NEHRU ARTS AND SCIENCE COLLEGE

(Autonomous)

Reaccredited by NAAC with 'A' Grade, Certified by ISO 9001:2008 &14001:2004

Recognized by UGC & Affiliated to Bharathiar University

Nehru Gardens, Coimbatore-641 105

Scheme of Examination

M. Sc. Biotechnology

(Applicable to the students admitted during the Academic Year 2022-2023 onwards)

Semester	Course Code	Name of the Course	Ins. Hrs / Week	Duration of Examination	Exam			Credits
					CIA	ESE	Total	
I	22PGBTC101	Paper – I Molecular Biology	4	3	50	50	100	4
	22PGBTC102	Paper – II Biochemistry	4	3	50	50	100	4
	22PGBTC103	Paper – III Microbiology	4	3	50	50	100	4
	22PGBTC104	Paper – IV Bioinstrumentation & Biostatistics	4	3	50	50	100	4
	21PGBTQ201	Practical – I Biochemistry and Industrial Biotechnology	5	-	-	-	-	-
	21PGBTQ202	Practical – II Microbiology and rDNA Technology	5	-	-	-	-	-
	21PGBTE101/ 102/ 103 22PGBTE101/ 102/ 103	Discipline Specific Elective Paper – I	4	3	50	50	100	4
			30				**500**	**20**
II	21PGBTC205/ 22PGBTC205	Paper – V Plant Biotechnology	4	3	50	50	100	4
	22PGBTC206	Paper – VI Genetic Engineering	4	3	50	50	100	4
	22PGBTC207	Paper – VII Industrial Biotechnology	4	3	50	50	100	4
	22PGBTC208	Paper – VIII Bioethics, Biosafety & IPR	4	3	50	50	100	4
	22PGBTQ201/ 21PGBTQ201	Practical – I Biochemistry and Industrial Biotechnology	5	6	50	50	100	4
	22PGBTQ202/ 21PGBTQ202	Practical – II Microbiology and rDNA Technology	5	6	50	50	100	4
	21PGBTC313	Online Course through SWAYAM**	-	-	-	-	-	-
	21PGBTE201/202/203/ 22PGBTE201/202/203	Discipline Specific Elective Paper – II	4	3	50	50	100	4
			30				**700**	**28**
III	21PGBTC309	Paper – IX Immunology and Immunotechnology	4	3	50	50	100	4
	21PGBTC310	Paper – X Animal Biotechnology	4	3	50	50	100	4
	21PGBTC311	Paper – XI Pharmaceutical Biotechnology	4	3	50	50	100	4
	21PGBTC312	Paper – XII Bioinformatics and System Biology	4	3	50	50	100	4

	21PGBTQ403	Practical III – Plant and Animal Biotechnology	5	-	-	-	-	-
	21PGBTQ404	Practical IV – Immunology and Pharmaceutical Biotechnology	5	-	-	-	-	-
	21PGBTE301/21PGBTE302/ 21PGBTE303	Elective Paper – III	4	3	50	50	100	4
	21PGBTT301	*Internship Training	-	-	External		50	2
	21PGBTONLC	Online Course	-	-	-	-	-	-
			30				**550**	**22**
IV	21PGBTV401	**Research Project and Viva-Voce	16	-	100	100	200	8
	21PGBTE401/21PGBTE402/21PGBTE403	Elective Paper – IV	4	3	50	50	100	4
	21PGBTQ403	Practical III – Plant and Animal Biotechnology	5	6	50	50	100	4
	21PGBTQ404	Practical IV – Immunology and Pharmaceutical Biotechnology	5	6	50	50	100	4
			30				**500**	**20**
		TOTAL					**2250**	**90**
	Advanced Learners Courses for Additional Credits		2 Credits / Paper				-	8[$]

[$] Not included in CGPA calculation

* **Internship Training:**

Industrial Training has to be undergone during II semester vacation period (15 days).
Mark shall be given based on training report and presentation

** **Research Project and Viva-Voce:**

1) Project is pertain to the field of Biotechnology
2) Three review meetings should be conducted in the presence of HoD and respective guide.

Project	Maximum Marks
Review I (Last week of December)	25
Review II (Last week of January)	25
Review III (Last week of February)	25
Document preparation and Implementation(First week of March)	25

Dissertation evaluation	60 Marks
Viva-Voce	40 Marks

List of Discipline Specific Elective Papers

Elective	Course Code	Group	Name of the Course
Elective – I	21PGBTE101	A	Environmental Biotechnology
	21PGBTE102	B	Bioentrepreneurship
	21PGBTE103	C	Research Methodology
Elective – II	21PGBTE201	A	Agricultural Biotechnology
	21PGBTE202	B	Down Stream Processing
	21PGBTE203	C	Applied Biostatistics
Elective – III	21PGBTE301	A	Food Biotechnology
	21PGBTE302	B	Quality Control and Assurance
	21PGBTE303	C	Bioinformatics and Molecular Biology Databases

Elective – IV	21PGBTE401	A	Clinical Pathology and Diagnosis
	21PGBTE402	B	Occupational Health and Industrial Safety
	21PGBTE403	C	Drug Designing and Molecular Modeling

List of Advanced Learners Course [Self study]

S. No.	Course Code	Name of the Course
1.	21PGBTSS01	Cell Communication and Cell Signaling
2.	21PGBTSS02	Diversity of Life Forms
3.	21PGBTSS03	Ecological Principles
4.	21PGBTSS04	Applied Biology
5.	21PGBTSS05	Histochemical and Immunological Techniques

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Nehru Arts and Science College
Coimbatore

Course Code	Title		
22PGBTC101	Core Paper I: Molecular Biology		
Semester: I	Credits: 4	CIA: 50 Marks	ESE: 50 Marks

Course Objective	To provide knowledge of molecular biology and genetics of prokaryotic and eukaryotic organisms to the students
Course Category	Employability
Development Needs	Global
Course Description	It helps to explore the organization of genetic material emphasizing the chemical and evolutionary aspects of biological process

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Tell about basic genetics concept the structure of genes and chromosomes.	Lecture	Assignment
CO 2	Explain the changes in genes and its phenotypic effects	Lecture	Seminar
CO 3	Illustrate the process of replication and gene expression	Video Lessons	Quiz
CO 4	Examine the process of recombination and mutation and infer its outcome	Case Studies	project
CO 5	Know different models of recombination	Video Lessons	Assignment

Offered by **Biotechnology**

Course Content **Instructional Hours / Week : 4**

Unit	Description	Text Book	Chapters
I	**Gene Structure:** Fine structure of gene, split genes, pseudogenes, overlapping genes and multigene families. DNA and RNA as genetic material; Chemistry and structure of DNA. **Chromosome:** Structure, organization, banding, karyotyping, and labeling. Special types of chromosomes - sex chromosomes, B-chromosome, polytene and lambrush chromosomes	**1**	**1,2**
		Instructional Hours	**10**
Suggested Learning Methods: lectures about the Gene structure and chromosomes			**2**
II	**Genes for Development:** Genes for development in Drosophila and Arabidopsis, Fertilization and Development; genetic control of X inactivation; in vitro fertilization and embryo transfer Numerical and structural changes in the chromosome, Techniques in the study of chromosomes and applications. **Epigenetics:** Gene expression without a change in DNA sequence changes in gene expression arising from chemical modification of DNA or histone proteins.	1,2	3,4,5,9
		Instructional Hours	10
Suggested Learning Methods: Lectures about the genes and its phenotypic effects			2
III	**DNA replication in prokaryotes and eukaryotes:** mechanism of replication, Meselson and Stahl experiment; Transcription – steps, eukaryotic promoters, enhancers, transcription factors, post transcriptional modifications. **Translation:** Prokaryotes and eukaryotes translation and their regulation, post translational modifications, Regulation of gene expression in prokaryotes and eukaryotes.	1	6,7,8
		Instructional Hours	10
Suggested Learning Methods: Video lecture to show DNA replication			2
IV	**Gene Mutation and its mechanism:** Types of mutation: Forward; Reverse; Intragenic suppressor; Extragenic suppressor; point mutations; Missense; Nonsense; Somatic versus germinal mutation. Mutagenesis- spontaneous and induced. **DNA repair mechanisms:** Direct reversal; Excision repair (base excision, nucleotide excision and mismatch); recombinational repair; SOS response and SOS bypass.	2	8
		Instructional Hours	10

Suggested Learning Methods: Case studies on gene mutations			2
V	**Recombination:** Models; Rec A, Rec BCD, Ruv ABC, and molecular mechanism of Recombination. Conjugation; transformation and transduction. Transposons - simple and complex in prokaryotic and eukaryotic systems.	1	13,17
		Instructional Hours	12
Suggested Learning Methods: Video lessons based on methods of recombination			
		Total Hours	60 Hrs

Text Books	1. Benjamin Lewin, **Genes VI,** Published by Oxford University Press, U.K., 6th Edition, 1997. 2. Darnell, Lodish, Baltimore, **Molecular Cell Biology,** Published by Scientific American Books, Inc., 1994. 3. Benjamin A Pierce, **Genetics: A Conceptual Approach** by Published by Freeman and Company, New York, 2nd Edition, 2005. 4. William S. Klug & Michael R. Cummings, **Essentials of Genetics,** Prentice Hall Internationals, 2nd Edition, 1996.
Reference Books	1. Brown, T. A., **Genomes 2,** Published by Garland Science Publishing, New York. 2002. 2. Gerald Karp, **Cell and Molecular Biology,** Published by John Wiley, 6th Edition, 2009. 3. Bruce Alberts, **Molecular Biology of the Cell**, Published by Garland Science, Taylor & Francies, 2014.
Web. URLs	1. https://pdfs.semanticscholar.org/a610/f4e5b9797218bd6ecbfd597787129deaf78f.pdf 2. https://www.youtube.com/watch?v=aWpAe3rc5BU

Tools for Assessment (50 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
8	8	10	8	8	8	50

Mapping

CO \ PO	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PS O5
CO1	H	M	L	L	M	M	L	H	M	M	M	L	L
CO2	H	M	M	L	M	M	M	H	M	H	L	M	M
CO3	H	H	H	M	M	H	H	H	H	H	H	H	H
CO4	H	H	H	M	M	H	H	H	H	H	M	L	L
CO5	H	M	H	M	M	M	H	H	M	M	L	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by
Dr. M. DHANALAKSHMI, BIOTECHNOLOGY	Dr. N. SARANYA

Course Code	Title		
22PGBTC102	Paper –II Biochemistry		
Semester: I	Credits: 4	CIA : 50 Marks	ESE: 50 Marks

Course Objective	To understand the structure of atoms, molecules and chemical bonds, enzyme kinetics, biochemical concepts and techniques which will be necessary for future scientific endeavors
Course Category	Employability
Development Needs	Global
Course Description	Metabolism and generation of ATP and diagnose of metabolic diseases

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	To know phenomena, laws, rules, definitions, different interactions and physical quantities relevant to biochemical reactions	**Lecture method**	**Assignments**
CO 2	To understand the importance of carbohydrate and yield of energy	**Problem based learning**	**Problem**
CO 3	To integrate the various aspects of metabolism and their regulatory pathways	**Lecture method**	**Seminar**
CO 4	To understand three dimensional structure of protein and its components	**Activity based learning**	**Assignment**
CO 5	To learn the components and different forms of nucleic acids	**Lecture method**	**Assignment**

Offered by **Biotechnology**

Course Content **Instructional Hours / Week : 4**

Unit	Description	Text Book	Chapters
I	Structure of atoms, molecules and chemical bonds. Classes of organic compounds and functional groups. Covalent and Non-covalent interactions - Van der Waals, Electrostatic, Hydrogen bonding and hydrophobic interactions. Principles of thermodynamics. Coupled reactions. ETC and generation of ATP. Kinetics, dissociation and association constants.	**1**	**1,5,11,13, 14**
	Instructional Hours		**10**
Suggested Learning Methods – Experiential learning			**2 Hrs**
II	Classification of Carbohydrates. Glycolysis, TCA Cycle, Gluconeogenesis, Glycogen breakdown and synthesis, interconversion of hexoses and pentoses, Co-ordinated control of metabolism, Oxidation of fatty acids, Biosynthesis of fatty acids: Triglycerides; Phospholipids; Sterols	1,2	1,13,16-22
	Instructional Hours		10
Suggested Learning Methods – Problem based learning			**2 Hrs**
III	Amino acids and peptides – classification. Classifications and functions of proteins. Structural organization of protein (primary, secondary, tertiary, quaternary and domain structure). Ramchandran map. Purification and criteria of homogeneity.	1,2	3,4,5
	Instructional Hours		10
Suggested Learning Methods – Experiential learning			**2 Hrs**
IV	Enzymes and coenzymes: Coenzymes interactions: activators and inhibitors. Active sites, Enzyme kinetics (negative and positive cooperativity). kinetics of enzyme inhibitors. Factors affecting enzymatic activity. Isoenzymes, Allosteric enzymes – Haemoglobin and PFK. Ribozyme, hammer head, hair pin and other ribozymes. Abzyme: structure and drug targets (enzymes and receptors).	1, 2, 4	2,6,7,8
	Instructional Hours		10
Suggested Learning Methods – Problem and experiential learning			**3 Hrs**

V	Nucleic acids: chemical structure. Structure of double stranded DNA (A, B and Z DNA). Physical properties of double stranded DNA. Biosynthesis of purines. Biosynthesis of pyrimidines. Types of RNAs and their biological significance. Biochemistry and molecular basis of different disorders related to carbohydrate, protein. fat and nucleic acids	1,2,3	5,8,24,33, 34
		Instructional Hours	10
Suggested Learning Methods: Experiential learning			**02 Hrs**
		Suggested Learning Methods	**10 Hrs**
		Total Hours	60 Hrs

Text Books	1. Albert L. Lehninger, David Lee Nelson, Michael M. Cox, Lehninger principles of biochemistry, Published by W.H. Freeman, 5 th Edition, 2008. 2. Robert K. Murray, Darryl K. Granner, Peter A. Mayes, Victor W. Rodwell, Harper's Illustrated Biochemistry, Published by McGraw-Hill Professional, 29th Edition, 2012. 3. Jeremy Mark Berg, John L. Tymoczko, Lubert Stryer, Biochemistry, Published by W. H. Freeman, 6 th Edition, 2006. 4. Donald Voet, Judith G. Voet, Biochemistry, Published by J. Wiley & Sons, 4 th Edition, 2010.
Reference Books	1. Geoffrey L. Zubay, Published by Wm.C, Biochemistry, Brown Publishers, 3 rd Edition, 1993. 2. Burtis et. al., Teitz Text book of Clinical Biochemistry, 3 rd edition, William Heinmann Medical Books, Ltd., 1999. 3. Trevor Palmer, Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, Published by Horwood Publishing Limited, 5 th Edition, 2001.
Web. URLs	1. https://byjus.com/jee/chemical-kinetics/ 2. https://www.youtube.com/watch?v=UOGMqrkJYlM

Tools for Assessment (50 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
8	8	10	8	8	8	50

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	M	M	L	H	H	H	M	M	H	H	M
CO2	H	H	M	M	L	L	M	M	H	H	H	H	M
CO3	M	H	H	H	M	M	H	H	H	L	M	H	H
CO4	H	M	H	M	L	H	H	M	M	L	H	M	H
CO5	H	H	M	M	M	L	L	H	H	M	H	H	M

H-High; M-Medium; L-Low

Course designed by	Verified by
Dr. V. SHANMUGAM, BIOTECHNOLOGY	Dr. N. SARANYA

Course Code	Title		
22PGBTC103	Core Paper III Microbiology		
Semester: I	Credits: 4	CIA: 50 Marks	ESE: 50 Marks

Course Objective	Students will understand the basics of microbiology, with an emphasis on microbial growth and control.
Course Category	Employability
Development Needs	Global
Course Description	Description about Course category and Development Needs Upon successful completion of this course the student will be able to

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Upon successful completion of this course the student will be able to	Lecture / Flipped Classroom	Assignment work
CO 2	Understand the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes and also Understand the structural similarities and differences among various physiological groups of bacteria/ archaea	Video Lectures	Seminar
CO 3	Apply appropriate microbiological techniques for purification	Project-Based Teaching	Field Visit
CO 4	Differentiate structural and special differentiation in bacteria	interactive method	Case study
CO 5	Know the specific characteristic features of microorganisms	Experiential Teaching	quiz

Offered by	**Biotechnology Technology**

Course Content	Instructional Hours / Week : 4

Unit	Description	Text Book	Chapters
I	**Concepts of Microbiology:** Spontaneous generation conflict, Germ theory of diseases, Cell theory, Contributions: Antoni van Leeuwenhoek, Francesco Redi, Louis Pasteur, John Tyndall & Ferdinand Cohn, Robert Koch, Edward Jenner, Elie Metchnikoff, Joseph Lister, Paul Ehrlich, Alexander Fleming and Richard Petri. Purification of Microorganisms. Principle and nutritional requirements for Bacterial growth, Cuture media.	1	1
		Instructional Hours	**10**
Suggested Learning Methods: peer team learning about the basics microbiology subject			**02 Hrs**
II	**Observing Microorganisms:** Microscopy – Introduction, Bright field, Dark Field, Phase contrast and Fluorescent. **Preparing and Staining Specimens:** Smear, Wet mount; Types of stains – Simple, Differential (Gram's and Acid fast), Special (Endospore and Flagella), Fungal staining. **Control of Microorganisms:** Physical methods – Heat, Filtration and Radiation; Chemical methods – Phenolics, Alcohols, Halogens and Gases.	2,	3, 12
		Instructional Hours	10
Suggested Learning Methods : Group discussion about the basics microbiology techniques			**02 Hrs**
III	**Cell structure and Function:** Prokaryotes –Over view (Size, Shape and Arrangements), Plasma membrane, Internal membrane, Cytoplasmic inclusion bodies, Ribosomes, Nucleiod, Cell wall structure (Gram positive and Gram negative), Capsule, Slime layer, Flagella & motility, Pili and Fimbriae; Eukaryotes: Over view, Cytoplasmic matrix, Endoplasmic reticulum, Golgi apparatus, ribosomes, mitochondria, Chloroplast, Nucleus, Cilia and Flagella	3	3
		Instructional Hours	10
Suggested Learning Methods : Video lectures about the microbial taxonomy subject			**02 Hrs**

IV	**Bacterial Taxonomy:** Outline Classification and General Characterization of Eubacteria and Archaebacterium **Fungal Taxonomy**: General Properties, Classification (Alexopolus - up to class level) and Economic importance	1, 4	20-22,1-13
		Instructional Hours	10
Suggested Learning Methods : Video lectures about the microbial taxonomy subject			**02 Hrs**
V	**Algal Taxonomy:** Classes, General characteristics and Economic importance **Classification of Protozoa** – Out line, General Characters and importance. **Classification of Virus** - Classification and general characteristics and importance.	4 - 6	1-13,18, 3-131
		Instructional Hours	10
Suggested Learning Methods : Video lectures about the microbial taxonomy subject			**02 Hrs**
		Total Hours	60 Hrs

Text Books	1.Joanne Willey and Linda Sherwood and Christopher J. Woolverton, **Prescott's Microbiology**, McGraw-Hill Publications, 3rd Edition, 2017. 2.Jacquelyn G. Black, Laura J. Black, **Microbiology: Principles and Explorations**, Wiley Publication, 9th Edition, 2015. 3.Michael T. Madigan, Kelly S. Bender, Daniel H. Buckley, W. Matthew Sattley, David A.Stahl, **Brock Biology of Microorganisms**, 15th Edition, Pearson Publication, 2018. 4. Constantine J. Alexopoulos, Charles W. Mims, Meredith M. Blackwell, **Introductory Mycology**, Wiley Publication,4th Edition, 1996. 5. E.C.S. Chan,Michael J. Pelczar, Jr.,Noel R. Krieg, **Microbiology**, McGraw-Hill Publications, 5th Edition, 2010. 6. Martinez Marty Hewlett, David Camerini, David C. Bloom. Basic Virology, 4th edition, 2021
Reference Books	1. Kathleen Park Talaro, **Foundation in Microbiology**, McGraw-Hill Publications, 9th Edition, 2015. 2.Gerard J. Tortora,Berdell R. Funke, Christine L. Case, **Microbiology: An Introduction**, Pear Publication, 20th Edition, 2015.
Web. URLs	1. https://www.edx.org/learn/microbiology 2. https://study.com/articles/List_of_Free_Online_Microbiology_Courses_and_Training_Options.htm 3. https://microbiologysociety.org/education-outreach/resources.html

Tools for Assessment (50 Marks)

CIA I	CIA II	CIA III	Seminar	Case study	Viva voice	Total
8	8	10	8	8	8	50

Mapping

CO \ PO	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PS O5
CO1	L	L	L	M	L	M	H	L	M	L	M	M	L
CO2	L	M	M	L	L	H	L	M	L	L	M	M	L
CO3	M	L	L	H	L	L	L	M	H	H	M	M	L
CO4	L	L	L	M	L	M	H	L	H	M	M	M	M
CO5	M	L	M	L	H	L	M	H	M	H	L	M	M

H-High; M-Medium; L-Low

Course designed by	Verified by
Dr. P. THIRUNAVUKKARASU, BIOTECHNOLOGY	Dr. N. SARANYA

Course Code	Title		
22PGBTC104	Paper – IV Bioinstrumentation and Biostatistics		
Semester: I	Credits: 4	CIA: 50 Marks	ESE: 50 Marks

Course Objective	To understand the importance of the analytical techniques in the field of Biotechnology
Course Category	Skill Development and Employability
Development Needs	Global
Course Description	Adequate knowledge on various instrumentation techniques for scientific discovery, in terms of the principle involved, why that particular equipment is used, what information does the equipment provide to eventually analyse and interpret the data with the biostatics tools find its application in the research work, also at the industry level.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Remember specific facts, terms concepts and principles	Lecture / Demo	Assignment
CO 2	Understand the purpose of instrumentation in bioscience	Demo / Video Lessons	Seminar
CO 3	Apply concepts, calculation and principles of instruments	Demo / Video Lessons	Quiz
CO 4	Critically review and analyze basic parameters of the equipment related to bioscience	Tutorial / Case Studies	Assignment
CO 5	Understand the application of statistical software for biological research	Tutorial / Case Studies	Assignment

Offered by	**Biotechnology**

Course Content	Instructional Hours / Week : 4

Unit	Description	Text Book	Chapters
I	**Buffers and Spectrophotometry:** pH, pK, acids, bases and buffers, Henderson - Hassel bach equation pH meter, Colorimetry & Spectrophotometry: Principles, types and applications, UV-VIS double beam spectrophotometry, Spectrofluorometry, Mass spectroscopy, IR spectroscopy, Flame photometry, NMR Spectroscopy, Circular Dichroism, X- ray diffraction	1	1, 12, 13
		Instructional Hours	**10**
Suggested Learning Methods: Video lectures, Kinaesthetic and Laboratory practice about the principles of the instruments			**02 Hrs**
II	**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), Mass spectrometry (MS). MALDI TOF	1,2	3, 10 & 12
		Instructional Hours	10
Suggested Learning Methods: Video lectures, Kinaesthetic and Laboratory practiceabout the principles of the instruments			**02 Hrs**
III	**Principles, types and applications of Centrifuges**: Various types of Centrifuges, Separation methods and their Specific applications **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 and Flow Cytometry	1	3, 10 & 12
		Instructional Hours	10
Suggested Learning Methods: Apply the statistical methods in various projects			**02 Hrs**

IV	**Scope of Biostatisticsand Measures of Central Tendency:**Measures of Central tendency – Arithmetic mean, Median and Mode. Calculation of mean, median, mode in series of individual observation discrete series, continuous open end classes	2	1, 5
		Instructional Hours	10
Suggested Learning Methods: Apply the statistical methods in various projects			**02 Hrs**
V	**Classification, tabulation and Representation of Data:** Classification and tabulation of data – Graphical and diagrammatic representations Scale diagrams – Histograms – frequency polygon - Frequency curves, Measures of Dispersion, standard deviation and Range, Student t test, Regression, Correlation one way and two way ANOVA, Application of statistical software for biological research	1	13,17
		Instructional Hours	10
Suggested Learning Methods: Laboratory practice			**02 Hrs**
		Suggested Learning Methods	**10 Hrs**
		Total Hours	60 Hrs

Text Books	1. Keith Wilson and John Walker, Principles and Techniques of Biochemistry and Biology, Cambridge University Press, Edition: 7, 2010. 2. Arora, P.N. and Malhan, P.K., Biostatistics, Himalaya Publishing House, 2006.
Reference Books	1. Sawhney, K. and Randhir Singh, Introductory Practical Biochemistry, Narosa Publishing House, 2010. 2. Lee, T., Introductory Biostatistics, Wiley – Interscience, 2011.
Web. URLs	1. http://www.itl.nist.gov/div898/handbook/prisection3/pri3.htm (online e book) 2. http://www.statease.com/de7_man.html (Software Tutorial Website)

Tools for Assessment (50 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
8	8	10	8	8	8	50

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	L	H	M	L	M	M	L	M	H	M	H	M
CO2	M	L	L	M	M	L	L	L	H	H	H	H	H
CO3	L	L	M	M	L	L	L	M	M	L	M	M	L
CO4	L	L	M	M	L	L	M	H	H	M	H	M	L
CO5	M	M	L	L	L	M	M	M	H	H	M	H	H

H-High; M-Medium; L-Low

Course designed by	Verified by
Dr. O. S. NIMMI	Dr. N. SARANYA

Course Code	Title		
22PGBTC205	Paper –V Plant Biotechnology		
Semester: II	Credits: 4	CIA: 50 Marks	ESE: 50 Marks

Course Objective	To understand the in vitro culture techniques & genetic engineering in plants, mechanism and uses of transgenic plants and Industrial applications of plant products
Course Category	Employability and Entrepreneurship
Development Needs	Global
Course Description	Develop the skills of *in vitro* cultivations of plants

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Outline requirements for plant tissue culture lab construction	Lecture	Seminar
CO 2	Illustrate the methods of *invitro* culture and transformation techniques	Tutorial	Assignment work
CO 3	Illustrate the gene transfer technology for transgenic plant production	Video Lessons	Field visit and Learning
CO 4	Realize the importance of phytochemical in industry	Lectures	Quiz
CO 5	Appropriate transformation technologies for production of transgenic plants	Class Projects	Case study

Offered by **Biotechnology**

Course Content **Instructional Hours / Week : 4**

Unit	Description	Text Book	Chapters
I	**Conventional plant breeding methods:** Selection, hybridization, mutation and polyploidy. **PTC Requirements:** Design of Plant tissue culture laboratory. Nutritional requirements of plant tissue culture. Composition of MS media, Gamborgs media, Nitch's media, Whites media and their preparation. Plant growth regulators. Sterilization techniques.	**1**	**1,2**
	Instructional Hours		**10**
Suggested Learning Methods: lectures about the basics of Plant tissue culture			**02 Hrs**
II	***Invitro* culture for plants:** Micropropagation, Callus culture, somatic embryogenesis, suspension culture, embryo culture, haploid culture, protoplast culture and fusion; Somaclonal variation; Artificial seeds; Green house conditions, hardening.	1,2	3,4,5,9
	Instructional Hours		10
Suggested Learning Methods: Demonstration of plant tissue culture techniques			**02 Hrs**
III	**Gene Transfer Methods:** *Agrobacterium* mediated gene transfer, *Agrobacterium* based vectors (Ti plasmids and Ri plasmids), viral vectors and their applications. Direct gene transfer methods - electroporation, microinjection and particle bombardment. Characterization of transgenics, screenable and selectable markers. Marker free methodologies and gene targeting.	1	6,7,8
	Instructional Hours		10
Suggested Learning Methods: Develop skills of transgenic crops from video lectures			**02 Hrs**
IV	**Secondary metabolic pathways in plants:** Industrial phytochemical products from plants - Alkaloids,Biodegradable Plastics, Therapeutic proteins, biodegradable plastics, antibodies, plant vaccines, herbal drugs, bioethanol and biodiesel.	2	8
	Instructional Hours		10
Suggested Learning Methods: Understand the nature of secondary metabolites using online tools			**02 Hrs**
V	Application of gene transformation in plant: Insect resistance, fungus resistance, virus resistance, drought, cold resistance, saline resistance, Transgenic plant with vitamin A, Gene silencing in crop plants, Terminator seed technology, Production of therapeutic antibodies, edible vaccine. Heat	2, 3	13,17

	Shock Proteins, Male Sterile Lines, Nitrogen Fixation, long shelf life of fruits & flowers. Bioethics on transgenic plants.		
		Instructional Hours	10
Suggested Learning Methods: Case study			**02 Hrs**
		Suggested Learning Methods	**10 Hrs**
		Total Hours	60 Hrs

Text Books	1. Razdan, M. K., Introduction to Plant Tissue Culture, Science Publisher Inc., UK.2013. 2. Chawla, H. S., **Introduction to Plant Biotechnology,**Science Publisher Inc., UK., 2012. 3. Srivatsava, S., and Narula, A., **Plant Biotechnology and Molecular Markers,** Springer, Netherlands, 2004
Reference Books	1. Mantel. S.H, Mathews. J.A. and Mickee, R.A., **An Introduction to Genetic Engineering in Plants**, Black well Scientific Publishers, London, 2015. 2. Pierik, R.L.M., ***Invitro* Culture of Plants,** MartinusNijhoff Publishers, Dordrecht, 2017. 3. Dixon, R.A. and R.A. Gonzales. **Plant Cell Culture, A Practical Approach**, Oxford University Press, Oxford, 2nd Edition, 2014. 4. Grierson, D., and S.N. Covey, **Plant Molecular Biology.** Blackie & Sons. Ltd. Glascow, 2018. 5. Monica. A. Hughes, **Plant Molecular Genetics,** Pearson Education Ltd, England, 2019. 6. Mantell and Smith, **Plant Biotechnology,** Cambridge University Press, 2013.
Web. URLs	1.http://www.biologydiscussion.com/plants/plant-breeding-steps-and-methods-of-plant-breeding-for-disease-resistance/1340 2.web.nchu.edu.tw/pweb/users/taiwanfir/lesson/1146.pdf

Tools for Assessment (50 Marks)

CIA I	CIA II	CIA III	Seminar	Viva voce	Mini project	Total
8	8	10	8	8	8	50

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	H	M	L	L	L	M	H	M	L	L	M
CO2	L	L	M	L	L	L	L	L	H	H	H	M	M
CO3	M	L	M	L	L	M	L	L	M	H	H	L	M
CO4	L	M	M	H	L	M	L	L	M	H	M	L	M
CO5	L	M	M	M	L	M	L	M	H	H	H	M	M

H-High; M-Medium; L-Low

Course designed by	Verified by
Dr. P. SENTHILKUMAR, BIOTECHNOLOGY	Dr. N. SARANYA

Course Code	Title		
22PGBTC206	Paper – VI Genetic Engineering		
Semester: II	Credits: 4	CIA: 50 Marks	ESE: 50 Marks
Course Objective	To provide the student with the relevant background information necessary to understand genetic engineering and impart knowledge to perform cloning		
Course Category	Employability		
Development Needs	Global		
Course Description	It discusses the basic terms used in genetic engineering and also provides knowledge on various molecular techniques and its applications		

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Know different tools of Genetic Engineering	Lecture	Assignment
CO 2	Understand the technical know-how on versatile techniques in Genetic Engineering	Video lessons	Seminar
CO 3	Apply Genetic Engineering Techniques in Basic and Applied Experimental Biology	Demonstration	Quiz
CO 4	Have Proficiency in designing and conducting experiments involving genetic manipulation	Virtual	Mini review
CO 5	Understand the application of different types of PCR	Lecture	Case study

Offered by Biotechnology

Course Content | **Instructional Hours / Week : 4**

Unit	Description	Text Book	Chapters
I	**Genetic Engineering and Tools of Genetic Engineering:** Introduction, scope and importance. Enzymes used in manipulation - Polymerases; nucleases - endonuclease, exonuclease and restriction enzymes; ligase; topoisomerase, methylase; other modifying enzymes. Linkers and adaptors	1	4
	Instructional Hours		10
Suggested Learning Methods : Video lectures on basics in genetic engineering			**02 Hrs**
II	**Vectors:** general characteristics of vectors, Plasmid based-pBR322, pUC vectors, Phage based-lambda, M13, Cosmids, Phagemids, **Viral vectors – AAV, Baculo virus vectors**, cloning and expression vectors, shuttle vectors, artificial chromosomes: YAC, PAC, BAC, HAC. Cloning and selection of individual gene, gene library and cDNA library. TAGs and Affinity purification method.	1	2,6,7
	Instructional Hours		10
Suggested Learning Methods: Adaptive learning			**02 Hrs**
III	**Transformation Techniques:** Methods of DNA transfer, exogenously supplied chemical methods, calcium phosphate precipitation method, liposome mediated method and electroporation, gene gun method; Determination of transformation / transfection efficiency. Lambda DNA based DNA recombinants: *In vitro* packaging of DNA	1	5
	Instructional Hours		10
Suggested Learning Methods: Inquiry based learning			**02 Hrs**
IV	**Plating, screening and selection:** Preparation of nutrient media with selection marker, antibiotics and additives for visual screening of recombinant clones, selection of clones. **Labelling of DNA, RNA and proteins:** Uses of radioactive isotopes, Non-radioactive labelling relative advantages and disadvantages, *in vivo* labelling, Nick translation, random primer labelling, auto-radiography, auto-fluorography.	2	5,6,7
	Instructional Hours		
Suggested Learning Methods : Interactive learning			**02 Hrs**

V	**Confirmation and analysis of expression of DNA:** Blotting techniques - Southern, Northern and Western blotting, PCR based techniques - PCR, **Real Time PCR**, Assay based techniques - DNA and protein microarray, Metagenomics, types, functions and applications, Genome analysis and genome editing technologies: Gene silencing – siRNA, microRNA; principle and application of gene silencing; gene knockouts - Cre-Lox systems; CRISPR-Cas9 systems.	3	6
		Instructional Hours	10
Suggested Learning Method : Kinaesthetic learning			**02 Hrs**
		Total Hours	60 Hrs

Text Books	1. Brown T.A., **Introduction to Gene Cloning,** Stanley Thomas Publishing Ltd, London, 3rd Edition, 1998. 2. Primrose, S.B., **Principles of Gene Manipulation,** Blackwell Science Ltd, Germany, 6th Edition, 2003. 3. Glick and Pasternak, **Molecular Biotechnology, Principles and Application of Recombinant DNA**, AMS Publications, US, 4th Edition, 2010.
Reference Books	1. Old R.W. and S.B. Primrose, **Principles of Gene Manipulation**, Boston Blackwell Scientific Publications, 1994. 2. Kingsman, S.M and A.J. Kingsman, **Genetic Engineering: An Introduction to Gene Analysis and Exploitation in Eukaryotes**, Blackwell Scientific publications, Oxford. 1998. 3. Davies J.A. and Reznikoff, **Milestones in Biotechnology**, classic papers on genetic engineering. Butterworth-Heinemnn, 1992. 4. John M Walker and Ralph Raply, **Molecular Biology and Biotechnology**, RSC Publishing, 5th Edition, 2009.
Web. URLs	http://nptel.ac.in/downloads/102103013/

Tools for Assessment (50 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
8	8	10	8	8	8	50

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	M	L	L	M	L	M	L	L	M	L	L
CO2	H	M	H	M	L	H	H	H	M	L	L	M	L
CO3	M	M	M	H	H	H	H	M	H	H	M	H	H
CO4	L	M	H	H	H	H	M	H	H	H	M	M	H
CO5	M	H	M	H	M	H	H	M	H	M	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by
Dr. E. VIJAYA GOWRI, BIOTECHNOLOGY	Dr. N. SARANYA

Course Code	Title		
22PGBTC207	Core Paper – VII Industrial Biotechnology		
Semester: II	Credits: 4	CIA: 50 Marks	ESE: 50 Marks
Course Objective	On successful completion of the course the students should have understood the basics of fermentation technology and learned the concept of screening, optimization and maintenance of cultures.		
Course Category	Employability and Entrepreneurship		
Development Needs	Global		
Course Description	It emphasizes the biological and engineering principles further explains various aspects of applied and industrial Biotechnology		

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Recall the basis of fermentation technology	Lecture	Assignment
CO 2	Know the types of fermentation and fermenter used in industries	Tutorial	Seminar
CO 3	Develop the transport phenomena in bioprocess technology	Constructivist approach	Quiz
CO 4	Analyse the mechanism of fermenter in industry	Virtual	Report
CO 5	Design the production process for industrially important products	Case studies	Review

Offered by	Biotechnology

Course Content	Instructional Hours / Week : 4

Unit	Description	Text Book	Chapters
I	**Historical overview of industrial fermentation process**: traditional and modern Biotechnology. **Advantages of bioprocess over chemical process:** Basic function, design and body construction; Peripheral parts and accessories- Impellers types, sparger, temperature control; pH, control and foam, baffles. **Sterilization:** Types of sterilization – Heat, Radiation and Filtration methods, air sterilization, Aseptic inoculation and sampling methods.	**1**	**1,2**
		Instructional Hours	**10**
Suggested Learning Methods: Video lectures on industrial fermentation			**02 Hrs**
II	**Types of fermentation** – Solid state fermentation – Tray fermenter, Column fermenter, and Drum fermenter, Submerged fermentation – Batch and continuous, fed batch.**Types of fermenters**- CSTR, Tower fermenter, Jet loop, Air lift, Bubble column, Packed bed, trickle bed reactor, Fluidized, Tubular fermenter. Immobilized enzyme and cells.	1,2	2,7
		Instructional Hours	10
Suggested Learning Methods: Experiential learning			**02 Hrs**
III	**Transport phenomena in bioprocess** – Mass transfer , resistance, Rate of oxygen transfer, determination of oxygen transfer coefficients. Biological heat transfer for microbial cultivations, Microbial growth Kinetics.**Fermentors** – Continuous parameters, sampling systems – Chemostat, Turbidostat. Containment – Mechanism of foam fermentations and foam breaking. Computers in bioprocess control systems, Biosensor	2	7,8,9
		Instructional Hours	10
Suggested Learning Methods: Interactive learning			**02 Hrs**
IV	**Assessment in Fermentation: Up-steam processing** - Media formulation; Inocula development and Sterilization; Aeration and agitation in bioprocess; Measurement and control of bioprocess parameters.	2	

	Down Steam processing - Removal of microbial cells- Centrifugation, Sedimentation, Flocculation, Microfiltration, cell disruption – physical, chemical and enzymatic methods. P**urification of fermentation products** - precipitation methods, membrane process, centrifugation – Ultracentrifugation; Purification by chromatography techniques, crystallization, drying, lyophilisation and packaging.		8,9,10
		Instructional Hours	10
Suggested Learning Methods: Interactive learning			**02 Hrs**
V	**Industrial Fermentative products:** Production of secondary metabolites: Antibiotics - penicillin, Vitamin B_{12}, Production of enzymes: amylase, Production of organic acids: citric acid, Production of amino acids: Glutamic acid, Organic solvents - ethanol by Yeast, Production of recombinant and therapeutic proteins: Insulin, Interferon; Vaccines, and SCP and biofertilizer.	3	22
		Instructional Hours	10
Suggested Learning Methods: Experiential learning			**02 Hrs**
		Total Hours	60 Hrs

Text Books	1. Michael L. Shuler FikretKarg, **Bioprocess Engineering Basic Concept,** Prentice Hall International Services, 2nd Edition, 2001. 2. Peter. F. Stanbury, Allan Whitaker, Stephen. J. Hall, **Principles of Fermentation Technology,** Published by Elsevier Science Ltd., reprinted, 2nd Edition, 2007.
Reference Books	1. Pauline M. Doran, **Bioprocess Engineering Principles,** Elsevier, Reprinted, 2006. 2. Basantarai, **Essential of Industrial Microbiology.** Lulu publisher, 4th Edition, 2012. 3. Karia, G.L. and Christian, R.A. Prentice, **Waste Water Treatment: Concepts and Design Approach,** Hall of India private Limited, New Delhi, 2006.
Web. URLs	1. https://www.pdfdrive.net/modern-industrial-microbiology-and-biotechnology-d14938252.html

Tools for Assessment (50 Marks)

CIA I	CIA II	CIA III	Assignment	Semin ar	Quiz	Total
8	8	10	8	8	8	50

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	L	M	L	L	L	L	L	H	M	H	M	L
CO2	L	L	M	M	M	L	L	M	H	M	M	H	M
CO3	L	M	L	L	M	L	L	L	M	M	L	H	H
CO4	L	L	M	L	L	L	L	L	H	M	H	H	H
CO5	L	L	M	M	L	L	L	M	M	M	L	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by
Dr. N. SARANYA, BIOTECHNOLOGY	Dr. N. SARANYA

Course Code	Title		
22PGBTC208	Core Paper – VIII Bioethics, Bio safety and IPR		
Semester: II	Credits:4	CIA:50Marks	ESE:50Marks

Course Objective	To enable the students, get an idea about the advantages and disadvantages of biotechnological applications, ethical implications and intellectual property rights
Course Category	Skill development
Development Needs	Global
Course Description	It imbibes the knowledge and skills on bioethics, bio safety and intellectual properties of rights

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understand the basics of Bioethics and ethical aspects	Lecture	Assignment
CO 2	Outline the ethical implications of genetic modifications	Lecture	Assignment
CO 3	Assess the risk management and biosafety guidelines to be followed at different situations	E- Modules	Case study
CO 4	Analyze the intellectual properties and patent rules	Demonstration	Seminar
CO 5	Compare and contrast the IPR at different parts of the world	Tutorials	Case study

Offered by	**Department of Biotechnology**

Course Content	Instructional Hours / Week :5(T)

Unit	Description	Text Book	Chapters
I	**Introduction to ethics/bioethics:** Framework for ethical decision making. **Biotechnology and ethics:** Benefits and risks of genetic engineering, ethical aspects of genetic testing, ethical aspects relating to use of genetic information. Genetic engineering and bio-warfare	1	1
	Instructional Hours		**10**
Suggested Learning Methods: Assignment and seminar			**02 Hrs**
II	**Ethical implications of cloning:** Reproductive cloning, therapeutic cloning. **Ethical, legal and socioeconomic aspects:** Aspects of gene therapy, germ line, somatic, embryonic and adult stem cell research. GM crops and GMO's Biotechnology and Biopiracy – ELSI of human genome project	1	5,9
	Instructional Hours		**10**
Suggested Learning Methods: Online materials and case study			**02 Hrs**
III	**Introduction to biosafety:** Biosafety issues in biotechnology. Risk assessment and risk Management, safety protocols: risk groups Biosafety levels, biosafety guidelines and regulations (National and International). Operation of biosafety guidelines and regulations, types of biosafety containment.	1	7
	Instructional Hours		10
Suggested Learning Methods: Personalized learning, Assignment			**02 Hrs**
IV	**Introduction to IPR:** Intellectual property and intellectual property rights. Types: patents, copy rights, Trade marks, design rights, geographical indications, importance of IPR. World intellectual Property rights organization (WIPO). IPR laws patent infringement and legal consequences.	2	1,3
	Instructional Hours		10
Suggested Learning Methods: Peer learning			**02 Hrs**

V	**Patents:** What can and what cannot be patented. Patenting life, legal protection of biotechnological Inventions. National and International Patenting.	3	7,5
		Instructional Hours	10
Suggested Learning Methods: Group activity			**02 Hrs**
		Instructional Hours	60

Text Books	1. Sateesh M.K., **Bioethics and Biosafety,** I.K. International Publishing House Pvt. Ltd. 2008. 2. Das, H.K., **Text Book of Biotechnology,** Edition: 3,Wiley India Pvt. Ltd. 2007. 3. Ramdass, P., **Animal Biotechnology Recent Concepts and Development**, MJP Publishers, 2008.
Reference Books	1. Jose Cibelli, Robert P. lanza, Keith H. S. Campbell, Michael D. West, **Principles of Cloning,** Academic Press, 2002.
Web. URLs	1. http://www.actahort.org/members/showpdf?booknrarnr=447_125 2. http://www.cordis.lu/elsa/src/about.htm

Tools for Assessment (50 Marks)

CIA I	CIA II	CIA III	Seminar	Assignment	Case study	Total
8	8	10	8	8	8	50

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	L	L	L	M	M	L	L	H	H	M	M	L
CO2	L	L	M	L	L	L	M	L	M	H	H	L	L
CO3	L	L	L	M	L	M	M	L	M	H	H	H	H
CO4	L	M	L	L	L	M	L	L	L	M	H	H	H
CO5	L	L	M	L	M	M	L	L	M	H	M	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by
Dr. N. SARANYA, BIOTECHNOLOGY	Dr. N. SARANYA

Course Code	Title		
22PGBTE101/ 21PGBTE101	Elective Paper – I (A) Environmental Biotechnology		
Semester: I	Credits: 4	CIA: 50 Marks	ESE: 50 Marks
Course Objective	To identify and address issues of environmental concerns by applying chemical, biological and molecular sciences.		
Course Category	Employability		
Development Needs	Global		
Course Description	This course imparts the environmental quality monitoring, remediation, and mitigation of contaminated environments.		

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understand the basics concepts of the biota.	Flipped Classroom	Assignment
CO 2	Demonstrate the management of the ecosystem	Tutorial	Seminar
CO 3	Apply the methodology to solve pollution problems	Lectures	Debate
CO 4	Apply the management of liquid waste.	Case Studies	Seminar
CO 5	Evaluate the role of microbes in waste management	Video Lessons	Quiz

Offered by | **Biotechnology**

Course Content | **Instructional Hours / Week : 4**

Unit	Description	Text Book	Chapters
I	**Basic concepts:** Interactions between environment and biota; Concept of habitat and ecological niches; Limiting factor; Energy flow, food chain, food web and tropic levels. Ecological pyramids and recycling **Biotic community -**concept, structure, dominance, fluctuation and succession; Concepts and theories of evolution - Population ecology - community structure.	1	1,3
Instructional Hours			**10**
Suggested Learning Methods: Video lectures about the basics of environment and biota			
II	**Ecosystem dynamics and management:** Stability and complexity of ecosystems; Speciation and extinctions; environmental impact assessment; Principles of conservation. **Conservation strategies;** sustainable development. Global environmental problems: ozone depletion, UV-B green-house effect and acid rain, their impact in biotechnological approaches for management.	1,2	6,5
Instructional Hours			10
Suggested Learning Methods: Lecture based on ecosystem dynamics and management			
III	**Environmental pollution:** Types of pollution, Methods for the measurement of pollution; **Methodology of environmental management** – the problem - solving approach, its limitations. Air pollution and its control through Biotechnology. **Water Pollution and control:** Need for water management, Measurement and sources water pollution. Kind of aquatic habitats, (fresh and marine), distribution and impact of environmental factors on the aquatic biota, productivity, mineral cycles and biodegradation different aquatic ecosystems.	3	2,4
Instructional Hours			10
Suggested Learning Methods: Case studies			

IV	**Liquid waste management**. Composition, BOD, COD and DO. Physical, Chemical and Microbiological treatment. Water borne diseases.	3	6
	Instructional Hours	10	
Suggested Learning Methods: Hands on traning.		**02 Hrs**	
V	**Role of Microbes in waste process technology** – Bioremediation, Bioleaching, Degradation of xenobiotics. Utilization of waste as food (SCP, Yeast and Mushroom), as fuel (Ethanol and Methane) as fertilizer (Algae) and as feed (Algae and Yeast). Ecological considerations, decay behaviour and degradative plasmids; hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, pesticides.	4	5,7
	Instructional Hours		10
Suggested Learning Methods: Laboratory practice			
	Total Hours		60 Hrs

Text Books	1. Sharma, P.D., **Ecology and Environment**, Rastogi Publications, 2007 2. Paulsamy, S., **Introduction to Environmental Biology**, Emkay publications, 1998. Revised 2016. 3. Goel, P.K., **Water Pollution** (Causes, effects and control), New age international publishers, 2011. 4. Joseph, C. Daniel, **Environmental aspects of Microbiology**, Humana Press, 2013.
Reference Books	5. Vijaya Ramesh, K., **Environmental Microbiology**, MJP Publishers, 2008. 6. Sunakar Panda, **Environmental and Ecology**, Vrinda Publications, 2007 7. Arumugam, N. and Kumaresan, V.**Environmental Biology**, Sara's publishers, 2013.
Web. URLs	http://www2.hcmuaf.edu.vn/data/quoctuan/8122418481%20Environmental_Science.pdf

Tools for Assessment (50 Marks)

CIA I	CIA II	CIA III	Seminar	Case Study	Quiz	Total
8	8	10	8	8	8	50

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	L	M	L	L	M	M	L	M	M	L	H	-
CO2	L	L	M	L	M	L	L	M	H	H	M	L	H
CO3	M	L	L	H	L	L	-	M	L	H	H	-	M
CO4	L	M	L	L	L	H	M	-	H	L	H	L	-
CO5	M	M	L	M	L	L	-	M	H	M	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by
Dr. N. SARANYA, BIOTECHNOLOGY	Dr. N. SARANYA

Course Code	Title		
21PGBTE102/ 22PGBTE102	Elective Paper – I (B) Bio Entrepreneurship		
Semester: I	Credits: 4	CIA:50Marks	ESE: 50Marks

Course Objective	To recognize a business opportunity that fits the individual student and also to demonstrate the understanding of how to launch the individual's entrepreneurial career.
Course Category	Entrepreneurship
Development Needs	Global
Course Description	To enhance relevant skills students who are interested in doing an internship in industry, e.g. a pharmaceutical company or a biotech start-up, should register for a Project course (elective). Biotechnology master's students can take Project courses too.

Course Outcomes		Teaching Methods	Assessment Methods
CO1	Gain Knowledge on how to assess business opportunities and an in – depth understanding of what typically characterize success and failures	Lecture	Assignment work
CO2	Understand the key and the most effective processes in bringing different types of products or services to markets	Model preparation	Seminar
CO3	Learn Technology and Entrepreneurship in a cross – disciplinary- fashion to identify and develop attractive opportunities within their field of experience	Project-Based Teaching	Field Visit and Learning
CO4	Know the limitations of each concept and looking for an alternative in analysis	Participative and interactive method	Case study
CO5	Identification of project selection and business opportunities	Experiential Teaching	quiz

Course Offered by	**Biotechnology**
Course Content	**Instruction Hours /Week : 4**

Unit	Description	Text Book	Chapter
I	**Management and Practices:** Introduction, definition – Management, Principles of Henry Fayol, Setting and Managing Biotechnology Industry: principles and decisions on starting a venture Sources of financial assistance, Making a business proposal, Approaching loan from bank and other financial institutions, Budget planning and cash flow management, Basics in accounting practices.	1,2	1, 2, 7
	Instructional Hours		**13**
Suggested Learning Methods: Lectures and Video demonstration			**02 Hrs**
II	**Process and Marketing:** Recruitment and selection process, Leadership skills and Managerial skills, Organization structure, Training, Team Building, Marketing Definition and Functions, Assessment of market demand for potential product(s) of interest, Market conditions, segments; prediction of market changes, Identifying needs of customers including gaps in the market.	1,4	8
	Instructional Hours		**13**
Suggested Learning Methods: Field practice in industries			**02 Hrs**
III	**Entrepreneur:** Meaning of entrepreneur, evaluation of the concept, function of an entrepreneur types of entrepreneur, Evolution of entrepreneurship, Development of entrepreneurship, stages in entrepreneurial process, Role of entrepreneurs in economic development entrepreneurship in India, Entrepreneurship - its barriers.	1,3	1, 7, 9
	Instructional Hours		**13**
Suggested Learning Methods: Group activity			**02 Hrs**

IV	**Small Scale Industry:** Definition, characteristic and Need and rationale, Objectives, Scope, Role of SSI in economic development, Advantages of SSI, Steps to start an SSI, Govt. policy towards SSI, different policies of SSI, Govt. support for SSI during 5 year plans, Impact of liberalization, privatization, globalization on SSI, Effect of WTO/ GATT, Supporting agencies of Govt for SSI, meaning; nature of support, objectives, and functions, Types of help, Ancillary industry and Tiny industry.	4	6, 17
		Instructional Hours	**11**
Suggested Learning Methods: Hand-on training.			**02 Hrs**
V	**Projects and Application:** TECKSOK, KIADB, KSSIDC, KSIMC, DIC single window Agency SISI, NSIC, SIDBI, KSFC; Preparation of Project-Meaning of Project; Project Identification Project Selection. Project Report, Need and significance of Report, Contents, Formulation Guidelines by Planning Commission for Project report, Network Analysis; Errors of Project Report, Project Appraisal, Identification of Business Opportunities. Market Feasibility Study, Technical Feasibility study, Financial Feasibility Study & Social Feasibility study.	2	11, 13
		Instructional Hours	**10**
Suggested Learning Methods: Industry visit and Get training			**02 Hrs**
		Total Hours	**60**

Text Books	1. Robert D. Hisrich, Michael P. Peters & Dean A. Shepherd, Entrepreneurship, Tata McGraw Hill, 2007. 1.Tripathy, P.C. and P. N. Reddy, McGraw Hill, Principles of Management, 2008. 2. Khanka, S.S., and S. Chand sons, Entrepreneurial Development, 2008. 3. Gary Desseler, Human Resource Management, Prentice Hall, Edition: 10, Prentice Hall Publishers, 2005. 4. Vasant Desai, Himalaya Publishing, Dynamics of Entrepreneurial Development andManagement, 2007.
Ref Books	1. Openstax, David S. Bright, Anastasia H. Cortes. 2022. Principles of Management. 2. Veerabhadrappa Havinal., 2009. Management and Entrepreneurship. 3. Gary M. Armsrong, Stewart Adam, Sara Manron Denize. 2017. Principles of Marketing.
Ref Link	https://www.simplilearn.com/principles-of-management-by-henri-fayol-article

Tools for Assignment (50 Marks)

CIA I	CIA II	CIA III	Seminar	Case study	Viva-Voce	Total
8	8	10	8	8	8	50

Mapping

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	L	M	M	M	L	L	L	L	H	H	L	H
CO2	M	L	L	M	L	L	M	L	M	L	H	L	H
CO3	L	L	M	L	L	L	H	M	M	H	L	H	L
CO4	L	M	M	M	L	L	H	L	H	H	H	H	H
CO5	L	L	L	M	L	L	H	M	L	M	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by
Dr. N. SARANYA, BIOTECHNOLOGY	Dr. N. SARANYA

Course Code	Title		
21PGBTE103	Elective Paper – I (C) Research Methodology		
Semester: I	Credits: 4	CIA:50Marks	ESE: 50Marks
Course Objective	The primary objective is to develop a research orientation among the students and to acquaint them with fundamentals of research methods. Specifically, introducing them to the basic concepts used in research and to scientific social research methods and their approach		
Course Category	Skill development and Employability		
Development Needs	Global		
Course Description	The goals of this course is to help and encourage students completely understand basic concepts and methods of quantitative empirical research and to stimulate their interests to learn more about the research. At the end of the course, students will be equipped with basic and applied research methodology.		

Course Outcomes		Teaching Methods	Assessment Methods
CO1	Basic framework of research process	Video lessons	Assignment
CO2	Various research designs and technique	Review Article based lessons	Assignment
CO3	Various sources of information for literature review and data collection	Research articles based lessons	Seminar
CO4	Ethical dimensions of conducting applied research Appreciate the components of scholarly writing and evaluate its quality	Lectures / Hands -on training	Writing skill test
CO5	Procedure for writing research proposal and grant	Lectures / Online based teaching	Online searching test

Course Offered by	Biotechnology
Course Content	Instruction Hours /Week : 4

Unit	Description	Text Book	Chapter
I	**Objective and Steps in Research process**: Definition, objectives of research. Types and its significance. Steps in research process. Criteria for good research. Defining and formulating a research problem. Literature survey, Development of working hypothesis.	1	1, 2
		Instructional Hours	**10**
Suggested Learning Methods: Presentation and Video lectures of basic research process.			**02 Hrs**
II	Research design: Definition and related concepts, Basic principles of experimental designs- Informal and formal experimental designs Sampling design: Steps in sample design, Non-probability sampling and Probability sampling -random sampling; Measurement and scaling techniques- Methods of data collection.	1	3, 4,5
		Instructional Hours	**10**
Suggested Learning Methods: Practice in field study, sample collection and preservation methods.			**02 Hrs**
III	Sources of Data: Primary Data, Secondary Data; Procedure Questionnaire: Sampling Merits and Demerits - Experiments - Kinds - Procedure; Procedure Schedules: Sampling Merits and Demerits - Experiments - Kinds - Procedure; Control Observation: Merits - Demerits - Kinds - Procedure - Sampling Errors: Type-I Error, Type-II Error	1	6, 9
		Instructional Hours	**10**

Suggested Learning Methods: Data processing techniques by statistical tools and data interpretation methods through computer software.			**02 Hrs**
IV	Research report writing: steps in report writing layout of the Research Report, Types of Reports, Styles of reporting. Editing and evaluation of final draft, evaluating the final draft; Editing and evaluation of final draft, evaluating the final draft	1 & 2	14, 10, 20
		Instructional Hours	**10**
Suggested Learning Methods: Hand-on training on writing skills such as, report and article writing.			**02 Hrs**
V	**Research proposal/Grant**: Presentation of data - preparation of master's thesis for oral presentation; Presenting the research findings in open defense. Research proposal/Grant- definition, structure, budget allocation, specific aims, background and significance. Hierarchy of funding agencies in India and their operations.	2	20
		Instructional Hours	**10**
Suggested Learning Methods: Awareness on funding agencies and training to write the proposals.			**02 Hrs**
		Total Hours	**60**

Text Books	1. Kothari, C.R., Research Methodology: Methods and Techniques, New Age International Publishers, 2nd Edition, 2010. 2. Chawla Deepak &SondhiNeena., Research Methodology: Concepts and Cases, Vikas Publishing House Pvt. Ltd. Delhi, 2011
Reference Books	1. Gurumani, N., Research Methodology for Biological Science, MJP Publishers, Chennai, 2006 2. Rt. Kumar, Research Methodology: A Step-by-Step Guide for Beginners, SAGE pub., 2010. 3. C. R. Kothari, Research Methodology: Methods and Techniques, New Age Intl., 1985
Web. URLs	1. https://onlinelibrary.wiley.com/doi/book/10.1002/97811187630252. 2. https://mtechlib.files.wordpress.com/

Tools for Assignment (50 Marks)

CIA I	CIA II	CIA III	Seminar	Viva voce	Case study	Total
8	8	10	8	8	8	50

Mapping

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	L	H	M	L	M	M	L	H	L	L	M	H
CO2	M	L	L	M	M	L	L	L	H	M	M	M	H
CO3	L	L	M	M	L	L	L	M	L	M	M	M	L
CO4	L	L	M	M	L	L	M	H	L	L	M	M	H
CO5	M	M	L	L	L	M	M	M	H	M	H	M	L

H-High; M-Medium; L-Low

Course designed by	Verified by
Dr. C. CHELLARAM, BIOTECHNOLOGY	Dr. N. SARANYA

Course Code	Title		
21PGBTE201	Elective Paper – II (A) Agricultural Biotechnology		
Semester: II	Credits: 4	CIA: 50 Marks	ESE: 50 Marks
Course Objective	Students will understand the basics of microbiology, with an emphasis on microbial growth and control.		
Course Category	Employability		
Development Needs	Global		
Course Description	On successful completion of this course, the student will be able to		

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understand the basic concept of biotechnology in Agriculture	Lecture	Assignment work
CO 2	Different techniques of Agriculture Biotechnology in Plant Breeding Methods	Video Lectures and preparation	Seminar
CO 3	Sympathetic crop plantings through model biotechnological approach	Project-Based Teaching	Field Visit and Learning
CO 4	Analyze the applications and environmental risk assessment on transgenic Plants	Participate and interactive method	Mini project
CO 5	Apply biotechnology in agricultural field for crop improvement	Experiential Teaching	quiz

Offered by	Biotechnology Technology

Course Content	Instructional Hours / Week : 4

Unit	Description	Text Book	Chapters
I	**Scope of Biotechnology in agriculture**: Biotechnology in Agriculture, growth and historical perspective of agriculture biotechnology; Science of Genetic leading to modern biotechnology to agriculture.	1	3,6,7
		Instructional Hours	**4**
Suggested Learning Methods: peer team learning about the plant breeding			**02 Hrs**
II	**Central Concepts in Plant Breeding**: Simple versus complex Inheritance, Phenotype versus Genotype, Mating System, Varieties, Landraces and Pure Lines; Plant Breeding is a numbers Game; Plant Breeding is an Iterative and Collaborative process; Diversity; Adaptation and Ideotypes. **Methods of Plant Breeding**: Methods of Hybridization- Self-pollinated species, Out crossing species, Synthetic varieties, Hybrid varieties, Clonally propagated species. **Breeding**: enhancements: Double Haploidy, Marker-Assisted Selective, Mutation Breeding.	1,2	3,4, 7
		Instructional Hours	12
Suggested Learning Methods : Group discussion about the crop techniques			**02 Hrs**
III	**Biotechnology Crops Plantings**: Farmers Use Biotech Crops; Herbicide Tolerant Crop, Insect Resistant Crops, Pathogen Resistance Crop; Environmental impact from changes in Insecticide and Herbicide use; Improved **Products and Food Quality**: Nutritional Improvements, Modified Plant Oils, Pharmaceutical Products, Biofuels. Impact on Green house (GHS) Emissions- Impact of Biofertilizers in agriculture - advantage and current status - Applying Biotechnology in Resource Poor Areas.	1	1,8
		Instructional Hours	12
Suggested Learning Methods : Video lectures about the transgenic plant			**02 Hrs**

IV	**Field Testing of Transgenic Plants:** Environmental Risk Assessment (Era) Process- Initial Evaluation (ERA Step 1), Problem Formulation (ERA Step 2), Controlled Experiments and Gathering of Information (ERA Step 3), Risk Evaluation (ERA Step 4), Progression through a Tiered Risk Assessment. **Risk Assessment**: Bt Maize Pollen on Non-target Caterpillars, Statistical analysis and Relevance for Predicting; Potential Adverse Effects on Butterflies.	1	13
		Instructional Hours	
Suggested Learning Methods : Video lectures about the IPR			**02 Hrs**
V	**Intellectual Property** in Agricultural Biotechnology Research; Anticommons – Transformation methods, Selectable Markers, Constitutive Promoters, Tissue or Development Specific Promoters. Freedom to Operate (FTO), Strategies for Open Access. **Future of Agriculture Biotechnology** – Site specific Recombination System, Zinc-Finger Nucleases; Future of Food, Fuel and Pharmaceuticals.	1	16
		Instructional Hours	12
Suggested Learning Methods : Video lectures about the microbial taxonomy subject			**02 Hrs**
		Total Hours	60 Hrs

Text Books	1. Stewart, C. Neal. **Plant Biotechnology and Genetics; Principles, Techniques and Applications.** John Wiley & Sons, Inc. Canada, 2008. 2. Acquaah, George, **Principles of Plant Genetics and Breeding** - 2nd Edition, John Wiley & Sons, Inc. Canada, 2012.
Reference Books	1. Kumar H.D., **Agricultural Biotechnology**, Daya Publishing House, 2005. 2. Arie Altman, **Agricultural Biotechnology**,CRC Press, 1997. 3. Ahindra Nag, **Agricultural Biotechnology**, PHI Learning Pvt.Ltd. 2008 4. Ashok Kumar, **Agricultural Biotechnology,** Discovery Publishing House, 2005.
Web. URLs	1. https://www.edx.org/learn/microbiology 2. https://study.com/articles/List_of_Free_Online_Microbiology_Courses_and_Training_Options.html 3. https://microbiologysociety.org/education-outreach/resources.html

Tools for Assessment (50 Marks)

CIA I	CIA II	CIA III	Seminar	Viva voice	Mini Project	Total
8	8	10	8	8	8	50

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	L	M	L	L	M	M	L	H	L	L	M	H
CO2	L	L	M	L	M	L	L	M	H	M	M	M	H
CO3	M	L	L	H	L	L	L	M	H	M	M	M	H
CO4	L	M	L	L	L	H	M	L	H	M	M	M	H
CO5	M	M	L	M	L	L	L	M	H	M	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by
Dr. P. THIRUNAVUKKARASU, BIOTECHNOLOGY	Dr. N. SARANYA

Course Code	Title		
22PGBTE203/ 21PGBTE203	Elective Paper – II (C) Applied Biostatistics		
Semester: II	Credits:4	CIA:50Marks	ESE:50Marks
Course Objective	To provides an introduction to applied statistics, with an emphasis on medical and epidemiological data		
Course Category	Skill development		
Development Needs	Global		
Course Description	It provides an overview of statistical methods for analyzing the data and data analysis techniques		

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Demonstrate an organized approach to the analysis of data collected to answer a scientific question	Smart board	**seminar**
CO 2	Refine a scientific question into a statistical framework. Identifying the response variable and an appropriate summary measure of that variable. Identifying the predictor of interest	Problem oriented learning	Solving ability
CO 3	Perform descriptive analyses of data Identifying and computing appropriate summary statistics. Identifying and constructing appropriate graphical displays. Univariate and multivariate descriptive analysis.	Experiential learning	Viva voce
CO 4	Define the sampling distribution of a statistic Application of basic tools in research aspect	Smart board	Mini model
CO 5	Understand Categorical Data and Chi-Square Tests	Thinking based learning	Interpretation skills

Offered by	Department of Biotechnology

Course Content	Instructional Hours / Week :5

Unit	Description	Text Book	Chapters
I	**Types of Studies:** Surveys and Cross-Sectional Studies, Retrospective Studies, Prospective Studies, Experimental Studies and Quality Control, Clinical Trials	1	1
		Instructional Hours	**10**
Suggested Learning Methods: Smart Board			**02 Hrs**
II	**Basic Epidemiological Concepts:** Introduction to basic epidemiological concepts, such as study designs as well as the difference between observational studies and randomized clinical trials.	1	1 & 2
		Instructional Hours	**10**
Suggested Learning Methods: Problem oriented learning			**02 Hrs**
III	**Selecting Proper Statistical Tests:** Simple Random Sampling, Bootstrap Sampling, Convenience Sampling, Systematic Sampling, Cluster Sampling	1	2
		Instructional Hours	10
Suggested Learning Methods : Mini survey			**02 Hrs**

IV	**Correlation and Regression:** Correlation, Linear Regression, and Logistic Regression	2	11
		Instructional Hours	10
Suggested Learning Methods : Assignment and Group activity			**02 Hrs**
V	**Categorical Data and Chi-Square Tests:** Understanding Chi-Square, Chi-Square Distributions and Tables, Testing Independence between Two Variables, Testing for Homogeneity, Testing for Differences between Two Proportions, The Special Case of 2 × 2 Contingency Table, Simpson's Paradox in the 2 × 2 Table, McNemar's Test for Correlated Proportions, Relative Risk and Odds Ratios, Goodness of Fit Tests-Fitting Hypothesized Probability Distributions, Limitations to Chi-Square and Exact Alternatives.	1	5
		Instructional Hours	10
Suggested Learning Methods : Experiential learning			**02 Hrs**
		Instructional Hours	60

Text Books	**1.** Michael R. Chernick and Robert H. Friis, **Introductory Biostatistics for t Health Sciences** (Modern Applications Including Bootstrap), John Wiley Sons, Inc. Canada, 2003. **2.** Gerald Van Belle, Lloyd D. Fisher, Patrick J. Heagerty, Thomas Lumle **Biostatistics** (A Methodology for the Health Sciences), John Wiley & So Inc., 2004.
Reference Books	1. Stephen C. Newman, **Biostatistical Methods in Epidemiology**, John Wiley & Sons, Inc., 2001. 2. Lee, T., **Introductory Biostatistics,** Wiley - Interscience, 2011 3. Stephen W. Looney**, Statistical Methods,** Humana publications**,** 2009.
Web. URLs	1. https://catalyst.harvard.edu/services/biostatscertificate/ 2. https://www.edx.org/course/introduction-applied-biostatistics-osakaux-med101x-0 3. https://www.statistics.com/biostatistics/

Tools for Assessment (50 Marks)

CIA I	CIA II	CIA III	Seminar	Mini model	Viva voce	Total
8	8	10	8	8	8	50

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO 5
CO1	H	M	M	L	L	M	M	M	L	L	H	L	H
CO2	M	H	M	M	L	M	H	M	M	L	L	H	L
CO3	H	H	H	H	L	H	H	H	H	L	M	L	H
CO4	H	H	M	H	H	M	L	M	H	H	L	M	L
CO5	H	H	H	M	M	H	H	H	M	M	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by
Dr. O. S. NIMMI, BIOTECHNOLOGY	Dr. N. SARANYA

Course Code	Title		
22PGBTQ201/ 18PGBTQ201	Practical – I Biochemistry and Industrial Biotechnology		
Semester: I &II	Credits: 4	CIA: 50 Marks	ESE: 50 Marks

Course Objective	To understand the principles behind the qualitative, quantitative estimation of biomolecules, production of industrial important products, purification and its kinetics analysis.
Course Category	Skill Development
Development Needs	Global
Course Description	It helps to identify the microorganism in natural resources and to isolate their genome for Skill Development further applications in the field of genetic engineering.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Learn about quantification of biomolecules	Project based learning	Hands on Training
CO 2	Determining the kinetic parameters of enzyme	Project based learning	Hands on Training
CO 3	Demonstrate the separation of biomolecules by Chromatographic techniques -Paper /Column	Project based learning	Hands on Training
CO 4	Assessing the purity of enzyme preparation	Project based learning	Hands on Training
CO 5	Troubleshoot the problem occurred during analysis	Project based learning	Hands on Training

Offered by	**Biotechnology**

Course Content	Instructional Hours / Week: 5

Unit	Description
1	Safety guidelines in Biochemistry laboratory practices.
2	Estimation of reducing sugars by Nelson - Somogyi method
3	Estimation of total carbohydrates by Anthrone method
4	Estimation of acid value, saponification value, Iodine number of fat
5	Estimation of total free amino acids
6	Estimation of DNA by DPA Method
7	Estimation of RNA by Orcinol method
8	Protein estimation by Absorbance at 280nm and Lowry's method
9	Estimation of Cholesterol s
10	Thin Layer Chromatography - separation of amino acids
11	Estimation of inorganic phosphates by Fiske-Subarao method
12	Estimation of calcium, iron and Phosphate
	Industrial Biotechnology
13	Production and estimation of biomass (SCP) – dry weight and wet weight method.
14	Production of wine and Estimation of alcohol
15	Isolation/extraction of any one industrially important enzyme (Amylase)and assay of amylase activity

16	Enzyme immobilization – Gel entrapment/ Cross linking
17	Partial purification of amylase enzyme –ammonium sulphate precipitation, Dialysis, Gel permeation Chromatography
18	Determination of enzyme kinetic parameters – pH, Temperature, Km, Vmax and Kcat
19	Separation of proteins by SDS-PAGE

Suggested Learning Methods : Experiential Learning

Instructional Hours	**150**
Total Hours	**150 Hrs**

Text Books	
Reference Books	
Web. URLs	https://link.springer.com/book/10.1007/978-1-4419-9785-2

Tools for Assessment (50 Marks)

Technical skill	Analytical Skill	Lab Performance	Test I	Test II	Observation note book	Total
8	8	8	10	10	6	50

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	L	L	M	L	M	H	L	M	M	L	L	M
CO2	L	L	M	L	L	H	L	M	H	M	-	H	M
CO3	M	L	L	L	L	L	L	M	M	M	H	H	L
CO4	L	L	L	M	L	M	H	L	H	H	M	H	M
CO5	M	L	M	-	M	L	M	H	M	H	H	M	M

H-High; M-Medium; L-Low

Course designed by	Verified by
Dr. V. SHANMUGAM, BIOTECHNOLOGY	Dr. N. SARANYA

Course Code	Title		
22PGBTQ202	Practical – II Microbiology and rDNA Technology		
Semester: I &II	Credits: 4	CIA: 50 Marks	ESE: 50 Marks

Course Objective	To make the student should able to demonstrate practical experience of selected microbiological and molecular techniques.
Course Category	Skill Development
Development Needs	Global
Course Description	It helps to identify the microorganism in natural resources and to isolate their genome for Skill Development further applications in the field of genetic engineering.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Know the importance of steps involved in microbiology and rDNA practical.	Project based learning	Hands on Training
CO 2	Understand the safety measure and regulations in handing the macromolecules	Project based learning	Hands on Training
CO 3	Demonstrate laboratory tools in rDNA technology	Project based learning	Hands on Training
CO 4	Exhibit techniques related to microbiology and molecular biology	Project based learning	Hands on Training
CO 5	Troubleshoot the problem related to molecular techniques	Project based learning	Hands on Training

Offered by	**Biotechnology**

Course Content	Instructional Hours / Week: 5

Unit	Description
1	Orientation to the Microbiology Laboratory (Safety Procedures and Precautions, General Laboratory Directions)
2	Microscope: Bright-Field Light, Dark Field and Phase Contrast
3	Handling and Examining Cultures
4	Bacterial Motility
5	Gram Staining
6	Capsule Staining
7	Endospore Staining
8	Negative Staining
9	Negative Staining
10	Measurement of bacterial cell size
11	Enumeration of bacteria from soil
12	Morphology of fungi (Lactophenol Cotton Blue Technique)
	rDNA Technology
13	Isolation of genomic DNA from bacteria
14	Isolation of plasmid DNA from bacteria
15	Restriction digestion of DNA
16	Separation of DNA fragments using agarose gel electrophoresis

17	Polymerase chain reactions
18	Cloning, transformation and Screening recombinants
	Instructional Hours **150**
	Total Hours **150 Hrs**

Text Books	NIL
Reference Books	NIL
Web. URLs	NIL

Tools for Assessment (50 Marks)

Technical skill	Analytical Skill	Lab Performance	Test I	Test II	Observation note book	Total
8	8	8	10	10	6	50

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO 4	PSO5
CO1	L	L	L	M	L	M	H	L	M	M	L	L	M
CO2	L	L	M	L	L	H	L	M	H	M	L	H	M
CO3	M	L	L	L	L	L	L	M	M	M	H	H	L
CO4	L	L	L	M	L	M	H	L	H	H	M	H	M
CO5	M	L	M	L	M	L	M	H	M	H	H	M	M

H-High; M-Medium; L-Low

Course designed by	Verified by
Dr. M. DHANALAKSHMI, BIOTECHNOLOGY	Dr. N. SARANYA