M.Sc.,
BIOTECHNOLOGY

SYLLABUS

FROM THE ACADEMIC YEAR 2023-2024

TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION, CHENNAI - 600 005

Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum Framework (LOCF) Guideline Based Credits and Hours Distribution System

for all Post – Graduate Courses including Lab Hours

FIRST YEAR – SEMESTER – I

Part	List of Courses	Credits	No. ofHours
	Core – I	4	5
	Core – II	4	5
	Core – III	4	5
	Elective – I	2	4
	Elective – II	2	3
	Practical-I	4	8
		20	**30**

SEMESTER-II

Part	List of Courses	Credits	No. ofHours
	Core – IV	4	5
	Core – V	4	5
	Core – VI	4	5
	Elective –III	4	4
	Elective –IV	2	3
	Practical –II	2	6
	Skill enhancement Course-1	2	2
		22	**30**

SECOND YEAR – SEMESTER – III

Part	List of Courses	Credits	No. of Hours
	Core – VII	4	5
	Core – VIII	4	5
	Core – IX	4	5
	Core (Industry Module) – X	4	5
	Elective – V	2	3
	Practical –III	2	2
	Practical –IV	2	3
	Skill Enhancement Course - II	2	2
	Internship / Industrial Activity/Field visit/Research Updating activity*	2	-
		26	**30**

SEMESTER-IV

Part	List of Courses	Credits	No. of Hours
	Core – XI	4	5
	Core – XII	4	5
	Project with VIVA VOCE	7	10
	Practical-V	2	3
	Elective – VI (Industry Entrepreneurship)	3	4
	Skill Enhancement Course – III / Professional Competency Skill	2	3
	Extension Activity	1	-
		23	**30**

Total 91 Credits for PG Courses

***- Internship / Industrial Activity/Field visit/Research Updating activity-A report should be submitted at the end of IIIrd Semester and evaluated by external examiners**

-Internship students should submit certificate of attendance from the industry along with the report.

METHODS OF EVALUATION		
Internal Evaluation	Continuous Internal Assessment Test	**25 Marks**
	Assignments / Snap Test / Quiz	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	**75 Marks**
Total		**100 Marks**

METHODS OF ASSESSMENT	
Remembering (K1)	• Thelowestlevelofquestionsrequirestudentstorecallinformationfromthecoursecontent • Knowledgequestionsusuallyrequirestudentstoidentifyinformationinthetextbook.
Understanding (K2)	• Understanding of facts and ideas by comprehending organizing, comparing, translating, interpolating and interpreting in their own words. • Thequestionsgobeyondsimplerecallandrequirestudentstocombinedatatogether
Application (K3)	• Studentshavetosolveproblemsbyusing/applyingaconceptlearnedintheclassroom. • Studentsmust usetheir knowledgetodetermineaexactresponse.
Analyze (K4)	• Analyzingthequestionisonethatasksthestudentstobreakdownsomethingintoitscomponentparts. • Analyzingrequiresstudentstoidentifyreasonscausesormotivesandreachconclusionsorgeneralizations.
Evaluate (K5)	• Evaluationrequiresanindividualtomakejudgmentonsomething. • Questionstobeaskedtojudgethevalueofanidea,acharacter,aworkofart,orasolutiontoaproblem. • Studentsareengagedindecision-makingandproblem–solving. • Evaluationquestionsdonothavesinglerightanswers.
Create (K6)	• Thequestionsofthiscategorychallengestudentstogetengagedincreativeandoriginalthinking. • Developingoriginalideasandproblemsolvingskills

FIRST YEAR

Subject Status (Core/Elective)		*Subject Title*	*ins. hrs /week*	*Credits*	*Int. Marks*	*Ext. Marks*	*Total*
SEMESTER I							
Core Course	Core Paper- I	Biochemistry	5	4	25	75	100
	Core Paper - II	Cell and Molecular Biology	5	4	25	75	100
	Core Paper - III	Microbiology	5	4	25	75	100
	Core Practical-I	Lab in Biochemistry, Cell & Molecular Biology & Microbiology	8	4	50	50	100
Elective	Elective- I	A. Genetics B. Virology C. Basic Analytical Methods	4	2	25	75	100
	Elective-II	A. Enzyme technology B. Dairy technology C. Pharmaceutical technology	3	2	25	75	100
			30	**20**			
SEMESTER II							
Core Course	Core Paper -IV	Immunology	5	4	25	75	100
	Core Paper - V	Genetic Engineering	5	4	25	75	100
	Core Paper -VI	Developmental and Stem cell Biology	5	4	25	75	100
	Core Practical-II	Lab in Immunology & GeneticEngineering	6	4	50	50	100
Elective	Elective -III	A. Medical Laboratory Technology B. Food and Nutrition C. Biodiversity	4	2	25	75	100
	Elective - IV	A. Genomics & Proteomics B. Environmental Sciences C. Herbal Biotechnology	3	2	25	75	100
Skill Enhancement Course	SEC - I	A. Mushroom Cultivation and Apiculture B. Vermiculture Technology C. Validation of Medicinal Plants	2	2	25	75	100
			30	**22**			

SECOND YEAR

Subject Status (Core/Elective)	*Subject Status (Core/Elective)*	*Subject Title*	*ins. hrs /week*	*Credits*	*Int. Marks*	*Ext. Marks*	*Total*
SEMESTER III							
Core Course	Core Paper VII	Plant Biotechnology	5	4	25	75	100
	Core Paper VIII	Animal Biotechnology	5	4	25	75	100
	Core Paper IX	Microbial Biotechnology	5	4	25	75	100
	Core Paper X	Environmental Biotechnology	5	4	25	75	100
	Core Practical-III	Lab in Plant and animal Biotechnology	2	2	50	50	100
	Core Practical-IV	Lab in Microbial Biotechnology and Environmental Biotechnology	3	2	50	50	100
Elective	Elective-V	Nano Biotechnology / Systems Biology	3	2	25	75	100
Skill Enhancement Course	SEC-II	AgriculturalBiotechnology	2	2	25	75	100
	Internship/Industrial Activity/Field Visit/ Research Updating Activity		-	2	50	50	100
			30	**26**			
SEMESTER IV							
Core Paper	Core Paper -XI	Bioinformatics	5	4	25	75	100
	Core Paper -XII	Research Methodology	5	4	25	75	100
	Core -XII	Project and Viva Voce	10	7	50	50	100
	Core Practical-V	Lab in Bioinformatics and Research Methodology	3	2	50	50	100
Elective	Elective -VI	Medical Microbiology/ Bioethics, Biosafety, and IPR	4	3	25	75	100
Skill Enhancement Course	SEC-III	Value added products from marine resources	3	2	25	75	100
	Extension Activity	Industrial Visit	-	1	-	-	-
			30	**23**			

FIRST YEAR- SEMESTER-I

Course	**CORE PAPER -I**
Title of the Course	**BIOCHEMISTRY**
Credits	**4**
Hours/Week	**5**
Course Objectives	1.To learn the physical and chemical nature of Biomolecules 2.To learn various types of biomolecules 3.To develop knowledge on intermediary metabolism of CHO, Proteins, and Lipids 4.To teach the basics and advance of enzymes and their classifications 5.To develop a piece of knowledge in clinical biochemistry.
Course Out Comes	1.After studying unit 1, the students will be able to identify the nature ofsolvents and solutions concerning pH and its important 2.After studying unit 2, the students will be able to classify carbohydrates,proteins lipids, and nucleic acids of biomolecules 3.After studying unit 3, the students will be able to describe the biomolecules involved in intermediary metabolism 4.After studying unit 4, the students will be able to explain enzymes and enzyme kinetics 5.After studying unit 5, the students will be able to apply Biochemistry, inclinical biochemistry procedures.

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	No	Yes	Yes	Yes	No
3	No	Yes	No	Yes	Yes	Yes
4	No	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	Course Contents	Teaching hours
Unit I	Basic Concepts: Units of measurements of solutes in solution, e.g. Normality, Molality, Molarity. The hyper and hypotonic solution, pH, pK, acids, bases, ionic bonds, covalent bonds, and secondary bonds (hydrogen bonds and Vander Waal‟ bonds)	12 hours
Unit-II	Biomolecules: Definitions, nomenclature, classification, structure, chemistry, and properties of carbohydrates, Definitions, nomenclature, classification, structure, chemistry, and properties of amino acids and proteins (hemoglobin, myoglobin, and plasma proteins), lipids and Nucleic acids,	12 hours
Unit-III	Metabolism: Metabolism of Carbohydrates, EMP, TCA, HMP. Glycogen metabolism, Gluconeogenesis. Amino Acids-Transamination, Deamination, Urea cycle. Lipids and Nucleic Acids-Their Biosynthesis. Mechanism of Oxidative Phosphorylation and Its Inhibitors, Uncouplers, Photophosphorylation	12 hours
Unit-IV	Enzymology: Enzymes: general aspects (classifications and structure). The allosteric mechanism, regulatory and active sites, andactive energy. Iso-enzymes. Enzyme kinetics (MM, LB plot, Km) and hormones.	12 hours
Unit-V	Clinical biochemistry: Blood sugar level, Factors controlling blood sugar level – hypo, hyperglycemia, Diabetes mellitus, types – GTT. Metabolism of bilirubin- jaundice-types. Differential diagnosis and liver function tests. Renal functional test and gastric function test.	12 hours
Unit-VI	**Internal Assessments, Seminars, and Guest lecture**	05 hours
Total Teaching hours		65

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Textbook:

1. J.L. Jain, S. Jain and N. Jain. Fundamentals of Biochemistry. S. Chand & Co, 2016.
2. Ambika Shanmugam. Biochemistry. Published by Wolters Kluwer, 8th Edition, 2016.
3. A.C. Deb. Fundamental of Biochemistry. New Central Book Agency, 2012
4. Biochemistry ,7th Edition, jermy M.Berg John,L .Tymoczko,Lubertstryer 2012.W.H,freeman & company ,newYork 2.
5. Molecular Bio methods handbook,2nd edition R.Rapley & J.M Walker,2 008, Humanapress.
6. Principles of Biochmeistry , 5th Edition AL. Lehninger ,D.L. Nelson and M.M Cox ., 2008.worth publishers , NewYork.
7. Biochemistry 4th Edition,G.Zubay,1998.Mc Millan publishing Co.NewYork.
8. Harper‟s Biochemistry,29th Edition-Rober K.Murray,DarylK.Grammer,2012 McGrawHill, lange Medical Books
9. Understanding enzymes -5theditionTrevorpalmer,Prentice Hall/Ellias Horwood1995
10. Text Book Medical Biochemistry M.N.Chatterjee 8th edition Jaypeebrothers Medicalpublishers.2013

Reference Book:

1. D.L. Nelson and M.M. Cox. Lehninger Principles of Biochemistry, WHFreemanPublishers, 7th Edition, 2017.

2. V.W. Rodwell, D.A. Bender, K.M. Botham, P.J. Kennell and P.A. Weil.Harper's Illustrated Biochemistry, 30th Edition. McGraw Hill, 2015.

3. Wilson and Walker. Principles and Techniques of Practical Biochemsitry,6th edition, Cambridge University, Press. 2005.

4. Upadhyaya A Upadhyaya K and Nath. Biophysical Chemistry: Principlesand Techniques, 3rd Edition. Himalayan publications, 2009.

5. M.N. Chatterjee and Rana Shinde, Textbook of Medical Biochemistry, 8thEdition. Jaypee Brothers Medical Publishers (P) Ltd., 2012.

6. Biochemistry – 4th edition Donald voet and Judith G.Voet ,VP Publishers2011 steitz and A.M.Weiner ,The Benjamin /CUMMINGS publ.Co.,Inc.,California,2013

7. Genes VI(9th Ed).Benjamin Lewin, oxford universitypress,uk.,2007 10. Molecularbiology of cell (5th edition) brucealberts, alexanderjohnson, Julianlewis, martinraff, keithRoberts, peterwalter, garland sciencepublications.2008

8. Molecular Biology (5th edition).weaver .R.F,McGraw Hillpublications,2011. Cell and molecular biology : concepts and experiments (5th edition).geraldkarp,wiley publications,2013

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]

https://nptel.ac.in/courses/104105076,https://oli.cmu.edu/courses/biochemistry-open-free/,
https://onlinecourses.nptel.ac.in/noc20_cy10/preview,
E-Books: https://www.pdfdrive.com/biochemistry-books.html,
E-journals: Process Biochemistry (Elsevier), Journal of Cellular Biochemistry (Wiley)

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	M	M	M	S	S	S
CO2	M	M	M	S	S	M	S	S	M	M
CO3	M	M	M	S	S	S	S	M	M	M
CO4	S	S	S	M	M	M	S	S	M	S
CO5	M	M	M	S	M	S	M	M	S	S

PO – Programme Outcome, CO – Course outcome, S – Strong, M – Medium, L – Low

Course	**CORE PAPER -II**
Title of the Course	**CELL AND MOLECULAR BIOLOGY**
Credits	**4**
Hours/Week	**5**
Course Objectives	1.To understand the basic concepts of the prokaryotic and eukaryotic cells. 2.To Understand the individual and coordinated functions of various cell organelles. 3.To familiarize the student with various aspects of cell and molecular biologystreams including cellular organization and their interactions in DNA replication, protein biosynthesis, and translational regulation 4.To develop a comprehensive understanding of the complete cellular and molecular function of cell organelles in terms of cell-to-cell interaction, gene regulation, cellular signaling 5.To impart the molecular biology knowledge in applications of various human health care
Course Out Comes	1.After studying unit-1, the student will be able to equip with a basic knowledge of the structural and functional properties of cells. 2.After studying unit-2, the student will be able to understand process of celldivision and replication process. 3. After studying unit-3, the student will be able to understand the occurrence ofcentral dogma of life in the cell and the machineries involved to initiate and inhibit RNA and protein synthesis. 4.After studying unit-4, the student will be able to control of geneexpressions in prokaryotes and eukaryotes and transposable elements. 5.After studying unit-5, the student will be able to understand mechanism of epigenetic controls andcancer biology.

Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	No	Yes	Yes	Yes	No
3	No	Yes	No	Yes	Yes	Yes
4	No	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	**Course Contents**	**Teaching hours**
UNIT I	Cell Biology: Structure and function of cells in prokaryotes and eukaryotes; Structure and organization of Membrane - Membrane Model, active and passive, transport channels and pumps., Structure& Biogenesis of Mitochondria and Chloroplast. Structure of Endoplasmic reticulum, Golgi complex, lysosomes.	12 hours
UNIT-II	Cell division: Mitosis, Meiosis, regulation of cell cycle; factors regulating cell cycle. Nucleic acid structure, Genome Organization. DNA replication: Enzymes and mechanisms of DNA replication in prokaryotes and eukaryotes, Telomeres, telomerase and end replication. Role of telomerase in aging and cancer. DNA replication models, DNA damage, Mutations, DNA repair and recombination.	12 hours
UNIT – III	Transcription: Basic mechanism in prokaryotes and eukaryotes. RNA polymerase, Reverse transcriptase and regulation. Post- transcriptional processing: 5'-Cap formation; 3'-end processing and polyadenylation; splicing: RNA editing; Nuclear export of mRNA; mRNA stability.Translation-Prokaryotic and eukaryotic translation, the translation machinery, Mechanisms of initiation, elongation and termination, Regulation of translation, co-and post-translational modifications of proteins and localization.	12 hours
UNIT – IV	Gene regulation: Prokaryotic gene regulation- Operon concept; Lac operon and tryptophan operon. Eukaryotic gene regulation: Chromatin Structure, Regulation at transcriptional Level: DNA binding domains of the regulatory proteins. Biochemistry and applications of ribozyme technologies. Transposable genetic elements	12 hours
UNIT-V	Epigenetics: Epigenetic regulation of gene expression, Modifications, Cancer Epigenetics. Cancer Biology: Viral and cellular oncogenes; Tumor suppressor genes - Structure, function and mechanism of action of pRB and p53, p21, BRACA1. Oncogenesas transcriptional activators.	12 hours
UNIT-VI	Internal Assessment: Assignments, Seminars and Guest lectures	5 hours

Total Lecture hours 65 hours	65 hours

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Text Books

1. Molecular cell Biology, by Darnell, Lodish, Baltimore, Scientific American Books,Inc.,1994.
2. Molecular and cellular Biology, Stephen L.Wolfe, Wadsworth PublishingCompany,1993.
3. Cell and Molecular Biology: Concepts and Experiments 5th Ed,Gerald Karp. Wileypublications,2013.
4. Cell biology D E SadavaCBS Publishers & Distributors, 2009

Reference books

1. Molecular and cellular Biology, Stephen L.Wolfe, Wadsworth Publishing Company,1993
2. Molecular Biology LabFax, T.A. Brown (Ed.), Bios Scientific Publishers Ltd., Oxford, 1991
3. Molecular Biology LabFax, T.A. Brown (Ed.), Bios Scientific Publishers Ltd., Oxford,1991.
4. Molecular Biology of the Gene (4th Edition), J.D.Watson, N.H.Hopkins, J.W.Roberts,
5. J.A. Steitz and A.M.Weiner, The Benjamin/Cummings Publ. Co., Inc., California,1987.
6. Genes VI (6th Edition) Benjamin Lewin, Oxford University Press, U.K.,1998
7. Molecular biology of cell – Albert Bruce et al.,1994 3rdEd
8. Molecular Biology-Weaver. R. F. 3rd ed. Mc Graw Hill publication ,2005
9. The Molecular Biology of Cancer: S. Pelengaris, M. Khan. Blackwell Publication.2002

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]

1. Swayam- Molecular biology course by Dr.Nayan K. Jain, Gujarat University
2. Swayam- Cell Biology by Dr K. Sanatombi
3. NPTEL - Molecular Cell Biology by Prof.D. Karunagaran
4. https://www.coursera.org/courses?query=molecular%20biology
5. https://www.cdc.gov/labtraining/training-courses/basic-molecular-biology/index.html

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	M	M	M	S	S	S

CO2	M	M	M	S	S	M	S	S	M	M
CO3	M	M	M	S	S	S	S	M	M	M
CO4	S	S	S	M	M	M	S	S	M	S
CO5	M	M	M	S	M	S	M	M	S	S

PO – Programme Outcome, CO – Course outcome, S – Strong, M – Medium, L – Low

Course	**CORE PAPER -III**
Title of the Course	**MICROBIOLOGY**
Credits	**4**
Hours/Week	**5**
Course Objectives	1. To understand the History of Microbiology. 2. To well understand the Nutritional classification of bacteria, etc. 3. To obtain knowledge about Sterilization and Disinfection. 4. To obtain knowledge of Microbial diversity. 5. To know the basic Microbial community in natural habitats.
Course Out Comes	1.After studying unit 1 the students will be able to identify the Classification of microorganisms 2.After studying unit 2 the students will be able to identify and differentiate thepure culture technique. 3.After studying unit 3 the students will be able to identify and describe the chemotherapeutic agent 4.After studying unit 4 the students will be able to identify and explain enzymes and the irregulations by kinetic parameters 5.After studying unit 5 the students will be able to identify and cross-examinethe Biotechnological applications of Extremophiles

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	Yes	Yes	Yes	No	No
3	No	Yes	No	Yes	Yes	Yes
4	No	No	Yes	Yes	Yes	Yes
5	Yes	Yes	No	Yes	Yes	Yes

Units	Course Contents	Teaching Hours
Unit-I	History of Microbiology - Classification of microorganism – Kingdom - Protista, Prokaryotic and eukaryotic microorganisms, Five kingdom concept of classification, Archaebacteria, Eubacteria, and eukaryotes. Microscope - Light field, Dark field, Fluorescent and Electron microscope, Prokaryotic and Eukaryotic cell structure. Staining techniques - Simple and Differential staining.	12 hours
Unit-II	Nutritional classification of bacteria, Isolation, cultivation, enumeration, and preservation of microbes; Culture media and its types - Pure culture technique - Growth curve; Axenic culture, Synchronous culture, Continuous culture; Effect of physical and chemical factors on microbial growth.	12 hours
Unit-III	Sterilization and Disinfection: Moist heat, Dry heat, Radiation, Filtration, Phenols, Halogens, Phenol coefficient method. Antibiotics - Inhibitors of Nucleic acid, protein, and cell wall synthesis. Chemotherapeutic agents - Antimicrobialsusceptibility test.	12 hours
Unit-IV	Microbial diversity- methods to assess microbial diversity, Culture dependent, and culture-independent methods. Molecularanalysis of bacterial community; Denaturating Gradient Gel Electrophoresis (DGGE), Terminal Restriction Fragment Length (TRFL) Polymorphism (T- RFLP), Amplified Ribosomal DNA and Restriction Analysis (ARDRA).	12 hours
Unit-V	Microbial communities in natural habitats – air, water, soil, food, and milk. Food and milk-borne diseases, Extremophiles-habitant& Classification, Halophiles, Thermophiles, Alkaliphiles, Acidophiles, Biotechnological applications of Extremophiles.	12 hours
Unit-VI	Internal Assessments, Seminars, and Guest Lectures	05 hours
	Total Teaching hours	65

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Text book:

1.Microbiology 3rd Edition by Dave Wessner (Author), Christine Dupont

(Author), TrevorCharles (Author), Josh Neufeld (Author) 3rd edition (December 3, 2020)

2. Fundamentals of Microbiology 12th Edition by Jeffrey C. Pommerville (Author) 12th edition(March 29, 2021)
3. Burton's Microbiology for the Health Sciences 11th Edition by Paul G. Engelkirk (Author) 11thedition (October 10, 2018)
4. Brock Biology of Microorganisms plus Pearson Mastering Microbiology with Pearson eText,Global Edition 15th Edition 15th edition (March 27, 2018)
5. Microbiology: An Evolving Science Fifth Edition by Joan L. Slonczewski (Author), John W.Foster (Author), Erik R. Zinser (Author) Fifth edition (July 1, 2020)
6. Microbiology with Diseases by Taxonomy, Loose-Leaf Plus Mastering Microbiology withPearson eText -- Access Card Package (6th Edition) 6th Edition 6th edition (January 14, 2019)

Reference Book:

1. Medical Microbiology: A Guide to Microbial Infections: Pathogenesis, Immunity, Laboratory Diagnosis and Control. With STUDENT CONSULT Online Access (Greenwood,Medical Microbiology) 17th Edition by David Greenwood BSc PhD DSc FRCPath (Author), Richard C. B. Slack MA MB BChir FFPHM MRCPath DRCOG (Author), John F. Peutherer BSc MB ChB MD FRCPath FRCPE (Author), & 1 more Churchill Livingstone; 17th edition (June 6, 2007)
2. Microbiology Experiments: A Health Science Perspective Paperback – International Edition,January 1, 2018MC GRAW HILL; 9th edition (January 1, 2018)
3. Hugo and Russell's Pharmaceutical Microbiology, 8th Edition 8th Editionby Denyer (Author)Wiley-Blackwell; 8th edition (August 12, 2011)
4. Clinical Bacteriology Hardcover – August 1, 1980 by E Joan Stokes E Arnold; Fifth Edition(August 1, 1980)
5. Review of Medical Microbiology and Immunology (Medical Microbiology & Immunology(Levinson)) 9th Edition (March 10, 2006)

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	M	M	S	S	S
CO2	M	M	M	S	S	M	S	S	M	M
CO3	M	M	M	S	M	S	S	M	M	M
CO4	S	M	S	M	M	S	S	S	M	S
CO5	M	M	M	S	M	S	M	M	S	M

PO – Programme Outcome, CO – Course outcome S – Strong, M – Medium, L – Low (may be avoided)

Course	CORE PRACTICAL -I
Title of the Course	Lab In Biochemistry, Cell & Molecular Biology and Microbiology
Credits	4
Hours/Week	8

Unit	Course Content	Teaching Hours
UNIT I	**Biochemistry** 1. Determination of Chl.a, Chl.b & total Chl. By Arnon method. 2. Estimation of Carbohydrates 3. Estimation of salivary amylase activity in relation to, substrate/pH/Temperature 4. Estimation of blood glucose &urea 5. Estimation of LDH. 6. Estimation of total serum proteins 7. Estimation of creatinine in urine. 8. Paper / thin layer chromatography	20 hours
UNIT-II	**Cell and Molecular biology** 1. Isolation of Genomic DNA from E.coli 2. Isolation of plasmid DNA from E.coli 3. Elution & quantification of DNA from agarose gel. 4. Preparation of competent cells and transformation 5. PCR 6. Isolation of Total RNA from bacteria 7. Synthesis of cDNA by Reverse transcription polymerase chain reaction	20 hours
UNIT – III	**Microbiology** 1. Sterilization techniques 2. Preparation of culture media(Selective and Enriched media) 3. Staining techniques- Simple, Differential and Motility studies 4. Determination of Bacterial growth curve 5. Enumeration of bacteria from environmental samples- soil and water 6. Pure culture techniques - Streak, pour plate and spread plate. 7. Biochemical tests for identification of bacteria (IMViC, TSI, Catalase, Oxidase) 8. Antimicrobial assay, agar plate sensitivity method. 9. Water quality analysis – MPN method.	25 hours

	Total Lecture hours	**65 hours**

Method of Evaluation: (50 Internal marks + 50 External Marks=100)

Distribution for internals Test (CIA I + CIAII)	End Semester Examination	Total marks
50	50	100

Reference

1. Introduction to Practical Biochemistry, E.F Plummer Mu, PlummerTataMcGraw-Hill Education,1998.
2. Molecular cloning: a laboratory manual, 4th ed. J.Sambrook, Fritsch and T.Maniatis. cold spring harbor laboratory press ,NewYork,2012
3. Essential cell biology : a practical approach volume 1: cellstructure. JohnDavey,J. Michaellord. Oxford university press,USA,2003
4. Principles and techniques of biochemistry and molecular biology (7th ed).keithWilson(editor),john walker (editor),Cambridge universitypress,2010.
5.Microbiology- A Laboratory manual P. Gunasekaran . New age publications, Newdelhi,1995.
6. Molecular cloning-A Laboratory manual. Sambrook, J , Fritsch. E.F, and T.Maniatis, 2nd Edition. Cold spring Harbor Laboratory press, New York,1989.
7. Laboratory exercise of Microbiology, J.P. Harley and L.M. Prescott, 5th Edition, theMcGraw-Hill companies,2002.
8. Microbiology: A Laboratory Manual, J.G. Cappuccino and N. Sherman, Addison-Wesley,2002.
9. Laboratory Manual of Experimental Microbiology ,R.M.Atlas, A.E.Brown andL.C.Parks, 1995. Mosby,St.Louis,2002.
10. Laboratory manual in General Microbiology, N.Kannan, Panimapublishers.
11. Bergey‟s Manual of Determinative Bacteriology. Ninth Edition J.G.Holt,R.Krieg.,Lippincott Williams, Wilkin publishers, 2000.

Course	**ELECTIVE -1**
Title of the Course	**(A) GENETICS**
Credits	**2**
Hours/Week	**4**

Course Objectives	1.To provide the basic knowledge of genetics in higher eukaryotic domains and over all conceptsof Mendelian genetics. 2.To understand about genetic inheritance and linkages 3.To provide the basic concept sex determination 4.To understand about genetic code, mutation and regulations 5.To Enrich the students' knowledge with respect to genetic engineering, transgenesis and ethics
Course Out Comes	1. After studying unit-1, the student will be able to know about Mendelian laws. 2. After studying unit-2, the student will be able to understand how gene inherited 3. After studying unit-3, the student will be able to understand about sex determination. 4. After studying unit-4, the student will be able to gene re1gulations. After studying unit-5, the student will be able to know about ethics and transgenesis.

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes	No	No
5	Yes	Yes	Yes	No	Yes	Yes

Units	Course Contents	Teaching Hours
UNIT I	Genetics – History, Definition and scope - Pre- Mendelian genetic concepts. Basis of Mendelian Inheritance and Mendelian genetics. Chromosome theory of linkage, crossing over, recombinations and mapping of genes on chromosomes	12 hours
UNIT-II	Blood Groups and their inheritance in Human – Linkage and Crossing Over- Drosophila – Morgans' Experiments – Complete and Incomplete Linkage, Linkage Groups, Crossing Over types, Mechanisms – Cytological Evidence for Crossing Over, Mapping of Chromosomes – Interference and Coincidence.	8 hours
UNIT – III	Sex Linkage in Drosophila and Man, Sex influenced and Sex Limited Genes – Non- Disjunction and Gynandromorphs – Cytoplasmic Inheritance – Meternal effect on Limnaea (Shell Coiling), Male Sterlity (Rode's Experiment)	9 hours
UNIT – IV	Nature and Function of Genetic Material – Genetic code – Why the genetic code is comma less, non ambiguous, degenerate triplet code. Fine Structure of the Gene. Gene Regulation – Operon Concept – Lac Operon – Positive and Negative Regulation. Mutation – Molecular Basis of Mutation, Types of Mutation, Mutagens, Mutable and Mutator Genes. Chromosomal Aberrations – Numerical and Structural examples from Human.	8 hours
UNIT-V	Genetic engineering – Objectives, tools, gene cloning, and gene isolation. Transgenic plants and animals, Animal Breeding – Heterosis, Inbreeding, Out Breeding, Out Crossing, Hybrid Vigour. Population Genetics- Hardy Weinberg Law – Gene Frequency, Factors Affecting Gene Frequency, Eugenics, Euphenics and Euthenics.	8 hours
UNIT-VI	Internal Assessment: Assignments, Seminars and Guest lecturers	5 hours
	Total Lecture hours 65 hours	50 hours

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Text Books

1. Gardner et al (1991). Principles of Genetics. John Wiley.
2. Hartl. D.L. A primer of population genetics. III edition, Sinauer associates inc. Sunderland, 2000

3. Human genetics, A. Gardner, R. T. Howell and T. Davies, Published by Vinod Vasishtha for Viva Books private limited, 2008.
4. The science of Genetics by Alan G. Atherly, Jack. R, Girton, Jhon. F, Mc Donald. Sounders college publishers.

Reference Books

1. Strachan and Read (2003).Human Molecular Genetics. Wiley.
2. Pasternak (2005).An Introduction to Molecular Human Genetics. Fritzgarald.
3. Prichard &Korf (2004).Medical Genetics a ta Glance. Blackwell.
4. Manu L Lothari, Lopa A Mehta, sadhana S Roy Choudhury (2009). Essential of HumanGenetics (Universities Press India ltd) Publishing.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

https://www.classcentral.com/course/swayam-genetics-and-genomics-17623 2. https://nptel.ac.in/courses/102/104/102104052/

3. https://www.coursera.org/learn/genetics-evolution

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

PO – Programme Outcome, CO – Course outcome S – Strong, M – Medium, L – Low (may be avoided)

Course	**ELECTIVE -I**
Title of the Course	**(B) VIROLOGY**
Credits	**2**
Hours/Week	**4**
Course Objectives	1. Contrast differences in virus architecture and classification. 2. To understand the viral diagnostic and detection methods. 3. Distinguish characteristics of normal cells and virus-infected cells. 4. Explain and apply methods used in research and diagnosis of viral diseases. 5. Describe cellular and therapeutic antiviral strategies and social stigmas against infected individuals.

Course Out Comes	1. After studying unit-1, the student will be able to–describe and review the General Virology andcultivation of viruses 2. After studying unit-2, the student will be able to –know the Viral diagnostic and detection methods 3. After studying unit-3, the student will be able to - explain viral replication strategies; and compareand contrast replication mechanisms used by viruses relevant to human disease 4. After studying unit-4, the student will be able to - discuss principles of virus pathogenesis 5. After studying unit-5, the student will be able to - explain host antiviral immune mechanisms at acellular and molecular level and vaccine strategies and mechanisms of antiviral drugs

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	No	No	No	No
2	Yes	Yes	No	No	No	No
3	Yes	Yes	No	No	No	No
4	Yes	Yes	No	No	No	No
5	Yes	Yes	No	No	No	No

Units	Course Contents	Teaching hours
Unit I	General Virology: Structure of viruses: Enveloped and non-enveloped viruses, Capsid symmetries-icosahedral, polyhedral and helical, structural proteins- matrix proteins and lipoproteins, viral genomic organization and replication- types of nucleic acids, protein-nucleic-acid interactions and genome packaging, Virus related structures – viroids and prions. Cultivation of viruses, Cytopathic effect - pock forming unit.	10 hours
Unit-II	Viral diagnostic and detection methods: Sample processing-enrichment and concentration, Direct methods of detection-light microscopy (inclusion bodies), electron microscopy, Immuno diagnosis, hemagglutination, Complement fixation, neutralization, Western blot, Radioactive Immuno precipitation Assay (RIPA), Flow Cytometry and Immuno histochemistry. Nucleic acid-based diagnosis: Nucleic acid hybridization, PCR, microarray and nucleotide sequencing, LINE probe assay.	08 hours
Unit-III	Bacterio phages and plant viruses: Bacterio phage: Morphology, genome organization, classification - Lifecycle - Lytic and Lysogenic Cycle, Head and tail phages - T4 phage- phage - Filamentous Bacteriophages-174- M13, Phage therapy for control of bacterial poultry diseases. Viral Diseases in Plants: Histological, physiological and cytological changes in infected plants, Behavior of viruses in plants, Methods for detection of plant viruses, Transmission of plant viruses through vectors-insects, nematodes and fungi.	13 hours
Unit-IV	Clinical virology: Pathogenesis, clinical symptoms, epidemiology and prophylaxis of DNA Viruses - pox virus, Herpes Virus, Adenovirus, Hepatitis Virus. RNA Viruses- Picorna Virus, Orthomyxo Virus, Rabies Virus, HIV. Oncogenic viruses; Virus-induced cell transformation and oncogenesis, Mechanism of cell transformation by tumor viruses, Retrovirus mediatedoncogenesis.	08 hours
Unit-V	Viral vaccines and anti-viral drugs: Viral vaccines, conventional vaccines-killed and attenuated, Modern vaccines - DNA vaccines, recombinant DNA/protein vaccines, subunits vaccines, peptide vaccines, anti-idio type vaccines, edible vaccines, immuno modulators (cytokines), adjuvants to increase immunogenicity of vaccines. Antivirals: Interferons, 21 designing and screening for antivirals, mechanisms of action, anti retrovirals-mechanism of action and drug resistance.	05 hours
Unit-VI	Internal Assessments, Seminars, and Guest lecture	5 hours
	Total Teaching hours	50

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Reference & Text Books:

1. Virology principles and application John Carter and Venetia Saunders (2007) John Wiley andSons publishers.
2. Principles of Virology 4th edition Jane Flint.
3.Real –Time PCR: Current technology and applications 1st edition (2009) edited by Julie Logan *et al*.,
4. Analytical techniques in DNA sequencing edited by Brian K. Nunnally
5. Medical Microbiology: with student consult by Patrick R. Murray Ph.D. (Author), Ken S. Rosenthal PhD Saunders; 7th edition.
6. Antiviral Agents, Vaccines and Immunotherapies. Stephen K. Trying. October 2004. Marcel Dekker.

Course Material:

1. International Congress on Taxonomy of Viruses ;http://WWW.ncbi.nlm.nih.gov/ICTV
2. Knipe David M.,PeterM.Howley, Diane E.Griffin,Rober t A.Lamb,Malcolm A. Martin,BernardRoizman, Stephen E .Straus,(2007),Field's Virology, 5th Ed. LippincottWilliams &Wilkins
3. Cann Alan j, (2000),DNA virus Replication, Oxford University press
4. https://www.yourgenome.org/facts/what-is-PCR-polymerase-chain-reaction.

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

PO – Programme Outcome, CO – Course outcome S – Strong, M – Medium, L – Low (may beavoided)

Course	ELECTIVE -1
Title of the Course	**(C) BASIC ANALYTICAL METHODS**
Credits	**2**
Hours/Week	**4**
Course Objectives	1. To learn the principles of the various analytical instrument. 2. To teach the SOP of analytical instruments. 3. To study the different chromatography separation methodologies 4. To study different electrophoresis isolation methodologies 5. To learn advanced microscopic methods in image processing
Course Out Comes	1. After studying unit 1 the students will be able to know the significance of instrumentsconcerningdiagnostic procedures. 2. After studying unit 2 the students will be able to handle qualitative and quantitativechromatographictechniques 3. After studying unit 3 the students will be able to handle centrifugation and separatesamples forfurther practical's/research 4. After studying unit 4 the students will be able to handle different qualitative and quantitativeelectrophoresis techniques 5. After studying unit 5 the students will be able to handle microscopes and validatemicroscopicimages.

Matching Table (Put Yes / No in the appropriate box)

Unit/	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	No	Yes	Yes	Yes	No
3	Yes	Yes	No	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	Course Contents	Teaching hours
Unit I	Electrochemical techniques- basic principles- The pH electrode- Ion-selective gas- sensing and oxygen electrodes. Elementary details of biosensors. Beer- Lambert's law, light absorption and its transmittance. Basic principles & brief outline of instrumentation of UV- Visible Spectroscopy: Infrared Spectroscopy. NMR. Mass spectrometry. Spectrofluorometric, Flame photometry, Atomic absorption spectrophotometry– Principles, instrumentation, and applications	10 hours
Unit-II	Introduction & classification of chromatography. Instrumentation & applications of Column chromatography, TLC, Paper chromatography, GC, HPTLC, HPLC - detection methods, and systems qualitative and quantitative aspects, applications	08 hours
Unit-III	Centrifugation- basic principles-instrumentation-centrifugation units. Sedimentation velocity- sedimentation equilibrium - cell fractionation method. Differential, density gradient, isopycnic, and equilibrium centrifugation. Preparative and analytical ultracentrifugation techniques. Isoelectric focusing, Blotting methods, Western, Southern and Northern and their applications.	13 hours
Unit-IV	General principles. Factors affecting the migration rate – sample, electric field, buffer, and supporting medium. Tiselius moving boundary electrophoresis. PAGE. SDS– PAGE. Pulse-field gel electrophoresis. Cellulose acetate membrane electrophoresis, Agarose gel electrophoresis	08 hours
Unit-V	Radio isotopic techniques: GM Counter, Scintillation Counter and Autoradiography. Principles of microscopy- Fluorescent, Transmission and Scanning electron microscopy, Confocal microscopy. Microtome analysis and measurement of images	05 hours
Unit-VI	Internal Assessments, Seminars, and Guest lecture	5 hours
Total Teaching hours		50

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Textbook:

1. Keith Wilson, John M Walker. Principles and techniques of biochemistry and

molecularbiology.Cambridge University Press. 7th edition, 2017.
2. Shawney. Practical Biochemistry. Narosa Publishing, 1995.
3. Upadhyaya A Upadhyaya K and Nath. Biophysical Chemistry: Principles and Techniques, 3rdEdition. Himalayan publications, 2009.
4. D. Frifelder and M. Malacinski. Essentials of Molecular Biology, Jones & Bartlett, 5th Edition,2015.
5. R.D. Braun. Introduction to Instrumental Analysis. Pharma Book Syndicate, 2006.
6. Chatwal and Anand. Instrumental Methods of Analysis. 5th Edition, Himalayan publication,2007.
7. Jag Mohan. Organic Spectroscopy, Principles and Application. Narosa Publishing House, 2ndEdition, 2007.

Reference Book:

1. Principles and Techniques of Practical Biochemistry (Paperback) by KeithWilson (Editor),John Walker (Editor), John M. Walker (Author) " Fifth Edition2000
2. Introductory Practical Biochemistry (Hardcover).by S. K. Sawhney; RandhirSingh (Editor)2005
3. Principles of Physical Biochemistry (2nd Edition) by Kensal E van Holde,CurtisJohnson, andPui Shing Ho (Hardcover – April 16,2005)
4. Physical Biochemistry: Applications to Biochemistry and Molecular BiologybyDavid M.Freifelder (Paperback – Aug 15,1982)
5. Instrumental Methods of Chemical Analysis by G R Chatwal and S KAnand (Hardcover –Jun1980).

Course Material:

Website links: https://www.edx.org/course/basic-analytical-chemistry,
E-Books: http://shvaiko.ru/wp-content/uploads/2010/02/Analytical-Techniques-Julia-C.-Drees-Alan-H.-B.-Wu.pdf tml, https://www.uvm.edu/~gpetrucc/courses/chem196/Textbooks/Manahan%20-%20Fundamentals%20of%20Environmental%20Chemistry/1491Ch25.pdf,E- journals:
https://onlinelibrary.wiley.com/series/8247,
https://link.springer.com/chapter/10.1007/978-3-642-75490-6_15,

Mapping with ProgrammeOutcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	M	S	M	S	S
CO2	M	S	M	M	M	S	S	S	M	M
CO3	S	M	M	S	S	M	M	S	M	S
CO4	M	S	S	M	M	S	M	M	S	S
CO5	S	M	S	M	S	M	S	M	S	S

PO – Programme Outcome, CO – Course outcome, S – Strong, M – Medium, L – Low

Course	ELECTIVE -II
Title of the Course	(A) ENZYME TECHNOLOGY
Credits	2
Hours/Week	3
Course Objectives	1.To Learn about the classification and structure properties of enzymes 2.To Understand the kinetics, catalysis and inhibitions activities of enzymes 3.To understand physical properties, downstream process and purification of enzymes. 4.To Expedite how enzymes are used as co-factors. 5.To Enrich the students' knowledge with respect to different applications of Enzymes
Course Out Comes	1. After studying unit-1, the student will be able to know about basic knowledge of enzymes 2. After studying unit-2, the student will be able to understand mechanism of enzyme activities 3. After studying unit-3, the student will be able to understand physical properties of enzyme. 4. After studying unit-4, the student will be able to function of enzyme in different processes. 5. After studying unit-5, the student will be able to know various application of enzyme technologies.

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	No	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	No	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Unit	Course Contents	Teaching Hours
UNIT I	Introduction to enzymes: History of enzymes, nomenclature and classification of enzymes. Structural features of Enzymes: Chemical nature of Enzymes: amino acids, protein structure: Primary, secondary, tertiary and quartenery structure. Specificity of Enzymes: Types of specificity, the koshland "induced fit" hypothesis, strain or transition-state stabilization hypothesis.	10 hours
UNIT-II	Enzyme Catalysis and Kinetics: Factors affecting the rate of chemical reactions, kinetics of un catalyzed chemical reactions, kinetics of enzymes catalyzed reaction, methods for investigating the kinetics of enzyme- catalyzed reaction, nature of enzyme catalysis, inhibition of enzyme activity.	8 hours
UNIT – III	Extraction and purification of microbial enzymes: Importance of enzyme purification, different sources of enzymes. Extracellular an intracellular enzymes. Physical and chemical methods used for cell disintegration. Enzyme fractionation by precipitation (using Temperature, salt, solvent, pH, etc.), liquid-liquid extraction, ion exchange, gel chromatography, affinity chromatography and other special purification methods, Enzyme crystallization techniques. Criteria of purity of enzymes. Pitfalls in working with pure enzymes.	12 hours
UNIT – IV	Enzyme inhibition and Co-factors: Irreversible, reversible,competitive, non-competitive and un-competitive inhibition with suitable examples and their kinetic studies. Allosteric inhibition, types of allosteric inhibition and their significance in metabolic regulation & their kinetic study. Vitamins and their co-enzymes: Structure and functions with suitable examples. Metallo enzymes and Metal ions as co-factors and enzymes activators.	9 hours
UNIT-V	Immobilization of microbial enzymes and Enzyme Engineering: Methods viz. adsorption, covalent bonding, entrapment & membrane confinement and their analytical, therapeutic & industrial applications. Applications of microbial enzymes: Microbial enzymes in textile leather, wood industries and detergents. Enzymes in clinical diagnostics. Enzyme sensors for clinical processes and environmental analyses. Enzymes as therapeutic agents.	9 hours
UNIT-VI	Internal Assessment: Assignments, Seminars and Guest lecturers	5 hours
	Total Lecture hours	50hours

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Text Book(s)

1. Introduction to proteins Structure by Branden and Tooze (1998): GarlandPublishing Group.
2. Biotechnology . Volume 7 A- Enzymes in Biotechnology. 1983 Edited by H.J.Rehm and G.Reed. VerlagChemie.
3. Methods of Enzymatic analysis by Hans Ulrich, Bergmeyer, AcademicPress.
4. Methods in Enzymology by W.A.Wood, AcdemicPress.
5. Topics in Enzyme and Fermentation Biotechnology by L.N. Wiseman ,John Wileyand sons.

References Books

1. Enzymes by palmer(2001): Horwood publishingseries.
2. Fundamentals of Enzymology by price and Stevens (2002): Oxford UniversityPress.
3. Enzyme Technology by Helmut Uling (1998): JohnWiley.
4. Methods in Enzymology. Volume 22-Enzyme purification and related techniques. Edited by William B.Jakoby. Academic press, NewYork.
5. Allosteric Enzymes-Kinetic Behaviour. 1982. By B.I .Kurganov ,John Wiley and Sons. Inc., NewYork.
6. Enzymes as Drugs Edited by John S. Holcenberg and Joseph Roberts, John Wiley& sons NewYork.
7. Advances in Enzmology by Alton Meister, InterscIencePublishers.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	S	S	M	S
CO2	S	S	M	S	S	S	S	M	S	M
CO3	S	S	S	S	S	M	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S

PO – Programme Outcome, CO – Course outcome S – Strong, M – Medium, L – Low

Course	ELECTIVE- II
Title of the Course	(B) DAIRY TECHNOLOGY
Credits	2
Hours/Week	3
Course Objectives	1. To teach the microbial knowledge in milk 2. To learn the processing of milk microbiological methods 3. To understand how the milk products are in quality make through dairy industry 4. To made knowledge in differentiate the traditional and industrial make dairy products and its processing 5. To aware the students about milk borne diseases
Course Out Comes	1. After studying unit-1, the student will be able to know about basic knowledge of milk microbesand its changes in maintaining the storage of milk. 2. After studying unit-2, the student will be able to understand mechanism of processing of milkthrough microbiological methods 3. After studying unit-3, the student will be able to understand dairy products quality and its changesthrough microbes 4. After studying unit-4, the student will be able to differentiate dairy products in industry andhomemade. 5. After studying unit-5, the student will be able to know various application of milk and milkborne microbial diseases.

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes	No	No
5	Yes	Yes	Yes	No	Yes	Yes

Unit	Course Contents	Teaching Hours
UNIT I	Common microbes in milk and their significance .sources of microbial contamination of raw milk in influencing quality of milk during production, collection, transformation and storage. Clean milk production and antimicrobial systems in raw milk. Microbial changes in raw milk during long storage. Microbiological grading of raw milk.	12 hours
UNIT-II	Microbiological processing techniques: bactofugation, thermization ,pasteurization, sterilization ,boiling ,UHT, non thermal processes and membrane filtration of milk role of psychrophilic mesophilic, thermophilic and thermoduric bacteria in spoilage of processed milks and prevention microbiological standards (BIS/PFA) of heat treated fluid milks.	12 hours
UNIT – III	Microbiological quality of dairy products; fat rich (cream and butter),frozen (ice cream),concentrated (evaporated and condensed milk),dried milks(roller and spray dried), infant dairy foods and legal standards. Factors affecting microbial quality of these products during processing, storage and distribution. Pro biotics and pre biotics(GRAS),cloning - sanitation, control of micro organisms in dairy processing	12 hours
UNIT – IV	Microbiology quality of traditional dairy products; heat desiccated (khoa, burfi, peda, kheer), acid coagulated (paneer, chhana,rasgulla), fermented (lassi, srikhand)and frozen (kulfi).sources of microbial contaminants and their role in spoilage. Importance of personnel and environmental hygiene on quality of traditional milk products. microbiological standards for indigenous dairy foods.	12 hours
UNIT-V	Milk-borne diseases – viral and bacterial, zoonotic infections, pathogens associated with fluids milks, dairy products and their public health significance. sources of pathogens and their prevention ,importance of bio flims, their role in transmission ofpathogens in dairy products and preventive strategies. regulatorycontrol of dairy products, testing of milk and milk products, treatment of dairy wastes.	12 hours
UNIT-VI	Internal Assessment: Assignments, Seminars and Guest lecturers	5 hours
	Total Lecture hours 65 hours	65 hours

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Text Books:

1.Adams MR and Moss MO.(1995).food microbiology, the royal society of chemistry, Cambridge.
2. Andrews AT, Varley J(1994) biochemistry of milk products. Royal society of chemistry.
3. Banwart G J(1989), basic food microbiology, Chapman & hall, new York.
4.Frazier WC and Westh off D C.(1988) food microbiology, TATA McGraw hill publishing company Ltd. New Delhi.

References

1.Hobbs BC and Roberts D. (1993) food poisoning and food hygiene,Edward Arnold (a division of Hodder and Stoughton), London. May JM. (1987) modern food microbiology, CBS publishers and distributors, NewDelhi.
2. Robinson RK. 1990.the microbiology of milk. Elsevier applied Science.London
3. Edward Harth ,J.T.Steele. Applied dairy microbiology .1998. Marcel DeekerInc.
4. Modi, HA (2009) dairy microbiology pointer publishers, India.
5. Marth, E.H and steel J. L(2001) applied Dairy microbiology, 2nd Edition, Marcel Dekker, Inc.270 MadisonAvenue,new York, New York10016.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	S	S	M	S
CO2	S	S	M	S	S	S	S	M	S	M
CO3	S	S	S	S	S	M	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S

PO – Programme Outcome, CO – Course outcome S – Strong, M – Medium, L – Low

Course	**ELECTIVE - II**
Title of the Course	**(C) PHARMACEUTICAL TECHNOLOGY**
Credits	**2**
Hours	**3**
Course Objectives	1To learn dru.gs and its involved detoxification through phase 1 & 2 reactions 2 To teach drugmechanism like passive and active phases 3 To learn the drugs manufacture biotechnological pharmaceutical industry 4 To understand the importance of drugs in treating various metabolic disorders 5 To teachvarious applications of drugs in various fields.
Course Out Comes	1. After studying unit-1, the student will be able to know about basic knowledge of drugs of phase I& II 2. After studying unit-2, the student will be able to understand drug mechanism and its adverseeffects. 3. After studying unit-3, the student will be able to understand biotechnology in drug development,especially for AIDS 4. After studying unit-4, the student will be able to know drugs and its importance various treatmentlike diabetes, cancer, lipidemia and infertility 5. After studying unit-5, the student will be able to know various application of drug dependence andabuse-management

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes	No	No
5	Yes	Yes	Yes	No	Yes	Yes

Unit	Course Content	Teaching Hours
UNIT I	Objectives of Pharmaceutical Bioechnology – generic and Biogeneric drugs. Stages in drug development, FDA drug approval process. Pharmacokinetics and Pharmacodyanamics – Preclinical trials, clinical trials, New drug application (NDA), Post clinical trials, Drug marketing, Prodrug concept – Absorption, distribution and metabolism of drugs.	10 hours
UNIT-II	Adverse response to drugs, drug tolerance, drug intolerance, Idio SYNERACY (pharmacogenesis), drug allergy. Tachyphylaxis, drug abuse, novel drug delivery systems	08 hours
UNIT – III	Production of recombinant proteins as drugs – Humulin, Humatrope, Factor VIII Kogenate, Epogen, Neulasta, Avonex, Antimicrobial peptides (β – defensinz), vaccines (Pentavac), Cancer biologics (rituximab)	13 hours
UNIT – IV	Mechanism of action of drugs used in therapy of : respiratory system- cough, bronchial- asthma, pulmonary tuberculosis. GIT – digestents , appetite suppressants. hypolipidemia agents,, vomiting, constipation and peptic ulcer. antimicrobial drugs- sulfonamide s,trimethoprim, cotrimoxazole, penicillin and macrolides. amino glycosides, cephalosporin, Insulin and oral diabetic drugs, anti fertility and ovulation inducing drugs.	08 hours
UNIT-V	Muti drug resistance, Drug toxicity analysis - Common side effects of drugs and its management, National and International Drug approval agencies. Top National and International Pharmaceutical Industries.	08 hours
UNIT-VI	Internal Assessment: Assignments, Seminars and Guest lecturers	5 hours
	Total Lecture hours	**50 hours**

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Text Book:

1. The pharmacology Vol I and Vol II– Goodman and Gillman, Mc Graw Hill

professional;12 ed (2010)
2. Basic pharmacology – Foxter cox bulter worth‟s1980.
3. Pharmacology and pharmaco therapeutics – R.S.Satoskar.S.D.Bhandhhakar &S.S. Anilapure popular Prakashar Bombay.

Reference

1. Principles of medical chemistry – William O. Foge. B.I. Waverks Pvt Ltd, NewDelhi.
2. Oxford text books of clinical pharmacology and drug therapy.D.G.Burger‟s Medicalchemistry &drugdiscovery.
3.Principles and practice – Manfred. E. Wolf John Wiley andsons.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	S	S	M	S
CO2	S	S	M	S	S	S	S	M	S	M
CO3	S	S	S	S	S	M	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S

PO – Programme Outcome, CO – Course outcome S – Strong, M – Medium, L – Low

SEMESTER-II

Course	**CORE PAPER -1V**
Title of the Course	**IMMUNOLOGY**
Credits	**4**
Hours/Week	**5**
Course Objectives	1.To Learn the basic components and principles of defense mechanism against infections 2.To Understand the properties antigens and structure and types of Immunoglobulin 3.To understand principle behind Antigens- Antibody reactions. 4.To Expedite how the immune system recognizes foreign antigen and the significance of self/non-self-discrimination 5.To Enrich the students' knowledge with respect to different applications of Immunotechnology

Course Out Comes	1. After studying unit-1, the student will be able to know about basics of Immunity and variouscomponents ofImmune system 2. After studying unit-2, the student will be able to understand about Antigens and structuralproperties ofImmunoglobulin 3. After studying unit-3, the student will be able to understand principle of antigen-antibody reactionand theirtypes 4. After studying unit-4, the student will be able to how immune cells are signaled, processed anddestroyed 5. After studying unit-5, the student will be able to know various immunological technologies.

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes	No	No
5	Yes	Yes	Yes	No	Yes	Yes

Units	**Course Contents**	**Teaching Hours**
UNIT I	Introduction to the study of Immunology: Historic perspective, Overview and Concepts, Humoral and cellular- Mediated Immune responses. Components of immunity, Innate and Adaptive immunity. Haematopoiesis and differentiation of immune cells. Cells and Tissues of the immune system: Cells involved in the Immune response: Macrophages, B and T lymphocytes, Dendritic cells, Natural killer and Lymphokine activated killer cells, Eosinophils, Neutrophils and Mast cells. The lymphoid organs: Thymus, Bone marrow, Spleen, lymph nodes, MALT.	12 hours
UNIT-II	Antigens and Immunogenicity. Nature of Antigens and antibodies. Theories of Antibody formation. Antibody – basic structure, Properties of immunoglobulin and subtypes. Complement and its role in Immune Responses.	12 hours
UNIT – III	Antigen - Antibody Reaction, Strength of Antigen and Antibody reaction, Cross reactivity, Precipitation and Agglutination reactions, Radioimmunoassay and ELISA.	12 hours

UNIT – IV	Cytokines: structure of Cytokines; function of Cytokines. Complement fixation. Structure and function of MHC class I and II molecules - antigen recognition and presentation, HLA typing, Hypersensitivity Reactions, Types of Hypersensitivity, Immune tolerance, Autoimmunity and transplantation.	12 hours
UNIT-V	Hybridoma secreting monoclonal antibodies - Recombinant antibody molecules. Catalytic Antibodies. Modern vaccines - DNA vaccines, recombinant DNA/protein vaccines, subunits vaccines, peptide vaccines, anti-idiotype vaccines, edible vaccines. Immunological techniques for identification of infectious diseases: Immuno diffusion, immune-electrophoresis, Western blot and Flow cytometry.	12 hours
UNIT-VI	Internal Assessment: Assignments, Seminars and Guest lecturers	5 hours
	Total Lecture hours 65 hours	65 hours

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Text Book(s)

1. Parham, P. (2014). The Immune System (4th edition). W. W. Norton &Company.
2. Murphy, K., Travers, P., Walport, M., &Janeway, C. (2012).Janeway'sImmunobiology. New York: Garland Science.
3. Paul, W. E. (1993). Fundamental Immunology. New York: Raven Press. Goding, J. W.(1986). Monoclonal Antibodies: Principles and Practice
3. C.V.Rao. 2002, An Introduction to Immunology, Narosa Publishing House,Chennai.

References Books

1. Immunology (7th ed) J.Kuby ,W.H freeman and company , newYork.2013
2. Basic immunology updates ed: functions and disorders of immune system (3rd ed). abulk.abbas, Andrew H.HLictman ,saunders publishers , newYork,2010
3. Immunology: an introduction (4th) I.R Tizard, saunders college publishers, newYork.
4. Essential immunology (11th ed).peterdelves,seamusmartin,dennjis burton, Ivan Roitt, Wiley – Blackwell publication, Singapore,2006
5. Immunology (Lippincotts illustrated reviews series) thaodoan, roger melvold, susanviselli, Carl Waltenbaugh, Lippincott Williams & Wilkins publications2012
6. Fundamental immunology (7th ed) William e Paul, Lippincott Williams & Wilkins publications,2012
7. Essentials of clinical immunology (6th ed) Helen chapel ,Manselhaeney, Siraj misbah, Neil snowden,Wiley-Blackwell publications,2014
8. Monoclonal antibodies principles and practice(3rd ed) W.Goodings, academic press,2010

9. Monoclonal antibodies :P methods and protocols (2nd ed) .Vincentossipo, Nicolas fisher, Humanapress,2014
10. Essentials of clinical immunology (6th ed).Helen chapel, Manselhaeney, ,Siraj misbah, Neil Snowden,Wiley- Blackwell publications,2014 J.Kuby, 2003, Immunology 5th edition, W.H. Freeman and Company, Newyork..
12. I.R.Tizard, 1995, Immunology: An Introduction , 4th edition , Saunders College Publishers, NewYork.
13. I.Roitt, 1994, Essential Immunology, Blackwell Science,Singapore.
14. A. Bul and K.Abbas, 1994, Cellular and Molecularimmunology
15. Current Protocols in Immunology 3 Volumes, Wiley Publications1994.
16. Monoclonal Antibodies: Principles and Practice, J. W. Goding, 1983. AcademicPress
17. Hybridoma Technology in the Biosciences and medicine, T.A. Springer, 1985. Plenum PressNY

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://nptel.ac.in/courses/102/105/102105083/
2. https://www.coursera.org/specializations/immunology

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	S	S	M	S
CO2	S	S	M	S	S	S	S	M	S	M
CO3	S	S	S	S	S	M	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S		S

PO – Programme Outcome, CO – Course outcome S – Strong , M – Medium, L – Low

Course	**CORE PAPER -V**
Title of the Course	**GENETIC ENGINEERING**
Credits	**4**
Hours/Week	**5**
Course Objectives	1.To understand the basis of Enzyme, Ligases in Genetic Engineering Tools. 2.To well understood the Cloning Vectors. 3.To obtain knowledge about Gene cloning strategies and transformation techniques. 4.To obtain the knowledge of Selection, Screening, and analysis of recombinants. 5.To know the basic Genetic Engineering Techniques- Application of rDNA technology.

Course Out Comes	1. After studying unit 1 the students will be able to identify the tools which are used in Genetic Engineeringand exhibit them their practical's. 2. After studying unit 2 the students will be able to differentiate methods in Cloning Vector. 3. After studying unit 3 the students will be able to describe the Techniques in Gene cloning – Physical,chemical and methods. 4. After studying unit 4 the students will be able to explain techniques amo recombine recombinants likePCR, DNA sequencing, etc 5. After studying unit 5 the students will be able to analyze and can cross-examinethe Genetic Engineeringof patients who visit the Lab.

The Matching Table (Put Yes / No in the appropriate box)

Units	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	No	Yes	Yes	Yes
4	Yes	Yes	No	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	No

Units	**Course Contents**	**Teaching Hours**
Unit-I	Tools of Genetic Engineering: Enzymes - endo &exo nucleases-Restriction endonucleases- types, nomenclature, recognition sequences and mechanism of action. Isochizomers, Iso customers and star activity. Methylation, and modification. Ligases – types (NAD and ATP dependent), mechanism of action. Role of Kinases, phosphatases, polynucleotide phosphorylase, polynucleotide kinases, terminal transferase, Alkaline phosphatase, Reverse transcriptase, Taq polymerase.	12 hours
Unit-II	Cloning vectors: General characteristics of vectors-The promoter, MCS, Ori, and Marker genes-lac Z. Construction of pBR 322, pBR325, pBR327, pUC8, pUC 18 & 19 vectors, and Expression vectors- Bacteriophage vectors, Lambda phage, Insertion vectors, Replacement vectors, Cosmids, Phagemids, Mini chromosomes, BAC‟s, YAC‟s, Shuttle vectors, Ti plasmids, Vectors for animals-SV40 and Bovine papillomavirus.	12 hours

Unit-III	Gene cloning strategies and transformation techniques: Chimeric DNA Cloning strategies- Partial digestion, End modification, use of adaptors and linkers, Homopolymer tailing in cDNA cloning, ligation. Advanced cloning strategies-Cloning from mRNA, synthesis and Cloning of cDNA - Isolation and purification of RNA, Synthesis of cDNA, Isolation of plasmids, Cloning cDNA in plasmid vectors, Cloning cDNA in bacteriophage vectors. PCR amplified DNA. Genomic DNA libraries, cDNA library. Transformation techniques: Preparation of competent cells, Physical methods - Electroporation, Microinjection, Gene gun, chemical methods - PEG, DEAE, $CaCl_2$, calcium phosphate precipitation method, liposome-mediated method.	12 hours
Unit-IV	Selection, screening, and analysis of recombinants: Genetic selection - Insertional inactivation, Antibiotic Resistant genes, lac Z genes, Blue white screening, α - Complementation, colony hybridization, Immunological screening, Plaque hybridization, Blotting techniques, DNA sequencing - chemical and enzymatic methods, PCR and its variants, Preparation of radio labelled and non -radiolabelled probes and its applications.	12 hours
Unit-V	Applications of rDNA technology: Production of vaccines – Hepatitis B, Edible Vaccine, Hormones – Somatotropin, Humulin, Blood clotting factor VIII, Interferons, Diagnostics of inherited disorders and infectious diseases, Gene therapy, ADA- Cystic fibrosis.	12 hours
Unit-VI	Internal Assessments, Seminars, and Guest Lecture	05 hours
	Total Teaching hours	65

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Textbook:

1. Concepts of Genetics (Masteringgenetics) 12th Editionby William Klug (Author), Michael Cummings (Author), Charlotte Spencer (Author), Michael Palladino (Author), Darrell Killian (Author)
2. Genetics: A Conceptual Approach Sixth Edition by Benjamin A. Pierce (Author) W. H. Freeman; Sixth edition (December 19, 2016)
3. Genetics: From Genes to Genomes, 5th edition 5th Editionby Leland H. Hartwell (Author), Michael L. Goldberg (Author), Janice A. Fischer (Author), Leroy Hood (Author), Charles F.

Aquadro (Author)McGraw-Hill Education; 5th edition (September 5, 2014)
4. Genetics: Analysis of Genes and Genomes: Analysis of Genes and Genomes 9th Editionby Daniel L. Hartl (Author), Bruce Cochrane (Author) Jones & Bartlett Learning; 9th edition (December 14, 2017)
5. Principles of Genetics 6th Edition by D. Peter Snustad (Author), Michael J. Simmons (Author) John Wiley and Sons; 6th edition (August 23, 2011)
6. An Introduction to Genetic Engineering 3rd Edition, author : Desmonds S.T. Nicholl, University of Paisley May 2008.
7. Gene Cloning and DNA Analysis: An Introduction 7th Editionby T. A. Brown Wiley-Blackwell; 7th edition(January 19, 2016)
8. Biotechnology: Applying the Genetic Revolution 1st Editionby David P. Clark BA (honors)Christ's College Cambridge 1973
PhD University of Brsitol (England) 1977 (Author), Nanette Pazdernik Academic Cell;1st edition (September 19, 2008)

Reference Book:

1. An Introduction to Genetic Engineering (Studies in Biology) 2nd Edition**by** Desmond S. T. Nicholl
2. Genetically Engineered Foods (Volume 6) (Handbook of Food Bioengineering, Volume 6) 1st Editionby Alexandru Mihai Grumezescu (Editor), Alina Maria Holban (Editor) 2017.
3. Genetically Engineered Foods Hardcover – January 1, 2021 by Armando Mills (Author) ED-Tech Press; 1stedition
4. Genetic Engineering: A Christian Perspective Paperback – December 27, 2019 by Michael Scaife.

Course Material:

Website links: https://www.genome.gov/genetics-glossary/Genetic-Engineering

https://www.amazon.in/s?k=genetic+engineering+book&hvadid=82669701180826&hvbmt=bp&hvdev=c&hvq mt=p&tag=msndeskstdin-21&ref=pd_sl_3hztgcyjhj_p

E-journals: Process Biochemistry (Elsevier), Journal of Cellular Biochemistry (Wiley)

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	M	M	S	S	S
CO2	M	M	M	S	S	M	S	S	M	M
CO3	M	M	M	S	S	S	S	M	M	M
CO4	S	S	S	M	M	M	S	M	M	S
CO5	M	M	M	S	S	S	M	M	S	S

PO – Programme Outcome, CO – Course outcome S – Strong, M – Medium, L – Low

Course	**CORE PAPER - V1**
Title of the Course	**DEVELOPMENTAL AND STEM CELL BIOLOGY**
Credits	**4**

Hours/Week	**5**
Course Objectives	1. To study the basics of sperm, egg cell cycle and its various stages 2. To teach the developmental concepts of drosophila and chick 3. To teach the concepts of stem cell, embryonic and adult stem cell 4. To study the types of stem cell and stem cell mediated antigen role different stem cell To understand the recent advances and its applications to modern biotechnology.
Course Out Comes	1. After studying unit-1, the student will be able to know about basic knowledge of DevelopmentalBiology 2. After studying unit-2, the student will be able to understand mechanism of developmentalmorphogenesis andorganogenesis 3. After studying unit-3, the student will be able to understand the stem cell and its importance 4. After studying unit-4, the student will be able to know the different types of stem cell 5. After studying unit-5, the student will be able to know various application of stem cell inmedicine.

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes	No	No
5	Yes	Yes	Yes	No	Yes	Yes

Units	**Course Contents**	**Teaching Hours**
Unit-I	Introduction to Developmental Biology: Cells and morphogens gradients. Ultrastructure of sperm, egg, pollen and ovule. Production of gametes in animal and plant (Spermatogenesis, Oogenesis). Cell surface molecules in sperm - egg recognition in animals; zygote formation, cleavage, blastula formation, gastrulation and formation of germ layers in animals.	12 hours

Unit-II	Developmental Concepts: Morphogenesis and organogenesis in animals (Drosophila and Chick). Cell fate and cell lineages; genomic equivalenceand the cytoplasmic determinants; imprinting. Role of in development. Cellular differentiation and Differential activation. Role of cell death in development. Terato genesis - Ageing, transgenic.	12 hours
Unit-III	Introduction to stem cell biology: Introduction to concepts in stem cell biology (renewal and potency) introduction to stem cells, Germ line stem cells and germ line derived pluripotent cell, Epigenetics, nuclear transferand cloning, introduction to cell, tissues and organ. Introduction to embryonic and adult stem cell.	12 hours
Unit-IV	Basic and Types of Stem cell: Stem cell basic: Reprogramming and induced pluripotent cells (iPS cells), chromatin and stem cells, telomeres and stem cells, stem cell differentiation and characterization: CD antigens and its role in stem cell differentiation. Neuronal stem cell, mesenchymal stem cell, cardiac stem cells, hematopoietic stem cells	12 hours
Unit-V	Technique and Application Techniques used for stem cell isolation, enumeration and *in vivo* expansion, techniques used for stem cell characterization. Therapeutic applications of stem cell: fundamentals of regenerative medicine, autologous and allogenic stem cell transplantation, HLA typing, Stem cell banking – cryopreservation techniques, national and international guideline, recent advances in stem cell biology.	12 hours
Unit-VI	Internal Assessments, Seminars, and Guest Lecture	05 hours
Total Teaching hours		65

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Text Books

1. Essentials of stem cell biology 2009, (second ed)Robert Lanza, John Gearhart , Brigid Hogan, Douglass Melton, roger Pedersen, E. Donnall Thomas, James Thomson and sir Ian Wilmutt.
2. Ann a. Kiessling, human embryonic stem cells: an introduction to the science and therapeuticpotential, Jones andbartett,2003
3. Peter J ,Quesenberry, stem cell biology and gene therapy, 1st ed, willyless,1998
4. Developmental biology, (2018), 11th edition by Michael J. F. Barresi, Scott F. Gilbert. Reference
5. Book Human Embryology & Developmental Biology (2019), 6th edition by Bruce M. Carlson

6. Principles of Development (2019), 6th edition by Cheryll Tickle; Lewis Wolpert; AlfonsoMartinez Arias.
7. Freshney RI. 2016. Culture of animal cells: A manual of basic technique and SpecializedApplications. 7th Edn. Wiley- Blackwell.. United States of America.
8. Singh, B., Mal, G., Gautam, S.K., Mukesh, M.2019 Advances in animal biotechnology 1stEdnSpringer International Publishing. Switzerland

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

https://www.youtube.com/watch?v=dXknfffXeDM
https://courseware.cutm.ac.in/courses/biochemistry-and-enzyme-technology/
https://freevideolectures.com/course/85/enzyme-science-and-engineering
E-Journals: Reproductive Biology, Stem cell biology, Fertility and Sterility, Urology

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	S	S	M	S
CO2	S	S	M	S	S	S	S	M	S	M
CO3	S	S	S	S	S	M	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

PO – Programme Outcome, CO – Course outcome, S – Strong , M – Medium, L – Low

Course	**CORE PRACTICAL-II**
Title of the Course	**LAB IN IMMUNOLOGY AND GENETIC ENGINEERING**
Credits	**4**
Hours/Week	**6**

Units	**Course Contents**	**Teaching hours**

Unit I	**IMMUNOLOGY** 1. Blood grouping 2. Lymphocyte subset identification and enumeration. 3. Radial immuno-diffusion test. 4. Ouchterlony double diffusion 5. Immuno electrophoresis 6. Rocket Immunoelectrophoresis 7. Latex Agglutination 8. Quantitative Precipitin assay 9. Complement fixation test 10. ELISA 11. Western Blotting 12. Antigen-antibody reaction (precipitation and agglutination reaction tests).	30 hours
Unit-II	**GENETIC ENGINEERING** 1. Isolation of genomic DNA from the given sample and its molecular weight determination 2. Isolation of RNA from the given sample and its molecular weight determination 3. Isolation of plasmid DNA from the given sample 4. Restriction digestion of Lambda phage DNA 5. Ligation of DNA and analysis by electrophoresis 6. DNA amplification by PCR and RAPD 7. Preparation of competent cells and transformation by CaCl2 method and Selection oftransformed colony by X-Gal method 8. Determination of molecular weight of proteins by SDSPAGE	25 hours
		55 Hours

Method of Evaluation: (50 Internal marks + 50 External Marks=100)

Distribution for internals Test (CIA I + CIAII)	End Semester Examination	Total marks
50	50	100

Course	**ELECTIVE – III**

Title of the Course	**(A) MEDICAL LABORATORY TECHNOLOGY**
Credits	**2**
Hours/Week	**4**
Course Objectives	1.To teach the physical and chemical nature of Body fluids 2.To teach the safety measures in diagnostic laboratory 3.To learn knowledge about laboratory techniques 4.To learn hematology and pathology laboratory techniques 5.To teach advanced methods in collection and storage, preparation, analysis of body fluids, andresults.
Course Out Comes	1. After studying unit 1 the students will be able to follow safety precautions in the diagnostic laboratory. 2. After studying unit 2 the students will be able to general laboratory and instrumentation. 3. After studying unit 3 the students will be able to know the significance of biologicalsamples and their importance in the examination After studying unit 4 the students will be able to understand the various types ofinfection and clinical symptoms caused by microorganisms. 5. After studying unit 5 the students will be able to analyze and can cross-examine the Haematology tests of patients who visit the hospital.

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	No	Yes	Yes	Yes	No
3	Yes	Yes	No	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	Course Contents	Teaching hours
Unit I	General Laboratory and instrumentation: Code of conduct for laboratory personnel-safety measures the laboratory-chemical/Reagents, labeling, storage, and usage. First aid in laboratory accidents-Precautions and first aid equipment. Sterilization, and preparation of reagents. The general approach to quality control, quality control of quantitative data	5 hours
Unit-II	Clinical pathology: Urine analysis: Collection, composition, preservation, gross examination, chemical examination. Significance of sugar in the urine, ketone bodies, bile pigment, hematuria, uric acid, microscopic examination of the urinary sediment: stool Examination-specimen collection, pH, Interfering substance. Test for occult blood, fecal fat, and microscopic examination of a stool specimen.	5 hours
Unit-III	Clinical Hematology: Collection of blood-Anticoagulant, preservation Estimation of Hb, PCV, WBC (TC & DC), RBC, platelets, ESR Clotting time, bleeding time-normal value, clinical interpretation Serology-VDRL, CRP, RA, HIV, HBs Ag.	5 hours
Unit-IV	Histology: Basic concepts of different mammalian tissues and their histological structure. Different human organs and their gross and histological structure and functions. Receiving of biopsy specimens at the laboratory (Clinical notes/fixatives). Fixation of tissue –different fixatives and their mode of action. Methods of decalcification. Use of microtomes, selection and maintenance of knives, the technique of section cutting &mounting on slides. Staining of tissue sections, preparation of different stains, staining methods for Haematoxylin & Eosin.	5 hours
Unit-V	Blood banking: blood group (ABO & Rh)-methods of grouping & reverse grouping. Basic blood banking procedures- a collection of blood, anticoagulants used, cross-matching, different screening, Tests including Coomb‟s Test for incomplete antibodies preparation of different blood components for use and how to serve a requisition. preparation of red cell suspension. Blood transfusion & hazards. Detect the time when to discard blood in the blood bank, computerized record.	5 hours
Unit-VI	Internal Assessments, Seminars, and Guest lecture	05 hours
	Total Teaching hours	30

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Textbook:

1. Hand book medical laboratory technology 2nd edition-V.H.Talib CBS publishers& 2008.
2. Clinical laboratory practices in CMC procedure, CMC, Vellore
3. Text book of Medical lab technology, 1st Edition-Ranmniksood.jaypee2006.
4. Laboratory manual in biochemistry-Jayaraman New Age International Pvt Ltd publishers2011.

Reference Book:

1. Kanai L. Mukherjee and Anuradha Chakravarthy, Medical Laboratory Technology, Procedure Manual for RoutineDiagnostic Tests, Vols. I, II and III. Tata McGraw Hill Publishing Company Ltd., 2017.
2. Ramnik Sood, Concise Book of Medical Laboratory Technology Methods and Interpretations. Jaypee BrothersMedical Publishers (P) Ltd., New Delhi, 2015.
3. N. Pattabiraman. Laboratory Manual in Biochemistry, 4th Edition. All India Publishers & Distributors, 2015.
4. Namita Jaggi. Microbiology Theory for MLT. 2nd Edition. Jaypee Brothers Medical Publishers (P) Ltd., 2013.
5. Alan H. Lowenclock. Varley's Practical Clinical Biochemistry, 6th Edition. CBS Publishers and Distributors, 1988.

Course Material:

Website links:https://library.fvtc.edu/MLT/Links, https://libguides.gvsu.edu/MLS/websites,E-Books: https://www.pdfdrive.com/medical-laboratory-technician-e23958474.html,
E-journals : https://onlinelibrary.wiley.com/journal/10982825,

https://academicjournals.org/journal/JMLD.

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	M	S	M	S	S
CO2	M	S	M	M	M	S	S	S	M	M
CO3	S	M	M	S	S	M	M	S	M	S
CO4	M	S	S	M	M	S	M	M	S	S
CO5	S	M	S	M	S	M	S	M	S	S

PO – Programme Outcome, CO – Course outcome, S – Strong, M – Medium, L – Low

Course	**ELECTIVE III**
Title of the Course	**(B) FOOD & NUTRITION**
Credits	**2**
Hours/Week	**4**
Course Objectives	1. To enable the students to learn the basic concepts of nutrition and different categories offoods. 2. To enable the students to gain knowledge of different nutrient contents and theirimportance. 3. To make them learn the basics of nutritive and calorific value. 4. To enable the students to know food adulterants and food poisoning, disadvantages &healthproblems. 5. To enable the students learn the food spoilage and preservation methods.
Course Out Comes	1. The student will be able to differentiate the foods types and their nutritive value. 2. The student will be able to develop competence to carry out investigation in nutrition 3. The student will be able to measure and calculate calorific value of different types of foods 4. The student will be able to identify the food adulterants and food poisoning 5. The student will be able to practice food sterilization, preservation and processing.

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	No	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	Yes

Unit	Course Content	Teaching Hours
UNIT I	Definition and basis of food and nutrition, Different Food groups and classification, Nutritional significance and physiological role of food groups, Protein Energy Malnutrition (PEM), definition and types, Treatment and preventive measures of PEM.	5 hours
UNIT-II	Introduction to Vitamins., Fat soluble vitamins, Water soluble vitamins	5 hours
UNIT – III	Introduction to calorific value and nutritive value, Bomb calorimeter, Measurement of calorific value and nutritive of foods, RQ value, BMR and SDA of food stuffs, their measurements and influencing factors, Nutritive value of proteins and amino acids,Balanced diet, composition of balanced diet for pregnant woman, infants, old age.	5 hours
UNIT – IV	Definitions of food adulterations and food poisoning, Sources of foods and types of adulterants, advantages and disadvantages ofadulteration, Constituents of foods, carbohydrates, proteins, fats, oils, Flavours, colours and natural toxicants, Sources causes and remediesfor acidity, gastritis, indigestion and constipation.	5 hours
UNIT-V	Introduction to food spoilage, food preservation and food processing, Causes and types of food spoilage, types of food preservation and food processing, Food sterilization and pasteurization.	5 hours
UNIT-VI	Internal Assessment: Assignments, Seminars and Guest lectures	05 hours
	Total Lecture hours	30

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Text book:

1. Albanese, Anthony A Ed, Protein And Amino Acid Nutrition Academic Press New York 1959.
2. Devlin T.M., Biochemistry by Stryer Text book of Biochemistry with clinical correlations.
3. Lehninger, Principles of Biochemistry, by 4th Ed. By Nelson D.L. and Cox. M.M. 6

4. Murray R.K., Grammer, D.K., Mayer P.A., Rodwell V.W., Harpers Biochemistry, alange medical book 26thEd. Mc. Graw Hill, Health Professions Division.
5. West. E.S., Todal, W.R., Mason H.S. and Van Brygen J.T., Text Book of Biochemistry.
6. Mayer, J., Human Nutrition, Charles, C. Thomas, spring field.
7. Michael, J. Gibney, Barrie, M. Margetis, John, M. Kearney. Lenore Arab. PublicHealth Nutrition. Blackwellscience, Blackwell Publishing Company (2004).
8. Frazier, We, Food Microbiology, Tata Mc Graw Hill 19789. Meyer, Lilian H. Ed. (1987),

Food chemistry. Indian Ed. CBS Publishers andDistributors

10.Barker, D.J. P (1998), Mothers, Babies and Health in later life. Edinburgh,Churchill livingstone.

11. Ward, R.H.T; Smith, S.K. Donnai, D. (Eds.) (1994) Early fetal Growth and Development. London, & COG Press.

12. Wallace, H.M. and Giri, K. (1990), Health care of women and children indeveloping countries, third party publishing co.Oakland.

Reference Book:

1. Seema yadav: - Food Chemistry, anmol publishing (P) Ltd, NewDelhi
2. Car H.Synder: -the extraordinary chemistry for ordinary things, John Wiley & sonsinc,NewYork,1992.
3. B.Sivasankar – food processing and preservation – PHI learni9ng (P) LTD , New Delhi – 11001.

Course Material: website links, e-Books and e-journals

1. https://chico-primo.hosted.exlibrisgroup.com

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	S	S	M	S
CO2	S	S	M	S	S	S	S	M	S	M
CO3	S	S	S	S	S	M	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S

PO – Programme Outcome, CO – Course outcome, S – Strong , M – Medium, L – Low

Course	**ELECTIVE - III**
Title of the Course	**(C) BIODIVERSITY**
Credits	**2**
Hours/Week	**4**

Course Objectives	1. To learn the basic concepts of ecosystem and ecology 2. To teach various biodiversity across the country and globe face. 3. To understand the History, guiding principles, conservation of ecology and biodiversity as perICUN. 4. To learn the importance of pollution damages environmental through how it influencebiodiversity 5. To teach and understand how water pollution affects environment and its remedies.
Course Out Comes	1. After studying unit-1, the student will be able to understand the ecosystem and environment. 2. After studying unit-2, the student will be able to understand various types of biodiversity. 3. After studying unit-3, the student will be able to Understand History, guidingprinciples, conservationchallenges and models of conservation biology. 4. After studying unit-4, the student will be able to Gain knowledge of biosafety and risk assessmentofEnvironmental Pollution. 5. After studying unit-5, the student will be able to Understand Water conservation, Rain waterharvestingand disaster management of biodiversity.

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	No	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	Course Contents	Teaching Hours
UNIT I	Ecosystem concept Introduction and overview of ecosystem ecology - History of ecosystem ecology, Ecosystem structure and functioning, Ecosystem diversity and landscapes, Ecosystem resilience and change, Trophic dynamics and temporal dynamics, Ecological efficiencies	5 hours
UNIT-II	Biodiversity and its origin, Global and local trends , Mega biodiversity countries, hot spots and heritage sites, types of diversity, levels of biodiversity (genetic, species, ecological diversities), value of biodiversity.	5 hours
UNIT – III	History, guiding principles, conservation challenges and models of conservation biology. IUCN Red list categories and criteria, habitat management and establishment of wildlife corridors and protected areas, bio-indicators. Biosphere reserves, in situ and ex situ conservations (sanctuaries, national parks, zoological parks, botanical gardens, oceanorium).	5 hours
UNIT – IV	Environmental Pollution- Causes, effects and control measures of air pollution, water pollution, soil pollution, noise pollution, thermal pollutionand solid waste management. Environment Protection Act: Air, water,forest and wild life acts, issues involved in enforcement of environmental legislation.	5 hours
UNIT-V	Water conservation, Rain water harvesting & watershed management, and environmental ethics. Climate change, global warming, acid, rain, ozone layer depletion. Environmental protection act, population explosion. Disaster management.	5 hours
UNIT-VI	Internal Assessment: Assignments, Seminars and Guest lectures	5 hours
	Total Lecture hours 50 hours	30 hours

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Textbooks

1. Alcock J 2013 AnimalBehavior: An Evolutionary Approach, 10thedition (Sinauer Associates, Inc.)

2. Bolhuis J J and L Giraldeau (eds) 2005 The behaviour of animals (BlackwellPub.)

3. Breed and Moore 2011 Animal Behavior, 1st Edition (Academic Press) 4. Burnse D(ed.) 2001Animal: the definitive visual guide to worlds‟ wildlife (Cambridge UniversityPress)

4. Collen B, Pettorelli N, Baillie J E M and Durant S M (Eds) 2013 BiodiversityMonitoring andConservation: Bridging the Gap Between Global Commitment and Local Action(WileyBlackwell)

5. GL. Karia and R.A. Christian, West Water Treatment, Concepts and DesignApproach, PrenticeHall of India,2005.

6.Benny Joseph, Environmental Studies, Tata McGrawHill,2005

Reference book

1. Introduction to bioethics (2018), 2nd edition by J.A. Bryan

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://swayam.gov.in/nd1_noc20_hs18/preview2. https://nptel.ac.in/courses/109/106/109106092/
3. https://onlinecourses.nptel.ac.in/noc20_hs18/preview4. https://nptel.ac.in/courses/102/104/102104068/
5. https://www.futurelearn.com/courses/biosecurity

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	S	S	M	S
CO2	S	S	M	S	S	S	S	M	S	M
CO3	S	S	S	S	S	M	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S

PO – Programme Outcome, CO – Course outcome S – Strong, M – Medium, L – Low

Course	**ELECTIVE IV**
Title of the Course	**(A) GENOMICS & PROTEOMICS**
Credits	**2**
Hours/Week	**3**
Course Objectives	1. To provide the basic knowledge of gene characteristic feature and mapping concepts 2. To understand about the sequencing technologies 3. To provide the basic concept for protein analysis 4. To understand about protein sequencing 5. To Enrich the students' knowledge with respect to metagenomic and applications

Course Out Comes	1. After studying unit 1, the student will be able to know about genes functional properties. 2. After studying unit 2, the student will be able to understand how gene sequencing are done. 3. After studying unit 3, the student will be able to understand Protein analysis. 4. After studying unit 4, the student will be able to protein sequencing methods. 5. After studying unit-5, the student will be able to know about metagenomics and its application.

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes	No	No
5	Yes	Yes	Yes	No	Yes	Yes

Units	Course Contents	Teaching Hours
UNIT I	Organization of genes across living systems, interrupted genes, overlapping genes, alternative genes , (RNA editing and RNA Splicing) etc. identification and characterization of insert DNA fragments, gene content and C value paradox – gene cluster and gene families. restriction mapping, chromosome walking and chromosomal localization of genes. RFLP and other uses of cloned sequences, cloning of microbial genes.	10 hours
UNIT-II	Methods of preparing genomic DNA, DNA sequence analysis methods, Sanger Di deoxy method, next generation sequencing, SNP – single nucleotide polymorphism, expressed sequenced Tags (ESTs),Gene disease association, site directed mutagenesis and molecular chimeras , gungal genome and genomics. PCR based Analysis, DNA Fingerprinting.	08 hours
UNIT – III	Scope of proteomics, protein separation techniques – ion exchange chromatography, size – exclusion and affinity chromatography techniques, size – exclusion and affinity chromatography techniques , protein analysis (includes measurement of concentration, amino acid composition, N-terminal sequencing); SDS-PAGE , two dimensional gel electrophoresis and image analysis.	13 hours

UNIT – IV	Introduction to mass spectrometry; strategies for protein identification ; protein sequencing ; protein modifications and proteomics ; applications of proteome analysis to drug; protein – protein interaction (Two hybrid interaction screening), analysis and sequencing individual spots by mass spectrometry (Maldi toff) and protein microarrays .	08 hours
UNIT-V	A genomics – construction, vector design and screening of meta genomic libraries- biotechnological applications of meta genomics.	08 hours
UNIT-VI	Internal Assessment: Assignments, Seminars and Guest lecturers	5 hours
	Total Lecture hours	**50 hours**

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Text Books

1. Introducing proteomics (2011) Josip lovric. John Wiley Publication
2. Principles of proteomics (2013). R. M Twyman. Taylor and Francis publishers.

Reference Books

1. Expression Genetics: accelerated and High Throughput Methods (1999). Edited by M.McClelland and A. Pardee, Eaton Publishing, MA.
2. Microbial Functional Genomics (2004). J. Zhou, D.K. Thomson, Y. Xu and J.M. Tiedje, WileyLiss.
3. Reviews and articles from Journals such as Nature, Science, PNAS (USA), Nucleic AcidsResearch, Trends and Current Opinion Series.
4. Principles of Gene Manipulation and Genomics (2013) Sandy B. Primrose, Richard Twyman – BlackwellPublishing.
5. An Introduction to Genetic Engineering 3rd Edition DesmondS. T. Nicholl CambridgeUniversity Press
6. Molecular Biotechnology: Principles and Applications of Recombinant DNA 4th EditionBernard R. Glick, Jack J.Pasternak, Cheryl L. Patten ASM Press
7. Post-translational modifications in host cells during bacterial infection, D. Ribert, P. Cossart,FEBS letters, 2010.
8. Proteomics in practice: a laboratory manual of proteome analysis (2002).Westermeier, R., &Naven, T. John Wiley& Sons, Inc.
9. Proteomics for biological discovery. Veenstra, (2006). Timothy D. and John R. Yates John Wiley& Sons,
10. Plant proteomics: methods and protocols. (2007). Thiellement, H., Zivy, M., Damerval, C. and Méchin, V. eds. Totowa (NJ): Humana Press.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	S	S	M	S
CO2	S	S	M	S	S	S	S	M	S	M

CO3	S	S	S	S	S	M	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S

PO – Programme Outcome, CO – Course outcome S – Strong, M – Medium, L – Low

Course	**ELECTIVE -IV**
Title of the Course	**(B) ENVIRONMENTAL SCIENCES**
Credits	**2**
Hours/Week	**3**
Course Objectives	1.To introduce students to the basics of Environment. 2.To enable the students learn basic structure and functions of ecosystem. 3.To make students understand the distribution of life and life forms on earth. 4.To make students aware of the different forms of energy in environment. 5.To make the students understand the different pollutants and pollution and their Management.
Course Out Comes	1. The student will be able to understand the principles and scope of environment. 2. The student will be able to understand the distribution and cycling of energy in environment 3. The student will be able to identify and characterize the earth sciences. 4. The student will be able explore the sources of energy from environment. 5. The students will be able to apply methods to control and manage the environment pollution.

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	No	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	No	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	**Course Contents**	**Teaching Hours**
UNIT I	Definitions, principles and scope of environmental science. Structure and composition of atmosphere, hydrosphere, lithosphere, biosphere. Meteorological parameters. Environmental education and awareness. Environmental Ethics.	5 hours
UNIT-II	Introduction to origin of life and speciation, Ecosystem structure and functions, food chains and webs, Basis of ecosystem classification, Biotransformation, water and air borne microbes, Bioremediation, Bioindicators, Biofertilizers, Biofuels, Biosensors.	5 hours

UNIT – III	Introduction to origin of earth, components of earth, zones of earth, Climates of India, weather reactions, erosion, transport, deposition of sediments, Soil forming minerals and process, identification and characterization of clay minerals, Ground water quality, pollution of ground water and mitigation of its impacts.	5 hours
UNIT – IV	Sources of energy, Sun as source of energy, Solar radiation and its spectral characteristics, Characteristics and energy content of coal, petroleum, and natural gases, Energy usage pattern in world and India, Pollutants, emissions of CO_2 and Global warming.	5 hours
UNIT-V	Introduction to pollution, air, noise, water, soil, thermal, marine and radioactive Pollution, Concept of Waste management, Solid and hazardous waste management, Electrical energy generation, e-waste, fly ash, plastic waste, Environmental management system standards, IPCC, UNEP, IGBP, Global environmental issues-Biodiversity loss, climate change, Ozone depletion, sea level rise.	5 hours
UNIT-VI	Internal Assessment: Assignments, Seminars and Guest lecturers	5 hours
	Total Lecture hours	30 hours

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Text book:

1. Hardy, J.T. 2003. Climate Change: Causes, Effects and Solutions. John Wiley & Sons.
2. Harvey, D. 2000. Climate and Global Climate Change. Prentice Hall.
3. Minkoff, E.C. 1983. Evolutionary Biology. Addison Wesley. Publishing Company.
4. Nei, M. & Kumar, S. 2000. Molecular Evolution and Phylogenetics. Oxford University Press.
5. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2006. Environmental and Pollution Science. Elsevier Academic Press.
6. Purohit, S.S.& Ranjan, R. 2007. Ecology, Environment & Pollution. Agrobios Publications.
7. Owen, O.S, Chiras, D.D, & Reganold, J.P. 1998. Natural Resource Conservation –Management for Sustainable Future (7th edition). Prentice Hall.
8. Elliott, D. 1997. Sustainable Technology. Energy, Society and Environment (Chapter 3). New York, Routledge Press.
9. Bagchi, A. 2004. Design of Landfills and Integrated Solid Waste Management. JohnWiley & Sons.
10. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Sounders.
11. Barry, R. G. 2003. Atmosphere, Weather and Climate. Routledge Press, UK.
12. Mitra, A.P., Sharma, S., Bhattacharya, S., Garg, A., Devotta, S.&Sen, K. 2004. Climate Change and India.Universities Press, India.

Reference Book:

1. Botkin, Daniel B. (2011). Environmental Science: Earth as a living Planet, John Wiley andSons, New Delhi.
2. Chapman. J. L. and Reiss, M.J. (2005). Ecology, Principles ad Applictions, CambridgeUniversity

Press, London.
3. Dash, M.C. (1994).Fundamentals of Ecology, Tata Mc Graw Hill, New Delhi.
4. Gunther, O. (1998) Environmental Information Systems. Berlin, New York, Springer.
5. Miller G. Taylor and Scot Spoolman. (2011). Essentials of Ecology, Books/ Cole Learning, sU.S.A.
6. Odum, E.P. (1971). Fundamentals of Ecology, W.B. Saunder Company, Philadelphia
7. Sharma P. D. (1996). Environmental Biology, Rastogi Publications, Meerut.
8. Verma P.S. and V.K. Agarwal. (1985). Principles of Ecology. S. Chand and Company(Pub.), New Delhi.
9. Strahler, A. V. and Strahler, A.A (1973). Environmental Geoscience, Wiley International.
10. PrimackR.B. 2014. Essentials of Conservation Biology, Oxford University Press, USA.

Course Material: website links, e-Books and e-journals

1. https://www.hzu.edu.in/bed/E%20V%20S.pdf.
2. https://www.intechopen.com/books/1882.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	S	S	M	S
CO2	S	S	M	S	S	S	S	M	S	M
CO3	S	S	S	S	S	M	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S

PO – Programme Outcome, CO – Course outcome, S – Strong , M – Medium, L – Low

Course	**ELECTIVE - IV**
Title of the Course	**(C) HERBAL BIOTECHNOLOGY**
Credits	**2**
Hours/Week	**3**
Course Objectives	1. To enable the students to learn about the biochemical parameters used in the identificationand utilization of medicalplants 2. To enable the students to learn about the extraction of phytochemicals and procedures 3. To exploit and explore the medicinal values of plants 4. know the evaluation techniques for the herbal drugs To provide knowledge on biotech-based production of Herbal medicines

Course Out Comes	1. After studying unit-1, the student will be able to – know the Study of on history and scope ofherbals 2. After studying unit-2, the student will be able to – understand the Important medicinal herbs intreating diseases 3. After studying unit-3, the student will be able to –learn the Biotechnological methods of plantpropagation 4. After studying unit-4, the student will be able to –explore methods Involved in secondarymetabolite production 5. After studying unit-5, the student will be able to –know about pharmaceutical applications and Intellectual Property Rights

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	No	No	No	No
2	Yes	Yes	No	No	No	No
3	Yes	Yes	No	No	No	No
4	Yes	Yes	No	No	No	No
5	Yes	Yes	No	No	No	No

Units	**Course Contents**	**Teaching hours**
Unit I	Study of on history and scope of herbals - Introduction to the Indian system ofmedicine – Herbal drugs and importance- Herbal Cosmetic andCosmeceuticals - Formulation Development of herbal preparations - Herbal Drugdiscovery and Novel drug delivery systems.	10 hours
Unit-II	Important medicinal herbs in treating diseases- Phytochemistry of medicinal plants- alkaloids- flavones- flavonoids and xanthones - furocoumarins - glycosides - naphthoquinones - phenols and acylphloroglucinols - resins, oleoresins and gum resins. Saponins - sterols and steroid-like compounds - tannins and terpenes.	08 hours
Unit-III	Biotechnological methods of plant propagation. - Micropropagation – Somatic Embryogenesis and somoclonal variation. Herbal gardening and maintenance - Standardization of cultivation protocols of selected medicinal plants; *in vitro* production of secondary metabolites. Polyhouse Technology - Important diseases of medicinal plants and their management.	13 hours
Unit-IV	Methods Involved in secondary metabolite production - Organ culture, Cell culture, Biotransformation (Microbial and Plant cells) - Scaleup – Enhancement of product formation by elicitation-Immunodiagnostics and molecular diagnostics in selection of elite plant species.	08 hours
Unit-V	Introduction to analysis and quality controls of herbal products (TLC, HPLC, IR, NMR, and mass spectroscopy). Pharmaceutical application of alkaloids, terpenoids, glycosides, volatile oils, tannins and resins. - Intellectual Property Rights - Regulatory Affair herbal pharmaceuticals – Entrepreneurship Management.	08 hours

Unit-VI	Internal Assessments, Seminars, and Guest lecture	5 hours
	Total Teaching hours	**50 hours**

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Reference & Text Books:

1. Harborne, J.B., 1998. Phytochemical methods to modern techniques of plant analysis. Chapman & Hall, London.
2. Trease G. E, M. C. Evans, 1979. Textbook of Pharmacognosy12th ed. Balliere-Tindal, London.
3. Irfan A. Khan and AtityaKhanum (Eds.). 2004. Role of Biotechnology in medicinal andAromatic plants, Vols. I-X.Ukaaz Publications, Hyderabad. Analytical techniques in DNA sequencing edited by Brian K. Nunnally. 97
4. Agrawal S.S. and M. Paridhavi, Herbal Drug Technology, University press 2007.
5. Henry, R. J. 1997. Practical Applications of Plant Molecular Biology. Chapman &Hall, London, UK.
6. Bidlack, W.R., Omaye, S.T., Meskin, M.S.andTopham, D.K.W.," Phytochemicals as Bioactive Agents", 1St Edition, CRC Press, 2000.
7. Sharol Tilgner, N. D. 1999. Herbal medicine - From the heart of the earth. Edn. 1, Printed in the USA by MalloyLithographing Inc.
8. Balasubramanian, Bryce, Dharmalingam, Green and Jayaraman (ed), Concepts in Biotechnology, University,Press, 1996.
9. Anderson, F.J Illustrated History of the Herbals. New York: Columbia University press.2009.
10. Callow, J. A., Ford-Lloyed, B. V. and Newbury, H. J. 1997. Biotechnology and PlantGenetic Resources:Conservation and Use, CAB International, Oxon UK.
11. Gokhale, S.S,C.K.Kokate and A.P.Purohit (1994). Pharmacognosy. Niraliprakashan, Pune.
12. Faroogi, A.A. and B.S.Sreeramu (2004), Cultivation of Medicinal and Aromatic crops. University Press (India) P.Ltd., Hyderabad.
13. Pal. D.C and S.K. Jain (1998), Tribal medicine, Naya Prakash, 206, Bidhan Sarani, Calcutta.
14. Thirugnanam, Akbarsha and Krishnamurthy (2010),Indian Medicinal plants and Home

Course Material:

1. Rasheeduzzafar (2006), Medicinal plants of India, CBS publication.
2. International Journal of Herbal Medicine
3. Journal of Herbal medicine Elsevier
4. en.wikipedia.org/wiki/Herbal medicine

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S

CO5	S	S	S	S	S	S	S	S	S	S

PO – Programme Outcome, CO – Course outcome, S – Strong , M – Medium, L – Low

Course	**SKILL ENHANCEMENT COURSE-I**
Title of the Course	**(A) MUSHROOM CULTIVATION AND APICULTURE**
Credits	**2**
	2
Course Objectives	1.To make the students to know about mushroom and their types. 2.To enable the students to learn the mushroom spawn production conditions. 3.To make the students learn about mushroom cultivation and maintenance. 4.To make the students to know about apiculture scope and bee keeping and types. 5.To enable the students to understand the importance of honey and applications.
Course Out Comes	1.The student will be able to differentiate the edible and poisonous mushrooms. 2.The student will be able to develop mushrooms culture conditions. 3.The student will be able to practice the mushroom cultivation and production. 4.The student will be able to practice the bee keeping and culture maintenance. 5.The student will be able to produce and analyze the applications of honey in different Fields.

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	No	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	**Course Contents**	**Teaching hours**
UNIT I	History of Mushroom, cultivation and its practice, Introduction to mushroom cultivation, Classification of Mushrooms and different types, Edible Mushrooms, its types and their origin, Poisonous Mushrooms, its types and their origin.	5 hours
UNIT-II	Introduction to mushroom cultivation, sources of beds and types, Spawn, Sources, spawn run, cultivation set up, Culture ventilation and humidity management, temperature, lighting, moisture, pH, CO2, Culture chambers preparation, sterilization, Instructions, precautions, handling and sensors.	5 hours

UNIT – III	Mushroom cultivation maintenance, conditions, and duration, Spawn collection, preparation, storage, Spawning techniques, Environmental conditions, temperature, moist, Fruiting initiation, monitoring, maintenance and harvest.	5 hours
UNIT – IV	Introduction to apiculture, definitions, history, scope, importance of apiculture, Bee Keeping methods practiced in world and in India, Traditional Bee keeping techniques, Modern Bee keeping methods, Urban Beekeeping methods.	5 hours
UNIT-V	Introduction to nutritional product of honey and its constituents, Honey properties biological activities, medicinal values, Applications of Honey in various fields, Honey types and value added honey products.	5 hours
UNIT-VI	Internal Assessment: Assignments, Seminars and Guest lecturers	5 hours
	Total Lecture hours 65 hours	30 hours

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Text book:

1. Paul Stamets, J.S. and Chilton, J.S. 2004. Mushroom cultivation A practical guide to growing mushrooms athome, Agarikon Press.
2. Tewan and Pankaj Kapoor S.C. 1993. Mushroom cultivation. Mittal Publication. Delhi.
3. Marimuth et al., 1991. Oyster Mushrooms. Dept. of Plant pathology, TNAU, Coimbatore.
4. Nita Bahl. 1988. Hand book of Mushrooms, 2nd Edition, Vol I & II.
5. Shu Fing Chang, Philip G. Miles and Chang, S.T. 2004. Mushrooms Cultivation, nutritional value, medicinaleffect and environmental impact. 2nd ed., CRC press.
6. Prost, P. J. (1962). Apiculture. Oxford and IBH, New Delhi.
7. Bisht D.S., Apiculture, ICAR Publication.
8.Singh S., Beekeeping in India, Indian council of Agricultural Research, New Delhi

Reference Book:

1. Laidlaw, H.H., 1997. Contemporary queen rearing. Published by Dadant and Sons. R. A. Morse, Rearing queen honeybees. Wicwas press, NY.
2. Alison Benjamin, By (author) Brian McCallum, 2008. Keeping Bees and Making Honey. David & Charles, NewtonAbbot.
3. Kim Pezza, 2013. Backyard Farming: Keeping Honey Bees: From Hive Management to Honey Harvesting and More.Hatherleigh Press, U.S.
4. Kim Flottum, 2014. The Backyard Beekeeper: An Absolute Beginner's Guide to KeepingBees in Your Yard andGarden. Quarry Books.
5. Kannaiyan, S. Ramasamy, K. (1980). A hand book of edible mushroom, Today & TomorrowsPrinters &Publishers,New Delhi.
6. Pandey B P 1996. A textbook of fungi.Chand and Company N Delhi. **Course Material: website links, e-Books and e-journals**
1.https://books.google.co.in/books/about/Mushroom_Cultivation_in_India.

2.https://books.google.co.in/books/about/Mushroom_Cultivation_in_India.html?id=6AJx99OGT KEC&redirhttps://books.google.co.in/books/about/Mushroom_Cultivation_in_India.html?id=6AJx99OGTKEC&re dir

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	S	S	M	S
CO2	S	S	M	S	S	S	S	M	S	M
CO3	S	S	S	S	S	M	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S

PO – Programme Outcome, CO – Course outcome, S – Strong , M – Medium, L – Low (may be avoided

Course	**SKILL ENHANCEMENT COURSE -1**
Title of the Course	**(B) VERMICULTURE TECHNOLOGY**
Credits	**2**
	2
Course Objectives	1.To enable the students learn about Vermiculture compositing. 2.To enable the students to know the humus cycle, soil transformation 3.To enable the students analyze the nutritional composition of vermicompost. 4.To enable the students to learn Vermiculture technology. 5.To enable the students to learn the harvest of vermicompost.
Course Out Comes	1.The student will be able to understand the Vermiculture and 4R's of recycling. 2.The student will be able to identify the decomposing organic matter and humus formation. 3.The student will be able to differentiate nutritional value of vermicompost and fertilizer. 4.The student will be able to practice the Vermiculture composting and maintain conditions. 5.The student will be able to produce Vermiculture compost, harvest the compost andapplication.

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	No	Yes	No	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	Course Contents	Teaching hours
UNIT I	Introduction to Vermiculture technology, definition, meaning and history, Economic importance of Vermiculture, their value in soil texture, Concept of recycling, Concept of four r' s reduce, reuse, recycle and restore.	5 hours
UNIT-II	Introduction to matter, types of matter, Introduction to Humus, Humus cycle, Sources, quality of products for Humus formation, Ground population, and transformation process in organic matter.	5 hours
UNIT – III	Introduction of plant fertilizers, nutritional value and theirimportance, Vermicompost composition and its nutritional value, Importance of vermicompost as fertilizer for plants, Comparison of vermicompost with other fertilizers.	5 hours
UNIT – IV	Introduction to vermibeds, sources, types, Preparation of vermibeds, measurements, Maintenance of vermicompost, Compositing conditions, moist, temperature, aeration.	5 hours
UNIT-V	Vermicompost identification, conditions and separation, compost packing, sources and methods, Compost storage, conditions and durations, Vermicompost handling and transport.	5 hours
UNIT-VI	Internal Assessment: Assignments, Seminars and Guest lecturers	5 hours
	Total Lecture hours 65 hours	30 hours

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Text book:

1. Kevin, A and K.E.Lee (1989) " Earthworm for Gardeners and Fisherman" (CSIRO,Australia, Division of Soils)
2. Rahudakar V.B. (2004). Gandul khatashivay Naisargeek Paryay, Atul Book Agency,Pune.
3. Satchel, J.E. (1983) "Earthworm Ecology" Chapman Hall, London.
4. Wallwork, J.A. (1983) "Earthworm Biology" Edward Arnold (Publishers) Ltd. London.
5. Sultan Ahmed Ismail, 2005. The Earthworm Book, Second Revised Edition. Other IndiaPress, Goa, India. 2.Bhatnagar & Patla,2007.
6. Earthworm vermiculture and vermin-composting, Kalyani Publishers,New Delhi

Reference Book:

1. Bhatt J.V. & S.R. Khambata (1959) "Role of Earthworms in Agriculture" Indian Council of Agricultural Research, New Delhi 2.

2. Dash, M.C., B.K.Senapati, P.C. Mishra (1980) " Verms and Vermicomposting" Proceedings of the National Seminar on Organic Waste Utilization and Vermicomposting Dec. 5-8, 1984, (PartB), School

of Life Sciences, Sambalpur University, Jyoti Vihar, Orissa.
3. Edwards, C.A. and J.R. Lofty (1977) "Biology of Earthworms" Chapman and Hall Ltd., London.
4. Lee, K.E. (1985) "Earthworms: Their ecology and Relationship with Soils and Land Use" Academic Press, Sydney. 5. Kevin, A and K.E.Lee (1989) " Earthworm for Gardeners and Fisherman" (CSIRO, Australia, Division of Soils)
5.Mary Violet Christy,2008. Vermitechnology,MJP Publishers, Chennai.
6.Aravind Kumar, 2005.Verms & Vermitechnology, A.P.H. Publishing Corporation, New Delhi.

Course Material: website links, e-Books and e-journals

1. Vermiculture Technology, Earthworms, Organic Wastes, and EnvironmentalManagement Edited By Clive
2. A. Edwards, Norman Q. Arancon, Rhonda L. Sherman,https://www.scirp.org/journal/paperinformation.aspx?paperid=2490, DOI: 10.4236/ti.2010.13019

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	S	S	M	S
CO2	S	S	M	S	S	S	S	M	S	M
CO3	S	S	S	S	S	M	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S

PO – Programme Outcome, CO – Course outcome S – Strong , M – Medium, L – Low (may be avoided)

Course	**SKILL ENHANCEMENT COURSE -1**
Title of the Course	**(C) VALIDATION OF MEDICINAL PLANTS**
Credits	**2**
	2
Course Objectives	1.To enable the students to understand the importance of medicinal plants. 2.To enable the students to identify the medicinal plants. 3.To enable the students to learn the techniques of validation of medicinal plants. 4.To enable the students to learn the cultivation methods and maintenance of medicinal plants. 5.To enable the students to understand the importance of medicinal plant in human health.
Course Out Comes	1. The student will be able to gain knowledge about importance of medicinal plant parts and itsmedicinal value. 2. The student will be able to classify the medicinal plants on Bentham and Hooker and Practiceherbarium techniques. 3. The student will be able to identify the medicinal values of plants using different validationTechniques. 4. The student will be able to cultivate and propagate the medicinal plants 5. The student will be able to practice the usage of medicinal plants in treatment of human Diseases.

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	No	Yes	No	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	**Course Contents**	**Teaching hours**
UNIT I	Introduction to Medicinal plants, meaning, definition and types, Medicinal properties of plants and their importance, Medicinal values in plant parts, fruits, stem, leaves and roots, Leaf, fruit, root and stem modifications, aerial and underground.	5 hours
UNIT-II	Introduction to Medicinal plant identification, Elementary knowledge of binomial nomenclature, Bentham and Hooker classification, Herbarium, preparation and preservation.	5 hours
UNIT – III	Introduction to validation of medicinal plants, Macroscopic characteristics of medicinal plants, Microscopic characteristics of medicinal plants, Chemical compounds and tests of medicinal plants, Chromatographic techniques for validation TLC, HPLC, HPTLC & gas, Chromatography.	5 hours
UNIT – IV	Introduction to medicinal plant cultivation, Cultivation techniques, and factors affecting cultivation of medicinal plants, Propagation of medicinal plants and different methods of propagation, Management and Maintenance of medicinal plants.	5 hours
UNIT-V	Importance of medicinal value in plants, Medicinal properties of plants in human health and its role, advantages, Role of medicinal plants in prevention and treatment of human diseases, Traditional knowledge and utility of Indian medicinal plants.	5 hours
UNIT-VI	Internal Assessment: Assignments, Seminars and Guest lecturers	5 hours
		30 hours

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Text book:

1. Indian Medicinal Plants by P.C. Trivedi (2009).
2. Medicinal Plants of Indian Himalaya by S.S. Samant and U. Dhar.
3. Indian Medicinal Plants (Vol 1- 4) by K.R. Kirtikar and B.D. Basu (2006).
4. Indigenous Medicinal Plants Social Forestry & Tribals by M.P. Singh et al. (2003).
5. Ayurvedic Drugs and their Plant Sources by V.V. Sivarajan & I. Balachandran, Oxford &IBH(1994).
6. The Handbook of Ayurveda Shantha by Godagama, Bishen Singh Mahendrpal Singh, Dehradun(2004).
7. Direct uses of medicinal plants and their identification by Vardhana, Sarup and Sons, Ansari Road, Dariyaganj, New Delhi (2008).
8. Medicinal plants, applied biology of domestication and export by K. Singh, S.K. Tyagi,Bishen SinghMahendrapal Singh Dehradun.
9. Quality Control Methods for Medicinal Plants Materials, W.H.O. (1998).
10. Evaluation of herbal medicinal products by Houghton

Reference Book:

1. A Class Book of Botany. A.C. Dutta. Oxford University Press.
2. Cultivation of Medicinal Plants by C.K. Atal & B.M. Kapoor.
3. Hartmann, H.T & Kester, D.E (1989). Plant Propagation – Principles and Practices. PrenticeHall of India
4. Awadesh N, Ghoeami A and Sharma R, Indigenous Health Care and Ethnomedicine, Sarupand Sons.
5. Medicinal Plants Cultivation: A Scientific Approach by S.S. Purohit, (2004).
6. Bruneton Jean, Caroline K. Hatton, Pharmacognosy, Phytochemistry, Medicinal plants.Lavoisier, 1999.ISBN 1898298637.
7. Nikolaus J. Sucher, Maria C. Carles, Genome-Based Approaches to the Authentication of Medicinal Plants. Planta Med., 74: 603–623; 2008.
8. WHO guidelines on good agricultural and collection practices (GACP) formedicinal plants, World HealthOrganization, Geneva, 2003.
9. Iqbal Ahmad, FarrukhAqil, and Mohammad Owais, Modern Phytomedicine: Turning Medicinal Plants intoDrugs. WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim,2006. ISBN-10: 3-527-31530-6.
10. Ved D.K. & Goraya, G.S. Demand & supply of medicinal plants in India, NMPB,New Delhi & FRLHT,Bangalore, India, 2008.

Course Material: website links, e-Books and e-journals

1. Planta Medica, Issue 13 · Volume 79 · August 2013. https://www.thieme-connect. Com / products / ejournals
2. https://www.sciencedirect.com/book/9780128008744/evidence-based-validation-of- herbal-medicine.
3. https://www.tandfonline.com/doi/citedby/10.1080/13880200902800196?scroll=top&needAcces

s=true.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	S	S	M	S
CO2	S	S	M	S	S	S	S	M	S	M
CO3	S	S	S	S	S	M	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S

PO – Programme Outcome, CO – Course outcome, S – Strong , M – Medium, L – Low

SECOND YEAR- SEMESTER III

Course	**CORE PAPER -VII**
Title of the Course	**PLANT BIOTECHNOLOGY**
Credits	**4**
Hours/Week	**5**
Course Objectives	1.To Understand the role of plants nuclear, chloroplast and mitochondrial genomes and Equip students withknowledge on molecular markers and marker-aided breeding 2. To Understanding the mechanism of gene transfer in plant and various methods of gene transfer 3.To understand various Components of plant genetic engineering 4. To Expedite the students to understand the techniques involved in plant tissue culture 5. To Enrich the students' knowledge with respect to different applications of transgenic technology
Course Out Comes	1. After studying unit-1, the student will be able to know about genomic organization in plants and about theMarkers 2. After studying unit-2, the student will be able to know methods of gene transfer in plants 3. After studying unit-3, the student will be able to understand the plant 4. genetic engineering aspect 5. After studying unit-4, the student will be able to know plant cell and tissue culture techniques 6.After studying unit-5, the student will be able to understand Applications of plant Biotechnology in variousfields.

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes	No	No
5	Yes	Yes	Yes	No	Yes	Yes

Units	Course Content	Teaching Hours
UNIT I	Genome organization in PlantsNucleus, Chloroplast and Mitochondria, Molecular Marker-aided Breeding: RFLP maps, linkage analysis, RAPD markers, STS, Microsatellites, SCAR (Sequence Characterized Amplified Regions), SSCP (Single Strand Conformational Polymorphism), AFLP, QTL, map based cloning, molecular marker assisted selection.	12 hours
UNIT-II	Methods of gene transfer in plants Structure and function of Ti plasmid of Agrobacterium, Mechanism of T-DNA transfer to plants. Ti plasmid vectors for planttransformation. Transient and stable gene transformation. Physical method of gene transfer, Particle bombardment, electroporation, microinjection, chemical mediated transformation and floral dip method.	12 hours
UNIT – III	Plant Genetic Engineering :Plant vectors: Co-integrate, binary vectors and viral vectors. Designing gene constructs - Promoters and polyA signals, Protein targeting signals, Plant selectable markers, Reporter genes. Positive selection, Selectable marker elimination, Transgene silencing.Transplastomics: Chloroplast transformation: advantages. Strategies for marker free transformation. Analysis of transgenic plants. Genome editing technology in Plant- CRISPR/Cas.	12 hours
UNIT – IV	Plant Cell and Tissue Culture: Tissue culture media (composition and preparation), Callus and suspension culture; Somaclonal variation; Micropropagation; Organogenesis; Somatic embryogenesis. Embryo culture and embryo rescue. Artificial seeds. Protoplast fusion and somatic hybridization; cybrids; anther, pollen and ovary culture for production of haploid plants. Cryopreservation and DNA banking for germplasm conservation.	12 hours
UNIT-V	Application of transgenesis for : crop improvement: Insect resistance, disease resistance, virus	12 hours

	resistance, herbicide resistance, and resistance to biotic & abiotic stress. Transgenesis for male sterility and terminator seed. Transgenesis for quality improvement: Protein, lipids, carbohydrates, vitamins & mineral nutrients. Molecular pharming: Exploitation of Biotechnological techniques for plant therapeutic compounds - production of recombinant proteins in plants. Expression of antibodies in plants for immunotherapy. Expressio of recombinant antibody fragments in plants.	
UNIT-VI	Internal Assessment: Assignments, Seminars and Guest lecturers	5 hours
	Total Lecture hours 65 hours	65 hours

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Text Book(s)

1. Plant Biotechnology: The genetic manipulation of plants. Secon edition. Slater, Scott, and Fowler, 2008, Oxford University Press, UK.
2. Plant cell culture.A practical approach. Second edition. Edited by R.A. Dixon and R.A. Gonzales.1994. Oxford University Press. UK.
3. An Introduction to Plant Tissue Culture, Third Edition, M .K. Razdan, Oxford and IBH Publishing Co., 2003.
4. Introduction to plant biotechnology, Third edition, H S Chawla, 2009. Cassells, A. C and Peter B. Gahan. (2006)Dictionary of Plant Tissue Culture. Food ProductsPress, an Imprint of the Haworth Press, Inc., New York-London-Oxford.
5. Adrian Slater, Nigel Scott and Mark Fowler. (2008). Plant Biotechnology – the Genetic Manipulation of Plants. Second Edition. Oxford University Press. Paul Christou and Harry Klee. (2004).
6. Handbook of Plant Biotechnology, 2nd volume set,Wileypublisher.
7. Bhojwani and Dantu, (2013). Plant Tissue Culture: an Introductory Text, Springer, New Delhi.
8. Bhojwani, S.S and Razdan. M.K. (2009). Plant Tissue Culture-Theory and Practice. ElsevierIndia Pvt. Ltd.

Reference Books:

1. Slater A, NW Scott, MR Fowler. Plant bio technology, Oxford University Press,2003.
2. Hans Walter Heldt. Plant Biotechnology & Molecular Biology, Oxford University Press, 1997.
3. Nigel W. Scott, Mark R. Fowler,Adrian Slater. Plant Biotechnology: The genetic manipulation of plants 2nd Edition 2nd Edition, Oxford University Press,2008.
4. J. Hammond, P. McGarvey,V. Yusibov. Plant Biotechnology: New Products and Applications 1sted. Springer1999.
5. Bob Buchanan,Wilhelm Gruissem, Russell Jones. Biochemistry & Molecular Biology of Plants. I.k. International Pvt. Ltd,2007.
6. Robert J. Henry. Practical Applications of Plant Molecular Biology. Routledge Chapman & Hall,1997.
7. Introduction to Plant Biotechnology by H.S. Chawla, 2002. Oxford and IBH P Publishing Co.Pvt.Ltd. NewDelhi.
8. Plant molecular genetics by Monica. A. Hughes.1999. Pearson Education limited, England.
9. An introduction to genetic engineering in plants, Mantel S.H, Mathews J.A. Mickee R.A.1985. Blackwell Scientific Publishers.London.
10. Scott and Mark R. Fowler, 2003, Oxford University press, UK. 11. Molecular Plant Biology: Apractical approach (Vol. I and II), Edited by Gilmartin and Bowler, 2002, Oxford University press,UK.
11. Gonzales.1994.Oxford University Press. Oxford. 4. Plant Molecular Biology by DonaldGrierson and S.V. Convey.1984. Blackie and Son.
12. Plant cell culture. A practical approach. Second edition. Edited by R.A. Dixon and R.A.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]

1.https://nptel.ac.in/courses/102/103/102103016/
2.https://www.mooc-list.com/tags/biotechnology
3.https://www.coursera.org/courses?query=biotechnology
4.https://www.intechopen.com/books/genetic-transformation
5.https://link.springer.com/book/10.1007% 2F978-3-662-07424-4
6.https://link.springer.com/book/10.1007%2F978-81-322-1026-9
7.https://www.ebook777.com/plant- tissue-c

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	S	S	M	S
CO2	S	S	M	S	S	S	S	M	S	M
CO3	S	S	S	S	S	M	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S		S

PO – Programme Outcome, CO – Course outcome, S – Strong , M – Medium, L – Low

Course	**CORE PAPER -VIII**
Title of the Course	**ANIMAL BIOTECHNOLOGY**
Credits	**4**
Hours/Week	**5**
Course Objectives	1. To provide the basic knowledge on cloning methods, animal tissue culture techniques and applications of genetic engineering to the students. 2. To obtain the knowledge of research related Various laboratory animals 3. To know the advanced methods in animal handling according to CPCSEA guidelines 4. To provide an overview and current developments in different areas of animal Biotechnology and its application. 5.To obtain knowledge on difference between in vivo & in vitro for uses of animal modelling
Course Out Comes	1. After studying unit-1, the student will be able to know about the genetic engineering tools, vectors, methodsof gene cloning. 2.After studying unit-2, the student will be able to know techniques and application of animal in rDNAtechnology 3.After studying unit-3, the student will be able to understand about the animal tissue culture 4.After studying unit-4, the student will be able to know how to conduct research in breeding, physiology, production, yield and management of crops and agricultural plants or trees, shrubs, and nursery stock, theirgrowth in soils, and control of pest 5.After studying unit-5, the student will be able to understand applications of animal biotechnology

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes	No	No
5	Yes	Yes	Yes	No	Yes	Yes

Units	Course Content	Teaching Hours
UNIT I	Introduction to animal tissue culture. Mammalian cell culture, Tissues, Continuous cell lines, Suspension cultures, Cryopreservation and transport of Animal germplasm, (Embryo, Semen and ovum).	12 hours
UNIT-II	Cell cultures media and Growth parameters of animal cell culture, Role of serum and essential supplements to medium and their applications. Cell Synchronization, Cell cloning Methods and Micromanipulation.	12 hours
UNIT – III	Gene transfer in animal cells. Animal Germ cell and development, Valuable genes for Animal biotechnology, Transgenic Animals and Hybridization, and gene knockout, Somatic cell cloning Production of transgenic animals – mice, sheep and fish.	12 hours
UNIT – IV	Testing of drugs, testing the toxicity of environmental pollutants in cell culture, Cytotoxicity, Apoptosis, Tissue, Diagnostic antigens	12 hours
UNIT-V	Potential applications of transgenic animals – Animal models for diseases and disorders. Transgenic poultry, transgenic insects as bioreactor. Commercial scale production of animal cells, applicationof animal cell culture for *in vitro*, cultures technology in production of pharmaceutical proteins, and animal viral vaccines.	12 hours
UNIT-VI	Internal Assessment: Assignments, Seminars and Guest lecturers	5 hours
	Total Lecture hours 65 hours	65 hours

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Text book:

1. Culture of Animal cells, 2006, 3rd Edition, R. Ian Freshney . A John Wiley &Sons, Inc., publications.
2. Animal Cell Culture – Practical Approach, R.W. Masters, Oxford. AnimalCell Culture Techniques. Ed. MartinClynes, Springer.
3. Biotechnology by Kashav. T (Wiley EasternLtd).
4. Animal Cell Biotechnology; Methods and protocols, Nigel Jenkins, HumanaPress.
5. Biotechnology of Animal Tissue. P.R. Yadav & Rajiv Tyagi, 2006. Discovery 54 publishing House. New Delhi.
6. From Genes to Clones Introduction to Gene Technology – Winnacker, E.L.1987., Panima

Educational BookAgency, New Delhi.
7. Gene VII – Benjamin Lewin, 2000. Oxford University Press, UK.
8. Principles of Gene Manipulation and Genomics – Primrose, S.B. and Twyman, R.M. 2006. 7th Edition. BlackwellPublishingCompany.
9. Recombinant DNA Second Edition – James D. Watson, Micheal Gilman, MarkZoller, 2001. W.H. Freeman andCompany, NewYork.
10. Biotechnology, Satyanarayanan .U, (2008), Books and Allied (p)Ltd.

Reference Book:

1. CPCSEA Guidelines for Laboratory Animal Facility, CPCSEA, 2003.
2. Kumar, H.D. Modern Concept of Biotechnology. Vikas Publishing House Pvt. Ltd., 2007
3. Animal Biotechnology: Models in Discovery and Translation, Second Edition (Elsevier)

Course Material:

Website links: https://www.sciencedirect.com/book/9780128117101/animal-biotechnology#book-description,E-Books: https://www.pdfdrive.com/animal-biotechnology-e41305678.html,
E- journals: https://www.tandfonline.com/toc/labt20/current,

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	M	S	M	S	S
CO2	M	S	M	M	M	S	S	S	M	M
CO3	S	M	M	S	S	M	M	S	M	S
CO4	M	S	S	M	M	S	M	M	S	S
CO5	S	M	S	M	S	M	S	M	S	S

PO – Programme Outcome, CO – Course outcome, S – Strong, M – Medium, L – Low

Course	**CORE PAPER -IX**
Title of the Course	**MICROBIAL BIOTECHNOLOGY**
Credits	**4**
Hours/Week	**5**
Course Objectives	1.To understand the scope and importance of bioprocess engineering technology. 2.To well understood the fermentation technology 3.To obtain knowledge about downstream processing 4.To obtain knowledge of immobilization and biotransformation 5.To know the basic Production of Industrially important products
Course Out Comes	1. After studying unit 1 the students will be able to identify the nature of bioprocess engineering technology practicals

	2. After studying unit 2 the students will be able to differentiate the fermentation technology and typthe es of the fermentation process. 3.After studying unit 3 the students will be able to describe the downstream processing in cell disruption, precipitationmethods, etc. 4.After studying unit 4 the students will be able to explain the advantage of industrial application 5.After studying unit 5 the students will be able to analyze and can cross-examine the Production of industrialimportance.

Matching Table (Put Yes / No in the appropriate box):

Units	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	Yes	Yes	No	Yes	No
3	No	Yes	No	Yes	Yes	Yes
4	No	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	No	Yes	Yes	Yes

Units	**Course Contents**	**Teaching Hours**
Unit-I	Scope and importance of bioprocess engineering technology, Development and strain improvement of industrially important microorganisms. Bioreactors: Typical structure of advanced bioreactor and their working mechanism; Design features - Heat transfer and Mass transfer; Specialized bioreactors- design and their functions; Airlift bioreactor, Tubular bioreactors, Membrane bioreactors, Tower bioreactors, Fluidized bed reactor, Packed bed reactors and Photo bioreactors.	12 hours
Unit-II	Fermentation technology: Natural and synthetic media; Strategies for media formulation, sources of carbon, nitrogen, vitamins, and minerals. Role of buffers, precursors, inhibitors, inducers, and antifoam agents. Types of fermentation process-submerged fermentation, the surface solid-state fermentation, batch fermentation, continuous fermentation, the kinetics of fermentation process, bioprocess control, monitoring variables temperature, agitation, pH, and pressure.	12 hours
Unit-III	Downstream processing: cell disruption, precipitation methods, solid-liquid separation, liquid-liquid extraction, filtration, centrifugation, chromatography, drying devices (Lyophilization and spray dry technology), crystallization-biosensors-construction and Applications	12 hours

Unit-IV	Immobilization and Biotransformation: Methods of immobilization - adsorption, crosslinking, ionic bonding, entrapment, encapsulation; Advantages and industrial applications of Immobilization of enzymes and whole cells. Biotransformation of antibiotics, steroids, and their applications.	12 hours
Unit-V	Production of Industrially important products: Alcohol- Ethanol, glycerol, butanol, Acetone; Organic acids- citric, acetic, and gluconic acid; Amino acids- lysine, glutamic acid; Antibiotics- penicillin, streptomycin, tetracycline; Vitamins- riboflavin; Enzymes- amylase, protease; biodegradable plastic- poly hydroxy alkanoates (butyrate, propionate).	12 hours
Unit-VI	Internal Assessment – Seminar, Assignment, Lecture	05 hours
	Total Teaching hours	65

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Textbook:

1. Microbial Biotechnology: Principles And Applications (2nd Edition) by **Yuan Kun Lee**, August 24, 2006.

2. Microbial Biotechnology: Principles And Applications (Third Edition): Principles and Applications (3rdEdition) Paperback – Import, 15 April 2013 by Yuan Kun Lee (Editor)

3. Microbial Biotechnology: Principles And Applications (3rd Edition) 3rd Edition, Kindle Edition by Yuan KunLee (Editor) Format: Kindle Edition World Scientific; 3rd edition (30 January 2013)

4. Microbial biotechnology: principles and applications, Yuan Kun Lee. Edition 3rd ed. Imprint Singapore ;Hackensack, NJ : World Scientific, c2013.

5. Microbial Biotechnology, Principles and Applications, Yuan Kun Lee, Publisher- World Scientific PublishingCompany 2013.

6. Microbial Biotechnology ,Elsa Cooper, Syrawood Publishing House, 2016 M05 24 - 216 pages
7. Microb Biotechnol. 2016 Sep; 9(5): 529. Published online 2016 Aug 11. doi: 10.1111/1751 7915.12403

8. Microbial Biotechnology-2020 Kenneth Timmis, Juan Luis Ramos, Willem de Vos, Siegfried Vlaeminck, AuxiPrieto, Antoine Danchin, Willy Verstraete, and Victor de Lorenzo

9. Microbial Biotechnology: Methods and Applications by Elsa Cooper 06/11/2019 **Publisher:** ML Books International.

10. Microbial Biotechnology Hardcover – 23 March 2006 by A. R. Alagawadi (Editor), P.U. Krishnaraj (Editor), K. S. Jagadeesh (Editor), J.H. Kulkarni (Editor), & 1 More

Reference Book:

1. Basic Biotechnology 2nd Edition by Colin Ratledge (Editor), Bjorn Kristiansen (Editor) Cambridge University Press; 2nd edition (April 30, 2001)

2. Manual of Industrial Microbiology and Biotechnology 3rd Edition by Richard H. Baltz (Editor), Arnold L. Demain (Editor), Julian E. Davies (Editor) ASM Press; 3rd edition (March 25, 2010)

3. Microbial Biotechnology: Fundamentals of Applied Microbiology 2nd Edition by Glazer, Alexander N.; Nikaido, Hiroshi published by Cambridge University Press Hardcover Paperback – January 1, 1994 by aa (Author) Cambridge University Press; 13338th edition (January 1, 1994)

4. New and Future Developments in Microbial Biotechnology and Bioengineering: Trends of Microbial Biotechnology for Sustainable Agriculture and Biomedicine Systems: Perspectives for Human Health 1st Edition, Kindle Edition Elsevier; 1st edition (May 15, 2020)

5. Microbial Biotechnology: Principles And Applications (3rd Edition) 3rd Edition, Kindle Edition by Yuan Kun Lee (Editor) Format: Kindle Edition World Scientific; 3rd edition (January 30, 2013)

6. Microbial Biotechnology: Basic Research and Applications (Environmental and Microbial Biotechnology Book1) 1st ed. 2020 Edition, Kindle Edition Springer; 1st ed. 2020 edition (July 7, 2020)

7. Microbial Biotechnology by Elsa Cooper (Editor) Syrawood Publishing House (June 20, 2019)

8. Microbial Biotechnology Principles and Applications Third Edition https://doi.org/10.1142/8265 | April 2013

9. 2017 Microbial Biotechnology Volume 1. Applications in Agriculture and Environment

10. Microbial Biotechnology, Fundamentals of Applied Microbiology, 2nd Edition TEXTBOOK: AUTHORS:Alexander N. Glazer, University of California, Berkeley Hiroshi Nikaido, University of California, BerkeleyDATE PUBLISHED: October 2007

Course Material:
Website links: https://www.nifa.usda.gov/microbial-biotechnology

Mapping with Program me Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	M	M	M	S	S	S
CO2	M	M	M	S	S	M	S	S	M	M
CO3	S	M	M	S	S	S	S	M	M	M
CO4	S	S	S	M	S	M	S	S	S	S
CO5	M	M	S	S	M	S	M	S	S	S

PO – Programme Outcome, CO – Course outcome, S – Strong, M – Medium, L – Low

Course	**CORE PAPER -X**
Title of the Course	**ENVIRONMENTAL BIOTECHNOLOGY**
Credits	**4**
Hours/Week	**5**
Course Objectives	1. Introduce the student to the different areas in which biotechnology is developed and the environmental applicationmethods. 2. Emphasize the knowledge of the different types of biotechnological processes that exist in the field of environmentalapplications. 3. To make known the wide range of professional activities linked to biotechnological knowledge. 4.Know the possibilities of environmental application presented by the biotechnology of higher organisms. 5.To make known the great biodiversity existing in the microbial world and the biogeochemical cycles that govern theterrestrial ecosphere.
Course Out Comes	1. After studying unit-1, the student will be able to understand and assimilate the specific concepts and terminology ofenvironmental biotechnology. 2. After studying unit-2, the student will be able to describe the properties of microorganisms with potential applicationto environmental biotechnology processes. 3. After studying unit-3, the student will be able to Explain technologies, tools and techniques in the field ofenvironmental biotechnology. 4. After studying unit-4, the student will be able to Know the role of microorganisms as biotechnological agents. 5.After studying unit-5, the student will be able to Study biodegradation for environmental application

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analysing	v. Evaluating	vi. Creating

1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	Yes	Yes	Yes	Yes	Yes
3	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	**Course Contents**	**Teaching hours**
Unit I	Environmental pollution: Basic concepts and global issues-Global warming & Acid rain. Pollution measurements- air and water. Biosensor in environmental monitoring. Bioremediation of environmental pollutants in soil and water- oils, heavy metals and detergents. Biofouling and Biosensors.	12 hours
Unit-II	Waste treatment: Wastewater treatment: Physical, chemical and biological treatment processes. Various industrial effluent treatment methods- Sugar, distillery, dairy, tannery and pharmaceutical industries. Solid wastes: Types andcharacteristics. Solid waste disposal- landfilling incineration. Biogas from solid waste. Composting and vermicomposting. Monitoring parameters for composting.	12 hours
Unit-III	Bioremediation: Introduction of Bioremediation advantages and applications; Types of bioremediations. Microbial remediation of phenolics-sewage nutrients (phosphate and nitrate). Impact of bioremediation in the petroleum industry, paper industry, marine oil pollutants and chemical industry. Phytoremediation advantages and applications (agriculture).	12 hours
Unit-IV	Biocorrosion and microbial mediated recovery: Microbial corrosion, Bioaugmentation, Bio metallurgy- Bioleaching- application, Biotechnology approaches for heavy metal elimination from effluents - Biosorption. Bio-mediated recovery of metals (gold and platinum)- Biomining. Recovery of petroleum-MEOR- Biosurfactant.	12 hours
Unit-V	Biodegradation: Definition, Biodegradation of organic pollutants: Factors affecting biodegradation. Pollution problems and biodegradation of simple aliphatic, aromatic, polycyclic aromatic hydrocarbons, halogenated hydrocarbons, azo dyes, lignin and pesticides. Bioenergy.	12 hours
Unit-VI	Internal Assessments, Seminars, and Guest lecture	05 hours
	Total Teaching hours	65

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Reference & Text Books:

1. Murugesan AG and Rajakumari C. (2005). Environmental Science and Biotechnology: Theory and Techniques.
2. Sharma PD. (1994). Environmental Biology, Rastogi Publications.
3. Eugenia J.Olguin. (2000). Environmental Biotechnology and cleaner Bioprocesses, Tayloir and Francis.
4. Beech IB and Gaylarde CC (1999). Recent advance in the study of biocorrosion- an overview. *Rev Microbial* **30**,177- 190.
5. Booth GH (1971). Microbiological corrosion, M and B monographs CE11, Mills and Boon, London.
6. Agarwall KV. (2005). Environmental Biotechnology, Nidhi Publishers.
7. Jogdand SN.(2008).Environmental Biotechnology, 4th Edt Himalaya Publishing House Pvt. Ltd.
8. Fundamentals of Ecology Eugene P. Odum and Gary W (2007). Barrett. Saunders Publishers.
9. Instant Notes in Ecology Aulay MacKenzie, Andy Ball and Sonia Virdee (2001). Taylor & Francis Publishers.
10. Environmental Biotechnology by Alan Scragg (2005). IInd edition. Pearson Education Limited, Eng.
11. Environmental Biotechnology by S.N.Jogdand. (1995). Ist edt. Himalaya Publishing House. Bombay
12. Wastewater Engineering – Treatment, Disposal and Reuse. Metcalf and Eddy (2017). Tata Mc Graw Hill, NewDelhi.
13. Environmental chemistry by A.K. De (2007). New Age international Publishers.
14. Introduction to Biodeterioration by D. Allsopp and K.J. Seal, (2004). Cambridge University Press.

Course Material:

1. http://www.fao.org/3/t0551e/t0551e05.htm
2. http://www.fao.org/fcit/environment-health/solid-waste/en/

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

PO – Programme Outcome, CO – Course outcome, S – Strong, M – Medium, L – Low

Course	**CORE PRACTICAL-III**
Title of the Course	**LAB IN PLANT BIOTECHNOLOGY AND ANIMAL BIOTECHNOLOGY**

Credits	**2**
Hours/Week	**2**

Units	**Course Contents**	**Teaching hours**
Unit I	**Plant Biotechnology** 1. Introduction to plant tissue culture-induction of callus and suspension cultures. 2. Isolation and purify the protoplasts and check its viability. 3. Induction of somatic embryogenesis and analysis of different stages. 4. Extract the genomic DNA from plants by CTAB 5. Culture and selection of Agrobacterium on Agar medium 6. Agrobacterium mediated gene transformation 7. Gus assay 8. Isolation of Total RNA from leaves 9. Gene gun method of transformation 10. Synthetic seed preparation	15 hours
Unit-II	**Lab in Animal Biotechnology** 1. Development of primary cell lines/maintenance of established cell lines. 2. Cell counting and cell viability. 3. Trypsinization of monolayer and subculturing. 4. Gene transfer by transfection 5. Preparation of metaphase chromosomes from cultured cells. 6. Isolation of DNA and demonstration of apoptosis of DNA laddering 7. MTT assay for cell viability and growth	15 hours
		30 Hours

Method of Evaluation: (50 Internal marks + 50 External Marks=100)

Distribution for internals Test (CIA I + CIAII)	End Semester Examination	Total marks
50	50	100

References

1. Practical Applications of Plant Molecular Biology. Robert J. Henry .Routledge Chapman & Hall,2008.
2. Molecular Plant Biology: A practical approach (Vol. I and II). Gilmartin andBowler. Oxford Universitypress, UK,2002.

3. Plant Cell Culture: Essential Methods. Michael R. Davey, Paul Anthony.Wiley, 2010.
4. Plant Tissue Culture, Third Edition:Techniques and Experiments . Roberta H. Smith. AcademicPress,2012.
5. Plant cell culture Protocols (Methods in Molecular Biology, 3rd Ed). Victor M. Loyola-Vargas, NeftaliOchoa-Alejo. Humana Press,2012.
6. Plant Cell, Tissue and Organ Culture: Fudamental Methods (Springer Lab Manuals). Oluf L. Gamborg(Editor), Gregory Phillips (Editor), Springer,2013.
7. Immunology and Animal Biotechnology – A laboratory Manual by Dr. Amit Gupta (2019) Lambert Academic Publishing.
8. Lab in Industrial, plant and animal Biotechnology – A Student's Manual by Prakash Balu.
9. Laboratory Manual – Animal Biotechnology by Dr. Asita Elengoe, Lincoln University Pub.

Course	**CORE PRACTICAL-IV**
Title of the Course	**LAB IN MICROBIAL BIOTECHNOLOGY & ENVIRONMENTALBIOTECHNOLOGY**
Credits	**2**
Hours/Week	**3**

Units	**Course Contents**	**Teaching hours**
Unit I	**Microbial Technology** 1. Study of fermentor-Demonstration. 2. Production and isolation of antibiotics (Penicillin and Streptomycin) 3. Production and analysis of Single cell protein (Spirullina and yeast) 4. Production of yoghurt and estimation of lactic acid. 5. Estimation of percentage of alcohol of given sample 6. Production and assay of α-amylase from Aspergillus niger by solid substrate fermentation. 7. Immobilization of given enzyme/whole cell 8. Estimation of amount of citric acid in the given sample.	20 hours
Unit-II	**Environmental Biotechnology** 1. Water Analysis: Measurement of Total Solids, Total dissolved solids, Total suspended solids,dissolved oxygen, total hardness, chloride, turbidity, nitrite, nitrate, fluoride and total nitrogen. 2. Estimation of COD, BOD of industrial effluents. 3. Potability test of water (MPN technique). 4. Screening of Biosurfactant activity-Oil Displacement test-Drop collapse test 5. Culture of Sewage water for the determination of microbial occurrence.	20 hours

		40 Hours

Method of Evaluation: (50 Internal marks + 50 External Marks=100)

Distribution for internals Test (CIA I + CIAII)	End Semester Examination	Total marks
50	50	100

References:

1. A Practical Guide to Environmental Biotechnology by H. Thatoi et al., 2020, Springer.
2. Environmental Microbiology A laboratory Manual by Ian Pepper et al., 2004, Academic Press.
3. Environmental Biotechnology Theory and Lab Practices by Debajit Borah, 2013, Global Vision Publishing House.

Course	**ELCTIVE-V**
Title of the Course	**NANO BIOTECHNOLOGY**
Credits	**2**
Hours/Week	**3**
Course Objectives	1. To create Knowledge on Nano particle synthesis, characterization. 2. To know the Nano particles importance in drug delivery 3.To compare the analytical methods knowledge in nano particle characterization like (SEM & TEM) 4. To apply the nano particles on various in vivo & in vitro for its applications 5.To compare various nano particles on biomedical & environmental applications
Course Out Comes	1. After studying unit-1, the student will be able to understand Nano technology on Cancer treatment 2. After studying unit-2, the student will be able to know Nano Technology application in Diabetes 3. After studying unit-3, the student will be able to develop an understanding Nano technology effecton target drug delivery 4. After studying unit-4, the student will be able to detailed know the Nano technology uses in environmental remediation and recycling process 5. After studying unit-5, the student will understanding the Nano technology uses in variousbiomedical & agriculture applications

Matching Table (Put Yes / No in the appropriate box)

Unit/ level(K)	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	No	No	Yes	Yes
2	Yes	No	Yes	No	Yes	Yes
3	Yes	Yes	No	Yes	No	No
4	Yes	No	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	**Course Contents**	**Teaching hours**
Unit I	Introduction to nanotechnology: characteristic scale for quantum phenomena, nano particles, nano-clusters, nano composite, nano tubes, nano wires emergence of bio nanotechnology. Characterization of nano particles- UV-Vis spectroscopy, electron Microscopy- HRTEM,SEM, AFM, EDS, XRD.	10 hours
Unit-II	Microbial nanotechnology –Microbial synthesis of nano drugs-metal nano particles and drug delivery vehicles- Nanoshels – Tectodentrimers Nano particle drug systems– diagnostic applications of nanotechnology.	08 hours
Unit-III	Preparation of nano materials by physical, chemical and Green methods: Polymeric scaffolds collagen, elastin's: Muco polysaccharides, Proteoglycans ,cellulose and derivate; dextran's ; alginates; Pectin's; Chitin. Nanoparticles – types, functions-Silver, Gold and Titanium. Physical and chemical properties of nanoparticles.	13 hours
Unit-IV	Nanoscale applications in biology and medicine: nanotechnology for biology and medicine – micro and nano-fluides- scanning probe microscopy in biology and medicine- self –assembly of biological molecules .drug delivery – protein mediated and nanoparticle mediated. Hybrid conjugates of gold nano particles – DNA oligomers - use of DNA molecules in nanomechanics and computing	08 hours
Unit-V	Implications of nanotechnology : health and safety implications from nano particles: health issues- environmental issues- need for regulation – societal implications : possible military applications–potential benefits and risk for developing countries – intellectual property issues – criticism of Nanotechnology – studies on the implications of Nanotechnology.	08 hours
Unit-VI	Internal Assessments, Seminars, and Guest lecture	5 hours
	Total Teaching hours	**50 hours**

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Text book:

1. Parthasarathy, B.K (2007). Introduction to Nano technology, Isha publication.
2. Elisabeth Papazoglou and Aravind Parthasarathy (2007).Bio nanotechnology. Morgan & Claypoolpublishers.
3. Bernd Rehm (2006). Microbial bio nanotechnology: biological self-assembly78 systems and biopolymer – based nanostructures. Horizon scientificpress.
4. David E. Reisner ,Joseph D. Bronzino (2008). Bio nanotechnology: global prospects.CRC Press.
5. Ehud Gazit(2006).Plenty of room for biology at the bottom: An introduction to bio nanotechnology. Imperial college press.
6. Hari Singh Nalwles , " Nano structured materials and nanotechnology ",2002academic press
7. M.H.Fulekar, 2010" Nanotechnology importance and applications."I.K. International publishinghousePvt.
8. Nanotechnology: Global strategies, Industry Trends and applications 2005John Wiley & sonsLtd.

Reference Book:

1. CPCSEA Guidelines for Laboratory Animal Facility, CPCSEA, 2003.
2. Kumar, H.D. Modern Concept of Biotechnology. Vikas Publishing House Pvt. Ltd., 2007
3. Animal Biotechnology: Models in Discovery and Translation, Second Edition (Elsevier)
4. Arun Bahl, B.S. Bahl and G.D. Tuli. Essentials of Physical Chemistry. Sultan Chand & Sons,2014.
5. P.L. Soni. Textbook of Inorganic Chemistry. Sultan Chand & Sons, 2013.
6. P.L. Soni and H.M. Chawla. Textbook of Organic Chemistry, Sultan Chand & Sons, 29th RevisedEdition, 2014
7. Subbiah Balaji. Nanobiotechnology, MJP Publishers, 2010.
8. W.J. Moore. Physical Chemistry, Longman, 5th Edition. 1972.
9. Robert R Crichton. Biological inorganic chemistry: a new introduction to molecular structure andfunction. Amsterdam: Academic Press, 3rd edition, 2018.

Course Material:

Website links: https://jnanobiotechnology.biomedcentral.com/,
E-Books: http://www.a-zshiksha.com/forum/viewtopic.php?f=148&t=61561**E- journals:** https://digital-library.theiet.org/content/journals/iet-nbt Mapping with Programme Outcomes

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	M	S	M	S	S

CO2	M	S	M	M	M	S	S	S	M	M
CO3	S	M	M	S	S	M	M	S	M	S
CO4	M	S	S	M	M	S	M	M	S	S
CO5	S	M	S	M	S	M	S	M	S	S

PO – Programme Outcome, CO – Course outcome, S – Strong, M – Medium, L – Low

Course	**ELECTIVE-V**
Title of the Course	**SYSTEMS BIOLOGY**
Credits	**2**
Hours/Week	**3**
Course Objectives	1. To provide basic knowledge on databases that are related with systems biology 2. To teach microarray tools to become familiar with system biology 3. To learn KEGG and biochemical neural networks to find protein and carbohydratemechanism related to systems biology 4. To teach Integration of networks, data integration, modeling for metabolomics. 5. To learn the AI technology of systems biology
Course Out Comes	1. After studying unit-1, the student will be able to understand the basic knowledge on databasesthat are related with systems biology 2. After studying unit-2, the student will be able to Understand microarray tools to becomefamiliar with system biology 3. After studying unit-3, the student will be able to Understand KEGG and biochemical neuralnetworks to find protein and carbohydrate mechanism related to systems biology 4. After studying unit-4, the student will be able to Gain knowledge of Integration of networks,data integration, modeling for metabolomics 5. After studying unit-5, the student will be able to Understand AI technology of systems biology

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes	No	No

5	Yes	Yes	Yes	No	Yes	Yes

Unit	Course Contents	Teaching Hours
UNIT I	Molecular databases: accessibility, compatibility, comprehensive database, portability, quality, and navigability. Systems Biology: Definition, Hypothesis-driven research in systems biology, Wet experiments-Dry experiments: predictions and simulations. Reductionist and Integrative approach.	10 hours
UNIT-II	Interpreting expression data using Gene Ontology; Evolution of modularity and transcriptional networks, Riboswitches, metabolite sensing, and translational control; Microarrays-types and applications, Importance of non-coding sequence.	08 hours
UNIT – III	Protein-carbohydrate metabolism; Biochemical cycles; Interconnection of pathways- metabolic regulation; Translating biochemical networks into linear algebra; KEGG: theory and practice	13 hours
UNIT – IV	Genomics, Proteomics, Metabolomics, Transcriptomics, Interactomics, Phenomics, Localizomics; Gene networks - Integration of Networks. Combination of omics approaches: data integration, modeling;	08 hours
UNIT-V	Synthetic biology, Artificial Intelligence (AI): Methodology, tools, and its application in agriculture, drug discovery, and biomedicine.	08 hours
UNIT-VI	Internal Assessment: Assignments, Seminars and Guest Lecturers	5 hours
Total Lecture hours 65 hours		50 hours

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Text Books & References

1. Kitano, Systems Biology: A Brief Overview. Science, 2002, 295: 1662-1664.

2. Ideker et al. A new approach to decoding life: Systems Biology. Annual Review onGenomics and Human Genetics 2001, 2: 343-372.

3. Ideker et al. Integrated Genomic and Proteomic Analyses of a Systematically Perturbed

Metabolic Network. Science, 2001, 292: 929-934.
4. Ge et al. Integrating „omic" information: a bridge between genomics and systemsbiology. Trends in Genetics, 2003, 19, 10: 551-560.
5. Chong et al. Wholistic Biology, Science, 200820, 295:1661.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://swayam.gov.in/nd1_noc20_hs18/preview
2. https://www.tandfonline.com/toc/iaan20/current,
3. https://www.tandfonline.com/toc/iaan19/32/3,
4. **https://chico-primo.hosted.exlibrisgroup.com**

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	S	S	M	S
CO2	S	S	M	S	S	S	S	M	S	M
CO3	S	S	S	S	S	M	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S

PO – Programme Outcome, CO – Course outcome, S – Strong , M – Medium, L – Low

Course	**SKILL ENHANCEMENT COURSE- II**
Title of the Course	**AGRICULTURAL BIOTECHNOLOGY**
Credits	**2**
Hours/Week	**2**
Course Objectives	1. To provide the students the knowledge in biotechnological innovations pertaining to issuesin agriculture 2. To enable the students learn basics of genetics in the plant evolution. 3. To enable the students to understand the concepts of molecular biology. 4. To make the students aware of advanced molecular techniques in plant biotechnology. 5. To make the students understand the different ways of gene transfer methods andIdentification of transgenic genes.
Course Out Comes	1. The student will be able to appreciate the importance of agriculture and need forBiotechnology in agriculture. 2. The student will be able to learn the basics concepts of plant system and their genetics.

	3. The student will be able to differentiate the genome, plasmids and vectors and theirtranslation. 4. The student will be able to select the different ways of gene transfer methods forPlant transgenesis, various developments and their applications. 5. The students will be able to apply suitable methods of biotechnology in agriculture andidentification of plant hybridization.

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	No	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	No	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Unit	Course Contents	Hours/Week
UNIT I	History, scope and importance of biotechnology in Agriculture – Application of biotechnology in Agriculture	5 hours
UNIT-II	Mendelian genetics, allosomes, linkage and extra chromosomal inheritance-Introduction to genetics -Earlier concepts of inheritance – cell and cell organelles- Cell division, Mendel‟s laws	5 hours
UNIT – III	Nucleic acid structure and its function-Modes of DNA replication-Genetic code - Central dogma of life – Transcription – Translation-Recombinant DNA technology - DNA modifying enzymes – Cloning Vectors –Plasmids-cosmids-phagemids-Shuttlevectors- BAC-YAC-HAC-applications.	5 hours
UNIT – IV	Gene transfer methods – *Agrobacterium* - mediated gene transfer, direct gene transfer, gene silencing – Principles of QTL and Marker Assisted Selection (MAS) –Achievements - Transgenic plants – Achievements – Current trends.	5 hours
UNIT-V	Gene isolation, synthesis and cloning, genomic and cDNA libraries, PCR based cloning, positional cloning- Nucleic acid hybridization and immunochemical detection- DNA sequencing.	5 hours
UNIT-VI	Internal Assessment: Assignments, Seminars and Guest lecturers	5 hours
	Total Lecture hours	30 hours

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Text book:

1. Benjamin Lewin, Gene IX, 9thEdition, Jones and Barlett Publishers, 2007.
2. J.D. Watson, N.H. Hopkins, J.W Roberts, J. A. Seitz & A.M. Weiner; Molecular Biology of the Gene, 6thEdition,Benjamin Cummings Publishing Company Inc, 2007.
3. Alberts et al; Molecular Biology of the Cell, 4th edition, Garland, 2002.
4. Esau's Plant Anatomy; Meristems, Cells, and Tissues of the Plant Body: TheirStructure, Function, and Development, 3rdEdition, John Wiley & Sons, 2006.
5. Martin J Ingrouille and William Eddie, Plants: Diversity and Evolution
6. Bingru Huang, Plant-Environment Interactions, 3rdEdition, CRC Press, 2006.
7. R.H.Smith, Plant Tissue Culture: Techniques and Experiments, Academic Press, SanDiego. 1992.
8. S S Bhojwani and M K Razdan, Plant Tissue Culture, Elsevier Publ.
9. S.B. Primrose, R.M. Twyman and R.W.Old; Principles of Gene Manipulation. 6th Edition, S.B.University Press, 2001.
10. J. Sambrook and D.W. Russel; Molecular Cloning: A Laboratory Manual, Vols 1-3, CSHL, 2001.

Reference Book:

1. Brown CM, Campbell I and Priest FG. 2005. Introduction to Biotechnology. Panima Publications.
2. Bhojwani and Dantu, 2013. Plant tissue culture: An introductory text, Springer,New Delhi.
3. Singh, B.D., Fundamentals of genetics 2014, Kalyani Publishers, New Delhi.
4. Gardner, E.J. & Snustad, D.P. 1991. Principles of Genetics. John Wiley & Sons, USA.
5. Chawla, H.S. 2008. Introduction to Plant Biotechnology, 3rd Ed. Oxford IBH, India.69.
6. Dale, J.W. and Von Schantz, M. 2002. From Genes to Genomes: Concepts andApplications of DNA Technology. John Wiley & Sons, New york, USA.
7. Snustad, D.P. & Simmons, M.J. 2006. Genetics. 4th Ed. John Wiley & Sons, USA.
8. Strickberger, M.W. 2005. Genetics (III Ed). Prentice Hall, New Delhi, India

Course Material: website links, e-Books and e-journals

2. https://www.isaaa.org/resources/publications/agricultural_biotechnology/download/Agricultural_Biotechnology.pdf.

3. https://www.researchgate.net/publication/267338355_Book_Review_Agriculture_Biotechnology_and_Develop me

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10

CO1	S	S	S	M	S	S	S	S	M	S
CO2	S	S	M	S	S	S	S	M	S	M
CO3	S	S	S	S	S	M	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S

PO – Programme Outcome, CO – Course outcome, S – Strong , M – Medium, L – Low

SEMESTER IV

Course	**CORE –XI**
Title of the Course	**BIOINFORMATICS**
Credits	**4**
Hours/Week	**5**
Course Objectives	1. To provide information an understanding of the major computational problems in the field of molecular biology and to gain knowledge on molecular databases. 2. To enable to learn alignment of sequence, rapid similarity searching, phylogenies. 3. Comparative genomics, pattern search, classification of sequence and structure, 4. Automated pattern learning, representing and searching protein structure, gene expression profiling, clustering expressed genes, discovering transcription factor bindings sites, discovering common functions of co- expressed genes, 5. To make them translate metabolic pathways, signal transduction pathways and management.
Course Out Comes	After successful completion of this course, students will be able to: 1. The student will be able to use various biological databases. 2. The student will be able do alignment and compare the differences of local and global using BLAST and advanced alignment tools. 3. The student will be to understand the techniques used in genomics and proteomics and their applications 4. The student will be able to comprehend basis of protein structure determination, identify domains and motifs in protein, usage of tools to predict the sites in protein, and learn the computational methods and application of bioinformatics techniques 5. The student will be able to interpret the biological metabolic pathways,

Matching Table (Put Yes / No in the appropriate box)

U Nit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	No	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	No	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	**Course Contents**	**Teaching Hours**
UNIT I	Biological data bases: gen bank: sequence data/ types ; - protein data bases – ESTs STSs – GSSs – HTGS; NCBI- PubMed- Entrez –BLAST – OMIM; Types Of Accession Numbers- Locus Link, Unigene, Entrez, EBI, and Expasy, Nucleic Acid Data Bank (NDB)	12 hours
UNIT-II	Sequence alignment: alignment algorithms – global and local – significance ; BLAST search steps –BLAST algorithm –BLAST search strategies ; advanced BLAST-alignment tools.	12 hours
UNIT – III	Gene expression analysis tools: the mRNA-c DNA-libraries; microarrays: experimental design – probe – hybridization – DNA fragment counting assembly and restriction enzyme mapping. image analysis – data analysis- biological confirmation – microarray database.	12 hours
UNIT – IV	Proteomic analysis tools: protein domains and motifs – bio informatic tools for high throughput protein analysis – protein structure – Sequence Similarty Basics: Similarty, Identity, Homology, Homology Modelling and visulaization	12 hours
UNIT-V	Pathway bioinformatics : protein – carbohydrate metabolism – biochemical cycles – interconnection of pathways – metabolic regulation —KEGG: theory and practice.	12 hours
UNIT-VI	Internal Assessment: Assignments, Seminars and Guest lecturers	5 hours
	Total Lecture hours 65 hours	65 hours

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Text book:

1. Bioinformatics: Sequence and genome analysis by David, W Mount, Cold Spring HarburPress.

2. Bioinformatics Computing By Bryan Bergeron, Publisher: Prentice Hall PTR.
3. Bioinformatics a practical guide to analysis of genes and protein, Eds A D Baxevanis and B.F.Francis Ouellette, Wiley Interscience.
4. Discovering Genomics, Proteomics, and Bioinformatics, 2 nd Edition, Campbell AM & Heyer LJ, Pearson, 2007.
5. Bioinformatics: Sequence and Genome Analysis, 2 nd Edition, Mount D, CSHL Press, 2004.
6. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd Edition, Baxevanis AD & FrancisBF, Wiley, 2004.
7. School of Biotechnology SYLLABUS of M. Sc. (Biotechnology) ODD SEMESTERS (2017 & 2018 Batches)Page 11 of 25 4. A Bioinformatics Guide for Molecular Biologists,
8. Aerni S & Sirota M, CSHL Press, 2014. 5. Genomes, 2nd Edition, Brown TA, Oxford, Wiley, 2002.

Reference Book:

1. Botkin, Daniel B. (2011). Environmental Science: Earth as a living Planet, John Wiley andSons, New Delhi.
2. Chapman. J. L. and Reiss, M.J. (2005). Ecology, Principles ad Applictions, CambridgeUniversity Press, London.
3. Dash, M.C. (1994).Fundamentals of Ecology, Tata Mc Graw Hill, New Delhi.
4. Gunther, O. (1998) Environmental Information Systems. Berlin, New York, Springer.
5. Miller G. Taylor and Scot Spoolman. (2011). Essentials of Ecology, Books/ Cole Learning, sU.S.A.
6. Odum, E.P. (1971). Fundamentals of Ecology, W.B. Saunder Company, Philadelphia
7. Sharma P. D. (1996). Environmental Biology, Rastogi Publications, Meerut.
8. Verma P.S. and V.K. Agarwal. (1985). Principles of Ecology. S. Chand and Company(Pub.), New Delhi.
9. Strahler, A. V. and Strahler, A.A (1973). Environmental Geoscience, Wiley International.
10. PrimackR.B. 2014. Essentials of Conservation Biology, Oxford University Press, USA.

Course Material: website links, e-Books and e-journals

. https://www.pdfdrive.com/basics-of-bioinformatics-lecture-notes-
https://www.elsevier.com/books/bioinformatics/singh/978-0-323-89775-4.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	S	S	M	S
CO2	S	S	M	S	S	S	S	M	S	M
CO3	S	S	S	S	S	M	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S

PO – Programme Outcome, CO – Course outcome, S – Strong , M – Medium, L – Low

Course	**CORE PAPER –XII**
Title of the Course	**RESEARCH METHODOLOGY**
Credits	**4**
Hours/Week	**5**
Course Objectives	1. Understand some basic concepts of research and its methodologies 2. Identify appropriate research topics 3. Select and define the appropriate research problem and parameters 4. Prepare a project proposal (to undertake a project) 5. Organize and conduct research (advanced project) in a more appropriate manner
Course Out Comes	1. After studying unit-1, the student will be able to understand research concepts, issues and types andbasic knowledge of qualitative research 2. After studying unit-2, the student will be able to know read, comprehend, and explain researcharticles in their academic discipline. 3. After studying unit-3, the student will be able to develop an understanding of various kinds of research, objectives of doing research, research process, research designs, sampling, principles and research techniques. 4. After studying unit-4, the student will be able to detailed know the Observation and Collection ofdata and Generalization and Interpretation 5. After studying unit-5, the student will be able to Have adequate knowledge of ethics, plagiarism,citation and acknowledgment

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	Yes	Yes	Yes	Yes	Yes
3	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	**Course Contents**	**Teaching hours**

Unit I	Objectives and types of research: Motivation and objectives – Research methods *vs* Methodology. Types of research – Descriptive *vs*. Analytical, Applied *vs*. Fundamental, Quantitative *vs*. Qualitative, Conceptual *vs*. Empirical.	12 hours
Unit-II	Research Formulation – Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem – Literature review – Primary and secondary sources – reviews, treatise, monographs- patents – web as a source – searching the web - Critical literature review – Identifying gap areas from literature review - Development of working hypothesis.	12 hours
Unit-III	Research design and methods – Research design – Basic Principles- Need of research design — Features of good design – Important concepts relating to research design – Observation and Facts, Laws and Theories, Prediction and explanation, Induction, Deduction, Development of Models. Developing a research plan - Exploration, Description, Diagnosis, experimentation. Determining experimental and sample designs. Research techniques- microscopy, HPLC, HPTLC, GC-MS, FTIR, SEM/TEM, NMR and AAS.	12 hours
Unit-IV	Data Collection and analysis: Execution of the research - Observation and Collection of data - Methods of data collection – Sampling Methods- Data Processing and Analysis strategies - Data Analysis with Statistical Packages -Hypothesis-testing - Generalization and Interpretation.	12 hours
Unit-V	Reporting and ethics – Structure and components of scientific reports - Types ofreport – Technical reports and thesis – Significance – Different steps in the preparation – Layout, structure and Language of typical reports. Environmental impacts - Ethical issues - ethical committees - Commercialization – Copy right- royalty - Intellectual property rights and patent law – Trade Related aspects of Intellectual Property Rights – Reproduction of published material- Plagiarism - Citation and acknowledgement - Reproducibility andaccountability.	12 hours
Unit-VI	Internal Assessments, Seminars, and Guest lecture	05 hours
	Total Teaching hours	65

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Reference & Text Books:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. *An introduction to*

ResearchMethodology, RBSA Publishers.
2. Kothari, C.R., 1990. *Research Methodology: Methods and Techniques*. New Age International.418p.
3. Sinha, S.C. and Dhiman, A.K., 2002. *Research Methodology*, EssEss Publications. 2 volumes.
4. Trochim, W.M.K., 2005. *Research Methods: the concise knowledge base*, Atomic Dog Publishing.270p.
5. Wadehra, B.L. 2000. *Law relating to patents, trademarks, copyright designs and geographicalindications*. Universal LawPublishing.
6. Satarkar, S.V., 2000. *Intellectual property rights and Copy right*. EssEssPublication
7. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS
8. Kothari, C.R.,1985, Research Methodology- Methods and Techniques, New Delhi
9. MS office, Sexena, S. 2001.Vikas Publishing House Pvt. Ltd., New Delhi M
10. Kothari, C.R.,1985, Research Methodology- Methods and Techniques, New Delhi
11. Authoring a PhD, thesis: how to plan, draft, write and finish a doctoral dissertation, Duncary, P.2003. Macmillan, pp 256.
12. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS

Course Material:

1. https://bbamantra.com/research-methodology/

2.https://www.researchgate.net/publication/329736173_Research_Methodology_Msc_notes_of_Dr_J udu_illavarasusvyasa_univ

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

PO – Programme Outcome, CO – Course outcome, S – Strong, M – Medium, L – Low

Course	**CORE PRACTICAL-V**
Title of the Course	**LAB IN BIOINFORMATICS AND RESEARCH METHODOLOGY**
Credits	**2**
Hours/Week	**3**

Units	Course Contents	Teaching hours
Unit I	**Bioinformatics** 1. Pairwise alignment – global alignment of DNA and protein using Needleman – Wunch algorithm 2. Perform local alignment of DNA and protein using Smith-Watermann algorithm 3. Multiple alignment of nucleotide 4. Multiple alignment of protein 5. BLAST 6. FASTA 7. CLUSTAL Omega 8. Protein structure viewing – RASMOL, SWISS PDB VIEWER 9. PCR primer designing 10. NGS data analysis	15 hours
Unit-II	**Research Methodology** 1. Defining project 2. Choosing research methods 3. Conducting background research 4. Choosing your participants 5. Preparing a research proposal 6. Preparing a manuscript for publication in journal 7. Analysing the data 8. Reporting the findings	15 hours
		30 Hours

Method of Evaluation: (50 Internal marks + 50 External Marks=100)

Distribution for internals Test (CIA I + CIAII)	End Semester Examination	Total marks
50	50	100

References:

1. Bioinformatics: A Practical Manual by K Kasthuri and K Sri Lakshmi (2018), Pharmamed Press.
2. Bioinformatics Practical Manual: An easy guide to in silico analysis by Jaspreet Kaur and Jasvinder Kauer, New Delhi Publishers.
3. A Practical guide for Basic Bioinformatics and Biostatistics by Pooja Tiwari and Pallavi Pandey, (2017), Ist edition, Notion Press.

Course	**ELECTIVE –VI**
Title of the Course	**MEDICAL MICROBIOLOGY**
Credits	**3**
Hours/Week	**4**
Course Objectives	1. To introduce students to the basics of collection and transport of microbial source 2. To teach students about host parasite relationship. 3. To make students understand that bacterial pathogens and its related diseases of phase I. 4. To make students understand that bacterial pathogens and its related diseases of phase II. 5. To make the students understand that Nosocomial and Zoonotic diseases
Course Out Comes	1. After studying unit-1, the student will be able to – know the basics of collection and transport of microbial source 2. After studying unit-2, the student will be able to – understand the host parasite relationship 3. After studying unit-3, the student will be able to –learn bacterial pathogens and its related diseases of phase I 4. After studying unit-4, the student will be able to bacterial pathogens and its related diseases of phase II 5. After studying unit-5, the student will be able to –know about Nosocomial and Zoonotic diseases

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	No	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	No	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	**Course Contents**	**Teaching Hours**
UNIT I	Collections and transport of specimens: Collections and transport of specimens. Primary Media for isolation and their quality control. Antibiotic sensitivity testing procedure.	5 hours
UNIT-II	Host Parasite Relationship: Normal microbial flora of human body, Virulence factors of bacteria causing infection, Microbial Infections, Host Parasite Relationships.	5 hours

UNIT – III	Bacterial pathogens and associated diseases part I, Classification, Morphology, cultural &Biochemical characteristics, pathogenicity, Lab diagnosis &Prophylaxis and treatment of disease caused by Staphylococci, Streptococcai, Neisseriae, Mycobacteria, Corynebacteria, Bacillus, Clostridium.	5 hours
UNIT – IV	Bacterial pathogens and associated diseases part II E,coli, Samonella, Shigella, Vibrio, pseudomonas, Spirochaetes, Rickettisiae. Gram Negative anaerobes.	5hours
UNIT-V	Nosocomial and Zoonotic diseases, Hospital acquired infection – infection control committee, Zoonotic diseases- Anthrax, Plague.	5hours
UNIT-VI	Internal Assessment: Assignments, Seminars and Guest lectures	5 hours
	Total Lecture hours	30 hours

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

TextBooks &References

1.David Greenwood, Richard C.B, Slack, John Forest peuthere "Medical Microbiology" 14 thEdn. ELBS withChurchill Livingstone.
2. Ananthanarayanan R and JayaramPanicker, C.K. Textbook of microbiology-Orient Longman
2.Colle JC, Duguid JP, Fraser AC, Marimon (Bp) 1996. Mackie and McCartney Practical Medical Microbiology14thEdn. Churchill Livingstone.
3.Baron L.J, Peterson L.R and Finegod S.M (1994) Bailey and Scott Diagnostic Microbiology, 9thEdn. MosbyPublications.
4.Cowan and Steel (1995) Manual for identificatioin of Medical Bacteria. 4th EDN, Cambridge University PressLondon.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	S	S	M	S
CO2	S	S	M	S	S	S	S	M	S	M
CO3	S	S	S	S	S	M	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S

PO – Programme Outcome, CO – Course outcome S – Strong, M – Medium, L – Low

Course	**ELECTIVE- VI**
Title of the Course	**BIOETHICS, BIOSAFETY AND IPR**
Credits	**3**
Hours/Week	**4**
Course Objectives	1. To provide basic knowledge on intellectual property rights and their implications inbiological research and product development 2. To become familiar with India's IPR Policy 3. To learn biosafety and risk assessment of products derived from biotechnology andregulation of such products 4. To become familiar with ethical issues in biological research. 5. This course will focus on consequences of biomedical research technologies such as cloningof whole organisms, genetic modifications, DNA testing
Course Out Comes	6. After studying unit-1, the student will be able to Understand the rationale for and againstIPR and especially patents. 7. After studying unit-2, the student will be able to Understand why India has adopted anIPR Policy and be familiar with broad outline of patent regulations. 8. After studying unit-3, the student will be able to Understand different types of intellectual property rights in general and protection of products derived frombiotechnology research and issues related to application and obtaining patents 9. After studying unit-4, the student will be able to Gain knowledge of biosafety and riskassessment of products derived from recombinant DNA research and environmentalrelease of genetically modified organisms, national and international regulations 10. After studying unit-5, the student will be able to Understand ethical aspects related tobiological, biomedical, health care and biotechnology research

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes	No	No
5	Yes	Yes	Yes	No	Yes	Yes

Units	Course Contents	Teaching Hours
UNIT I	Introduction To Biodiversity Levels of biodiversity –values of biodiversity – loss of biodiversity – Species concept – Classification and systematics: biological nomenclature – biological classification; Biodiversity conservation: in situ and ex situ - Magnitude and distribution of biodiversity -wild life biology – conservation strategies – measures of biodiversity – biodiversity in India and global level – biodiversity hot spots. National Biodiversity Authority.(NBA)	12 hours
UNIT-II	Introduction To Ethics/Bioethics: Framework for ethical decision making; biotechnology and ethics – biotechnology in agriculture and environment: benefits and risks – benefits and risks of genetic engineering – ethical aspects of genetic testing – ethical aspects relating to use of genetic information – genetic engineering and bio warfare	8 hours
UNIT – III	Ethical Implications Ethical implications of cloning: Reproductive cloning, therapeutic cloning ; Ethical, legal and socio- economic aspects of gene therapy, germ line, somatic, embryonic and adult stem cell research- GMcrops– biotechnology and biopiracy – ELSI of human genome project.	8 hours
UNIT – IV	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 containments - definition of GMOs & LMOs; principlesof safety assessment of transgenic plants.	9 hours
UNIT-V	Introduction To Intellectual Property And Intellectual Property Rights Types: patents, copyrights, trade-marks, design rights, geographical indications – importance of IPR – patentable and non-patentable – patenting life – legal protection of biotechnological inventions – patent databases - country-wise patent searches (USPTO, EPO, India) – History of world intellectual property rights organization (WIPO), GATT, WTO and TRIPS.	8 hours
UNIT-VI	Internal Assessment: Assignments, Seminars and Guest lecturers	5 hours
	Total Lecture hours 65 hours	50 hours

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Text Book

1. IPR, Biosafety and Bioethics (2013), by DeepaGoel, ShominiParashar
2. Biodiversity and Biomedicine: Our Future (2020), 1st edition by MunirOzturk, DilfuzaEgamberdieva, MilicaPešić.
3. The basics of bioethics (2019), 4th edition by Guidry-Grimes, Laura; Veatch, Robert.

Reference book

1. Introduction to bioethics (2018), 2nd edition by J.A. Bryan

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://swayam.gov.in/nd1_noc20_hs18/preview2.
https://nptel.ac.in/courses/109/106/109106092/
3. https://onlinecourses.nptel.ac.in/noc20_hs18/preview4.
https://nptel.ac.in/courses/102/104/102104068/
5. https://www.futurelearn.com/courses/biosecurity

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	S	S	M	S
CO2	S	S	M	S	S	S	S	M	S	M
CO3	S	S	S	S	S	M	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S

PO – Programme Outcome, CO – Course outcome S – Strong, M – Medium, L – Low

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Course	**SKILL ENHANCEMENT COURSE- III**
Title of the Course	**VALUE ADDED PRODUCTS FROM MARINE RESOURCES**
Credits	**2**
Hours/Week	**3**

Course Out Comes	After completion of the course, the students will be able to 1. To know about the production of value added fish products 2. To understand the preparation of value added shell fish wastes 3. To know about the preparation of chicken feed from fish wastes

Matching Table (Put Yes / No in the appropriate box)

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	Yes	No	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	No	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Unit	**Course Contents**	**Hours/Week**
UNIT I	Fish meal – Dry reduction and wet reduction methods – specification-packaging and storage	5 hours
UNIT-II	Fish oil – Body oil – Liver oil – Extraction, Purification, Preservation, storage – Application. Biogas production from fish wastes.	5 hours
UNIT – III	Shrimp wastes – chitin, chitosan – production – Uses, Fish protein concentrate – Fish hydrolysate-Partially hydrolysed and deodorized fish meat, Functional fish protein concentrate and their incorporation into various products, Shell fish wastes and its applications.	5 hours
UNIT – IV	Fish silage- Ensiling- Chicken feed production- Acid silage-Fermented Silage – application – Fish maws, Shark Leather, fish glue, fish gelatin, pearl essence.	5 hours
UNIT-V	Biochemical and pharmaceutical products from marine sources – Algae, Corals, Fishes. Utilization of sea weeds – agaragar, gelatin, carrageenan	5 hours
UNIT-VI	Internal Assessment: Assignments, Seminars and Guest lecturers	5 hours
	Total Lecture hours	30 hours

Method of Evaluation: (25 Internal marks + 75 External Marks=100)

Distribution for internals Test (CIA I + CIAII + CIA III)	Seminars	Assignment	End Semester Examination	Total marks
15	05	05	75	100

Text books and Reference Books:

1. Balachandran. K K. (2016). Post-harvest technology of Fish and Fish products. Daya Publ.
2. Gopakumar. K. (1997). Tropical Fishery products. Science Publishers.
3. Nambudiri. D d (2006) Technology of Fishery products. Fishing Chimes.
4. Venugopal V. (2006). Sea Food Procesing. Taylor and Francis.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	S	S	M	S
CO2	S	S	M	S	S	S	S	M	S	M
CO3	S	S	S	S	S	M	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S

PO – Programme Outcome, CO – Course outcome, S – Strong , M – Medium, L – Low

PROJECT / DISSERTATION WITH VIVA-VOCE

For question paper settingANNEXURE - III

BLOOM TAXONOMY QUESTION PAPER SETTING CHECKLIST

Q. No.	Cos	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
PART – A (Two questions from each category except vi. Creating)							
1.	CO1	**1**	**Nil**	**Nil**	**Nil**	**1**	**Nil**
2.	CO1	**Nil**	**Nil**	**Nil**	**1**	**Nil**	**Nil**
3.	CO2	**Nil**	**1**	**Nil**	**Nil**	**Nil**	**Nil**
4.	CO2	**Nil**	**Nil**	**1**	**Nil**	**Nil**	**Nil**
5.	CO3	**Nil**	**Nil**	**Nil**	**Nil**	**Nil**	**Nil**
6.	CO3	**Nil**	**Nil**	**Nil**	**1**	**Nil**	**Nil**
7.	CO4	**Nil**	**Nil**	**Nil**	**Nil**	**1**	**Nil**
8.	CO4	**Nil**	**Nil**	**Nil**	**Nil**	**Nil**	**Nil**
9.	CO5	**Nil**	**Nil**	**1**	**NIl**	**Nil**	**Nil**
10.	CO5	**1**	**Nil**	**Nil**	**1**	**Nil**	**Nil**
PART – B (At the least one question from each category not more than two questions from one category)							
11. A.	CO1	**Nil**	**Nil**	**1**	**Nil**	**Nil**	**Nil**
11. B.	CO1	**Nil**	**Nil**	**Nil**	**Nil**	**1**	**Nil**
12. A.	CO2	**Nil**	**Nil**	**1**	**Nil**	**Nil**	**Nil**
12. B.	CO2	**Nil**	**Nil**	**Nil**	**1**	**Nil**	**Nil**
13. A.	CO3	**Nil**	**Nil**	**Nil**	**Nil**	**Nil**	**1**
13. B.	CO3	**Nil**	**Nil**	**Nil**	**Nil**	**1**	**Nil**
14. A.	CO4	**1**	**Nil**	**Nil**	**Nil**	**Nil**	**Nil**
14. B.	CO4	**Nil**	**1**	**Nil**	**Nil**	**Nil**	**Nil**
15. A.	CO5	**Nil**	**Nil**	**Nil**	**Nil**	**1**	**Nil**
15. B.	CO5	**Nil**	**Nil**	**Nil**	**Nil**	**Nil**	**1**
PART – C (One question from each category except i. Remembering)							
16.	CO1	**Nil**	**Nil**	**Nil**	**1**	**Nil**	**Nil**
17.	CO2	**Nil**	**Nil**	**Nil**	**Nil**	**Nil**	**1**
18.	CO3	**Nil**	**1**	**Nil**	**Nil**	**Nil**	**Nil**
19.	CO4	**Nil**	**Nil**	**Nil**	**Nil**	**1**	**Nil**
20.	CO5	**Nil**	**Nil**	**1**	**Nil**	**Nil**	**Nil**
Total Marks *							

* Not exceeding 24 total marks in each category of (ii), (iii), (iv) and (v). Not exceeding 14 marks in category (i) and 20 marks in category (vi).

Revised Bloom - Anderson 2000 Taxonomy: Code and Verbal Content

Definitions	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
Bloom's Definition	Exhibit memoryof learned material by recalling facts, terms, basic, concepts, and answers.	Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving, descriptions, and stating main ideas	Solve problems tonew situations by applying acquired knowledge, facts, techniques and rules in a different way	Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations	Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a setof criteria	Compile information together in a different wayby combining elements in a new pattern or proposing alternative solutions
Verbs	1.1: Choose 1.2:Define Find How Label List Match Name Omit Recall Relate Select Show Spell Tell What When Where Which Who Why	Classify Compare Contrast Demonstrate Explain Extend Illustrate Infer Interpret Outline Relate Rephrase Show Summarize Translate	Apply Build Choose Construct 3.6 Develop3.7 Experimentwith Identify Interview 3.10 Makeuse of 3.11 Model 3.12 Organize Plan Select Solve Utilize	4.1. Analyse Assume Categorize Classify Compare Conclusion Contrast Discover 4.9 Dissect4.10 Distinguish Divide Examine Function Inference Inspect List 4.17 Motive 4.18 Relationships Simplify Survey 4.21 Take partin Test for Theme	Agree Appraise Assess Award Choose Compare Conclude Criteria Criticize Decide Deduct 5.12 Defend 5.13 Determine Disprove Estimate Evaluate 5.17 Explain5.18 Importance Influence Interpret Judge Justify Mark Measure Opinion Perceive Prioritize Prove 5.29 Rate 5.30 Recommend Rule on Select Support Value	Adapt Build Change Choose Combine Compile Compose Construct Create Delete Design Develop Discuss Elaborate Estimate Formulate Happen Imagine Improve Invent Make up Maximize Minimize Modify Original Originate Plan Predict Propose Solution Solve Suppose Test Theory

Technical Terms – Definition

Programme Objectives:

Total papers, teaching, learning and evaluation comes under programme. Aim of the study including theoretical, practical courses.

Programme Educational Objectives:

Program educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.

Programme Specific Outcomes:

Program specific outcomes are statements that describe what the Post Graduates of a specific Science Programme should be able to do.

Programme Outcomes:

Programme outcomes describe what students are expected to know and would be above to do by the time of Post-Graduation. These relate to the skills, knowledge, and behaviours that students acquire as they progress through the program.

Course Objectives:

Aim of the paper including unit wise contents.

Course Outcomes:

Statements indicating what a student can do after the successful completion of a course.Every course leads to some course outcomes. The Course Outcomes statements are defined by considering the course content covered in each module of a course. For every course there may be 4or 5 course outcomes. The keywords used to define course outcomes are based on Bloom's T