan and phenylalanine. Lipids: Structure and Classification – Properties – Oxidation of Fatty acids – Biosynthesis of Fatty acids – Triglycerides.	11
IV	Nucleic Acids 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	11
V	Enzymes and Vitamins Classification – Regulation of Enzymatic Activity - Enzyme Kinetics - Active Sites; Coenzymes – Coenzymes Interactions, Activators and Inhibitors – Isoenzymes – Allosteric Enzymes – Ribozyme – Hammer Head – Hair Pin and other Ribozymes – Abzyme: Structure and Drug Targets (Enzymes and Receptors). Vitamins – Classification – Fat soluble and Water Soluble vitamins and their significance	10
Total		52

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

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*, 6th Edition, W.H. Freeman and Company, NY, USA.
2. Donald Voet, Judith G. Voet, 2010, *Biochemistry*, 4th Edition, J. Wiley & Sons.

REFERENCE BOOKS:

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

WEB RESOURCES: SWAYAM, NPTEL, HARVARD, COURSERA**WEB LINK:**

1. https://onlinecourses.swayam2.ac.in/cec19_bt02/preview
2. 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	PO5	PO6	PO7
CO1	M	M	M	M	M	-	S
CO2	S	M	M	S	M	M	M
CO3	S	M	M	S	M	-	M
CO4	S	S	M	S	M	M	S
CO5	S	S	M	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
 Dr. D. BHARATHI Name & Signature of the Staff	 Dr. G. RAJALAKSHMI Name & Signature	 Name & Signature

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BOS meeting approved

Approved in 7th Academic Council meeting on 24.08.2021

Programme Code:	DSC	Programme Title: Master of Science in Biotechnology							
Course Code:	21BTP04	Course Title					Batch:	2021-2022 onwards	
		PRACTICAL I - CELL AND MOLECULAR BIOLOGY					Semester:	I	
Hrs/Week:	4	L	-	T	1	P	3	Credits:	2

COURSE OBJECTIVES

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

COURSE OUTCOMES (CO)

S. No	COURSE OUTCOME	BLOOMS LEVEL
CO1	Find the basic concepts, principle and application of microscopy for identification different cell types	K1
CO2	Outline procedure for cellular components fractionation and Analyse the cell division	K2
CO3	Examine and Identify different chromosomes for the sex determination	K3
CO4	Investigate and execute the principle mechanism involved mutant identification using plating study	K4
CO5	Assess the mechanism of lipid solubility of membrane system and its determination	K5
K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5 - Evaluate		

SYLLABUS

Course Code	Course	Semester No.
21BTP04	PRACTICAL I - CELL AND MOLECULAR BIOLOGY	I
Experiment No.	Topics	Hours
1	Microscopy – Working principle of Bright Field Microscope	04
2	Identification of Cell Types – Plant, Animal and Microbes.	05
3	Fractionation of Cellular components – Nucleus, Mitochondria, Chloroplast.	05
4	Mitotic Preparation - Onion Root Tip.	04
5	Identification of Barr Bodies.	04
6	Mounting of Polytene Chromosome from Chironomus Larvae.	05
7	Identification of Mutants - Physical and Chemical Methods	05
8	Auxotrophic selection of mutants by replica plating technique	10
9	Sucrose Fractionation of Castor Bean	05
10	Lipid Solubility of Membranes	05
Total		52

Distribution of marks for Practical :(IE 50; EE 50)

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

REFERENCE BOOKS:

1. Cappuccino, P., & Sherman, D., 2009, *Microbiology-A Lab Manual. 7th Edition.*, Singapore: Pearson Education.
2. Dubey, R., & Maheswari, E., 2012, *Practical Microbiology, 5th 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>



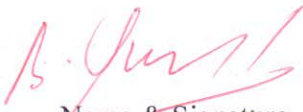
MAPPING WITH PROGRAM OUTCOMES

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	-	M	S	-	M
CO2	S	S	M	S	S	M	S
CO3	S	S	M	S	S	-	S
CO4	S	S	M	S	S	M	S
CO5	S	M	-	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. U. SURIYAKALAA Name & Signature of the Staff	 Dr. G. RAJALAKSHMI Name & Signature	 Name & Signature

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Programme Code:	DSC	Programme Title: Master of Science in Biotechnology							
Course Code:	21BTP05	Course Title						Batch:	2021-2022 onwards
		PRACTICAL II - APPLIED MICROBIOLOGY						Semester:	I
Hrs/Week:	5	L	-	T	1	P	4	Credits:	3

COURSE OBJECTIVES

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

COURSE OUTCOMES (CO)

S. No	COURSE OUTCOME	BLOOMS LEVEL
CO1	Remember the basic techniques of microbiology, isolation of pure culture and characterization of microorganism	K1
CO2	Discuss the procedure involved in preparation of sample for microscopic examination and measurement	K2
CO3	Examine the methods for isolation of microbes, various pure culture techniques and preparation of bacterial smears for morphological characterization	K3
CO4	Identify various test of biochemical characterizations, effect of physical factors on growth of microorganism, microbial counting from wastewaters, and drug response analysis	K4
CO5	Assess the procedure for exploration of various microbial flora in human clinical sample	K5
K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5 - Evaluate		

SYLLABUS

Course Code	Course	Semester No.
21BTP05	PRACTICAL II - APPLIED MICROBIOLOGY	I
Experiment No.	Topics	Hours
1	Basic Laboratory Techniques for Isolation, Cultivation, and Cultural Characterization of Microorganisms Effectiveness of Hand Washing, Culture Transfer Techniques, Techniques for Isolation of Pure Cultures, Cultural Characteristics of Microorganisms	02
2	Microscopy Microscopic Examination of Stained Cell Preparations, living Microorganisms Using a Hanging-Drop Preparation or a Wet Mount, The Microscopic Measurement of Microorganisms - Micrometry	03
3	Isolation of Microbes from Soil, Water and Contaminated Food	05
4	Bacterial Staining: Preparation of Bacterial Smears, Simple Staining, Negative Staining, Gram Stain, Acid-Fast Stain, Staining of Fungi - Lacto Phenol CottonBlue Method	05
5	Pure culture Techniques- Streak plate, pour plate, Spread plate, decimal dilution.	05
6	Biochemical Test: IMVIC Test, Hydrogen sulphide test, Oxidase test, Catalase Test. Urease test, TSI test, Carbohydrate fermentation.	08
7	Bacterial Growth curve: effect of pH and Temperature on Bacterial Growth by Turbidity method	07
8	Microbial analysis: MPN test (presumptive, confirmed and completed tests)	05
9	Antibiotic sensitivity test.	05
10	Medical Microbiology Microbial Flora of the Mouth: Determination of Susceptibility to Dental Caries	05
11	Normal Microbial Flora of the Throat and Skin	05
12	Microbiological Analysis of Urine Specimens	05
13	Microbiological Analysis of Blood Specimens	05
Total		65

Distribution of marks for Practical: (IE 50; EE 50)

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

REFERENCE BOOKS:

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

WEB RESOURCES: MICRORAO

WEB LINK:

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



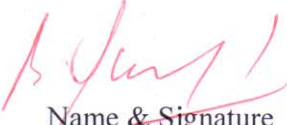
MAPPING WITH PROGRAM OUTCOMES

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	M	S	S	M	S
CO2	S	S	M	S	S	-	M
CO3	S	S	M	M	S	S	S
CO4	S	S	S	S	S	S	S
CO5	S	S	S	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
 Dr. U. SURIYAKALAA Name & Signature of the Staff	 Dr. G. RAJALAKSHMI Name & Signature	 Name & Signature

HEAD OF THE DEPARTMENT
PG & Research Dept. of Biotechnology
Hindusthan College of Arts and Science
Coimbatore - 641 028

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

Programme Code:	DSC	Programme Title: Master of Science in Biotechnology							
Course Code:	21BTP06	Course Title					Batch:	2021-2022 onwards	
		PRACTICAL III – BIOCHEMISTRY AND METABOLISM					Semester:	I	
Hrs/Week:	4	L	-	T	1	P	3	Credits:	2

COURSE OBJECTIVES

1. To enable the students learn the qualitative and quantitative analysis carbohydrates, lipids and aminoacids as well as proteins
2. To provide insights on separation and purification of enzymes using SDS PAGE
3. To gain knowledge on identification macromolecules using various chromatographic methods
4. To learn the principle and mechanism for estimation of acids and iron
5. To make familiar with concept of enzyme activity and kinetics

COURSE OUTCOMES (CO)

S. No	COURSE OUTCOME	BLOOMS LEVEL
CO1	Describe techniques, skills and modern tools necessary for detection, analysis of macromolecules	K1
CO2	Predict the methodology and laboratory procedure for separation and purification of enzymes	K2
CO3	Illustrate the various chromatographic techniques for the separation and identification of pigments and Aminoacids	K3
CO4	Identify the laboratory experimental procedure for determination of acid value and iron content	K4
CO5	Recommend the mechanism of analysis for enzyme activity and kinetics	K5
K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5 - Evaluate		

SYLLABUS

Course Code	Course	Semester No.
21BTP06	PRACTICAL III – BIOCHEMISTRY AND METABOLISM	I
Unit No.	Topics	Hours
1	Estimation of Carbohydrates by Anthrone method	03
2	Estimation of Acid Value, Saponification value, Iodine number of fats	05
3	Estimation of Amino Acids by Ninhydrin Method	04
4	Protein Estimation by Lowry's Method and Bradford method	03
5	Separation of LDH Isozymes from Serum by SDS-PAGE	04
6	Extraction and purification of peroxidase from soy bean seeds	04
7	Paper Chromatography - Separation of Plant Pigments	03
8	Thin Layer Chromatography - Separation of Amino Acids	04
9	Ion Exchange Chromatography	04
10	Gel permeation Chromatography	04
11	Estimation of Ascorbic Acid	04
12	Estimation of Calcium and Iron	05
13	Assay of amylase activity and determination of enzyme kinetic parameters - Km, Vmax and Kcat	05
Total		52

Distribution of marks for Practical : (IE 50; EE 50)

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

REFERENCE BOOKS:

1. J. Jayaraman, 2011, *Laboratory Manual in Biochemistry, 5th Edition, Willy Eastern.*
2. Daniel M. Bollag et al., 1996, *Protein Methods, 2nd Edition, Wiley-Liss, Inc.*
3. S. Sadasivam and A. Manickam, 2009, *Biochemical Methods, 3rd Edition, New age publishers.*
4. David T Plummer, 2004, *An Introduction to Practical Biochemistry 3rd Edition, Tata Mcgraw hill Publication.*

WEB RESOURCES: NPTEL

WEBLINK:

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




MAPPING WITH PROGRAM OUTCOMES

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	M	S	S	S	S
CO2	S	S	M	S	S	S	S
CO3	S	M	M	M	S	S	M
CO4	S	M	-	M	S	M	M
CO5	S	S	M	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

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 Coimbatore-641 028.

Programme Code:	DSE	Programme Title: Master of Science in Biotechnology							
Course Code:	21BTP07A	Course Title						Batch:	2021-2022 onwards
		ELECTIVE I / DSE - I BIOETHICS AND BIOSAFETY						Semester:	I
Hrs/Week:	4	L	4	T	-	P	-	Credits:	3

COURSE OBJECTIVES

1. To provide basic knowledge about the legal, safety and public policy issues raised due to the rapid progress in biotechnology
2. To explore the knowledge on biosafety guidelines and its different protocols
3. To learn the ethical issues in biomedical research with their general principles
4. To provide insight in to ethical implications of biological research for environmental protection
5. To understand the GMO application in food and agriculture

COURSE OUTCOMES (CO)

S. No	COURSE OUTCOME	BLOOMS LEVEL
CO1	Define knowledge of biosafety and risk assessment and recognize the ethical issues and regulatory compliances of Biotechnology.	K1
CO2	Describe the basis of biosafety committee and explain laboratory biosafety procedures	K2
CO3	Explain ethical aspects related to biological, biomedical, health care and biotechnology research	K3
CO4	Analyze products derived from recombinant DNA research and environment release of genetically modified organisms, national and international regulations.	K4
CO5	Appraise various aspects of biosafety regulations and bioethics concerns arising from the commercialization of GMO products	K5
K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5 - Evaluate		

SYLLABUS

COURSE CODE	COURSE	SEM NO.
21BTP07A	ELECTIVE I / DSE - I BIOETHICS AND BIOSAFETY	I
Unit No.	Topics	Hours
Unit I	Introduction to Bioethics in Cloning Biotechnology and Ethics –Benefits and Risks of Genetic Engineering – Ethical Aspects of Genetic Testing and Genetic counselling - Ethical Implications of Cloning: Reproductive and Therapeutic Cloning.	10
Unit II	Bioethics in Genetic Engineering and Animal Biotechnology Ethical, Legal and socioeconomic aspects of Gene Therapy (ELSI), Germ Line, Somatic, Embryonic and Adult Stem Cell Research. Ethical Issues related to Assisted Reproductive technologies (Artificial Insemination, IVF and embryo transfer)	10
Unit III	Biosafety Regulations Guidelines and Regulations (National and International), Nagoya Protocol - Convention on Biological Diversity - Cartagena Protocol on Biosafety –The Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA).	10
Unit IV	Biosafety Committees and Biosafety Protocols Regulatory framework for GMOs and LMOs in India RCGM, GEAC etc. for GMO application in food and agriculture; Environmental release of GMO's. Introduction to Biosafety and its Issues in Biotechnology – Risk Assessment and Risk Management – Safety Protocols: Risk Groups – Biosafety Levels – Bio-containment.	11
Unit V	Laboratory Biosafety General Principles, Microbiological Risk Assessment, Code of Practice, Laboratory design and facilities, Laboratory equipment, Health and Medical surveillance, Laboratory Animal Facility, Laboratory Bio-security concepts, Safety Equipment, Contingency plans and Emergency Procedures.	11
Total		52

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

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

TEXT BOOK:

1. Shaleesha A. Stanley, 2008, "Bioethics", 1st 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", 2nd Edition, Academic Press, USA.
2. Fleming, Diane O. and Hunt, Debra L., 2006, Biological safety: principles and practices. 4th Edition, Washington, ASM Press
3. World Health Organization, Geneva, 2004, Laboratory Biosafety Manual, 3rd Edition.




MAPPING WITH PROGRAM OUTCOMES

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	S	S	M	M	S
CO2	S	S	S	S	M	S	S
CO3	S	S	S	S	M	M	S
CO4	S	M	S	M	M	S	S
CO5	S	M	S	M	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
 Mrs. N. V. SITHARA Name & Signature of the Staff	 Dr. G. RAJALAKSHMI Name & Signature	 Name & Signature

HEAD OF THE DEPARTMENT
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Hindusthan College of Arts & Science,
Coimbatore-641 028.

Programme Code:	DSE	Programme Title: Master of Science in Biotechnology							
Course Code:	21BTP07B	Course Title						Batch:	2021-2022 onwards
		ELECTIVE I / DSE - I DEVELOPMENTAL BIOLOGY AND BEHAVIORAL STUDIES						Semester:	I
Hrs/Week:	4	L	4	T	-	P	-	Credits:	3

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)

S. No	COURSE OUTCOME	BLOOMS LEVEL
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
K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5 - Evaluate		

SYLLABUS

Course Code	Course	Semester No.
21BTP07B	ELECTIVE I / DSE - I DEVELOPMENTAL BIOLOGY AND BEHAVIORAL STUDIES	I
Unit No.	Topics	Hours
Unit I	Basic Concepts of Development 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
Unit II	Gametogenesis, Fertilization and Early Development Production of gametes - cell surface molecules in sperm-egg recognition in animals - zygote formation – cleavage – blastulation - gastrulation and germ layers in animals. Morphogenesis and Organogenesis in Plants: 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> .	11
Unit III	Morphogenesis and Organogenesis in Animal 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.	11
Unit IV	Introduction to Evolution and Origin of Cells 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
Unit V	Brain, Behavior Relationship 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
Total		52

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

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

TEXT BOOK:

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

REFERENCE BOOKS:

1. Enger Ross, 2008, Concepts in Biology, 13th Edition WCB McGraw Hill.
2. S. Chattopadhyay, 2017, A Introduction Developmental Biology, 1st Edition, 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

PO \ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	S	M	M	S	S
CO2	S	S	M	M	M	-	S
CO3	S	M	M	M	-	M	S
CO4	M	M	S	M	M	M	M
CO5	S	S	S	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
 Dr. A. MANJU Name & Signature of the Staff	 Dr. G. RAJALAKSHMI Name & Signature	 Name & Signature

HEAD OF THE DEPARTMENT
PG & Research Dept. of Biotechnology
Hindusthan College of Arts and Science
Coimbatore - 641 028

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

Programme Code:	DSC	Programme Title: Master of Science in Biotechnology							
Course Code:	21BTP09	Course Title						Batch:	2021-2022 onwards
		GENETIC ENGINEERING						Semester:	II
Hrs/Week:	4	L	4	T	-	P	-	Credits:	4

COURSE OBJECTIVES

1. To impart knowledge on gene, molecular scissors and linkers, gene cloning techniques for gene therapy and library construction
2. To gain insights on human genome project, sequencing methods, end modifying enzymes, and vector system
3. To make use of PCR, next generation sequencer and polymerase enzymes site directed mutagenesis and genetic counselling for social welfare
4. To explore tools required to edit genome and gene knockout
5. To impart prospective knowledge on automated DNA sequencing, cancer gene therapy, protein engineering for humankind

COURSE OUTCOMES (CO)

S. No	COURSE OUTCOME	BLOOMS LEVEL
CO1	Describing the role of molecular scissors and linkers such as endonuclease, exonucleases and ligases in gene cloning techniques for gene therapy and library construction	K1
CO2	Discussing the various sequencing methods and modifying enzymes used for human genome project and also for the designing of suitable vector system to transfer genes	K2
CO3	Examining the use of PCR, next generation sequencer and polymerase enzymes for the construction of hybrid vectors for protein engineering and also for genetic counselling	K3
CO4	Investigating the advanced vector construction tools for genome editing and gene knockout	K4
CO5	Justifying the use of genome sequencing methods and molecular enzymes for the construction of multifunctional vector system to humankind and welfare	K5
K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5 - Evaluate		

SYLLABUS

Course Code	Course	Semester No.
21BTP09	GENETIC ENGINEERING	II
Unit No.	Topics	Hours
I	Gene and Genome Genome Organization - C - Value Paradox. Genome Sequencing Methods - Maxam and Gilbert, Sanger's method, Pyrosequencing – Solid Phase and Liquid Phase, Automated DNA sequencing, Next generation sequencing – Basic Principle and Steps involved. Human Genome Project	10
II	Enzymes in Genetic Engineering 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	11
III	Vectors Steps in Gene Cloning – Host Cell Types – Prokaryotic Hosts, Eukaryotic Hosts – Vectors - Plasmid Vectors – pBR322 – pUC vectors, shuttle vectors – Bacteriophage Vectors – Lambda and M13 vectors; Hybrid Vectors – Cosmids – Phagemids. Eukaryotic Vectors – Yeast Vectors – YAC and BAC. Plant Vectors – Ti plasmids as a vector CaMV– TMV –Animal Vectors – SV40 – Retrovirus – Adenovirus.	11
IV	Advanced Molecular Techniques Genomic Library Construction – cDNA Library Construction – Chromosome Walking and Jumping. Screening of Recombinants –. Blotting Techniques - PCR – Real time PCR – RT-qPCR Genome editing – ZFN, TALENs, CRISPR Tool Site Directed Mutagenesis and Protein Engineering – in situ hybridization	10
V	Gene therapy and Genetic Counselling Gene Therapy – History and Development Germline, Somatic Cell Line – <i>In vivo</i> – <i>Ex vivo</i> – Anti-Sense Gene Therapy and Embryo Gene Therapy – mRNA based vaccines RNA interference (RNAi). Cancer Gene Therapy. Gene knockout Genetic Counselling – Prospective and retrospective genetic counselling	10
Total		52

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

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. 7th 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.
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, 7th 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://www.classcentral.com/course/swayam-genetic-engineering-theory-and-application-14090>
3. <https://www.edx.org/course/dna-biologys-genetic-code>
4. <https://online.stanford.edu/courses/xgen203-genetic-engineering-and-biotechnology>
5. <https://www.mooc-list.com/course/genes-and-human-condition-behavior-biotechnology-coursera>
6. <https://www.coursera.org/lecture/dna-decoded/genetic-engineering-KIRoE>



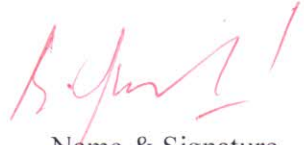
MAPPING WITH PROGRAM OUTCOMES

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	S	S	M	S	S
CO2	S	M	M	M	-	M	M
CO3	S	S	M	S	-	M	S
CO4	S	S	-	S	M	S	S
CO5	S	S	S	S	M	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
 Dr. G. RAJALAKSHMI Name & Signature of the Staff	 Dr. G. RAJALAKSHMI Name & Signature	 Name & Signature

BOS meeting approved

Approved in 7th Academic Council meeting on: 24.08.2021

HEAD OF THE DEPARTMENT
 PG & Research Dept. of Biotechnology
 Hindusthan College of Arts and Science
 Coimbatore - 641 028

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

Programme Code:	DSC	Programme Title: Master of Science in Biotechnology							
Course Code:	21BTP10	Course Title					Batch:	2021-2022 onwards	
		PLANT BIOTECHNOLOGY					Semester:	II	
Hrs/Week:	4	L	4	T	-	P	-	Credits:	4

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)

S. No.	COURSE OUTCOME	BLOOMS LEVEL
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
K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5 – Evaluate		

SYLLABUS

Course Code	Course	Semester No.
21BTP10	PLANT BIOTECHNOLOGY	II
Unit No.	Topics	Hours
I	Plant Tissue Culture 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
II	Plant Hybrid Production 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
III	Plant Transformation Technology 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
IV	Plant Recombinant Technology – Molecular Pharming 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
V	Applications 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
Total		52

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

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

TEXT BOOK:

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

REFERENCE BOOKS:

1. Sathyanarayana U., 2020, "Biotechnology", 12th Edition, Books and Allied Ltd, Bangalore, India.
2. Harmeet Kaur, 2009. Plant Biotechnology and Genetic Engineering, 1st Edition, Anmol Publisher.

WEB RESOURCES: Biology discussion

WEBLINK:

1. <https://www.biologydiscussion.com/genetic-engineering/methods-of-gene-transfer-used-in-plants/39218>




MAPPING WITH PROGRAM OUTCOMES

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	M	M	-	M	S
CO2	S	S	-	S	M	M	S
CO3	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S
CO5	S	M	-	M	-	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. P. SENTHILKUMAR Name & Signature of the Staff	 Dr. G. RAJALAKSHMI Name & Signature	 Name & Signature

HEAD OF THE DEPARTMENT
 PG & Research Dept. of Biotechnology
 Hindusthan College of Arts and Science
 Coimbatore - 641 028

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

Programme Code:	DSC	Programme Title: Master of Science in Biotechnology							
Course Code:	21BTP11	Course Title						Batch:	2021-2022 onwards
		RESEARCH METHODOLOGY AND BIostatISTICS						Semester:	II
Hrs/Week:	4	L	4	T	-	P	-	Credits:	4

COURSE OBJECTIVES

1. To enable the students to understand the basic knowledge of research, teaching learning, components of thesis, articles and its attributes
2. To gain insights on different journal databases, Information retrieval system, and various indexing parameters
3. To acquire knowledge on fundamentals of statistics, classification and measures of central tendency
4. To learn the advanced statistical tools for measures of dispersion and proportion data analysis
5. To explore available tools to develop a research data, analysis, as well as research proposal preparation

COURSE OUTCOMES (CO)

S. No	COURSE OUTCOME	BLOOMS LEVEL
CO1	Define the types of research, collection of data, citations, scope of Biostatistics and Standard deviation.	K1
CO2	Explain the significance of research, the types of journal databases, method of searching various indexing parameters and obtaining online information retrieval, sterility testing of medicines	K2
CO3	Implement the. Literature Collection ,Literature Citation, Citation Index , basics statistical methods for analysis of data and measures of central tendency and Application of statistical software for biological research.	K3
CO4	Examine the Format of Thesis and Dissertation, Search engines- Google Scholar Citation, principal methods of advanced statistical tools for design, interpret and effective analysis of experimental results	K4
CO5	Evaluate on the Reviewing of Monographs, Online Data Base Library, methodology and upgrade tools for developing analysis of research data, research proposal preparation.	K5
K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5 - Evaluate		

Syllabus

Course Code	Course	Semester No.
21BTP11	RESEARCH METHODOLOGY AND BIOSTATISTICS	II
Unit No.	Topics	Hours
I	Introduction to research methodology: What is Research? Basic and Applied Research - Essential steps in Research - Significance of Research, Teaching Learning, Evaluation and Monitoring Process. Defining the Research Problem - Research/Experimental Design. Literature Collection - Literature Citation. Research Report – Components – Format of Thesis and Dissertation – Manuscript/Research Article – Review Monographs – Bibliography.	11
II	Databases and Information Retrieval: Journals - Standard of Research Journals – Plagiarism – Copyrights - Impact Factor - Citation Index – Bibliometric – Search engines-Google Scholar Citation. Access to Archives and Databases – Science Direct – Sciverse– PubMed - National Informatics Center Network Services – Online Data Base Library	9
III	Biostatistics: Definitions - Scope of Biostatistics – Classification and Tabulation of Data – Graphical and Diagrammatic Representation – Scale Diagrams – Histograms – Frequency Polygon - Frequency Curves.– Arithmetic Mean – Median and Mode. Calculation of Mean – Median – Mode in Series of Individual Observation Discrete Series – Continuous Open-End Classes.	10
IV	Measures of Dispersion: Standard deviation and Range, Chi – Square Test, Student - t Test, Regression, Correlation, One Way and Two Way ANOVA. Experimentation Design:– Response Surface Methodology: Proportion Data and Analysis: Examples of Proportion data - MPM-sterility testing of medicines - animal toxicity infection and immunization studies (e.g., LD ₅₀ , ED ₅₀ , PD ₅₀) – statistical treatment to proportion data.	10
V	Developing a research data and Analysis Introduction to Count data – Examples (bacterial cell count, radioactivity count, colony and plaque count, etc.). Statistical treatment to count data Poisson distribution - standard error -confidence limits of counts. Application of statistical software for biological research. Developing a research question, Resources for research question, Literature Review: Traditional Qualitative Review, Meta-Analysis—A Quantitative Review Preparation of Research Proposal, The research report paper writing/ thesis writing, Different parts of the research paper	11
Total		52

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

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", 1st Edition, Bhalani Publishing House, New Delhi.
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", 3rd Edition, Palgrave Macmillan, Australia.
4. G. Nageswara Rao, 2018, "Biostatistics and Research Methodology" 1st Edition, B.S. Publication.

REFERENCE BOOKS:

1. Robert A. Day and Barbara Gastel, 2006, How to Write and Publish a Scientific Paper? 8th Edition, Cambridge, Cambridge University.
2. Ranjit Kumar, 2004, Research Methodology: A step by step guide for beginners, 3rd Edition, University of Western Australia, SAGE Publications Ltd.
3. P. S. S. Sundar Rao & J. Richard, 2012, Introduction to Bio-statistics and Research methods, 5th 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, 6th Edition, Wiley Publication.

WEB RESOURCES: MICHENER, COURSERA, NPTEL, SWAYAM

WEBLINK:

1. 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




MAPPING WITH PROGRAM OUTCOMES

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	-	M	M	M	S
CO2	S	M	M	S	M	S	S
CO3	S	M	-	M	M	M	S
CO4	S	S	M	S	M	M	S
CO5	S	S	M	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
 Mrs. N. KIRUTHIGA Name & Signature of the Staff	 Dr. G. RAJALAKSHMI Name & Signature	 Name & Signature

HEAD OF THE DEPARTMENT
 PG & Research Dept. 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 7th Academic Council meeting on: 24.08.2021

Programme Code:	DSC	Programme Title: Master of Science in Biotechnology							
Course Code:	21BTP12	Course Title					Batch:	2021-2022 onwards	
		R PROGRAMMING FOR BIOLOGISTS					Semester:	II	
Hrs/Week:	4	L	4	T	-	P	-	Credits:	4

COURSE OBJECTIVE

1. Expand R by installing R packages
2. Explore and understand how to use the R documentation
3. Read Structured Data into R from various sources
4. Understand the different data types in R
5. Understand the different data structures in R

COURSE OUTCOMES (CO)

S. No	COURSE OUTCOME	BLOOMS LEVEL
CO1	Understanding and developing GUI Applications	K1, K2
CO2	Experimenting components in UI	K2, K3
CO3	Understand the concepts of Objects in R	K4
CO4	Creating the application with Dataset	K4
CO5	File handling - GUI Programming	K5
KI- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate		

SYLLABUS

Course Code	Course	Semester No.
21BTP12	R PROGRAMMING FOR BIOLOGISTS	II
Unit No.	Topics	Hours
I	R introduction - data types, variable, operators, decision making, loops, functions, string. Vectors, list, matrices, arrays, factors, data frames.	10
II	Control Statements - Arithmetic and Boolean Operators- Math function - Functions Are Objects - Functions for statistical distributions – Sorting – Simulation programming in R - Environment and Scope Issues - No Pointers in R.	10
III	Creating Graphs - Customizing Graphs - Saving Graphs to Files - Creating Three-Dimensional Plots	10
IV	R Packages: Bio Conductor: Analysis of Genomic data using tools from Bio conductor Project. Analysis of gene regulators, ontologies, and microarray expression profiles CADMIM: Microarray Data Analysis MaxR: An R package for maximum-likelihood analysis of nucleotide sequence data	10
V	Interfacing R with Python: Python features - Variables- Operator - Data types-Decision making statements- Loops- Data structures in python-Functions- Regular expressions in python- File handling- GUI programming- Database Connectivity, Python Graphics modules. Biopython: Working with sequences. Parsing Gen bank files - Parsing Swiss rot files -Accessing Entrez - BLAST- Multiple Sequence Alignment- Handling PDB files using Bio python.	12
	Total	52

Teaching methods:

- Use of multi-media/AV (Audio-Visual)/ICT
- Flipped Learning and Flipped Classroom
- Active Learning Forums
- Usage of Projectors
- Inquiry-based learning through quizzing, MCQs, etc.
- Student seminars and workshops
- Availability of E-resources
- Group Discussions, Group learning-Assignments and Cooperative learning

TEXT BOOK

1. *R Programming for bioinformatics - Robert Gentleman.- CRC Press Taylor & Francis Group - 2008*

REFERENCE BOOK

1. *A First Course in Programming and Statistics - 16 July 2016 - by Tilman M. Davies (Author)*

WEB RESOURCES

<https://www.arraygen.com/R-programming.php>




MAPPING WITH PROGRAM OUTCOMES

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	S	S	M	S
CO2	M	M	M	S	S	S	S
CO3	S	S	S	M	S	M	M
CO4	S	M	M	S	S	S	S
CO5	S	S	S	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
 K.S.SENTHILKUMAR	 Dr. R. RANGARAJ	 Name & Signature

Dr.R.Rangaraj
 M.Sc.(CS),M.Phil.,Ph.D.,M.Sc(Psy)
 Professor & Head,
 PG & Research Dept. of Computer Science
 Hindusthan College of Arts & Science,
 Coimbatore - 641 028.

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

Programme Code:	DSC	Programme Title: Master of Science in Biotechnology							
Course Code:	21BTP13	Course Title						Batch:	2021-2022 onwards
		PRACTICAL IV- GENETIC ENGINEERING						Semester:	II
Hrs/Week:	5	L	-	T	1	P	4	Credits:	3

COURSE OBJECTIVES

1. To enable the students to understand the techniques involved in Isolation of Genomic DNA from different sources
2. To learn the concepts of Restriction enzymes and its role as cleavage and ligation.
3. To impart knowledge on Transformation techniques to study rDNA methodology
4. To exploit different molecular tools for detection of Nucleic acids and proteins
5. To explore knowledge of Reporter gene assay for histochemical analysis

COURSE OUTCOMES (CO)

S. No	COURSE OUTCOME	BLOOMS LEVEL
CO1	Describe the principle, methodology of genomic DNA isolation, subsequent estimation and quantification from different sources	K1
CO2	Restate the role of different restriction enzymes and their involvement in cleavage and ligation for manipulating the foreign DNA	K2
CO3	Illustrate the principles, methods, mechanism of Gene Transformation	K3
CO4	Investigate and execute molecular tools such as PCR, Blotting and hybridization techniques to detect and asses the nucleic acids and proteins.	K4
CO5	Assess the expression mechanism of Reporter gene in the transformed tissues and their effective role as promoter gene.	K5
K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5 - Evaluate		

SYLLABUS

Course Code	Course	Semester No.
21BTP13	PRACTICAL IV - GENETIC ENGINEERING	II
Experiment No.	Topics	Hours
1	Isolation of Genomic DNA from Plant Tissue	05
2	Isolation of Genomic DNA from Bacteria	05
3	Isolation of Genomic DNA from Animal Tissue	05
4	Isolation of Genomic DNA from Human blood	05
5	Isolation of Plasmid DNA from Bacteria.	05
6	Restriction Digestion	05
7	Ligation.	05
8	Transformation in <i>E. coli</i>	06
9	Polymerase Chain Reaction.	06
10	Southern Hybridization using Non-Radioactive Detection.	06
11	Western Blotting.	06
12	Reporter gene assay - GUS gene	06
Total		65

Distribution of marks for Practical: (IE 50; EE 50)

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

REFERENCE BOOKS:

1. John Vennison, 2009, "Laboratory manual for Genetic Engineering", 1st Edition, PHI Learning.
2. Aksan Kurnaz, 2015 "Techniques in Genetic Engineering" 1st Edition, CRC Press.
3. Dubey, R. C. & Maheswari, D. K., 2012, Practical Microbiology, 5th 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, 4th Edition, Cold Spring Harbor Laboratory Press.

WEB RESOURCES: KHAN ACADEMY

WEBLINK:

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




MAPPING WITH PROGRAM OUTCOMES:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	M	S	M	S
CO2	S	S	M	S	S	M	S
CO3	S	S	M	S	S	M	S
CO4	S	M	M	S	S	S	S
CO5	S	S	S	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
 Dr. G. RAJALAKSHMI Name & Signature of the Staff	 Dr. G. RAJALAKSHMI Name & Signature	 Name & Signature

HEAD OF THE DEPARTMENT
PG & Research Dept. 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 7th Academic Council meeting on: 24.08.2021

Programme Code:	DSC	Programme Title: Master of Science in Biotechnology							
Course Code:	21BTP14	Course Title						Batch:	2021-2022 onwards
		PRACTICAL V- PLANT BIOTECHNOLOGY						Semester:	II
Hrs/Week:	5	L	-	T	1	P	4	Credits:	3

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
K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5 - Evaluate		

SYLLABUS

Course Code	Course	Semester No.
21BTP14	PRACTICAL V –PLANT BIOTECHNOLOGY	III
Experiment No.	Topics	Hours
1	Plant Tissue Culture Laboratory Organization	03
2	Preparation of MS nutrient Medium and sterilization	06
3	Surface sterilization and establishment of Callus Culture	05
4	<i>In vitro</i> Germination of Seeds	05
5	Isolation and Culture of Embryos	06
6	Anther Culture	05
7	Establishment of suspension culture	06
8	Protoplast isolation and protoplast fusion.	06
9	Artificial seeds production and stability testing of sodium alginate	05
10	Production of Virus Free Plants	05
11	Axillary bud culture	05
12	GUS assay	08
Total		65

Distribution of marks for Practical :(IE 50; EE 50)

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

REFERENCE BOOK:

1. Robert N Trigiano, 2018. *Plant Tissue Culture Concepts and Laboratory Exercises*, 2nd Edition CRC Press, London

WEB RESOURCES: MOOC, UNOM, AGBIOTECH.NET, INDYCCL

WEBLINK:

1. <https://www.unom.ac.in/webportal/uploads/library/gcl-opac/lifeplantbio.html>
2. <http://aggie-horticulture.tamu.edu/tisscult/biotech/biotech.html>
3. <http://www.agbiotechnet.com/Directory/browse.asp>
4. <http://indyccl.agri.huji.ac.il/~tzvika/iapc/ip-home.htm>
5. <http://www.access-excellence.org/Lc/ST/st2bgplant.html>



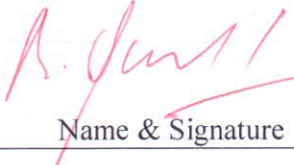
MAPPING WITH PROGRAM OUTCOMES

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	-	M	S	M	M
CO2	S	S	M	S	S	M	S
CO3	S	S	M	S	S	M	S
CO4	S	S	S	S	S	-	S
CO5	S	M	-	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. P. SENTHILKUMAR Name & Signature of the Staff	 Dr. G. RAJALAKSHMI Name & Signature	 Name & Signature

HEAD OF THE DEPARTMENT
 PG & Research Dept. of Biotechnology
 Hindusthan College of Arts and Science
 Coimbatore - 641 028

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

Programme Code:	DSC	Programme Title: Master of Science in Biotechnology							
Course Code:	21BTP15	Course Title						Batch:	2021-2022 & onwards
		PRACTICAL VI - R PROGRAMMING FOR BIOLOGISTS						Semester:	II
Hrs/Week:	3	L	-	T	-	P	3	Credits:	2

COURSE OBJECTIVE

1. Ability to understand about basics of R programming
2. Demonstrate Dataset handling in R
3. Able to manage file handling in R
4. Design their statistical analysis using R
5. Evaluate data visualizations with the ggplot package

COURSE OUTCOMES (CO)

S. No	COURSE OUTCOME	BLOOMS LEVEL
CO1	Create a statistical application for analyzing a Data	K1
CO2	Able to demonstrate Graphs in R Programming	K2,K4
CO3	Demonstrate Filehandling methods in R	K3
CO4	Statistical analysis in R	K5
CO5	Import external data into R for data processing and statistical analysis	K5
KI- Remember, K2- Understand, K3- Apply, K4- Analyse		

SYLLABUS

Course Code	Course	Semester No.
21BTP15	PRACTICAL VI - R PROGRAMMING FOR BIOLOGISTS	II
Ex. No.	PROGRAM LIST	Hours
1.	Write a program to implementing R objects	4
2.	Demonstrate Dataframe and Factors with Conditional Statements in R	6
3.	Create a program to call the (built-in) dataset iris and display the data frame with functions	6
4.	Write a R program to create two 2x3 matrix and add, subtract, multiply and divide the matrixes.	6
5.	Demonstrate File handling methods in R	5
6.	Demonstrate chi-Square Test using Bio-conductor Package	4
7.	Demonstrate Plot Graph using statistical analysis of Iris Dataset	4
8.	Create a package for classification accuracy to be used in Dataset	4
		Total 39

Teaching methods:

- Use of multi-media/AV (Audio-Visual)/ICT
- Flipped Learning and Flipped Classroom
- Active Learning Forums
- Usage of Projectors
- Inquiry-based learning through quizzing, MCQs, etc.
- Student seminars and workshops
- Availability of E-resources
- Group Discussions, Group learning-Assignments and Cooperative learning




MAPPING WITH PROGRAM OUTCOMES

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	S	S	S	S
CO2	M	M	M	S	M	S	M
CO3	S	S	S	M	S	M	S
CO4	S	M	M	S	S	S	S
CO5	S	S	S	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
 K. S. SENTHILKUMAR	 Dr. R. RANGARAJ	 Name & Signature

Dr.R.Rangaraj
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