SYLLABUS

for

M.Sc. Biotechnology Programme

(2023-2024 ONWARDS)

Outcome Based Education (OBE)

DEPARTMENT OF BIOTECHNOLOGY AND BIOINFORMATICS

BISHOP HEBER COLLEGE (Autonomous)

(Affiliated to Bharathiodasan University)
(Nationally Reaccredited with A Grade by NAACwith CGPA of 3.58 out of 4)
Recognized by UGC as 'College of Excellence'
Tiruchirappalli – 620 017.

Tamil Nadu State Council for Higher Education (TANSCHE)

M.Sc. DEGREE COURSE IN BIOTECHNOLOGY
Choice-Based Credit System

REVISED REGULATIONS AND SYLLABUS (w.e.f. 2023-2027)

TANSCHE COMPLIANCE

Programme : M.Sc. Biotechnology - 2023 onwards

Sem.	Part	Course	Course Title	Course Code	Hours / week	Credits	Marks		
							CIA	ESE	Total
I	Part I	Core Paper I	Biochemistry	P23BT101	7	5	25	75	100
		Core Paper II	Cell and Molecular Biology	P23BT102	7	5	25	75	100
		Core Practical I	Lab in Biochemistry and Cell And Molecular Biology	P23BT1P1	6	4	40	60	100
		Elective I	Microbiology	P23BT1:A	5	3	25	75	100
			Genetics	P23BT1:B					
			Virology	P23BT1:C					
			Basic Analytical Methods	P23BT1:D					
		Elective II	Lab in Microbiology	P23BT1:P	5	3	40	60	100
			Mushroom Cultivation and Apiculture	P23BT1:F			25	75	100
			Vermiculture Technology	P23BT1:G					
			Validation of Medicinal Plants	P23BT1:H					
					30	20			
II	Part I	Core Paper III	Immunology	P23BT203	6	5	25	75	100
		Core Paper IV	Genetic Engineering	P23BT204	6	5	25	75	100
		Core Paper V	Developmental and Stem cell Biology	P23BT205	6	4	40	60	100
		Elective III	Enzyme Technology	P23BT2:A	4	3	25	75	100
			Dairy Technology	P23BT2:B					
			Pharmaceutical Technology	P23BT2:C					
		Elective IV	Lab in Genetic Engineering and Immunology	P23BT2:P	4	3	40	60	100
			Medical Technology	P23BT2:E			25	75	100
			Food and Nutrition	P23BT2:F					
			Biodiversity	P23BT2:G					
		NMEC I	Human and Environment	P23BT2E1	4	2	25	75	100

					30	22			
III	Part I	Core Paper VI	Plant Biotechnology	P23BT306	6	5	25	75	100
		Core Paper VII	Animal Biotechnology	P23BT307	6	5	25	75	100
		Core Paper VIII	Microbial Biotechnology	P23BT308	6	5	25	75	100
		Core Practical II	Lab in Plant Biotechnology and Animal Biotechnology	P23BT3P2	6	4	40	60	100
		Elective V	Medical Microbiology	P23BT3:A	3	3	25	75	100
			Food and Nutrition	P23BT3:B					
			Herbal Biotechnology	P23BT3:C					
		NMEC II	Biotechnology for Society	P23BT3E2	3	2	25	75	100
		Internship	Internship / Industrial Activity	P23BT3I1	--	2	100	--	100
					30	26			

IV	Part A	Core IX	Environmental Biotechnology	P23BT409	6	5	25	75	100
		Core X	Research Methodology	P23BT410	6	5	25	75	100
		Core Project	Core Project with Viva-Voce	P23BT4PJ	8	7	40	60	100
		Elective VI	Bioethics, Biosafety, and IPR	P23BT4:A	4	3	25	75	100
			Nano Biotechnology	P23BT4:B					
			System Biology	P23BT4:C					
		SEC	Competitive Exams in Life Science	P23BT4S1	4	2	100	--	100
		Extension Activity	Extension Activity	P23ETA41	--	1	--	--	--
	Part B	VLO	The Big Picture	P23VLO41	2	2	100	--	100
			Flying High	P23VLO42					
					30	25			
					Total Credits :	91+2			

SEMESTER - I

Semester: I **Course Code: P23BT101**

Credits : 5 **Total Hrs/ Week : 7**

Core Paper-1

BIOCHEMISTRY

Paper – 1			
Title of the paper	BIOCHEMISTRY	Subject code:	
Category of the course	Year	Semester	Credits
Core Paper	1st	1st	5

Learning Outcome:

To enable the students to understand the basic concepts of biochemistry and biomolecules and also to learn the various metabolic cycles and also to analyze the significance of biochemical findings

Course outcomes:

At the end of the Course, the Student will be able to:

CO-1	To identify the nature of solvents and solutionsconcerning pH and its important
CO-2	To classify carbohydrates, proteins lipids, andnucleic acids of biomolecules
CO-3	To describe the biomolecules involved in intermediary metabolism
CO-4	To explain enzymes and enzyme kinetics.
CO-5	To apply Biochemistry, in clinical 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

SYLLABUS | Core Paper-1 | BIOCHEMISTRY				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
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	12	CO1	K1&k2

	bonds and Vander Waal‟ bonds)			
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	CO2	K1,K2 & K3
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	CO3	K1,K2 & K3
IV	Enzymology: Enzymes: general aspects (classifications and structure). The allosteric mechanism, regulatory and active sites, and active energy. Iso-enzymes. Enzyme kinetics (MM, LB plot, Km) and hormones.	12	CO4	K1,K2 & K3
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	CO5	K1,K2 & K3
VI	Internal Assessments, Seminars, and Guest lecture	05		
	Total Teaching hours	**65**		

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, Humana Press.
6. Principles of Biochmeistry , 5th Edition AL. Lehninger ,D.L. Nelson and M.M Cox ., 2008.worth publishers , NewYork.
7. Biochemistry 4THEdition,G.Zubay,1998.Mc Millan publishing Co.NewYork.
8. Harper‟s Biochemistry,29th Edition-Rober K.Murray,Daryl K.Grammer,2012 McGrawHill, lange Medical Books
9. Understanding enzymes -5theditionTrevorpalmer,Prentice Hall/Ellias Horwood1995
10. Text Book Medical Biochemistry M.N.Chatterjee 8th edition Jaypee brothers Medical publishers2013

Reference books:

1. D.L. Nelson and M.M. Cox. Lehninger Principles of Biochemistry, WH FreemanPublishers, 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: Principles and Techniques, 3rd Edition. Himalayan publications, 2009.
5. M.N. Chatterjee and Rana Shinde, Textbook of Medical Biochemistry, 8th Edition. Jaypee Brothers Medical Publishers (P) Ltd., 2012.
6. Biochemistry – 4th edition Donald voet and Judith G.Voet ,VP Publishers 2011 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. Molecular biology 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

Useful web sites: [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

Semester: I **Course Code: P23BT102**

Credits : 5 **Total Hrs/ Week : 7**

Core Paper-2

CELL AND MOLECULAR BIOLOGY

Paper – 1			
Title of the paper	**CELL AND MOLECULAR BIOLOGY**		Subject code:
Category of the course	Year	Semester	Credits
Core Paper	1st	1st	5

Learning outcome:

Understanding the structural and functional aspects of the cell provides the students with a strong foundation in the molecular mechanism underlying cellular functions.

Course outcomes:

At the end of the Course, the Student will be able to:

CO-1	To equip with a basic knowledge of thestructural and functional properties of cells.
CO-2	To understand process of cell division andreplication process.
CO-3-	To understand the occurrence of central dogma of life in the cell and the machineries involved to initiate and inhibit RNA and proteinsynthesis.
CO-4	To control of gene expressions inprokaryotes and eukaryotes and transposable elements.
CO-5	To understand mechanism of epigenetic controls and cancer 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

SYLLABUS | Core Paper-2 | CELL AND MOLECULAR BIOLOGY				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
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	CO1	K1,K2 & K3
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	CO2	K1,K2 &K3
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	CO3	K1,K2 &K3
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	CO4	K1 &K2
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.Oncogenes as transcriptional activators.	12	CO5	K1,K2 & K3
VI	Internal Assessment: Assignments, Seminars and Guest lectures	5		
Total Lecture hours 65 hours		65 hours		

References:

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. Wiley publications,2013.
4. Cell biology D E Sadava CBS 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	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, = 3, M – Medium, L – Low (may be avoided)

Semester: I **Course Code: P23BT1P1**
Credits : 4 **Total Hrs/ Week : 6**

CORE PRACTICAL -I

(Lab in Biochemistry and Cell & Molecular Biology)

Core Practical - I			
Title of the paper	**Lab in Biochemistry and Cell & Molecular Biology**	Subject code:	
Category of the course	Year	Semester	Credits
Core Paper	1st	1st	4

Learning Outcome:

The practical will establish a basic study skills on the subject and will improve the student's ability to calculate and improve their practical skill and knowledge.

Course outcomes:

On successful completion of the course the students will be able to

CO 1	(K2) Illustrate basic biochemistry procedures
CO 2	(K3) study the methods of estimation of biomolecules
CO 3	(K4) isolate & Analyze DNA, RNA & protein
CO 4	(K5) critically analyze the isolated biomolecules
CO 5	(K5) evaluate the quality and purity of DNA, RNA & Protein

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

SYLLABUS | Core Practical -I				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
A	**(A) Biochemistry - Practical** 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	15	CO1 CO2 CO3 CO4 CO5	K3 & K4
B	**(B) Cell and Molecular Biology - Practical** 9. Isolation of Genomic DNA from E.coli 10. Isolation of plasmid DNA from E.coli 11. Elution & quantification of DNA from agarose gel. 12. Preparation of competent cells and transformation 13. PCR- Isolation of Total RNA from bacteria 14. Synthesis of cDNA by Reverse transcription polymerase chain reaction	15	CO1 CO2 CO3 CO4 CO5	K3,K4 &K5

Reference

1. Introduction to Practical Biochemistry, E.F Plummer Mu, PlummerTata McGraw-HillEducation,1998.

2. Molecular cloning: a laboratory manual,4th ed. J.Sambrook, Fritsch andT.Maniatis.coldspring harbor laboratory press ,NewYork,2012.
3. Essential cell biology : a practical approach volume 1: cellstructure. John Davey,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.

Semester: I **Course Code: P23BT1:A**

Credits: 3 **Total Hrs/ Week : 5**

Elective Paper-I (A)
MICROBIOLOGY

Elective Paper– I			
Title of the paper	**MICROBIOLOGY**	Subject code:	
Category of the course	Year	Semester	Credits
Core Paper	1st	1st	3

Learning Outcome:

Studying the diversity and activity of microorganisms in their natural environment,their mutual interactions, and their survival and adaptation strategies.

Course outcomes:

C0-1	To identify the Classification of microorganisms
CO-2	To identify and differentiate the pure culture technique.
CO-3-	To identify and describe the chemotherapeutic agent
CO-4	To identify and explain enzymes and theirregulations by kinetic parameters
CO-5	To identify and cross-examine theBiotechnological 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

SYLLABUS |Elective Paper-I (A) | MICROBIOLOGY				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**

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	CO1	K1,K2 &K3
II	Nutritional classification of bacteria, Isolation, cultivation, enumeration, and preservation of microbes; Culture media andits types - Pure culture technique - Growth curve; Axenic culture, Synchronous culture, Continuous culture; Effect of physical and chemical factors on microbial growth.	12 hours	CO2	K1,K2 &K3
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 - Antimicrobial susceptibility test.	12 hours	CO3	K1,K2 &K3
IV	Microbial diversity- methods to assess microbial diversity,Culture dependent, and culture-independent methods. Molecular analysis 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	CO4	K1, K2 & K3
V	Microbial community 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	CO5	K1,K2 & K3
VI	Internal Assessments, Seminars, and Guest Lectures	05 hours		
	Total Teaching hours	**65 hours**		

Text book:

1. Microbiology 3rd Edition by Dave Wessner (Author), Christine Dupont (Author), Trevor Charles (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) 11th edition (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 with Pearson 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)

Semester: I **Course Code: P23BT1:B**

Credits : 3 **Total Hrs/ Week : 5**

ELECTIVE-1 (B)

GENETICS

Elective Paper – I (B)			
Title of the paper	GENETICS	Subject code:	
Category of the course	Year	Semester	Credits
Elective Paper	1st	1st	3

Learning Outcome:

To enable us to explore many different components of living systems and the advent of proteomics will made it possible to identify a broad spectrum of proteins in living systems. This elective subject will help to understand basic principles and applications in genomics and proteomics.

Course outcomes:

At the end of the Course, the Student will be able to:

CO-1	To know about Mendelian laws.
CO-2	T learn how a gene is inherited
CO-3-	To understand about sex determination
CO-4	To comprehend how gene regulation happens
CO-5	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

SYLLABUS | Elective Paper-1 (B) | GENETICS				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
I	History of Genetics: Definition and scope of Genetics- 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	CO1	K1 & K2
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	CO2	K1, K2,K3
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	CO3	K1, K2 & K3
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	CO4	K1,K2 & K3
V	netic 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 Ethenics, Bioethics.	8 hours	CO5	K1,K2 & K3
VI	nternal Assessment: Assignments, Seminars and Guest lecturers	5 hours		
	Total Lecture hours	**50 hours**		

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. Sounderscollege 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 Human Genetics (Universities Press India ltd) Publishing.

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

1. 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	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)

Semester: I **Course Code: P23BT1:C**

Credits : 3 **Total Hrs/ Week : 5**

Elective Paper-I (C)

VIROLOGY

Paper – 2			
Title of the paper	VIROLOGY	Subject code:	
Category of the course	Year	Semester	Credits
Elective Paper	1st	1st	3

Learning Outcome:

To understand the biology of viruses, pathogenesis, clinical features, epidemiology, and prophylaxis of dreadful viral infections in susceptible hosts.

Course outcomes:

At the end of the Course, the Student will be able to:

CO-1	To describe and review the General Virology andcultivation of viruses
CO-2	To know the Viral diagnostic and detection methods
CO-3	To explain viral replication strategies, and compareand contrast replication mechanisms used by viruses relevant to human disease
CO-4	To discuss principles of virus pathogenesis
CO-5	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

SYLLABUS | Elective Paper-I (C) | VIROLOGY				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
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: Inovo, In vivo, Ex vivo/In vitro. Cytopathic effect-pock forming unit.	10 hours	CO1 CO2 CO3	K1,K2,K3 & K4
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	CO1 CO2 CO5	K1,K2,K3 & K4
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 Disease 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	CO1 CO4 CO5	K1,K2,K3 & K4
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 mediated	08 hours	CO1 CO2 CO3	K1,K2,K3 & K4

	oncogenesis.			
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 screeningfor antivirals, mechanisms of action, anti retrovirals-mechanism of action and drug resistance.	05 hours	CO1 CO2 CO4 CO5	K1,K2,K3 & K4
VI	Internal Assessments, Seminars, and Guest lecture	5 hours		
	Total Teaching hours	50 hours		

Reference & Text Books:

1. Virology principles and application John Carter and Venetia Saunders (2007) John Wiley and Sons 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. Lippincott Williams &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)

Semester: I **Course Code: P23BT1:D**

Credits : 3 **Total Hrs/ Week : 5**

Elective Paper-I (D)

BASIC ANALYTICAL METHODS

Paper – 3			
Title of the paper	**BASIC ANALYTICAL METHODS**	Subject code:	
Category of the course	Year	Semester	Credits
Elective Paper	1st	1st	3

Learning Outcome:

To provide knowledge of various analytical techniques in biological research course

Course outcomes:

CO-1	To know the significance of instruments concerningdiagnostic procedures.
CO-2	To handle qualitative and quantitative chromatographictechniques
CO-3	To handle centrifugation and separate samples forfurther practical's/research
CO-4	To handle different qualitative and quantitativeelectrophoresis techniques
CO-5	To handle microscopes and validate microscopicimages.

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

SYLLABUS | Elective Paper-I (D) | BASIC ANALYTICAL METHODS				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
I	Electrochemical techniques- basic principles- The pH electrode- Ion-selective gas- sensing and oxygen electrodes. Elementary details of biosensors. Beer-Lambert law, light absorption, and its transmittance.	10 hours	CO1	K3 & K5

	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		CO5	
II	Introduction & classification of chromatography. Theory, instrumentation & applications of Column chromatography, TLC, Paper chromatography, GC, HPTLC, HPLC - detection methods, and systems qualitative and quantitative aspects applications	08 hours	CO1 CO2 CO5	K3 & K5
III	Centrifugation- basic principles-instrumentation-centrifugation units. Nature of particles centrifugation methods and accessories. 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- application- methods in life sciences and biotechnology.	13 hours	CO1 CO3	K3 & K4
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	CO1 CO4	K3, K4 & K6
V	Radio isotopic techniques: Introduction to radioisotopes, Detection. Measurement and uses of radioisotopes, Counting efficiency and autoradiography. Principles of microscopy, Fluorescent, Transmission and Scanning electron microscopy, confocal microscopy. Biotechnological applications Microscopy. Microtome analysis and measurement of images	05 hours	CO1 CO5	K3,K4, K5 & K6
VI	Internal Assessments, Seminars, and Guest lecture	5 hours		
	Total Teaching hours	**50**		

Textbook:

1. Keith Wilson, John M Walker. Principles and techniques of biochemistry and molecular biology. 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,Curtis Johnson, andPui Shing Ho (Hardcover – April 16,2005)
4. Physical Biochemistry: Applications to Biochemistry and Molecular Biologyby David 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:

1. **https://www.edx.org/course/basic-analytical-chemistry,**

E-Books:

1. **http://shvaiko.ru/wp-content/uploads/2010/02/Analytical-Techniques-Julia-C.-Drees-Alan-H.-B.-Wu.pdftml,**
2. **https://www.uvm.edu/~gpetrucc/courses/chem196/Textbooks/Manahan%20-%20Fundamentals%20of%20Environmental%20Chemistry/1491Ch25.pdf,**

E- journals:

1. https://onlinelibrary.wiley.com/series/8247,
2. **https://link.springer.com/chapter/10.1007/978-3-642-75490-6_15,**

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

Semester: I **Course Code: P23BT1:P**

Credits : 3 **Total Hrs/ Week : 5**

Elective Paper-II (P)

LAB IN MICROBIOLOGY

Elective Paper – II (P)			
Title of the paper	LAB IN MICROBIOLOGY	Subject code:	
Category of the course	Year	Semester	Credits
Elective Paper	1st	1st	3

Learning Outcome:

The practical will establish a basic study skills on the subject and will improve the student's ability to calculate and improve their practical skill and knowledge.

Course outcomes:

CO-1	To know the significance of instruments concerningdiagnostic procedures.
CO-2	To handle qualitative and quantitative chromatographictechniques
CO-3	To handle centrifugation and separate samples forfurther practical's/research
CO-4	To handle different qualitative and quantitativeelectrophoresis techniques
CO-5	To handle microscopes and validate microscopicimages.

SYLLABUS | Elective Paper-II (P) | LAB IN MICROBIOLOGY

Content	Hours	COs	Cognitive level
1. Sterilization techniques 2. Preparation of culture media(Selective and Enriched media) 3. Staining techniques- Simple, Differential, Negative staining and Motility studies 4. Determination of Bacterial growth curve 5. Enumeration of bacteria from environmental samples- soil, water, air and milk. 6. Pure culture techniques - Streak, pour plate and spread plate. 7. Biochemical tests for identification of bacteria (IMViC, TSI, Catalase,Oxidase) 8. Antimicrobial assay, phenol coefficient, agar plate sensitivity method.			

9. Water quality analysis – MPN method. 10. Milk quality analysis – MBRT method			

References:

1. Microbiology- A Laboratory manual P. Gunasekaran . New age publications, New delhi,1995.
2. Molecular cloning-A Laboratory manual. Sambrook, J , Fritsch. E.F, and T.Maniatis, 2nd Edition. Cold spring Harbor Laboratory press, New York,1989.
3. Laboratory exercise of Microbiology, J.P. Harley and L.M. Prescott, 5th Edition, the McGraw-Hill companies,2002.
4. Microbiology: A Laboratory Manual, J.G. Cappuccino and N. Sherman, Addison-Wesley,2002.
5. Laboratory Manual of Experimental Microbiology ,R.M.Atlas, A.E.Brown and L.C.Parks, 1995. Mosby,St.Louis,2002.
6. Laboratory manual in General Microbiology, N.Kannan, Panimapublishers.
7. Bergey‟s Manual of Determinative Bacteriology. Ninth Edition J.G.Holt, N.R.Krieg.,Lippincott Williams, Wilkin publishers, 2000.

Semester: I **Course Code: P23BT1:F**

Credits : 3 **Total Hrs/ Week : 5**

Elective Paper-II (F)

MUSHROOM CULTIVATION AND APICULTURE

Elective Paper – II (F)			
Title of the paper	**MUSHROOM CULTIVATION AND APICULTURE**	Subject code:	
Category of the course	Year	Semester	Credits
Elective Paper	1st	1st	3

Learning Outcome:

To exploit possibilities and assist in building up a mushroom cultivation and apiculture industry that will makea significant contribution to the general economy.

Course outcomes:

CO-1	To differentiate the edible and poisonous mushrooms
CO-2	To develop mushrooms culture conditions
CO-3	To practice the mushroom cultivation and production
CO-4	To practice the bee keeping and culture maintenance
CO-5	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

) SYLLABUS | Elective Paper-II (F) | MUSHROOM CULTIVATION AND APICULTURE				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
I	History of Mushroom, cultivations 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	CO1 CO5	K3 & K5
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	CO1 CO2 CO5	K3 & K5
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	CO1 CO3	K3 & K4
IV	Introduction to apiculture, definitions, history, scope, importance ofapiculture, Bee Keeping methods practiced in world and in India, Traditional Bee keeping techniques, Modern Bee keeping methods,Urban Beekeeping methods.	5 hours	CO1 CO4	K3, K4 & K6
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	CO1 CO5	K3,K4, K5 & K6
VI	Internal Assessments, Seminars, and Guest lecture	5 hours		
	Total Teaching hours	**30 hours**		

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. lison 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 Keeping Bees in Your Yard andGarden. Quarry Books.
5. Kannaiyan, S. Ramasamy, K. (1980). A hand book of edible mushroom, Today & Tomorrows Printers &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=6AJx99OGTKEC&redirhttps://ooks.google.co.in/books/about/Mushroom_Cultivation_in_India.html?id=6AJx99OGTKEC&redir

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)

Semester: I **Course Code: P23BT1:G**

Credits : 3 **Total Hrs/ Week : 5**

Elective Paper-II (G)

VERMICULTURE TECHNOLOGY

Elective Paper – II (G)			
Title of the paper	**VERMICULTURE TECHNOLOGY**	Subject code:	
Category of the course	Year	Semester	Credits
Elective Paper	1st	1st	3

Learning Outcome:

To exploit possibilities and assist in building up a Vermiculture technology in significant contribution to thegeneral economy.

Course outcomes:

CO-1	To understand the Vermiculture and 4R's of recycling
CO-2	To identify the decomposing organic matter and humus formation
CO-3	To differentiate nutritional value of vermicompost and fertilizer
CO-4	To practice the Vermiculture composting and maintain conditions.
CO-5	To produce Vermiculture compost, harvest the compost and 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	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

SYLLABUS | Elective Paper-II (G) | VERMICULTURE TECHNOLOGY

Unit	Content	Hours	COs	Cognitive level
I	Introduction to Vermiculture technology, definition, meaning and history, Economic	5	CO1	K3 & K5

	importance of Vermiculture, their value in soil texture, Concept of recycling, Concept of four r' s reduce, reuse, recycle and restore.	hours	CO5	
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	CO1 CO2 CO5	K3 & K5
III	Introduction of plant fertilizers, nutritional value and their importance, Vermicompost composition and its nutritional value, Importance of vermicompost as fertilizer for plants, Comparison of vermicompost with other fertilizers.	5 hours	CO1 CO3	K3 & K4
IV	Introduction to vermibeds, sources, types, Preparation of vermibeds, measurements, Maintenance of vermicompost, Compositing conditions, moist, temperature, aeration.	5 hours	CO1 CO4	K3, K4 & K6
V	Vermicompost identification, conditions, and separation, compostpacking, sources and methods, Compost storage, conditions and durations, Vermicompost handling and transport.	5 hours	CO1 CO5	K3,K4, K5 & K6
VI	Internal Assessment: Assignments, Seminars and Guest lecturers	5 hours		
	Total Lecture hours	30 hours		

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, (Part B), 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 Environmental ManagementEdited By Clive A. Edwards, Norman Q. Arancon, Rhonda L. Sherman,
2. 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)

Semester: I **Course Code: P23BT1:H**

Credits : 3 **Total Hrs/ Week : 5**

Elective Paper-II (H)

VALIDATION OF MEDICINAL PLANTS

Elective Paper – II (H)			
Title of the paper	**VALIDATION OF MEDICINAL PLANTS**	Subject code:	
Category of the course	Year	Semester	Credits
Elective Paper	1st	1st	3

Learning Outcome:

The course aims to introduce the students to the identification and validation of medicinal plantand to understand the cultivation and propagation techniques. To understand the importance of medicinal plants in human health care.

Course outcomes:

CO-1	To gain knowledge about the importance of medicinal plant parts andits medicinal value.
CO-2	To classify the medicinal plants on Bentham and Hooker andPractice herbarium techniques.
CO-3	to identify the medicinal values of plants using different validation Techniques.
CO-4	To cultivate and propagate the medicinal plants
CO-5	To practice the usage of medicinal plants in treatment of humanDiseases.

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

SYLLABUS | Elective Paper-II (H) | VALIDATION OF MEDICINAL PLANTS

Unit	**Content**	**Hours**	**COs**	**Cognitive level**
I	Introduction to Medicinal plants, meaning,	5	CO1	K3 & K5

	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.	hours	CO5	
II	Introduction to Medicinal plant identification, Elementary knowledge of binomial nomenclature, Bentham and Hooker classification, Herbarium, preparation and preservation.	5 hours	CO1 CO2 CO5	K3 & K5
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	CO1 CO3	K3 & K4
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	CO1 CO4	K3, K4 & K6
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	CO1 CO5	K3,K4, K5 & K6
VI	Internal Assessment: Assignments, Seminars and Guest lecturers	5 hours		
	Total Lecture hours	30 hours		

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, Sarup and 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 ofMedicinal Plants. Planta Med., 74: 603–623; 2008.
8. WHO guidelines on good agricultural and collection practices (GACP) for medicinal 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&needAccess=true.

Ma**pping 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

Semester: II **Course Code: P23BT203**

Credits: 5 **Total Hrs/ Week : 6**

Core Paper- III

IMMUNOLOGY

Paper – III			
Title of the paper	IMMUNOLOGY	Subject code:	
Category of the course	Year	Semester	Credits
Core Paper	I	II	5

Learning Outcome:

To provide the students insights into the various aspects of immunology such as classical immunology, clinical immunology, immunotherapy and diagnostic immunology.

Course outcomes:

On successful completion of the course the students will be able to

CO-1	Learn the basic components and principles of defense mechanism against infections
CO-2	Understand the properties antigens and structure and types of Immunoglobulin
CO-3	Understand principle behind Antigens- Antibody reactions.
CO-4	Expedite how the immune system recognizes foreign antigen and the significance of self/non-self-discrimination
CO-5	Enrich the students' knowledge with respect to different applications of Immunotechnology

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

SYLLABUS | Core Paper-III| IMMUNOLOGY				
Unit	**Content**	**Hours**	**Cos**	**Cognitive level**
I	Introduction to the study of Immunology: Historic perspective, Overview and Concepts, Humoral and cellular- Mediated Immunoresponses. 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	CO1	K1 & K2
II	Antigens and Immunogenicity. Nature of Antigens and antibodies. Theories of Antibody formation. Antibody structure, structural basis of Antibody diversity; Immunoglobulin as Anitgen, Properties of immunoglobulin and subtypes. Complement and its role in Immune Responses.	12	CO2	K1,K2,K3,
III	Antigen - Antibody Reaction, Strength of Antigen and Antibody reaction, Cross reactivity, Precipitation and Agglutination reactions, Radioimmunoassay and ELISA. B-cell generation, activation and differentiation. Antibody production, Regulation and Diversity.	12	CO3	K1,K2,K3
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, Cellular	12	CO4	K4 &K5

	Immunity. Hypersensitivity Reactions, Types of Hypersensitivity, Immune tolerance, Autoimmunity and transplantation.			
V	Hybridoma secreting monoclonal antibodies- Recombinant antibody molecules. Catalytic Antibodies. Vaccine technology including DNA vaccines. Immunological techniques for identification of infectious diseases : immune-electrophoresis, western blot, flowcytometry and immune-fluorescence microscopy including in situ localization techniques such as FISH and GISH.	12	CO5	K4 & K5

TEXT BOOKS

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
4. C.V.Rao. 2002, An Introduction to Immunology, Narosa Publishing House,Chennai.

REFERENCE 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, Humana press,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 Press NY

WEB RESOURCES

https://nptel.ac.in/courses/102/105/102105083/
https://www.coursera.org/specializations/immunolog

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

Semester: II **Course Code: P23BT204**

Credits: 5 **Total Hrs/ Week : 5**

Core Paper-IV

Genetic Engineering

Paper – IV			
Title of the paper	GENETIC ENGINEERING	Subject code: P23BT204	
Category of the course	Year	Semester	Credits
Core Paper	1	II	5

Learning Outcome:

To modify the genes to enhance the capabilities of the organisms beyond what is normal. Ethical controversy surrounds the possible use of both of these technologies in plants, nonhuman animals, and humans.

Course outcomes:

On successful completion of the course the students will be able to

CO-1	Understand the basis of Enzyme, Ligases in Genetic Engineering Tools.
CO-2	Differentiate methods the Cloning Vectors.
CO-3	Obtain knowledge about Gene cloning strategies and transformation techniques.
CO-4	Describe the techniques in Selection, Screening, and analysis of recombinants.
CO-5	Analyze and can cross-examine the basic Genetic Engineering Techniques in the Application of rDNA technology.

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

SYLLABUS | Core Paper-IV | GENETIC ENGINEERING				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
I	Tools of Genetic Engineering: Enzymes - endo &exo nucleases, Restriction endonucleases- types, nomenclature, recognition sequences and mechanism of action; Isochizomers, Iso customers - 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	CO1	K1,K2
II	Cloning vectors: General characteristics of vectors, Brief account of naturally occurring plasmids. 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	CO2	K1,K2 & K3
III	Gene cloning strategies and transformation techniques: Chimeric DNA, Cloning strategies- ligation, Transformation and selection, use of adaptors and linkers, Homopolymer tailing in cDNA cloning, genomic DNA libraries, Short gun method, Partial digestion, End modification, Cloning from mRNA- Isolation and purification of RNA, Synthesis of cDNA, Isolation of plasmids, Cloning cDNA in plasmid vectors, Cloning cDNA in bacteriophage vectors. cDNA library. Advanced cloning strategies-synthesis and Cloning of cDNA, PCR amplified DNA. Transformation techniques:	12	CO3	K2,K3,K4 & K5

	Preparation of competent cells, Physical methods - Electroporation, Microinjection, Gene gun, chemical methods - PEG, DEAE, $CaCl_2$, calcium phosphate precipitation method, liposome-mediated method			
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	CO4	K2,K3,K4 & K5
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	CO5	K3,K4, K5& K6

TEXT BOOKS

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)

Reference Books

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; 1st

edition

4. Genetic Engineering: A Christian Perspective Paperback – December 27, 2019 by Michael
5. 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)
    1. Principles of Genetics 6th Edition by D. Peter Snustad (Author), Michael J. Simmons (Author) John Wiley and Sons; 6th edition (August 23, 2011)
    2. An Introduction to Genetic Engineering 3rd Edition, author : Desmonds S.T. Nicholl, University of Paisley May 2008.
    3. Gene Cloning and DNA Analysis: An Introduction 7th Editionby T. A. Brown Wiley-Blackwell; 7th edition (January 19, 2016)
    4. 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)

WEB RESOURCES:

1. Website links: https://www.genome.gov/genetics-glossary/Genetic-Engineering
2. 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
3. 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	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

Semester: II **Course Code: P23BT205**

Credits: 4 **Total Hrs/ Week :6**

Core Paper- V

DEVELOPMENTAL AND STEM CELL BIOLOGY

Paper – V			
Title of the paper	DEVELOPMENTAL AND STEM CELL BIOLOGY	Subject code: P23BT205	
Category of the course	Year	Semester	Credits
Core Paper	1	II	4

Learning Outcome:

To understand the recent advances and its applications to modern biotechnology

Course outcomes:

On successful completion of the course the students will be able to

CO-1	Elucidate the basic knowledge of Developmental Biology
CO-2	Understand mechanism of developmental morphogenesis andorganogenesis
CO-3	Comprehend basis the of stem cell and its importance
CO-4	Analyze the types of stem cell and stem cell mediated antigen role different stem cell
CO-5	Evaluate the various application of stem cell in the field clinical research and in the field of 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	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

Unit	Content	Hours	COs	Cognitive level
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	CO1	K1, K2
II	Developmental Concepts: Morphogenesis and organogenesis in animals (Drosophila and Chick). Cell fate and cell lineages; genomic equivalence and the cytoplasmic determinants; imprinting. Role of in development. Cellular differentiation and Differential activation. Role of cell death in development. Terato genesis - Ageing, transgenic.	12	CO2	K1,K2, K3
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 transfer and cloning, introduction to cell, tissues and organ. Introduction to embryonic and adult stem cell.	12	CO3	K2,K3,K4 &K5
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 rolein stem cell differentiation. Neuronal stem cell, mesenchymal stem cell, cardiac stem cells,	12	CO4	K3,K4,K5

	hematopoietic stem cells			
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	CO5	K3,K4,K5 & K6

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 andtherapeuticpotential, 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 Books

1. Human Embryology & Developmental Biology (2019), 6th edition by Bruce M. Carlson
2. Principles of Development (2019), 6th edition by Cheryll Tickle; Lewis Wolpert; AlfonsoMartinez Arias.

REFERENCE BOOKS:

1. Freshney RI. 2016. Culture of animal cells: A manual of basic technique and Specialized Applications. 7th Edn. Wiley- Blackwell.. United States of America.
2. Singh, B., Mal, G., Gautam, S.K., Mukesh, M.2019 Advances in animal biotechnology 1st EdnSpringer International Publishing. Switzerland

WEB RESOUCRSES:

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

Semester:II **Course Code: P23BT2:A**

Credits : 3 **Total Hrs/ Week :4**

Elective Paper-III

Enzyme Technology

ELECTIVE PAPER– III			
Title of the paper	ENZYME TECHNOLOGY	Subject code: P23BT2:A	
Category of the course	Year	Semester	Credits
Elective Paper	1	II	3

Learning Outcome:

To provide knowledge of various enzymes and enzyme technology applied in the industries.

Course outcomes:

On successful completion of the course the students will be able to

CO-1	Learn about the classification and structure properties of enzymes
CO-2	Enumerate the kinetics, catalysis and inhibitions activities of enzymes
CO-3	Understand physical properties, downstream process and purification of enzymes.
CO-4	Expedite how enzymes function as co-factors in different processes
CO-5	Enrich the knowledge with various application of enzyme technology

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

SYLLABUS | Elective Paper-III | ENZYME TECHNOLOGY				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
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 koshl and "induced fit" hypothesis, strain or transition-state stabilization hypothesis.	10	CO1	K1& K2
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	CO2	K2 & K3
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, ionic 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	CO3	K2,K3,K4
IV	Enzymes inhibition and Co-factors: Irreversible, reversible, competitive, non-competitive and un-competitive inhibition with suitable examples and	9	CO4	K3 & K4

	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.			
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	CO5	K3,K4 &K5

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. Verlag Chemie.
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, Inter science Publishers.

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 – L

Semester: II **Course Code: P23BT2:B**

Credits: 3 **Total Hrs/ Week : 4**

Elective Paper- III

Dairy Technology

Paper – III			
Title of the paper	DAIRY TECHNOLOGY	Subject code: P23BT2:B	
Category of the course	Year	Semester	Credits
Elective Paper	1	II	3

Learning Outcome:

To impart current knowledge of basic and applied microbiological aspects of fluid milks anddairy products for improved quality and food safety.

Course outcomes:

On successful completion of the course the students will be able to

CO-1	Know about basic knowledge of milk microbes and itschanges in maintaining the storage of milk.
CO-2	Understand mechanism of processing of milk throughmicrobiological methods
CO-3	Learn dairy products quality and its changes through microbes
CO-4	Differentiate dairy products in industry and homemade.
CO-5	Elucidate the various application of dairy technology and dairy borne 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	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

SYLLABUS | Elective Paper-6 | ENVIRONMENTAL BIOTECHNOLOGY				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
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. Cleanmilk production and antimicrobial systems in raw milk. Microbial changes in raw milk during long storage. Microbiological grading of raw milk.	12	CO1	K1,K2
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	CO2	K3
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	CO3	K4
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	12	CO4	K4

	products. microbiological standards for indigenous dairy foods.			
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 of pathogens in dairy products and preventive strategies. regulatory control of dairy products, testing of milk and milk products, treatment of dairy wastes.	12	CO5	K5

TEXT BOOKS:

1. Adams MR and Moss MO.(1995).food microbiology, the royal society ofchemistry,Cambridge.
2. Andrews AT, Varley J(1994) biochemistry of milk products. Royal society ofchemistry.
3. BanwartGJ(1989),basic food microbiology, Chapman & hall, new York.
4. Frazier WC and Westh off DC.(1988) food microbiology, TATA McGraw hill publishingcompany Ltd. NewDelhi.

Reference Books:

1. Hobbs BC and Roberts D. (1993) food poisoning and food hygiene, Edward Arnold(adivision of Hodder and Stoughton),London.
2. May JM. (1987) modern food microbiology, CBS publishers and distributors, NewDelhi.
3. Robinson RK. 1990.the microbiology of milk. Elsevier applied Science.London
4. Edward Harth ,J.T.Steele. Applied dairy microbiology .1998. Marcel DeekerInc.
5. Modi, HA (2009) dairy microbiology pointer publishers, India. Marth, E.H and steel
6. 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

Semester: II **Course Code: P23BT2:C**

Credits : 3 **Total Hrs/ Week : 4**

Elective Paper-III

Pharmaceutical Technology

Paper – III			
Title of the paper	Pharmaceutical Technology		Subject code: P23BT2:C
Category of the course	Year	Semester	Credits
Elective Paper	1	II	3

Learning Outcome:

To impart knowledge on the importance of drug during life span. To enlighten on the biotechnological modifications in drugs. To find mechanism of action of drugs used in therapy.

Course outcomes:

On successful completion of the course the students will be able to

CO-1	Learn about basic knowledge of drugs of phase I & II
CO-2	Understand drug mechanism and its adverse effects.
CO-3	Gain insight about various aspects in biotechnology for drug development, especiallyfor AIDS
CO-4	Elucidate the applications of drugs and its importance various treatment like diabetes, cancer, lipidemia and infertility
CO-5	Analyze the significant application of drug dependence and its role in abuse-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	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

SYLLABUS | Elective Paper-| PHARMACEUTICAL TECHNOLOGY				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
I	Drug- structural feature and pharmacology activity, pro drug concept. Absorption – first – pass effect .distributor , metabolism- phase I, II reactions, action of cyto chrome p450 & elimination of drug receptor- localization, type and subtypes, models and their drug- receptor interaction, against & antagonist .	10	CO1	K1 &K2
II	Adverse response to drugs, drug tolerance, drug intolerance, Idio SYNERACY (pharmacogenesis), drug allergy. Tachyphylaxis, drug abuse, vaccination against infection	8	CO2	K2 & K3
III	Biotechnology and pharmacy: genetically engineered protein and peptide agents. novel drug delivery systems – non conventional routes of administration. Anti AIDS drug development, oncogenes target for drugs, multi- drugs resistance.	13	CO3	K2,K3 & K4
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	8	CO4	K2,K3,K4

	glycosides, cephalosporin and bacterial resistance .Insulin and oral diabetic drugs, anti fertility and ovulation inducing drugs.			
V	Drugs of plant origin: drug dependence and abuse-management of self poisoning cancer. Chemotherapy-cytotoxic drug. immuno suppressive drug therapy. New biological targets for drug development. Novel drug screening strategies.	8	CO5	K2,K3 & K5

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 books

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

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 Code: P23BT2:P**

Credits: 3 **Total Hrs/ Week : 4**

Lab in Genetic Engineering and Immunology

Paper – Elective IV			
Title of the paper	Lab in Genetic Engineering and Immunology	**Subject code: P23BT2:P**	
Category of the course	Year	Semester	Credits
Extra disciplinary subject	1	II	3

Learning Outcome:

The practical will establish a basic study skill on the subject and will improve the student's ability to calculate and improve their practical skill and knowledge.

Course Outcome:

On successful completion of the course the students will be able to

CO-1	Isolate, identify & enumerate immune cells
CO-2	Learn the technique of immunodiagnostics
CO-3	Understand the basic steps of gene cloning and the role of enzymes and vectors responsible for gene manipulation, transformation and genetic engineering
CO-4	Getting detailed knowledge of gene transfer methods and identifying suitable hosts for cloning.
CO-5	Acquiring knowledge in the techniques, tools, application and safety measures of genetic engineering.

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

SYLLABUS | ELECTIVE - IV | Lab in Genetic Engineering and Immunology				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
A	**(A)Immunology – practical** 1. Blood grouping 2. Lymphocyte subset identification and enumeration. 3. Radial immuno-diffusion test. 4. Ouchterlony double diffusion 5. Immuno electrophoresis 6. Rocket Immuno electrophoresis 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).	15	CO1 CO2 CO3 CO4 CO5	K1,K2,K3,K4 &K5
B	**(B) GENETIC ENGINEERING- practical**	15	CO1 CO2	K2,K3,K4

	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 of transformed colony by X-Gal method 8. Determination of molecular weight of proteins by SDS PAGE		CO3 CO4 CO5	

Semester: II **Course Code: P23BT2:E**

Credits: 3 **Total Hrs/ Week : 4**

Elective IV : MEDICAL LABORATORY TECHNOLOGY

ELECTIVE IV : MEDICAL LABORATORY TECHNOLOGY			
Title of the paper	MEDICAL LABORATORY TECHNOLOGY	Subject code: P23BT2:E	
Category of the course	Year	Semester	Credits
Elective Paper	1	II	2

Learning Outcome:

To enable the students to learn about the General laboratory and instrumentation. Know the significance of biological samples examination & understand the various types of infection and clinical symptoms caused by microorganisms.

Course outcomes:

On successful completion of the course the students will be able to

CO-1	follow safety precautions in the diagnostic laboratory.
CO-2	Understand the importance of general laboratory and instrumentation.
CO-3	comprehend the significance of biological samples and their importance
CO-4	Analyze the various types of infection and clinical symptomscaused by microorganisms.
CO-5	Elucidate 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

SYLLABUS | **Elective Paper- IV**| MEDICAL LABORATORY TECHNOLOGY				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
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	CO1	K1 &K2
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 theurinary sediment: stool Examination-specimen collection, pH, Interfering substance. Test for occult blood, fecal fat, and microscopic examination of a stool specimen.	5	CO2	K2 & K3
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	CO3	K2,K3 & K4
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,	5	CO4	K2,K3,K4

	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.			
V	Blood banking: blood group(ABO & Rh)-methods of grouping & reverse grouping. Basic blood banking procedures- a collection of blood, anticoagulantsused, 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	CO5	K2,K3 & K5

Text Book:

1. Medical LaboratoryTechnology 6th editionL.Mukherjee.vol.I,II,III.2010Tata Mcgraw-Hill publishing company limited.
2. Hand book medical laboratory technology 2nd edition-V.H.Talib CBS publishers& 2008.
3. Clinical laboratory practices in CMC procedure, CMC, Vellore
4. Text book of Medical lab technology, 1st Edition-Ranmniksood.jaypee2006.
5. Laboratory manual in biochemistry-Jayaraman New Age International Pvt Ltd publishers2011.

Reference books:

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.

WEB RESOURSCES:

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

Semester: II **Course Code: P23BT2:F**
Credits : 3 **Total Hrs/ Week : 4**

Elective Paper

Food and Nutrition

Paper – Food and Nutrition			
Title of the paper	FOOD AND NUTRITION		Subject code: P23BT2:F
Category of the course	Year	Semester	Credits
Elective Paper	1	II	3

Learning Outcome:

To enable students to gain a deeper understanding about principles of nutrition and also to develop competence to carry out investigation in nutrition

Course outcomes:

On successful completion of the course the students will be able to

CO-1	Differentiate the foods types and their nutritive value.
CO-2	Develop competence to carry out investigation in nutrition
CO-3	Measure and calculate calorific value of different types of foods
CO-4	Identify the food adulterants and food poisoning
CO-5	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

SYLLABUS | Elective Paper-IV| FOOD AND NUTRITION				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
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 andtypes, Treatment and preventive measures of PEM.	5	CO1	K1 &K2
II	Introduction to Vitamins., Fat soluble vitamins, Water solublevitamins	5	CO2	K2 & K3
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	CO3	K2,K3 & K4
IV	Definitions of food adulterations and food poisoning, Sources of foods and types of adulterants, advantages and disadvantages of adulteration, Constituents of foods, carbohydrates, proteins, fats,oils, Flavours, colours and natural toxicants, Sources causes and remedies for acidity, gastritis, indigestion and constipation.	5	CO4	K2,K3,K4

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	CO5	K2,K3 & K5

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, a lange medical book 26th Ed. 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. Public Health Nutrition. Blackwell science, Blackwell Publishing Company (2004).
8. Frazier, We, Food Microbiology, Tata Mc Graw Hill 1978.

Reference books

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.

Websites:

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

Semester: II **Course Code: P23BT2:G**

Credits : 3 **Total Hrs/ Week : 4**

Elective Paper-IV

Biodiversity

Paper – ELECTIVE IV- BIODIVERSITY			
Title of the paper	Biodiversity		Subject code: P23BT2:G
Category of the course	Year	Semester	Credits
Elective Paper	1	II	3

Learning Outcome:

To enable students to gain a deeper understanding about every living thingsincluding plants, bacteria, animals and humans .and enormous variety of life on Earth.

Course outcomes:

On successful completion of the course the students will be able to

CO-1	Understand the basic concepts of ecosystem and ecology
CO-2	Gain insights to various biodiversity across the country and globe face.
CO-3	Understand the History, guiding principles, conservation of ecology and biodiversity as per ICUN.
CO-4	Learn the importance of pollution damages environmental through how it influence biodiversity
CO-5	Interpret and understand how water pollution affects environment and its remedies.

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

SYLLABUS | Elective Paper- IV| BIODIVERSITY				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
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	CO1	K1 &K2
II	Biodiversity and its origin, Global and local trends , Mega biodiversitycountries, hot spots and heritage sites, types of diversity, levels of biodiversity (genetic, species, ecological diversities), value of biodiversity.	5	CO2	K2 & K3
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	CO3	K2,K3 & K4
IV	Environmental Pollution- Causes, effects and control measures of air pollution, water pollution, soil pollution, noise pollution, thermal pollution and solid waste management. Environment Protection Act: Air, water, forest and wild life acts, issues involved in enforcement of environmental legislation.	5	CO4	K2,K3,K4
V	Water conservation, Rain water harvesting & watershed management, andenvironmental ethics. Climate change, global warming, acid, rain, ozone layer depletion. Environmental protection act, population explosion.Disaster management.	5	CO5	K2,K3 & K5

Text Book:

1. Alcock J 2013 AnimalBehavior: An Evolutionary Approach, 10th edition (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.) 2001 Animal: the definitive visual guide to worlds‟ wildlife (Cambridge University Press)
4. Collen B, Pettorelli N, Baillie J E M and Durant S M (Eds) 2013 Biodiversity Monitoring and

Conservation: Bridging the Gap Between Global Commitment and Local Action(WileyBlackwell)

5. GL. Karia and R.A. Christian, West Water Treatment, Concepts and Design Approach, Prentice Hall of India,2005.
6. Benny Joseph, Environmental Studies, Tata McGrawHill,2005

Reference books

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

WEB RESOURCES:

1. https://swayam.gov.in/nd1_noc20_hs18/preview
2. https://nptel.ac.in/courses/109/106/109106092/
3. https://onlinecourses.nptel.ac.in/noc20_hs18/preview
4. 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 – L

Semester: II **Course Code: P23BT2E1**

Credits : 2 **Total Hrs/ Week : 4**

NMEC I - HUMAN AND ENVIRONMENT

Objectives

- To throw a light on the physiological functions of human and the impact of environmental changes.
- To provide awareness to the society on the deleterious effects produced by human to the society.
- To provide an in depth knowledge about the various impacts of global environmental changes.
- To have an additional knowledge about the different environment related issues and management strategies.
- To address the recent problems like Pollution, solid waste management, Acid rain, Global warming also create awareness about control and remedies.

Outcomes

At the end of the course students will be able to

- Carry the importance of bioscience and helps in integrating it with the day to day life.
- Gain knowledge on the effects of GM foods.
- Be convinced on the hazardous effects of stress, junk food and smoking to society.
- Lay a strong foundation in treating various environment related problems.
- Inter relate the concept of environment and biotechnological applications.
- Face challenging issues and offers solutions as introduction of biopesticides.

UNIT - I

Global Climatic and Environmental Changes

The human species - distribution and tolerances - body temperature and thermoregulation - response to high temperature, response to cold stress, high altitude. People and environment - overcoming oxygen scarcity, circadian rhythms - nature and control, jet lag and shift work, Man in space - space food, water in space.

UNIT -II

Pollution and Environmental Deprivation

Pollution of air, water, soil and their deleterious effects- Acid rain- Global warming; Transfer of harmful compounds through ecosystems; Control and remedies of pollution- Eco friendly cars, biofuels, Bio gas. Solid waste Management: Causes, effects and control measures of urban and industrial wastes recovery and utilization of resources.

UNIT- III

Changing Food Habits in Man

Environment risks of direct and indirect food additives, food colors and other contaminants, food fads and fallacies. GM foods - definition, why GM foods, potential risks to human health, risk assessment for the environment, GM foods in future.

UNIT- IV

Environment and Human Health

Stress and heart disease, junk food and obesity, psychotic behavior and their outcomes such as dementia, depression, schizophrenia. Smoking and man - hazardous effects of smoking.

UNIT- V

Biology and Future of Man

New application of biological sciences towards human welfare - Human gene therapy; Human population growth ¬Control of human fertility, Possible means of birth control, Invitro fertilization, Ethical considerations Eugenics, Guarding the genetic quality of man. Future of Homo sapiens

TEXT BOOKS

1. Agarwal, K.C. "Environmental Biology", Nidi Publ. Ltd. Bikaner, 2001.
2. Odum, E.P. "Fundamentals of Ecology". W'B, Saunders Co. USA, 1971.
3. John Adds, Erica Larkcom,Ruth Miller; "The organism and the environment", 2nd edition, Thomas Nelson and sons Ltd. Unit I,1997.

REFERENCES

1. " Environmental biotechnology" S.N. Jogdand. Himalaya publishing House. Bombay.
2. " Environmental Biotechnology" Alan Scragg. Pearson Education Limited, England,1999
3. "Wastewater engineering –Treatment Disposal and Reuse ".Metcalf and Eddy, Inc.Tata McGraw Hill, New Delhi,1979.
4. "Ecotoxicology", Schurmann, G.A .John Wiley & Sons, Inc, 1998.
5. "Environmental Toxicology and Chemistry". Crosby, Donald. G. Oxford University press, 1998.
6. "Introduction to Environmental Toxicology: impacts of chemicals upon Ecological systems":Landis,
7. Wayne and Hing-ho yu, Beca Raton, Lewis Publishers, 1995.

SEMESTER - III

Semester: III **Course Code: P23BT306**

Credits : 5 **Total Hrs/ Week : 6**

Core Paper-6

PLANT BIOTECHNOLOGY

Paper – 6			
Title of the paper	**PLANT BIOTECHNOLOGY**	Subject code:	
Category of the course	Year	Semester	Credits
Core Paper	2nd	3rd	5

Learning Outcome:

This paper has been designed to give the students comprehensive knowledge about the applications of plant Molecular biotechnology for increasing agricultural production, environment improvement, human, nutrition andhealth. Help students to get a career in both industry/R & D.

Course outcomes:

CO-1	To know about genomic organization in plants and about theMarkers
CO-2	To know methods of gene transfer in plants
CO-3	To understand the plant genetic engineering aspect
CO-4	To know plant cell and tissue culture techniques
CO-5	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

SYLLABUS | Core Paper-6 | PLANT BIOTECHNOLOGY				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
I	Genome organization in Plants Nucleus, 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	CO1	K1 & K2
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	CO2	K2,K3 & K5
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	12 hours	CO3	K2 & K5

	plants. Genome editing technology in Plant-CRISPR/Cas.			
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	CO4	K4 & K5
V	Application of transgenesis for : crop improvement: Insect resistance, disease resistance, virus 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. Expression of recombinant antibody fragments in plants.	12 hours	CO5	K3,K4 & K6
VI	Internal Assessment: Assignments, Seminars and Guest lecturers	5 hours		
	Total Lecture hours 65 hours	65 hours		

Text Book(s)

1. Plant Biotechnology: The genetic manipulation of plants. Second edition. Slater, Scott, andFowler, 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 IBHPublishing Co., 2003.
4. Introduction to plant biotechnology, Third edition, H S Chawla, 2009.
5. Cassells, A. C and Peter B. Gahan. (2006).
6. Dictionary of Plant Tissue Culture. FoodProductsPress, an Imprint of the Haworth Press, Inc., New York-London-Oxford.
7. 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).
8. Handbook of Plant Biotechnology, 2nd volume set, Wileypublisher.
9. Bhojwani and Dantu, (2013). Plant Tissue Culture: an Introductory Text, Springer, New Delhi.
10. 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 ofplants 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 Donald Grierson 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

Semester: III **Course Code: P23BT307**

Credits : 5 **Total Hrs/ Week : 6**

Core Paper-7

ANIMAL BIOTECHNOLOGY

Paper – 7			
Title of the paper	**ANIMAL BIOTECHNOLOGY**	Subject code:	
Category of the course	Year	Semester	Credits
Core Paper	2nd	3rd	5

Learning Outcome:

To provide an overview and current developments in different areas of animal Biotechnologyand its application

Course outcomes:

CO-1	To know about the genetic engineering tools, vectors, methodsof gene cloning.
CO-2	To know techniques and application of animal in rDNAtechnology
CO-3	To understand about the animal tissue culture
CO-4	physiology, production, yield and management of crops and agricultural plants or trees, shrubs, and nursery stock, theirgrowth in soils, and control of pest
CO-5	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

SYLLABUS | Core Paper-7 | ANIMAL BIOTECHNOLOGY				
Unit	**Content**	**Hours**	**Cos**	**Cognitive level**
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	CO1	K1 & K2
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	CO2	K2,K3 & K5
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	CO3	K2 & K5
IV	Testing of drugs, testing the toxicity of environmental pollutants in cell culture, Cytotoxicity, Apoptosis, Tissue, Diagnostic antigens	12 hours	CO4	K4 & K5
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	CO5	K3,K4 & K6
VI	Internal Assessment: Assignments, Seminars and Guest lecturers	5 hours		
	Total Lecture hours 65 hours	65 hours		

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:

1. https://www.sciencedirect.com/book/9780128117101/animal-biotechnology#book-description,

E-Books:

1. https://www.pdfdrive.com/animal-biotechnology-e41305678.html,

E- journals:

1. 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

Semester: III **Course Code: P23BT308**

Credits : 5 **Total Hrs/ Week : 6**

Core Paper-8

MICROBIAL BIOTECHNOLOGY

Paper – 8			
Title of the paper	**MICROBIAL BIOTECHNOLOGY**	Subject code:	
Category of the course	Year	Semester	Credits
Core Paper	2nd	3rd	5

Learning Outcome:

The study of microbes helps us to understand our world and our place within it. It gives us insights into the complexity of nature and society, which in turn provide much different health, environmental, social, cultural, industrial, and economic benefits.

Course outcomes:

CO-1	To identify the nature of bioprocess engineering technology
CO-2	To differentiate the fermentation technology and typthe es of the fermentation process.
CO-3	To describe the downstream processing in cell disruption, precipitation methods,
CO-4	To explain the advantage of industrial application
CO-5	To analyze and can cross-examine the Production of industrial importance.

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

SYLLABUS | Core Paper-8 | MICROBIAL BIOTECHNOLOGY				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
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 theirfunctions; Airlift bioreactor, Tubular bioreactors, Membrane bioreactors, Tower bioreactors, Fluidized bed reactor, Packed bed reactors and Photo bioreactors.	12 hours	CO1	K1 & K2
II	Fermentation technology: Natural and synthetic media; Strategiesfor 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	CO2	K2,K3 & K5
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	CO3	K2 & K5
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	CO4	K4 & K5
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	12 hours	CO5	K3,K4 & K6

	alkanoates (butyrate, propionate).			
VI	Internal Assessment – Seminar, Assignment, Lecture	05 hours		
	Total Teaching hours	65		

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

Semester: III **Course Code: P23BT3P2**

Credits : 4 **Total Hrs/ Week : 6**

CORE PRACTICAL -II

LAB IN PLANT BIOTECHNOLOGY AND ANIMAL BIOTECHNOLOGY

Core Practical - I I			
Title of the paper	**LAB IN PLANT BIOTECHNOLOGY AND ANIMAL BIOTECHNOLOG**		Subject code:
Category of the course	Year	Semester	Credits
Core Paper	2nd	3rd	4

Learning Outcome:

The practical will establish a basic study skills on the subject and will improve the student's ability to calculate and improve their practical skill and knowledge.

Course outcomes:

On successful completion of the course the students will be able to

CO 1	(K2) Illustrate basic biochemistry procedures
CO 2	(K3) study the methods of estimation of biomolecules
CO 3	(K4) isolate & Analyze DNA, RNA & protein
CO 4	(K5) critically analyze the isolated biomolecules
CO 5	(K5) evaluate the quality and purity of DNA, RNA & Protein

SYLLABUS | Core Practical -I				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
A	**(A) Plant Biotechnology - Practical** 1. Introduction to plant tissue culture-induction of callus and suspensioncultures. 2. Isolation and purify the protoplasts and check itsviability. 3. Induction of somatic embryogenesis and analysis of differentstages. 4. Extract the genomic DNA from plants byCTAB 5. Culture and selection of Agobacteriumon Agarmedium 6. Agrobacterium mediated genetransformation 7. Use of Agroinfilteration for Transient	15	CO1 CO2 CO3 CO4 CO5	K3 & K4

	Expression inPlant 8. Gusassay 9. Analysis of WT/ Transgenic plant byPCR 10. Isolation of Total RNA fromleaves 11. Gene gun method oftransformation 12. Synthetic seedpreparation			
B	**(B) Animal Biotechnology - Practical** 1. Development of primary cell lines/maintenance of established celllines. 2. Cell counting and cellviability. 3. Trypsinization of monolayer and subculturing. 4. Gene transfer bytransfection 5. Preparation of metaphase chromosomes from culturedcells. 6. Isolation of DNA and demonstration of apoptosis of DNAladdering 7. MTT assay for cell viability andgrowth	15	CO1 CO2 CO3 CO4 CO5	K3,K4 &K5

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.

Semester: III **Course Code: P23BT3:A**

Credits : 3 **Total Hrs/ Week : 3**

Elective Paper-V (A)

MEDICAL MICROBIOLOGY

Elective Paper – V (A)			
Title of the paper	**MEDICAL MICROBIOLOGY**		Subject code:
Category of the course	Year	Semester	Credits
Elective Paper	2nd	3rd	3

Learning Outcome:

To enable the students to understand the basics of Medical Microbiology

Course outcomes:

CO-1	To know the basics of collection and transport of microbial source
CO-2	To understand the host parasite relationship
CO-3	To learn bacterial pathogens and its related diseases of phase I
CO-4	To bacterial pathogens and its related diseases of phase II
CO-5	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

SYLLABUS | Elective Paper-V (A) | MEDICAL MICROBIOLOGY

Unit	Content	Hours	COs	Cognitive level
I	Collections and transport of specimens: Collections and transportof specimens. Primary Media for isolation and their quality control. Antibiotic sensitivity testing procedure.	5 hours	CO1 CO5	K3 & K5
II	Host Parasite Relationship: Normal microbial	5	CO1	K3 & K5

	flora of human body, Virulence factors of bacteria causing infection, Microbial Infections, Host Parasite Relationships.	hours	CO2 CO5	
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	CO1 CO3	K3 & K4
IV	Bacterial pathogens and associated diseases part II E,coli, Samonella, Shigella, Vibrio, pseudomonas, Spirochaetes,Rickettisiae. Gram Negative anaerobes.	5hours	CO1 CO4	K3, K4 & K6
V	Nosocomial and Zoonotic diseases, Hospital acquired infection – infection control committee, Zoonotic diseases- Anthrax, Plague.	5hours	CO1 CO5	K3,K4, K5 & K6
VI	Internal Assessment: Assignments, Seminars and Guest lectures	5 hours		
	Total Lecture hours	30 hours		

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
3. Colle JC, Duguid JP, Fraser AC, Marimon (Bp) 1996. Mackie and McCartney Practical Medical Microbiology14thEdn. Churchill Livingstone.
4. Baron L.J, Peterson L.R and Finegod S.M (1994) Bailey and Scott Diagnostic Microbiology, 9thEdn. MosbyPublications.
5. 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

Semester: III **Course Code: P23BT3:B**

Credits : 3 **Total Hrs/ Week : 3**

Elective Paper-V (B)

FOOD & NUTRITION

Elective Paper – V (B)			
Title of the paper	**FOOD & NUTRITION**	Subject code:	
Category of the course	Year	Semester	Credits
Elective Paper	2nd	3rd	3

Learning Outcome:

To enable students to gain a deeper understanding about principles of nutrition and also to develop competence to carry out investigation in nutrition

Course outcomes:

CO-1	To differentiate the foods types and their nutritive value.
CO-2	To develop competence to carry out investigation in nutrition
CO-3	To measure and calculate calorific value of different types of foods
CO-4	To identify the food adulterants and food poisoning
CO-5	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

SYLLABUS | Elective Paper-V (B) | FOOD & NUTRITION				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
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.	10 hours	CO1 CO5	K3 & K5
II	Introduction to Vitamins., Fat soluble vitamins,	08	CO1	K3 & K5

	Water solublevitamins	hours	CO2 CO5	
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.	13 hours	CO1 CO3	K3 & K4
IV	Definitions of food adulterations and food poisoning, Sources of foods and types of adulterants, advantages and disadvantages of adulteration, Constituents of foods, carbohydrates, proteins, fats, oils, Flavours, colours and natural toxicants, Sources causes and remedies for acidity, gastritis, indigestion and constipation.	08 hours	CO1 CO4	K3, K4 & K6
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.	08 hours	CO1 CO5	K3,K4, K5 & K6
VI	Internal Assessment: Assignments, Seminars and Guest lectures	5 hours		
	Total Lecture hours 50 hours	50 hours		

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, a lange medical book 26th Ed.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. Public Health Nutrition. Blackwellscience, Blackwell Publishing Company (2004).
8. Frazier, We, Food Microbiology, Tata Mc Graw Hill 1978.
9. Meyer, Lilian H. Ed. (1987), Food chemistry. Indian Ed. CBS Publishers and Distributors

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

Semester: III **Course Code: P23BT3:C**

Credits : 3 **Total Hrs/ Week : 3**

Elective Paper-V (C)

HERBAL BIOTECHNOLOGY

Elective Paper – V (C)			
Title of the paper	**HERBAL BIOTECHNOLOGY**		Subject code:
Category of the course	Year	Semester	Credits
Elective Paper	2nd	3rd	3

Learning Outcome:

To give the details of plant-derived value-added compounds and their functions. To provide knowledge onbiotech-based production of Herbal medicines.

Course outcomes:

CO-1	To know the Study of on history and scope of herbals
CO-2	To understand the Important medicinal herbs in treating diseases
CO-3	To learn the Biotechnological methods of plant propagation
CO-4	To explore methods Involved in secondary metabolite production
CO-5	To know about pharmaceutical applications and Intellectual PropertyRights

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

SYLLABUS | Elective Paper-V (C) | HERBAL BIOTECHNOLOGY				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
I	Study of on history and scope of herbals - Introduction to the Indian system ofmedicine – Herbal drugs and importance- Herbal Cosmetic and Cosmeceuticals - Formulation Development of herbal preparations - Herbal Drug discovery andNovel drug delivery systems.	10 hours	CO1 CO5	K3 & K5

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.	8 hours	CO1 CO2 CO5	K3 & K5
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	CO1 CO3	K3 & K4
IV	Methods Involved in secondary metabolite production - Organ culture, Cellculture, Biotransformation (Microbial and Plant cells) - Scale up – Enhancement of product formation by elicitation-Immunodiagnostics andmolecular diagnostics in selection of elite plant species.	8 hours	CO1 CO4	K3, K4 & K6
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.	8 hours	CO1 CO5	K3,K4, K5 & K6
VI	Internal Assessments, Seminars, and Guest lecture	5 hours		
	Total Teaching hours	**50 hours**		

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 and Aromatic plants, Vols. I-X.Ukaaz Publications, Hyderabad. Analytical techniques in DNA sequencing edited by Brian K. Nunnally.
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 Plant Genetic 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 Remedies,SelviPathipagam, Trichy.

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

Semester: III **Course Code: P23BT3E2**

Credits : 2 **Total Hrs/ Week : 3**

NMEC II: Biotechnology for Society

Learning Objective		
LO1	Will understand the role of Biotechnology in Sericulture, Apiculture and Mushroom Cultivation	
LO2	Will gain knowledge about the production of Bio fertilizer and advantages of Biopestisides	
LO3	Will understand the significance of microorganisms in Biodegradation	
LO4	Will get know about History of Antibiotics	
LO5	Will able to comprehend about Transgenic Plants	
UNIT	**Contents**	**No. of Hours**
1	Introduction to Biotechnology- Role of Biotechnology in sericulture- Rearing of silkworms- Importance and applications- Role of Biotechnology in apiculture- Bee hive hierarchy- Bee keeping process- Products obtained- Mushroom farming stages- Cultivation of paddy straw mushroom- Importance of mushroom cultivation.	15
II	Biofertilizer- Definition- Mass production of *Rhizobium*-Advantages and disadvantages- Biopesticides- Definition- Microbial biopesticides- *Bacillus thuringiensis*- Single cell protein- Introduction- history- production of *Spirulina* SCP- Applications- Advantages & disadvantages.	15
III	Biodegradation- Definition- Process-role of microorganisms in biodegradation - biodegradable plastics-advantages- Bio weapons- introduction- history- potential agents- delivery methods- harmful effects.	15
IV	Antibiotics- Definition- Introduction and history of antibiotics- sources- classification- spectrum- production of penicillin- definition of antibiotic resistance.	15
V	Transgenic plants – Definition of transgene and transgenesis - BT Cotton, Flavr-Savr tomato and Golden rice- history – importance, applications, advantages and disadvantages.	15
Total		**75**

Text Books	
1	Sathyanarayana, U., Chakrapani, U., (2008). *Biotechnology,* First edition, Books and allied (P) Ltd, Kolkata.
2	A.K. Chatterji, (2011).*Introduction to Environmental Biotechnology,* Third edition, PHI Learning Pvt Ltd. New Delhi. ISBN-978-81-203-4298-9
3	R.C. Dubey, (2014*). A text book of Biotechnology*, *S.Chand& Company, New Delhi.* ISBN 9788121926089
4	H. Patel, (2011).*Industrial Microbiology*,(2nd edition), MacMillan Publishers
5	Thakur, I.S., (2019).*Environmental Biotechnology- Basic principles and applications- (*2nd edition)- Dreamtech Press, ISBN 978-93-89307-55-9
3	
1	Basics of Biotechnology Paperback – 1 January 2004 by A.J. Nair (Author) Publisher Laxmi Publications
2	Basic Biotechnology Paperback – 2 February 2008 by Ratledge Colin (Author) Publisher Cambridge University Press

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**
CLO1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO2	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**3**
CLO3	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**2**	**3**
CLO4	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO5	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**3**
TOTAL	**15**	**14**	**15**	**15**	**14**	**15**	**13**	**14**	**15**
Average	**3**	**2.8**	**3**	**3**	**2.8**	**3**	**2.6**	**2.8**	**5**

Semester: III **Course Code: P23BT3F1**

Credits : 2 **Total Hrs/ Week : --**

INTERNSHIP

Paper –			
Title of the paper	INTERNSHIP	Subject code:	
Category of the course	Year	Semester	Credits
Paper	1st	2nd	2

Learning Outcome:

To gain hands on training and expertise in handling sophisticated instruments and acquire in depth knowledge in their applications.

Course outcomes:

The student will learn to

CO-1	(K2) understand working principles and the techniques of various processes
CO-2	(K3) apply standard operating procedures followed in industries
CO-3	(K3) prepare to face challenges & gain confidence in the field of study.
CO-4	(K5) critically assess the utilization of sophisticated instruments and expensive consumables
CO-5	(K6) develop work ethics to be followed in a scientific laboratory

SEMESTER - IV

Semester: IV **Course Code: P23BT409**

Credits: 5 **Total Hrs/ Week : 6**

Core Paper- IX

Environmental Biotechnology

Paper – IX			
Title of the paper	Environmental Biotechnology	Subject code: P23BT409	
Category of the course	Year	Semester	Credits
Core Paper	II	IV	5

Learning Outcome:

To acquire a basic comprehension of the environment in its totality and of its problems and to provide an understanding of the environmental and biological challenges facing society through the integration of biology with legal, regulatory and social issues.

Course outcomes:

On successful completion of the course the students will be able to

CO-1	Understand and assimilate the specific concepts and terminology of environmental biotechnology.
CO-2	Describe the properties of microorganisms with potential applicationto environmental biotechnology processes.
CO-3	Explain technologies, tools and techniques in the field ofenvironmental biotechnology.
CO-4	Know the role of microorganisms as biotechnological agents
CO-5	Analyze and the apply the methods of biodegradation for environmental pollution

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

SYLLABUS | Core Paper- IX| Environmental Biotechnology				
Unit	**Content**	**Hours**	**Cos**	**Cognitive level**
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	CO1	K1 & K2
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	CO2	K1,K2,K3,
III	Bioremediation: Introduction of Bioremediation advantages and applications; Types of bioremediations. Microbial remediation of phenolics-sewage nutrients (phosphate and nittare). Impact of bioremediation in the petroleum industry, paper industry, marine oil pollutants and chemical industry. Phytoremediation advantages and applications (agriculture).	12	CO3	K1,K2,K3
IV	Biocorrosion and microbial mediated recovery: Microbial corrosion and its control (petroleum industry and cooling tower system). Bio metallurgy- Bioleaching- application, biotechnology approaches for heavy metal elimination from effluents. Bio-mediated recovery of metals (gold and platinum). Recovery of petroleum-MEOR-Biosurfactant.	12	CO4	K4 &K5
V	Biodegradation: Biodegradation of organic pollutants: Mechanisms and factors affecting biodegradation. Pollution problems and biodegradation of simple aliphatic, aromatic, polycyclic aromatic hydrocarbons, halogenated hydrocarbons, azo dyes, lignin and pesticides. Bioenergy.	12	CO5	K4 & K5

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.

REFERENCE BOOKS

1. Agarwall KV. (2005). Environmental Biotechnology, Nidhi Publishers.
2. Jogdand SN.(2008).Environmental Biotechnology, 4th Edt Himalaya Publishing House Pvt. Ltd.
3. Fundamentals of Ecology Eugene P. Odum and Gary W (2007). Barrett. Saunders Publishers.
4. Instant Notes in Ecology Aulay MacKenzie, Andy Ball and Sonia Virdee (2001). Taylor & Francis Publishers.
5. Environmental Biotechnology by Alan Scragg (2005). IInd edition. Pearson Education Limited, Eng.
6. Environmental Biotechnology by S.N.Jogdand. (1995). Ist edt. Himalaya Publishing House. Bombay
7. Wastewater Engineering – Treatment, Disposal and Reuse. Metcalf and Eddy (2017). Tata Mc Graw Hill, New Delhi.
8. Environmental chemistry by A.K. De (2007). New Age international Publishers.
9. Introduction to Biodeterioration by D. Allsopp and K.J. Seal, (2004). Cambridge University Press.

WEB RESOURCES

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

Semester: IV **Course Code: P23BT410**

Credits: 5 **Total Hrs/ Week : 6**

Core Paper- X

Research Methodology

Paper – X			
Title of the paper	Research Methodology	Subject code: P23BT410	
Category of the course	Year	Semester	Credits
Core Paper	II	IV	5

Learning Outcome:

To enable the students to understand the importance of research, familiarize themselves with writing the project report, and learn about the various applications of statistics in the research.

Course outcomes:

On successful completion of the course the students will be able to

CO-1	understand research concepts, issues and types andbasic knowledge of qualitative research
CO-2	comprehend, and explain researcharticles in their academic discipline.
CO-3	develop an understanding of various kinds of research, objectives of doing research, research process, research designs, sampling, principles andresearch techniques.
CO-4	Elucidate the Observation and Collection ofdata and Generalization and Interpretation
CO-5	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

SYLLABUS | Core Paper- X| RESEARCH METHODOLOGY				
Unit	**Content**	**Hours**	**Cos**	**Cognitive level**
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	CO1	K1 & K2
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	CO2	K1,K2,K3,
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	CO3	K1,K2,K3
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	CO4	K4 &K5

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 ofIntellectual Property Rights - Reproduction of published material-Plagiarism - Citation and acknowledgement Reproducibility and accountability. _	12	CO5	K4 & K5

TEXT BOOKS

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, 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 geographical indications. Universal Law Publishing

REFERENCE BOOKS

6. Satarkar, S.V., 2000. Intellectual property rights and Copy right, Ess Publication
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

WEB RESOURCES

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

Semester: IV **Course Code: P23BT4:A**

Credits : 3 **Total Hrs/ Week : 4**

Elective Paper-VI

Bioethics, Biosafety, and IPR

Paper – ELECTIVE VI- Bioethics, Biosafety, and IPR			
Title of the paper	Biodiversity		Subject code: P23BT4:A
Category of the course	Year	Semester	Credits
Elective Paper	2	IV	3

Learning Outcome: Students get an idea about the advantages and disadvantages of biotechnological applications, ethical implications, and intellectual property rights.

Course outcomes:

On successful completion of the course the students will be able to

CO-1	Understand the rationale for and againstIPR and especially patents.
CO-2	Elucidate why India has adopted anIPR Policy and be familiar with broad outline of patent regulations.
CO-3	different types of intellectual property rights in general and protection of products derived frombiotechnology research and issues related to application and obtaining patents
CO-4	Gain knowledge of biosafety and riskassessment of products derived from recombinant DNA research and environmentalrelease of genetically modified organisms, national and international regulations
CO-5	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	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

SYLLABUS | Elective Paper- VI| BIODIVERSITY				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
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	CO1	K1 &K2
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	CO2	K2 & K3
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	CO3	K2,K3 & K4
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	CO4	K2,K3,K4
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	CO5	K2,K3 & K5

Text Book:

1. IPR, Biosafety and Bioethics (2013), by Deepa Goel, Shomini Parashar

2. Biodiversity and Biomedicine: Our Future (2020), 1st edition by Munir Ozturk, Dilfuza Egamber dieva, Milica Pešić.

3. The basics of bioethics (2019), 4th edition by Guidry-Grimes, Laura; Veatch, Robert.

Reference books:

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

WEB RESOURCES:

1. https://swayam.gov.in/nd1_noc20_hs18/preview
2. https://nptel.ac.in/courses/109/106/109106092/
3. https://onlinecourses.nptel.ac.in/noc20_hs18/preview
4. 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

Semester: IV **Course Code: P23BT4:B**

Credits : 3 **Total Hrs/ Week : 4**

Elective Paper-VI

Nano Biotechnology

Paper – ELECTIVE VI- Nano Biotechnology			
Title of the paper	**Nano Biotechnology**		Subject code: P23BT4:B
Category of the course	Year	Semester	Credits
Elective Paper	2	IV	3

Learning Outcome: This discipline helps to indicate the merger of biological research with various fields of nanotechnology. This technical approach to biology allows scientists to imagine and create systems that can be used for biological research. The most important objectives that are frequently found in nano biology involve applying nano tools to relevant medical/biological problems and refining theseapplications.

Course outcomes:

On successful completion of the course the students will be able to

CO-1	Understand Nano technology on Cancer treatment
CO-2	Elucidate Nano Technology application in Diabetes
CO-3	develop an understanding Nano technology effecton target drug delivery
CO-4	Comprehend the Nano technology uses inenvironmental remediation and recycling process
CO-5	Analyze the Nano technology uses in variousbiomedical & agriculture applications

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

SYLLABUS | Elective Paper- VI| Nano Biotechnology				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
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	CO1	K1 &K2
II	Microbial nanotechnology -Microbial synthesis of nano drugs-metal nano particles and drug delivery vehicles- Nanoshels – Tectodentrimers Nanoparticle drug systems- diagnostic applications of nanotechnology.	8	CO2	K2 & K3
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	CO3	K2,K3 & K4
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	8	CO4	K2,K3,K4
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.	8	CO5	K2,K3 & K5

Text Book:

1. Parthasarathy, B.K (2007). Introduction to Nano technology, Isha publication.
2. Elisabeth Papazoglou and Aravind Parthasarathy (2007).Bio nanotechnology. Morgan & Claypool publishers.
3. Bernd Rehm (2006). Microbial bio nanotechnology: biological self-assembly 78 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 publishing housePvt.

8. Nanotechnology: Global strategies, Industry Trends and applications 2005John Wiley & sons Ltd.

Reference books:

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 Revised Edition, 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 and function. Amsterdam: Academic Press, 3rd edition, 2018.

WEB RESOURCES:

https://jnanobiotechnology.biomedcentral.com/,
http://www.a-zshiksha.com/forum/viewtopic.php?f=148&t=61561.

https://digital-library.theiet.org/content/journals/iet-nbt

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

Semester: IV **Course Code: P23BT4:C**

Credits : 3 **Total Hrs/ Week : 4**

Elective Paper-VI

System Biology

Paper – ELECTIVE IV- BIODIVERSITY			
Title of the paper	System Biology	Subject code: P23BT4:C	
Category of the course	Year	Semester	Credits
Elective Paper	2	IV	3

Learning Outcome: To gain basic knowledge of systems biology and understand some of the larger questions and issues with systems biology and large-scale data collection and analysis

Course outcomes:

On successful completion of the course the students will be able to

CO-1	provide basic knowledge on databases that are related with systems biology
CO-2	teach microarray tools to become familiar with system biology
CO-3	learn KEGG and biochemical neural networks to find protein and carbohydrate mechanism related to systems biology
CO-4	teach Integration of networks, data integration, modeling for metabolomics.
CO-5	learn the 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	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

SYLLABUS | Elective Paper- VI| System Biology				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
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	CO1	K1 &K2
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.	8	CO2	K2 & K3
III	Protein-carbohydrate metabolism; Biochemical cycles; Interconnection of pathways- metabolic regulation; Translating biochemical networks into linear algebra; KEGG: theory and practice	13	CO3	K2,K3 & K4
IV	Genomics, Proteomics, Metabolomics, Transcriptomics, Interactomics, Phenomics, Localizomics; Gene networks -Integration of Networks. Combination of omics approaches:data integration, modeling;	8	CO4	K2,K3,K4
V	Synthetic biology, Artificial Intelligence (AI): Methodology, tools, and its application in agriculture, drug discovery, andbiomedicine.	8	CO5	K2,K3 & K5

Text book and reference books

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 on Genomics 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 systems biology. Trends in Genetics, 2003, 19, 10: 551-560.
5. Chong et al. Wholistic Biology, Science, 200820, 295:1661.

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

Mapping with Programme Outcomes

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

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

Semester: IV **Course Code: P23BT4S1**

Credits : 2 **Total Hrs/ Week :4**

SEC - IV SELECTED TOPICS FOR LIFE SCIENCE COMPETITIVE EXAMS (NET, SET, GATE, GAT B)

Course Objectives:

- To improve academic skill.
- To develop career track.

Unit-I: MOLECULES AND THEIR INTERACTION RELAVENT TO BIOLOGY

Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins). Stablizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.). Bioenergetics, glycolysis, oxidative phosphorylation Conformation of nucleic acids (helix (A, B, Z), t-RNA, micro-RNA). Metabolism of carbohydrates, lipids, amino acids nucleotides and vitamins.

Unit-II: CELLULAR ORGANIZATION AND COMMUNICATION

Membrane structure and function: Structure of model membrane, lipid bilayer and membrane protein diffusion,osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.

Structural organization and function of intracellular organelles : Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function ofcytoskeleton and its role in motility.

Organization of genes and chromosomes: Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons. **Cell division and cell cycle:**Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle.

Cellular Communication: Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and itsregulation.

Cancer: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle,virus-induced cancer, metastasis, interaction of cancer cells with normal cells,

apoptosis, therapeutic interventions of uncontrolled cell growth.

Programmed cell death, aging and senescence-Apoptosis, DNA repair enzymes, Insulin signaling pathway,Chromatin deacytylase mTOCR1 gene

Unit-III: FUNDAMENTAL PROCESSES

DNA replication, repair and recombination: Unit of replication, enzymes involved, replication origin andreplication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms, homologous and site-specific recombination.

RNA synthesis and processing: Transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport).

Protein synthesis and processing : Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity,aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post- translational modification of proteins.

Control of gene expression at transcription and translation level: Regulating the expression of phages, viruses,prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing.

Unit-IV: IMMUNOLOGY

Innate and adaptive immune system : Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity. B and T cell epitopes, structure and function of antibody molecules. generation of antibody diversity, monoclonal antibodies, antibody engineering, antigen-antibody interactions, MHC molecules, antigen processing and presentation, activation and differentiation of B and T cells, B and T cell receptors, humoral and cell-mediated immune responses, primary and secondary immune modulation, the complement system, Toll-like receptors, cell-mediated effector functions, inflammation, hypersensitivity and autoimmunity, immune responseduring bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, congenital and acquired immunodeficiencies, vaccines. Signal Transduction.

Unit- V: DEVELOPMENTAL BIOLOGY

Gametogenesis, fertilization and early development: Production of gametes, cell surface molecules in sperm-eggrecognition in animals; embryo sac development and double fertilization

in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination.

Morphogenesis and organogenesis in animals : Cell aggregation and differentiation in amphibia and chick; organogenesis – vulva formation in *Caenorhabditis elegans*, eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development- larval formation, metamorphosis; environmental regulation of normal development; sex determination.

Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in*Arabidopsis* and *Antirrhinum*

REFERENCES

1. Geoffrey M Cooper., and Robert E Hausman., The Cell-A Molecular Approach, Sixth Edition, ASM Press,Washington, 2013
2. Harvey Lodish., Arnold Berk., Paul Matsudaira., Chris A. Kaiser., Monty Krieger., Matthew
3. P. Scott., Lawrence Zipursky., James Darnell., Molecular Cell Biology, Sixth Edition, 2008
4. Gerald K., Cell and Molecular Biology, Third edition, John Wiley & Sons, New York, 2001
5. Alberts et al. Essential Cell Biology: An Introduction to the Molecular Biology of the Cell, Second Edition,Garland Science Taylor & Francis Group, New York, 2003
6. Benjamin A. Pierce., Genetics-A Conceptual Approach, W.H.Freeman & Company, New York, Second Edition,2006.
7. Deb A.C., Fundamental of Biochemistry, New Central Book Agency, Calcutta, Seventh Edition, 2001
8. David Rawn J., Biochemistry, Neil Patterson Publications, 2005
9. Nelson L. D., and Cox M. M., Lehninger's Principle of Biochemistry, Macmillan, Worth Publication Inc., SixthEdition, 2013
10. Berg J.M., and Stryer L., Biochemistry, W.H. Freeman & Co. New York, Seventh Edition, 2007
11. Thomas M. Devlin., Biochemistry with Clinical Correlation, Wiley-Liss Publication, Fifth Edition, 2002

12. Satyanarayana U., Biochemistry, Books and Allied Pvt. Ltd. Calcutta, 1999.

13. Janis Kuby J., Immunology, Fourth Edition, W. H. Freeman & Co.,

Semester: IV **Course Code: P23BT4PJ**

Credits : 7 **Total Hrs/ Week : 8**

Core Project-1

PROJECT

Paper – 14			
Title of the paper	DISSERTATION	Subject code: P23BT4PJ	
Category of the course	Year	Semester	Credits
Core Paper	2nd	4th	8

Learning Outcome:

The paper imparts a thorough knowledge on the basics of academic research. The student will get to understand the core concepts of pursuing research.