

INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)
(Deemed to be University Estd. u/s 3 of the UGC Act, 1956)
PALLAVARAM, THALAMBUR, PERIYAPALAYAM-CHENNAI
ACCREDITED BY NAAC WITH 'A++' GRADE

POSTGRADUATE DEGREE PROGRAMME

M.Sc., Biotechnology

Two Years

CURRICULUM & SYLLABUS

REGULATION 2024

Choice Based Credit System (CBCS)

&

Learning Outcomes Based Curriculum Framework (LOCF)

Effective from the Academic Year

2024 -2025

Department of Biotechnology
School of Life Sciences

VELS

INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)
(Deemed to be University Estd. u/s 3 of the UGC Act, 1956)
PALLAVARAM, THALAMBUR, PERIYAPALAYAM-CHENNAI
ACCREDITED BY NAAC WITH 'A++' GRADE

DEPARTMENT OF BIOTECHNOLOGY

VISION OF THE DEPARTMENT
To develop as a department of eminence, by achieving high standards in both research and teaching, and to become a sought-after destination for highly motivated students and faculty. The Department aspires in delivering distinctive learning skills in biotechnology enabling excellence in professional competence and innovation for further betterment of society and mankind

MISSION OF THE DEPARTMENT	
M1	To maintain high standards of teaching by innovating pedagogy, instilling in students the ability to be lifelong learners, and continually upgrading the program curriculum with international standards of life sciences education and to meet the requirement of industry and research community.
M2	To adopt effective teaching methods to improve the learning process and impart knowledge of biology and technology.
M3	To provide a flexible curriculum that allows the students to study courses of his/her choice (through Elective courses) that will fulfill their aptitude and professional aspirations.
M4	To provide hands-on training and technical skills to transform students into technocrats and facilitate research and higher education in the fields of biotechnology.
M5	To create opportunities and a supporting infrastructure for students – through laboratory courses, projects, dissertations, and possible entrepreneurial ventures in biotechnology to achieve their aspirations. To pursue and promote cutting-edge research in selected fields of biotechnology

PROGRAMME EDUCATIONAL OUTCOMES (PEO)	
PEO1	The post-graduates of Biotechnology will able to attain the in-depth knowledge of the basic and application-oriented subjects of Biotechnology and allied fields.
PEO2	The post-graduates of Biotechnology will able to gain the ability to use the concept of theories, practical skills and latest technological tools in solving any professional issues independently in a global and societal context.
PEO3	The post-graduates of Biotechnology are equipped to design, analyze, conduct and interpret the experiments and data for the development of process/product within the realistic constraints.
PEO4	The Post graduates of Biotechnology will continue to learn and update knowledge to become an entrepreneur in a current competitive world of science & technology and also contribute to society.

PROGRAMME OUTCOMES (PO)	
PO1	Graduates will able to have knowledge on the basic and applied theories in Biotechnology.
PO2	Making the graduates to demonstrate their communication effectively and scientifically.
PO3	Developing an interdisciplinary approach and a rational thinking.
PO4	Designing of research projects that are cost effective, ecofriendly, potent and beneficial to mankind.
PO5	Providing a broad educational and analytical knowledge to make the students to appear competitive examinations.
PO6	Generating the graduates with an ability to identify, formulate and to deliver process/product with professional, societal and ethical responsibilities.
PO7	Graduates will be able to recognize need for self-learning and lifelong learning.

PO8	Environment sustainability: Successful candidates will get adequate knowledge to use information and implement solutions for environmental protection, safeguards and remediation.
PO9	Lifelong learning: Successful candidates will carry on to learn, adapt and disseminate knowledge in a world of constantly evolving technology.

PROGRAMME SPECIFIC OUTCOMES (PSO)	
PSO1	Apply fundamental knowledge of biological sciences for the human Welfare and to have successful career as professional or a researcher through lifelong learning in the field of biotechnology.
PSO2	Demonstrate the application of Biotechnological processes in industries that are of social and commercial importance.
PSO3	Exhibit skills of handling microbial processes and biochemical analysis by making use of state-of-the-art facilities and environment.
PSO4	The ability to critically analyze the research in Biotechnology and to evaluate experimental design, methodology and interpretation of results and to understand the regulation of immune responses which includes the roles of different immune cells, cytokines and signaling pathways in health and disease.
PSO5	For the effective scientific communication and to relate plants, animals and microbes and their role in ecosystem and public health research with wide opportunities and career prospects.

BOARD OF STUDIES

List of Members

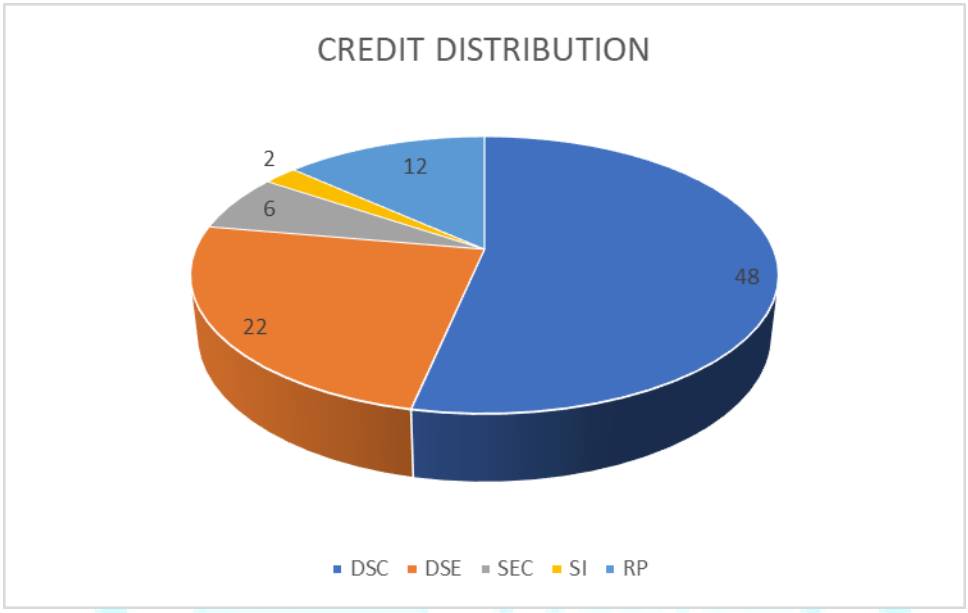
Department of Biotechnology

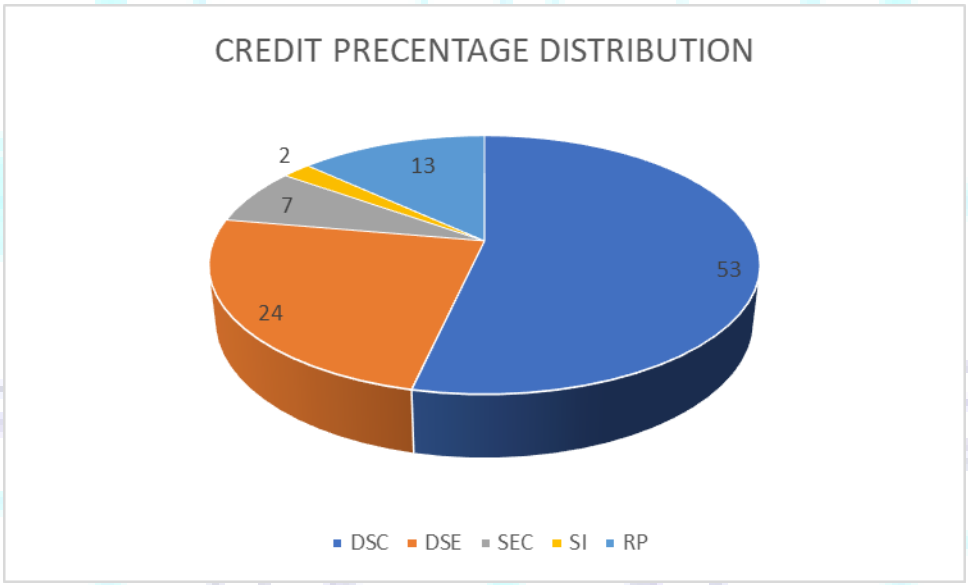
S. No	Name & Designation	Address	Role
1.	**Dr. K. Ashok Kumar** Associate Professor & Head i/c	Department of Biotechnology, Vels Institute of Science, Technology and Advanced Studies, Pallavaram, Chennai – 600117.	Internal Member
2.	**Dr. Rajeswary Hari** Professor and Head	Department of Biotechnology Dr MGR Educational & Research Institute University. Maduravoyal, Chennai – 600117	Academic Expert (External Member)
3.	**Dr. P. Balashanmugam** Director	AviGen Biotech Pvt Ltd. No7, 1st floor, 1st main road, New Colony, Chrompet, Chennai 600 044, Tamil Nadu	Industrial Expert (External Member)
4.	**Dr. N. K. Udaya Prakash** Professor	Department of Biotechnology, Vels Institute of Science, Technology and Advanced Studies, Pallavaram, Chennai-600117.	Internal Member
5.	**Dr. M. Thenmozhi** Associate Professor	Department of Biotechnology, Vels Institute of Science, Technology and Advanced Studies, Pallavaram, Chennai.600117.	Internal Member
6.	**Dr. B. Prakash** Associate Professor	Department of Biotechnology, Vels Institute of Science, Technology and Advanced Studies, Pallavaram, Chennai.600117.	Internal Member
7.	**Dr. G. Abirami** Assistant Professor	Department of Biotechnology, Vels Institute of Science, Technology and Advanced Studies, Pallavaram, Chennai.600117.	Internal Member
8.	**Dr. M. Suganthi** Assistant Professor	Department of Biotechnology, Vels Institute of Science, Technology and Advanced Studies, Pallavaram, Chennai.600117.	Internal Member
9.	**V. Keerthi Vasan**	B.Sc (2018-2021) & M.Sc (2021-2023)	Alumni Member (External Member)

CREDIT DISTRIBUTION

M.Sc., Biotechnology
Minimum credits to be earned: 90

Component	I Sem	II Sem	III Sem	IV Sem	2 Yrs Total Credits
DSC	14	16	14	4	48
DSE	8	4	6	4	22
SEC	2	2	2	-	6
SI	-	2	-	-	2
RP	-	-	-	12	12
Total Credits	24	24	22	20	90





ABBREVIATIONS

DSC	DSC courses
DSE	Disciplinary Specific Elective
SEC	Skill Enhancement Courses
SI	Summer Internship
RP	Research Project

CURRICULUM STURCTURE

M.Sc., Biotechnology

Total number of Credits: 90

	M.Sc Biotechnology Minimum Credits to be earned :90									
	Hours/Week						Maximum Marks			
SEMESTER 1										
Category	**Code**	**Course**	**L**	**T**	**P**	**O**	**C**	**CIA**	**SEE**	**Total**
DSC 1	24CMBT11	Cell and Molecular Genetics	4	0	0	2	4	40	60	100
DSC 2	24CMBT12	Microbiology	4	0	0	2	4	40	60	100
DSC 3	24CMBT13	Biochemistry	4	0	0	2	4	40	60	100
DSC 4 (Lab)	24PMBT11	Cell, Microbiology and Biochemistry Practical	0	0	4	1	2	40	60	100
DSE 1	24DMBT1-	DSE I	4	0	0	2	4	40	60	100
DSE 2	24DMBT1-	DSE II	4	0	0	2	4	40	60	100
SEC 1	24SSKP11	Soft Skill 1/ Sector Skill Course	2	0	0	1	2	40	60	100
			22	**-**	**4**		**24**			

CIA - Continuous Internal Assessment **SEE - Semester End Examination**

***L – Lecture, *T- Tutorial, *P- Practical, *O - Outside the class effort / self-study, *C - Credits**

SEMESTER 2										
Category	**Code**	**Course**	**L**	**T**	**P**	**O**	**C**	**CIA**	**SEE**	**Total**
DSC 5	24CMBT21	Genetic Engineering, IPR and Bioethics	4	0	0	2	4	40	60	100
DSC 6	24CMBT22	Immunotechnology	4	0	0	2	4	40	60	100
DSC 7	24CMBT23	Bioprocess Technology	4	0	0	2	4	40	60	100
DSC 8 (Lab)	24PMBT21	Genetic Engineering & Immunotechnology Practical	0	0	4	1	2	40	60	100
DSC 9 (Lab)	24PMBT22	Bioprocess technology Practical	0	0	4	1	2	40	60	100
DSE 3	24DMBT2-	DSE III	4	0	0	2	4	40	60	100
SI	24INPG21	Internship	0	0	2	1	2	40	60	100
SEC 2	24SSKP21	Soft Skill 2/ Sector Skill Course	2	0	0	1	2	40	60	100
			18	**-**	**10**		**24**	**-**	**-**	**-**

CIA - Continuous Internal Assessment **SEE - Semester End Examination**

***L – Lecture, *T- Tutorial, *P- Practical, *O - Outside the class effort / self-study, *C - Credits**

SEMESTER 3										
Category	**Code**	**Course**	**L**	**T**	**P**	**O**	**C**	**CIA**	**SEE**	**Total**
DSC 10	24CMBT31	Plant Biotechnology	4	0	0	2	4	40	60	100
DSC 11	24CMBT32	Animal Biotechnology	4	0	0	2	4	40	60	100
DSC 12	24CMBT33	Pharmaceutical Biotechnology	4	0	0	2	4	40	60	100
DSC 13	24PMBT31	Plant, Animal, Pharmaceutical Biotechnology Practical	0	0	4	1	2	40	60	100
DSE 4	24DMBT3-	DSE IV	3	0	0	2	3	40	60	100
DSE 5	24DMBT3-	DSE V	3	0	0	2	3	40	60	100
SEC 3	24SSKP31	Soft Skill 3 / Sector Skill Course	2	0	0	1	2	40	60	100
			20	-	**4**	-	**22**	-	-	-

CIA - Continuous Internal Assessment **SEE - Semester End Examination**

***L – Lecture, *T- Tutorial, *P- Practical, *O - Outside the class effort / self-study, *C - Credits**

SEMESTER 4										
Category	**Code**	**Course**	**L**	**T**	**P**	**O**	**C**	**CIA**	**SEE**	**Total**
DSC 14	24CMBT41	Research Methodology	4	0	0	2	4	40	60	100
DSE 6	24DMBT4-	DSE VI	3	0	0	2	3	40	60	100
DSC 15	24PMBT41	Skills in Biotechnology Practical	0	0	3	1	1	40	60	100
RP 1	24RMBT41	Research Project I	0	0	12	10	12	40	60	100
			8	-	**15**	-	**20**	-	-	-

CIA - Continuous Internal Assessment **SEE - Semester End Examination**

***L – Lecture, *T- Tutorial, *P- Practical, *O - Outside the class effort / self-study, *C - Credits**

DSC COURSES

Category	Code	Course	L	T	P	O	C
DSC 1	24CMBT11	Cell and Molecular Genetics	4	0	0	2	4
DSC 2	24CMBT12	Microbiology	4	0	0	2	4
DSC 3	24CMBT13	Biochemistry	4	0	0	2	4
DSC 4	24PMBT11	Cell, Microbiology and Biochemistry Practical	0	0	4	1	2
DSC 5	24CMBT21	Genetic Engineering, IPR and Bioethics	4	0	0	2	4
DSC 6	24CMBT22	Immunotechnology	4	0	0	2	4
DSC 7	24CMBT23	Bioprocess Technology	4	0	0	2	4
DSC 8	24PMBT21	Genetic Engineering & Immunotechnology Practical	0	0	4	1	2
DSC 9	24PMBT22	Bioprocess technology Practical	0	0	4	1	2
DSC 10	24CMBT31	Plant Biotechnology	4	0	0	2	4
DSC 11	24CMBT32	Animal Biotechnology	4	0	0	2	4
DSC 12	24CMBT33	Pharmaceutical Biotechnology	4	0	0	2	4
DSC 13	24PMBT31	Plant, Animal, Pharmaceutical Biotechnology Practical	0	0	4	1	2
DSC 14	24CMBT41	Research Methodology	4	0	0	2	4
DSC 15	24PMBT41	Skills in Biotechnology Practical	0	0	3	1	1

DISCIPLINE SPECIFIC ELECTIVE COURSES

Category	Code	Course	L	T	P	O	C
DSE 1	24DMBT11	Bioinstrumentation	4	0	0	2	4
	24DMBT12	Nano Biotechnology	4	0	0	2	4
DSE 2	24DMBT13	Bioinformatics	4	0	0	2	4
	24DMBT14	Entrepreneurship and Management in Biotechnology	4	0	0	2	4
DSE 3	24DMBT21	Environmental Biotechnology	4	0	0	2	4
	24DMBT22	Herbal Drug Technology	4	0	0	2	4
DSE 4	24DMBT31	Genomics & Proteomics	3	0	0	2	3
	24DMBT32	Stem Cell Biology and Tissue Engineering	3	0	0	2	3
DSE 5	24DMBT33	Clinical Research	3	0	0	2	3
	24DMBT34	Agricultural Biotechnology	3	0	0	2	3
DSE 6	24DMBT41	Biotechnology and Human Welfare	3	0	0	2	3
	24DMBT42	Drug Designing	3	0	0	2	3
	24DMBT43	Cyber Security	3	0	0	2	3

SKILL ENHANCEMENT COURSE

Category	Code	Course	L	T	P	O	C
SEC 1	24SSKP11	Soft Skills 1	2	0	0	1	2
SEC 2	24SSKP21	Soft Skills 2	2	0	0	1	2
DSE 2	24SSKP31	Soft Skills 3	2	0	0	1	2

SECTOR SKILL COURSE

Category	Code	Course	L	T	P	O	C
SSC 1	24SSCP31	Human Physiology and Medical Coding	2	0	0	1	2
SSC 2		Food and Nutraceuticals	2	0	0	1	2
SSC 3		Medical Lab Technology	2	0	0	1	2

SUMMER INTERNSHIP

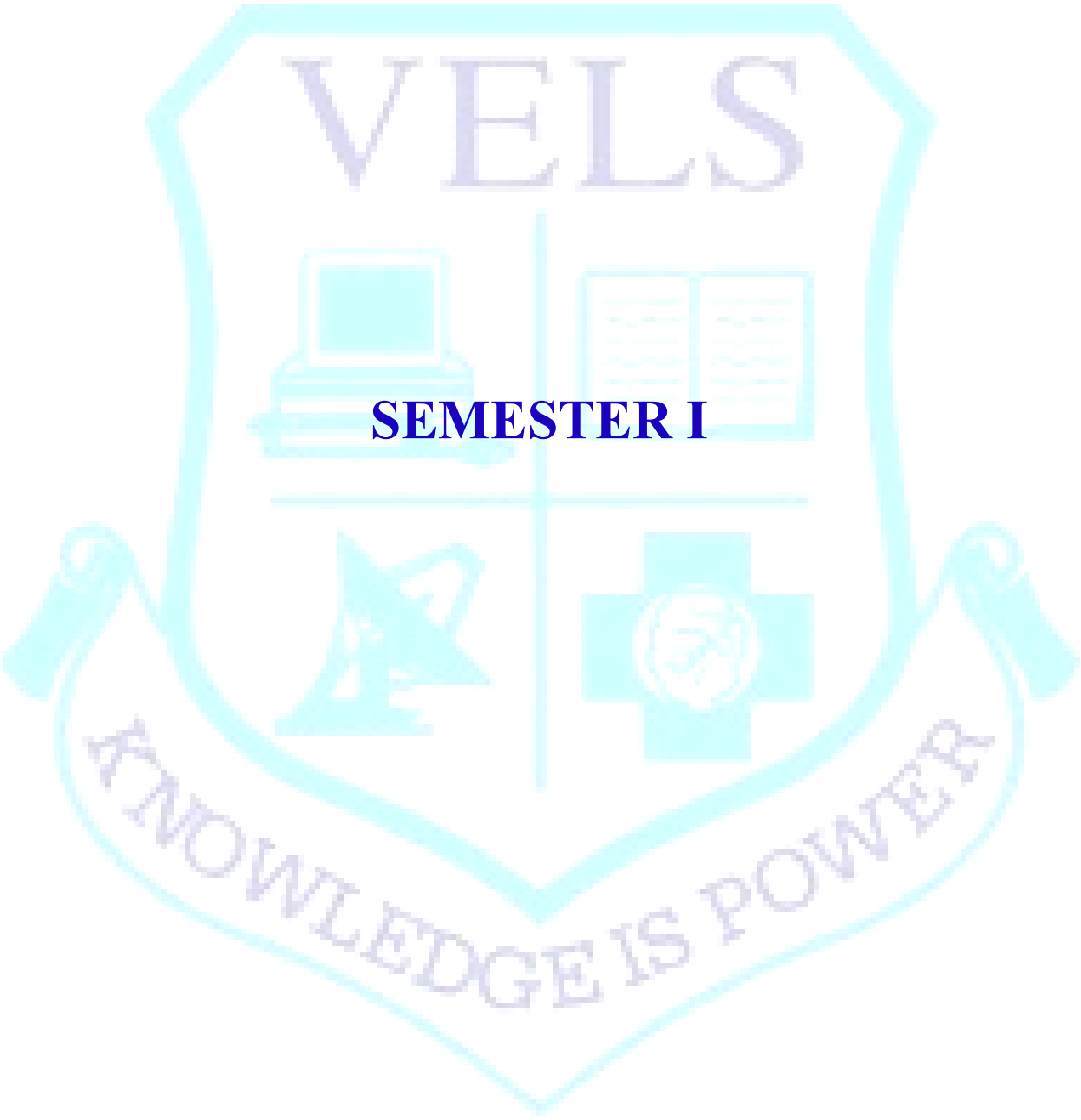
Category	Code	Course	L	T	P	O	C
SI	24INPG21	Internship	0	0	2	1	2

RESEARCH PROJECTS

Category	Code	Course	L	T	P	O	C
RP 1	24RMBT41	Research Project I	0	0	12	10	12

Generic Elective

Category	Code	Course	L	T	P	O	C
GE 1	24GMBT41	Food Safety and Hygiene	2	0	0	1	2
GE 2		Biofertilizer Technology	2	0	0	1	2
GE 3		Biomedical Waste Management	2	0	0	1	2



SEMESTER I

24CMBT11 **CELL AND MOLECULAR GENETICS**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE:

Understand the basics of cell biology and to know the cellular role in depth and make the students understand the basics of genetics

UNIT I INTRODUCTION **12**

Biogenesis theory of origin of life. Cell as a Basic unit; Cell size and shape; Prokaryotic & eukaryotic cell organization. Structural comparison of microbial, plant and animal cells. Cell wall and membrane: Plasma Membrane-Model of plasma membrane; Transport across the membrane, Cell adhesion; Cell junctions; Composition of bacterial cell wall.

UNIT II CELL ORGANELLES **11**

Structure and function of cell organelle; Mitochondria, Chloroplast, Endoplasmic reticulum, Golgi complex, lysosomes, Ribosomes, Peroxisomes, Vacuoles, Centrioles and Cytosols. Nucleus and molecular organization of chromatin. Specialized cells: Motile cells, Nerve cells and nerve impulse conduction

UNIT III CELL CYCLE AND CELL SIGNALING **12**

Cell Cycle, Cell division: Mitosis, Meiosis. Cell signaling- types- G Protein receptors, Cancer and molecular basis of cancer cell behavior. Cellular Senescence and Apoptosis, Oncogenes and tumor suppressor genes.

UNIT IV INTRODUCTION TO GENETICS **12**

Mendelian laws of inheritance; non-Mendelian inheritance; Chromosomal theory of inheritance. Back cross and Test cross. Structural and numerical alterations of chromosome- Deletion, Inversion, Duplication, Translocation. Ploidy and their genetic implications. Linkage, crossing over

UNIT V GENETIC MATERIAL **13**

Structure, types, forms and functions of DNA and RNA. Replication, Transcription, Post transcriptional modification, translation, co-and post-translational modifications, Recombination, DNA damage and repair.

Total: 60 Hours

COURSE OUTCOMES:

CO-1: Summarize the features of prokaryote and eukaryote cells,

CO-2; Understand the composition and spatial organization of the cell.

CO-3: Illustrate the structure and function of different subcellular organs in the cell.

CO-4: Assess the molecular mechanisms regulating and controlling cell division and the cell cycle and exemplify how extracellular signals affect cell division.

CO-5: Elaborate on the Apoptosis, Oncogenes and tumor suppressor genes and their significance in Cancer biology

CO-6: Recall on principles in genetics and genome organization in cells

CO-7: Identify the molecular mechanisms behind DNA damage and repair.

TEXT &REFERENCE BOOKS

1. G. Karp (2010), Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons, Inc.
2. E. D. P. De Robertis and E. M. F. De Robertis (2006), Cell and Molecular Biology, 8th edition, Lippincott Williams and Wilkins, Philadelphia.
3. G. M. Cooper and R. E. Hausman (2009), The Cell: A Molecular Approach, 5th edition, ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. W. M. Becker, L. J. Kleinsmith, J. Hardin, and G. P. Bertoni (2009), The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco.
5. Berk, C. A. Kaiser, H. Lodish, A. Amon, H. Ploegh, A. Bretscher, M. Krieger, and K. C. Martin (2016), Molecular Cell Biology, 8th edition, W.H. Freeman, USA.
6. J. F. Griffiths, S. R. Wessler, S. B. Carroll, and J. Doebley (2010), Introduction to Genetic Analysis, 10th edition, Pearson Benjamin Cummings Publishing, San Francisco.
7. E. J. Gardner, M. J. Simmons, and D. P. Snustad (2003), Principles of Genetics, 8th edition, John Wiley & Sons, Inc.
8. M. W. Strickberger (2008), Genetics, 3rd edition, Phi Learning.
9. P. S. Verma and K. Agarwal (2004), Cell Biology, Genetics, Molecular Biology, Evolution & Ecology, S. Chand Publication.

24CMBT12 **MICROBIOLOGY**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE:

Demonstrate the expertise in handling and controlling of microorganisms in labs as well as in various industries and illustrate the microbial knowledge in day-to-day life

UNIT I INTRODUCTION **12**

Historical development of Microbiology, Microbial Taxonomy, systematics, identification: Taxonomical hierarchy species-type strains: culture collections; binomial nomenclature; system of classification - phonetic, numerical taxonomy. General characteristics used in classification- five kingdoms, six kingdoms and eight kingdom systems.

UNIT II MICROBIAL GROWTH **12**

Nutritional requirements and types of microorganisms, Uptake of nutrients by microorganisms. Photosynthetic microorganisms. Definition, cell division in microbes, factors affecting growth, Batch culture, continuous culture and synchronous growth; growth phases and growth curves - Chemostat, Turbidostatic.

UNIT III MUTATION AND MUTAGENESIS: **12**

UV and chemical mutagens; Types of mutation; Ames test for mutagenesis. Plasmids and Transposons. Bacterial Reproduction: Transformation, Transduction and Conjugation. Endospores and sporulation in bacteria.

UNIT IV MEDICAL MICROBIOLOGY: **12**

Pathogenesis, lab diagnosis, prevention and control of important microbial diseases. Pathogenic bacterial diseases, Fungal diseases, Viral Diseases and Protozoan diseases. Antimicrobial agents and their mode of action – antibacterial, antiviral, antifungal, antiparasitic agents

UNIT V ENVIRONMENTAL MICROBIOLOGY: **12**

Nitrate and sulfur oxidizing bacteria, Nitrate and sulfate reducing bacteria. nitrogen fixation, biofertilizers. hydrocarbon transformation. Sewage treatment methods - Role of microorganism in agriculture, food and dairy industry.

Total: 60 Hours

COURSE OUTCOME:

CO-1: Recall about microscopy and Prokaryotic and eukaryotic cells and classification

CO-2: Demonstrate about the nutritional requirement for microbial growth and

CO-3: Elaborate on the role of microbes in various fields.

CO-3: Explain about mutation and various plasmids and gene transfer mechanism

CO-5: Illustrate on pathogenesis and Lab diagnosis of important microbial diseases.

CO-6: List about various microbial diseases and antimicrobial chemicals and its actions.

CO-7: Importance of microorganisms in environmental, food industry and various applications of microbes.

TEXT & REFERENCE BOOKS

1. M. J. Pelczar, E. C. S. Chan, and N. R. Krieg (2006), Microbiology, 5th edition, Tata McGraw Hill Publishing Company.
2. L. M. Prescott, J. P. Harley, and D. A. Klein (2005), Microbiology, 6th edition, McGraw Hill.
3. K. P. Talero and A. Talero (2002), Foundations in Microbiology, 4th edition, McGraw Hill.
4. H. J. Benson (1999), Microbiological Applications: A Laboratory Manual in General Microbiology, 7th edition, McGraw Hill.
5. A. J. Salle (1986), Principles of Bacteriology, 7th edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi.
6. H. A. Modi (1995), Elementary Microbiology (Volume-1 Fundamentals of Microbiology), Akta Prakashan Nadiad, Publication.
7. D. Freifelder (1995), Microbial Genetics, Narosa Publishing House.
8. S. R. Maloy, J. E. Cronan, and D. Freifelder (1994), Microbial Genetics, 2nd edition, Jones Barlett Publishers.
9. J. G. Cappuccino and N. Sherman (no year provided), Microbiology - A Laboratory Manual, 5th edition, Editors: A. E. Wirth and L. Olsen, Wiley VCH publishers.

24CMBT13 **BIOCHEMISTRY**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVES:

To develop understanding and provide scientific basics of the life processes at the molecular level and explain the structure, function and inter-relationships of biomolecules and their deviation from normal and their consequences for interpreting and solving clinical problems.

UNIT I BIOCHEMICAL ORGANIZATION AND BIOENERGETICS 12

Bioenergetics - and biological oxidation – general concept of oxidation and reduction, electron transport chain, oxidative phosphorylation, uncouplers and theories of biological oxidation and oxidative phosphorylation. High energy compounds, ATP cycle, Calculation of ATP during oxidation of glucose and fatty acids.

UNIT II BIOMOLECULES – CARBOHYDRATES 12

Carbohydrates – classification, properties. Starch, glycogen, dextrin, inulin, cellulose, metabolism of carbohydrates – gluconeogenesis, glycogenolysis, glycolysis. citric acid cycle, pentose phosphate pathway.

UNIT III BIOMOLECULES – LIPIDS 12

Classification, properties, Sterols, essential fatty acids, eicosanoids, phospholipids, sphingolipids, metabolism of lipids, oxidation of fatty acids, α, β - oxidation and biosynthesis of ketone bodies, cholesterol, porphyrin biosynthesis, metabolism of bile pigments.

UNIT IV BIOMOLECULES – PROTEINS & NUCLEIC ACID 12

Proteins and amino acids – Classification, properties, biosynthesis of amino acids and proteins, essential amino acids, metabolism of amino acids and proteins, Transamination & Deamination – Urea cycle. Nucleic acids – nucleoprotein, genetic code, nucleic acids, and structure of DNA and RNA, purine biosynthesis and pyrimidine biosynthesis.

UNIT V ENZYMES AND HORMONES 12

Classification, Properties, Nomenclature, enzyme kinetics, mechanism of action, Factors affecting enzyme activity, enzyme induction and inhibition, Vitamins as coenzymes, Allosteric enzymes, enzymes of clinical importance – Enzyme Markers, Hormones – classification, chemical nature and properties,

Total: 60 Hours

COURSE OUTCOMES

CO-1: Understand the importance of Bioenergetics in living system

CO-2: Explain the Structure and significance of ATP and other high-energy compounds.

CO-3: Illustrate the structure and Metabolism of carbohydrates.

CO-4: Summarise the structure and Metabolism of Lipids.

CO-5: Attain Knowledge of Protein structure and functions

CO-6: Understand on the Nucleic acid structure and functions

CO-7: Elaborate on Enzyme Classification, Mechanism and kinetics

TEXT & REFERENCE BOOKS:

1. L. Lehninger, D. L. Nelson, and M. M. Cox (2016), Principles of Biochemistry, 7th edition, CBS Publishers and Distributors.
2. R. K. Murray, D. K. Granner, P. A. Mayes, and V. W. Rodwell (1996), Harpers Biochemistry, 24th edition, Appleton and Lange, Stanford.
3. T. M. Devlin (2010), Textbook of Biochemistry with Clinical Correlations, 7th edition, Wiley Liss Publishers.
4. W. B. Burtis and E. R. Ashwood (1993), Tietz Textbook of Clinical Chemistry, 2nd edition, Saunders Company.
5. L. Stryer (2006), Biochemistry, 6th edition, W. H. Freeman and Company, New York.
6. D. Voet and J. G. Voet (2010), Biochemistry, 4th edition, John Wiley and Sons, Inc.
7. Rama Rao (2006), Textbook of Biochemistry, 9th edition, UBS Publishers' Distributors Pvt. Limited.
8. C. Deb (2001), Textbook of Biochemistry, 9th edition, New Central Book Agency (P) Ltd.

24PMBT11 CELL, MICROBIOLOGY AND BIOCHEMISTRY PRACTICAL

L	T	P	O	C
0	0	4	1	2

COURSE OBJECTIVES:

To get hands on experience on basic microscopy and its principles and functioning. To impart knowledge about various cell organelles and cell division, the students to learn and understand the principles behind the qualitative and quantitative estimation of biomolecules and to learn about the microbial techniques Like culture techniques, Staining techniques and Biochemical analysis.

LIST OF EXPERIMENTS:

CELL BIOLOGY

1. Microscopy: Bright field, phase contrast & Fluorescence Microscopy.
2. Cell Counting – Hemocytometer
3. Identification of mitotic phases from onion root tip.
4. Identification of meiotic phases from grass hopper testis / flower buds
5. Mounting epithelium and observing animal and plant cells using vital staining.

BIOCHEMISTRY

1. Qualitative tests for carbohydrates.
2. Qualitative analysis of amino acids & proteins.
3. Quantitative estimation of protein using Lowry's Reagent.
4. Quantitative analysis of urea in serum.
5. Chromatography: Separation of amino acid by Thin Layer Chromatography.

MICROBIOLOGY

1. Isolation and Culture Techniques: Pour plates, streak plates, spread plates, serial dilution
2. Preservation of culture: slants and cryopreservation
3. Isolation of microbes from water, air, soil and plant surface
4. Microscopic Methods in the Study of Microorganisms; Staining Techniques- Simple, Differential- Gram's Staining Capsule staining, Spore staining and biochemical test
5. Growth curve, Optimization of microbial growth.

Total: 30 Hours

COURSE OUTCOMES:

Upon completion of the laboratory sessions, the students will be able to

CO-1: Comparison of various stages in mitosis and meiosis

CO-2: Understand the parts and working principles of different microscopes.

CO-3: Analyze various biomolecules both quantitatively and qualitatively.

CO-4: Illustrate the principle and procedure of thin-layer chromatography for biomolecule separation.

CO-5: Explain the various methods of enzyme assays needed for clinical research.

CO-6: Examine microbes from water, air, soil and plant surface.

CO-7: Elaboration microbial techniques like culture techniques, Staining techniques and Biochemical analysis.

TEXT & REFERENCE BOOKS

1. J. Jayaraman (2011), Laboratory Manual in Biochemistry, 2nd edition, New Age International Private Limited.
2. S. K. Sawhney and R. Singh (2014), Introductory Practical Biochemistry, 5th or later edition, Narosa Publishing House, New Delhi.
3. R. C. Gupta and S. Bhargavan (2018), Practical Biochemistry, 5th edition, CBS.
4. D. T. Plummer (2006), An Introduction to Practical Biochemistry, 3rd edition, Tata McGraw Hill Publishing Company Ltd., New Delhi.
5. J. G. Cappuccino and N. Sherman (1999), Microbiology: A Laboratory Manual, 4th edition, Addison-Wesley.
6. J. G. Collee, R. S. Miles, and B. Watt (1996), Tests for the Identification of Bacteria, in J. G. Collee, B. P. Marmion, A. G. Fraser, and A. Simmons (Eds.), Mackie & McCartney Practical Medical Microbiology. 14th edition, Churchill Livingstone, New York.

L	T	P	O	C
2	0	0	1	2

24SSKP11 **SOFT SKILL 1**

COURSE OBJECTIVE:

- To enable participants Business Communication Skills
- To enhance participants E-mail writing skills
- To impart Leadership and Team Bonding skills

Credit Hours

UNIT- I READING COMPREHENSION AND VOCABULARY 06

Filling the blanks – Cloze Exercise – Vocabulary building – Reading and answering Questions.

UNIT- II LISTENING AND ANSWERING QUESTIONS 06

Listening and writing – Listening and sequencing sentences – Filling in the blanks Listening and answering questions.

UNIT- III GROUP DISCUSSIONS 06

Why GD part of a selection process – Structure of a GD – strategies in GD- Team Work – Body Language

UNIT- IV CONVERSATION. 06

Face to face Conversation and Telephone conversation

UNIT- V SELF- INTRODUCTION AND ROLE PLAY 06

Total: 30 Hours

COURSE OUTCOMES:

At the end of this course the students will be able to,

At the end of this course the students will be able to,

CO 1 Prioritize power of understanding and aids assimilation of vocables. Vocabulary to charge communication with educated words

CO 2 Develop comprehensive knowledge through listening leading to answering questions

CO 3 Build observation power and infuse self-confidence through group discussions

CO 4 Identify methodology for befitting constructional ability

CO 5 Experiments with inward looking and visualization of the 'otherness' of situations

Books Recommended

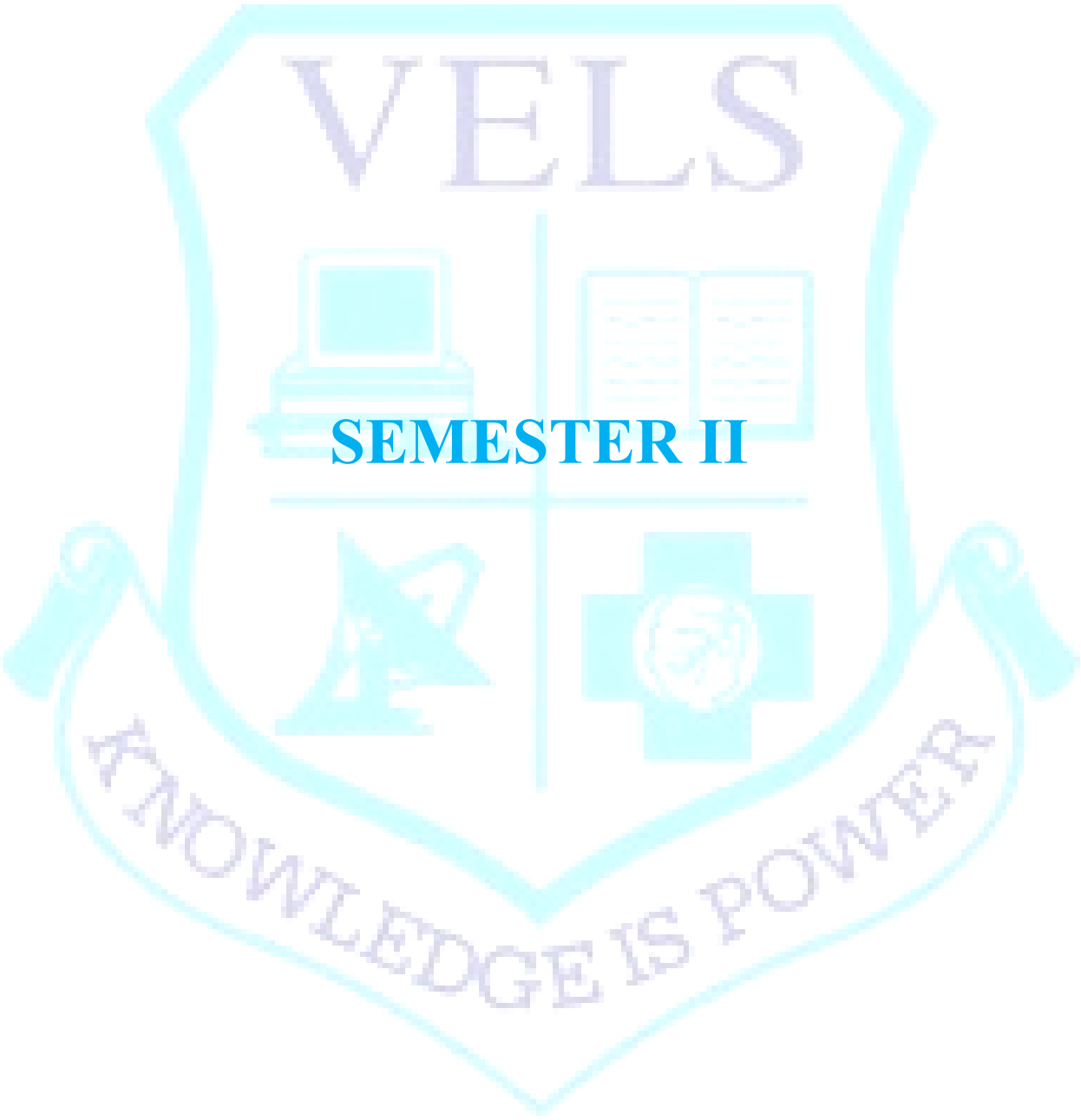
- Barun K. Mitra. Personality Development and Soft Skills. Oxford University Press. New Delhi.2011.
- S.P. Sharma. Personality Development. Pustaq Mahal. New Delhi. 2010.Meenakshi Raman

and Sangeetha Sharma. Technical Communication. Oxford University Press. New Delhi. 2009.

- Tiko, Champa & Jaya Sasikumar. Writing with a Purpose.OUP. New Delhi. 1979

Web Sources:

- https://www.skillsyouneed.com/ips/communication-skills.html
- https://blog.smarp.com/top-5-communication-skills-and-how-to-improve-them
- https://blog.hubspot.com/service/phone-etiquette



SEMESTER II

24CMBT21 GENETIC ENGINEERING, IPR AND BIOETHICS

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE:

To provide fundamental theoretical knowledge about Genetic Engineering, Cloning Vector, molecular techniques.

UNIT-I INTRODUCTION TO GENETIC ENGINEERING 12

Introduction to genetic engineering: Importance and outline of genetic engineering, organization of gene and genome, gene expression- Enzymes in genetic engineering- Endo and exonucleases - Restriction endonucleases- types, and mechanism of action, Ligases - types and mechanism of action, linker, adaptor, homopolymer tailing - Polymerases types and mechanism of action- other enzymes

UNIT-II CLONING VECTORS AND THEIR APPLICATIONS 12

E. coli Vectors - Plasmids (Properties, types, In vitro construction-pBR322, pUC), Bacteriophage-lambda and M13 (Biology, Classes, in vitro construction of cloning vectors), Cosmids and phagemids and its properties- -Plant viral vectors (CAMV, Gemini) animal viral vectors (SV40, Retro viral)- Cloning in Yeast- Expression vectors.

UNIT-III ISOLATION AND TRANSFER 12

Plasmid isolation and purification method- nucleic acid and protein electrophoresis -nucleic acid staining and labelling - types of gene transfer- molecular probes - Selection and screening of recombinants – Blotting techniques - hybridization techniques – Autoradiography, PCR technology – concept, types, primer design.

UNIT-IV MODERN TECHNIQUES 12

DNA sequencing methods - DNA microarray technology - Molecular markers and types- Chromosome walking and jumping - DNA finger printing - DNA Foot printing- Site directed mutagenesis- Protein engineering - Gene therapy – types, Application of genetic engineering in medicine, Industrial and agriculture- antisense technology- recombinant vaccine

UNIT V BIOETHICS AND IPR 12

Genetically modified organism- Ethical, legal and social issues, Biosafety and its types, environmental fallout. Principles and practices – containment facilities, ethical concerns of biotechnology research and innovation, Disposal of biowaste, Bioethics committees. Intellectual

property rights - patent, copyright, trade mark, TRIPS- GATT and PBR, WTO.

Total: 60 Hours

COURSE OUTCOMES:

CO-1: Understand the basics of gene cloning and various modern techniques used in rDNA technology.

CO-2: Summarize bout genetic engineering techniques, molecular probes and blotting techniques.

CO–3: Make use of various molecular techniques and their application such as DNA sequencing and fingerprinting.

CO–4: Discuss on Gene transfer technologies and their application the Agriculture

CO-5: Explain on the gene transfer technologies in Forensic science

CO–6: Explain the international and national controls regarding biosafety and biosecurity

CO-7: Illustrate on bioethics applicable to facilities and associated scientists handling pathogens.

TEXT & REFERENCE BOOKS:

1. R. W. Old and S. B. Primrose (1998), Principles of Gene Manipulation: An Introduction to Genetic Engineering, Blackwell Sciences, U.K.
2. T. A. Brown (2010), Gene Cloning and DNA Analysis, 6th edition, Wiley Blackwell Science.
3. J. D. Watson (2004), Molecular Biology of the Gene, 5th edition, Pearson Education, Singapore.
4. H. J. Kreuzer and A. Massey (2001), Recombinant DNA and Biotechnology, ASM Press.
5. I. E. Alcamo (2001), DNA Technology, Academic Press.
6. J. M. Walker and R. Rapley (2006), Molecular Biology and Biotechnology, 4th edition.
7. B. R. Glick and J. J. Pasternak (2002), Molecular Biotechnology, Panima Publishing House, New Delhi, India.
8. S. B. Primrose (2001), Molecular Biotechnology, Panima Publishing House, New Delhi, India.
9. E. L. Winnacker (2003), From Genes to Clones, Panima Publishing House, New Delhi, India.
10. B. D. Singh (2005), Molecular Biology and Genetic Engineering, Kalyani Publishers.

24CMBT22 **IMMUNOTECHNOLOGY**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVES

To provide a wider and global perspective of techniques involved as well as the genetic basis of the immunological diseases and their cure, with an ability to discriminate, evaluate, analyse and synthesis existing and new knowledge, and integration of the same for enhancement of knowledge

UNIT I INTRODUCTION TO IMMUNOTECHNOLOGY 12

Brief history and Introduction to Immunotechnology, immune system, components of the immune system, Antigen and Antibody, Innate and adaptive immune system, external and internal barriers, phagocytosis.

UNIT II ANTIBODIES & IMMUNODIAGNOSIS 12

Monoclonal and polyclonal antibodies – their production and characterization – Western blot analysis – Immunoelectrophoresis, SDS-PAGE – Purification and synthesis of antigens – ELISA principle and applications – Radio immuno assay (RIA) principles and applications – non-isotopic methods of detection of antigens – Enhanced chemiluminescence assay, Widal test, VDRL test.

UNIT III: CELLULAR IMMUNOLOGY 12

PBMC separation from the blood; identification of lymphocytes based on CD markers; FACS; Lympho -proliferation assay; Mixed lymphocyte reaction; macrophage cultures; cytokine bioassays-IL2, gamma IFN, TNF alpha; HLA typing.

UNIT IV: IMMUNOPATHOLOGY 12

Preparation and storage of tissues, identification of various cell types and antigens in tissues – Isolation and characterization of cell types from inflammatory sites and infected tissues, functional studies on isolated cells – Immunocytochemistry – Immuno fluorescence, Immuno- enzymatic and Immuno-ferritin techniques, immuno-electron microscopy.

UNIT V: MOLECULAR IMMUNOLOGY 12

Vaccines: Vaccine technology including DNA vaccines, identification of B and T epitopes for vaccine development. Immunodiagnosis of infectious diseases, Transplantation Immunology.

Total: 60 Hours

COURSE OUTCOME

CO-1 Understand the historical development and evolution of the immune system

CO-2: Demonstrate on the structure and function of Antigen and antibody.

CO-3: Summarize the Immunotechniques for diagnosis of various diseases and infections

CO-4: Explain the Cellular & molecular events involved in immunological processes and their regulation

CO-5: Analyze about antigen-antibody interactions and the techniques involved..

CO-6 Develop approaches in Vaccine technology and Transplantation

CO-7: Illustrate on the preparation of tissues for the anti-inflammatory studies.

TEXT & REFERENCE BOOKS

1. Roitt (1997), Immunology, 9th edition, Blackwell Scientific.
2. R. A. Goldsby, T. J. Kindt, B. A. Osborne, and J. Kerby (2003), Immunology, 5th edition, W. H. Freeman.
3. J. Punt, S. Stanford, P. Jones, and J. A. Owen (2018), Kuby Immunology, 8th edition, W. H. Freeman & Co.
4. K. Chakravarthy (2006), Immunology and Immunotechnology, Tata McGraw-Hill.
5. D. M. Weir and J. Stewart (1997), Immunology, 8th edition, Churchill Livingstone.
6. T. J. Kindt, B. A. Osborne, and R. A. Goldsby (2006), Kuby Immunology, 6th edition, W. H. Freeman and Company.

24CMBT23 **BIOPROCESS TECHNOLOGY**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE (EMPLOYABILITY)

To provide the students with the basics of bioprocess principles and bioreactor engineering. To develop bioengineering skills for the production of biochemical products using integrated biochemical processes.

UNIT I INTRODUCTION TO BIOPROCESS TECHNOLOGY 12

Scaling up of a Bioprocess, Upstream Processing, Downstream Processing, Fermentation- Types of Fermentation, Its significance in Industry, Submerged Fermentation and Solid-state fermentation, batch fermentation and continuous fermentation, Chemostat Fermentation

UNIT II DESIGN OF FERMENTATION PROCESS 12

Kinetics of substrate utilization, biomass growth and product formation, inhibition on cell growth and product formation. Design and operation of continuous cultures, chemostat in series, batch and fed batch cultures; Sterilization of liquid media and air, Design of batch and continuous sterilization.

UNIT III BIOREACTOR DESIGN & CONSTRUCTION 12

Basic configuration of Fermentor, Batch, continuous and fed batch cultivation; Types of Bioreactors - packed bed reactor, airlift reactor, fluidized bed reactor and bubble column reactor; Biomass estimation - direct and indirect methods.

UNIT IV DOWNSTREAM PROCESSING 12

Filtration, centrifugation, cell disruption, liquid/liquid extraction, dialysis, Purification, Drying, Packing and labelling. Chromatographic technique – HPLC.

UNIT V FERMENTATION DERIVED PRODUCTS 12

Industrial production of primary metabolites and secondary metabolites – shikimic acid, flavonoids; Fermentative production of alcohol, citric acid; Amino acid – Phenylalanine; Vitamins – Riboflavin; Antibiotics – Penicillin; Microbial production of enzymes – amylase, protease, cellulase; SCP production. Industrial Visit to production units of Biotechnology Industries.

Total Hours: 60

COURSE OUTCOMES

CO-1: Understand operation modes and select appropriate bioreactor configurations based on the nature of bioproducts and cell lines and other process criteria.

CO-2: Illustrate on upstream and Downstream processes in Bioprocess

CO-3: Explain the type of Bioprocess and standard Lab practices.

CO-4: Design bioreactor and control process of bioreactor.

CO-5: List the different techniques involved in downstream processing.

CO-6: Demonstrate the skills and techniques to design a process for product purification.

CO-7: Explain the bioprocess application in different biotechnology industries for product production.

TEXT & REFERENCE BOOKS

1. P. F. Stanbury,., Whitaker, A., & Hall, S. J. (2008). Principles of fermentation technology. Elsevier.
2. P. T.Kalichelvan, , & Arul Pandi, I. (2009). Bioprocess technology. MJP Publishers.
3. M.Shuler, , & Kargi, F. (2002). Bioprocess engineering. Prentice Hall.
4. E. M. T. Mansi., Bryce, C. F. A., Dmain, A. L., & Alliman, A. R. (2009). Fermentation microbiology and biotechnology. Taylor and Francis.
5. L. E. Cassida, (1968). Industrial microbiology. John Wiley and Sons.
6. W. Crueger, & Crueger, A. (2000). Biotechnology: A textbook of industrial microbiology. 2nd edition. Panima Publishing Corporation.
7. M. J. Waites, , Morgan, N. L., & Rockey, J. S. (2002). Industrial microbiology. 2nd edition. Blackwell Science.

24PMBT21 GENETIC ENGINEERING AND IMMUNOTECHNOLOGY PRACTICALS

L	T	P	O	C
0	0	4	1	2

COURSE OBJECTIVE:

To educate and train the students for lab techniques of genetic engineering and gene cloning. To teach advanced techniques and skills required in diagnosis, treatment and research in Immunotechnology. To acquire knowledge concerning the principles and applications of immunoassay procedure.

LIST OF EXPERIMENTS:

GENETIC ENGINEERING

1. Isolation of genomic DNA and Plasmid DNA
2. Estimation of nucleic acids
3. Identification of nucleic acids and protein (AGE, SDS).
4. Restriction and Ligation
5. Blotting Techniques – Southern, Northern
6. Transformation, selection of transformed colonies
7. PCR and Manual DNA sequencing (Demo)

IMMUNOTECHNOLOGY

1. Collection of Blood, Serum and Plasma
2. Methods of bleeding (Eg. Tail bleeding, Intravenous, intraorbital)
3. Blood smear identification of leucocytes by Giemsa stain
4. Agglutination reactions: Determination of hemagglutination titer of IgM antibodies using human RBC
5. Radial and Double immunodiffusion (Ouchterlony Double Diffusion)
6. Immunoelectrophoresis
7. Antigen-antibody reaction-Haemagglutination, precipitation-Widal and VDRL

Total Hours: 30

COURSE OUTCOME

CO-1: Demonstration of training in isolation of DNA Bacterial Culture.

CO-2: Illustrate on genomic and plasmid DNA isolation

CO-3: Understand on procedure of Agarose gel electrophoresis and SDS-PAGE

CO-4: Students will be given practical training in Purification and Quantization of nucleic acids and about selection of transformed colonies and preservation.

CO-5: Understand on immunological and clinical tests.

CO-6: Explain on Immunodiffusion techniques

CO-7: Elaborate on the principle of Immunoelectrophoresis.

TEXT & REFERENCE BOOKS:

1. J. Sambrook, Fritsch, E. F., & Maniatis, T. (2000). Molecular cloning: A laboratory manual. Cold Spring Harbor Laboratory Press.
2. D. M. Glover, & Hames, B. D. (2000). DNA cloning: A practical approach. IRL Press.
3. J. G. James, & Rao, V. B. (2001). Recombinant DNA: Principles and methodologies. Marcel Dekker Publications.
4. P.Maliga, (2000). Methods in plant molecular biology: A laboratory course manual. Cold Spring Harbor Laboratory Press.
5. E. A. Greenfield, (2014). Antibodies: A laboratory manual (2nd ed.). Cold Spring Harbor Laboratory Press.
6. F. C. Hay & Westwood, O. M. R. (2008). Practical immunology (4th ed.). Blackwell Science Ltd.

24PMBT22 BIOPROCESS TECHNOLOGY PRACTICALS

L	T	P	O	C
0	0	4	1	2

COURSE OBJECTIVE:

To learn - microbial process fundamentals, enzyme catalysis. Bioreactor design and analysis.

BIOPROCESS TECHNOLOGY

1. Growth optimization of Bacteria – Biomass estimation
2. Growth optimization of Algae - Biomass estimation
3. Fermenter design and structure
4. Inoculum preparation and sterilization
5. Isolation of amylase producing microorganisms
6. Isolation of antibiotic producing microorganisms from soil
7. Optimization of culture conditions for citric acid production
8. Effect of pH, temperature on enzyme activity
9. Immobilization of enzymes – Entrapment Method
10. Wine Production
11. Cell Disruption using chemical and enzymatic method
12. Downstream processing by Solvent extraction
13. Downstream processing by Ammonium sulphate precipitation
14. Downstream processing by Dialysis

Total: 30 Hours

COURSE OUTCOMES

CO-1: Learning of industrial important microorganism isolation

CO-2: Formulate fermentation process and fermentor design

CO-3: Evaluate the growth kinetics of microorganism and become adept with medium optimization technique

CO-4: Determine the knowledge about downstream processing

CO-5: Explain about biological and kinetic concepts underlying bioprocesses engineering

CO-6: Illustrate the importance of the Immobilization of enzymes by entrapment method.

CO-7: Elaborate the effect of temperature and pH on the activity of enzymes.

TEXT & REFERENCE BOOKS:

1. T. Palvannan, Shanmugam, S., & Sathishkumar, T. (2005). Laboratory manual on biochemistry, bioprocess and microbiology. SciTech Publications India Pvt. Ltd.
2. J. E. Bailey., & Ollis, D. F. (1986). Biochemical engineering fundamentals, 2nd edition. McGraw Hill.
3. M. L. Shuler., & Kargi, F. (1992). Bioprocess engineering. Prentice Hall.
4. P. Doran, (1995). Bioprocess engineering calculation. Blackwell Scientific Publications.
5. P. F. Stanbury., Hall, S. J., & Whitaker, A. (2016). Principles of fermentation technology. 3rd edition. Butterworth-Heinemann.
6. A. L. Demain., & Davies, J. . (2004). Manual of industrial microbiology and biotechnology. 2nd edition. ASM Press.
7. E. M. T.Mansi, , Bryce, C. F. A., & Demain, A. L. (2006). Fermentation microbiology and biotechnology. 2nd edition. CRC Press.

24SSKP21 **SOFT SKILL II**

L	T	P	O	C
2	0	0	1	2

COURSE OBJECTIVE:

- To enable students to develop their communication skills effectively
- To enhance students Reading, Writing, Listening and Speaking skills
- To develop their self-confidence through communication

UNIT- I PRESENTATION SKILLS 06

Elements of an effective presentation – structure of presentation – voice modulation –Audience analysis – Body language

UNIT- II SOFT SKILLS 06

Time Management – Articulateness – Assertiveness – Stress management

UNIT- III RESUME / REPORT PREPARATION / LETTER WRITING 06

Structuring the resume / Report – Business letters – E-Mail Communication

UNIT- IV INTERVIEW SKILLS 06

Kinds of Interviews – Required by Skills – Corporate Culture – Mock Interviews

UNIT- V 30 FREQUENTLY ASKED QUESTIONS 06

Total: 30 Hours

COURSE OUTCOMES:

At the end of this course the students will be able to,

At the end of this course, the students will be able to,

CO1 Illustrate the essentials of presentation skills, thoughts, structure, voice modulation, audience analysis, and body language

CO2 Utilize the psychological skills pertaining to time management, articulation, assertion, and stress management

CO3 Construct methodology for the preparation of resumes, reports, business letters, and email communication

CO4 Appraise learners with varied skills needed for exposure to interviews

CO5 Categorize the nature of questions asked usually in interviews

Books Recommended

- Barun K.Mitra. Personality Development and soft skills. Oxford University Press. New Delhi. 2011.
- S P Sharma. Personality Development. Pustaq Mahal. New Delhi. 2010.
- Meenakshi Raman and Sangeetha Sharma. Technical Communication. Oxford University Press. New Delhi. 2009.

Web Sources:

- https://www.skillsyouneed.com/ips/communication-skills.html
- https://www.businessnewsdaily.com/5836-top-interviewing-skills.html
- https://gdpi.hitbullseye.com/Group-Discussion.php

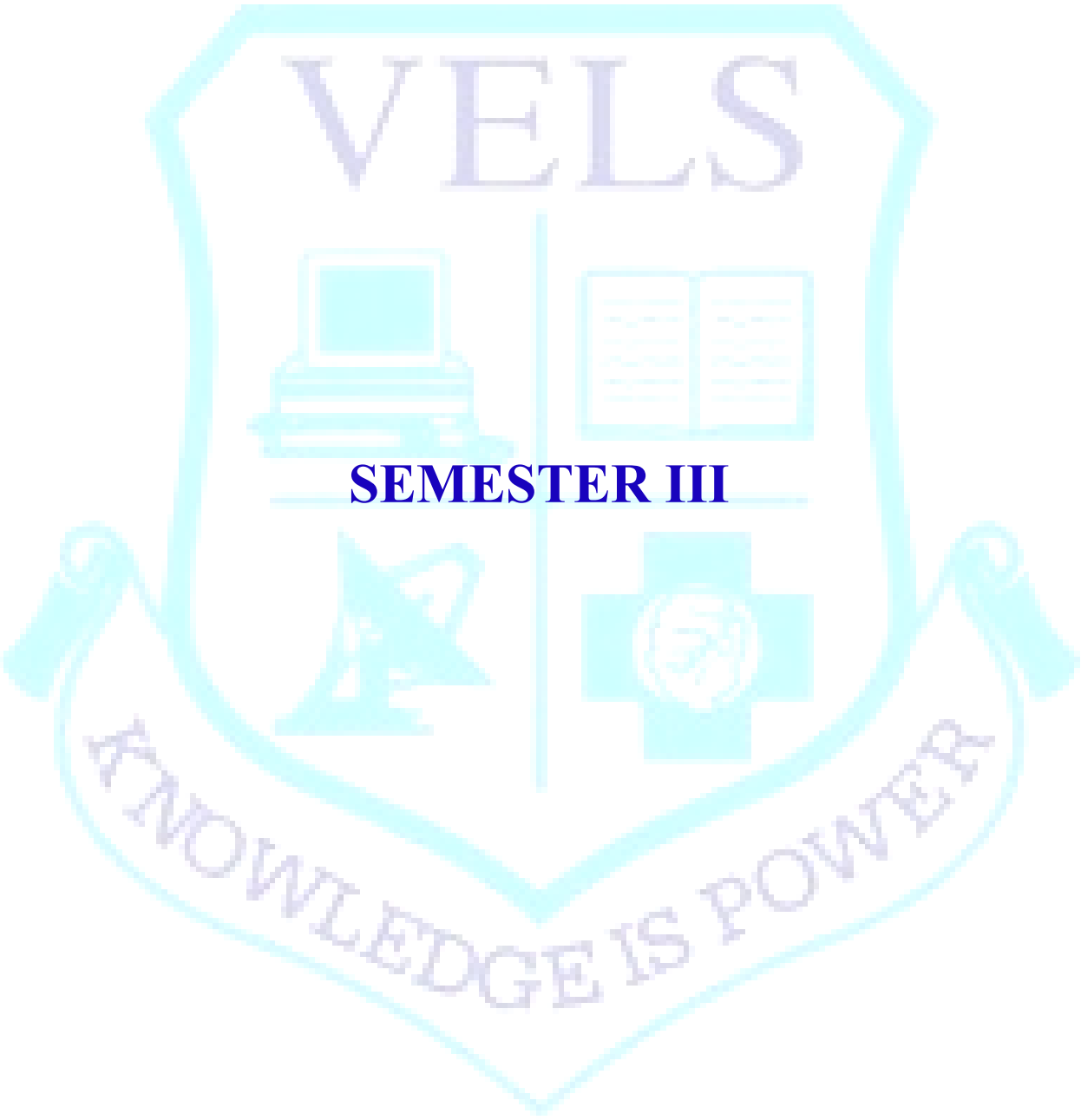
24IMPG21 **INTERNSHIP**

L	T	P	O	C
0	0	2	1	2

Course objective: Students should go for training in any biotechnological industry or laboratories and learn their laboratory techniques by hands on training. After the training, students should submit detailed reports about the training in an assignment.

- For the benefit of the students, it has been mandatory to attend a minimum of one internship/ Mini project during semester vacation
- Students should go for Internship/ Mini projects in any biotechnological industry or laboratories and learn their laboratory techniques by hands-on training.
- After the Internship/ Mini project, students should submit detailed reports about the Internship/ Mini project in printed format.
- Evaluation is based on work done, quality of report, performance in viva-voce, presentation etc.
- The report will be evaluated by a duly appointed teaching faculty from the head of department.

Total: 30hrs



SEMESTER III

24CMBT31 **PLANT BIOTECHNOLOGY**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE

The objective of the course is to give students new knowledge and widening of the knowledge acquired in other courses by handling classical and modern plant biotechnology processes, including breeding of healthy plants, plants with improved characteristics and plants for biomolecule production.

UNIT I: HISTORY OF PLANT TISSUE CULTURE 12

Plant genomic organization – nuclear, organelle genomes – mitochondria and chloroplast. Concept of totipotency. Design of Plant tissue culture laboratory. Nutritional requirements of plant tissue culture. Composition of MS media, Gamborg's media, Nitsch media, White's media and their preparation. Plant growth regulators. Sterilization techniques.

UNIT II: PLANT MICROPROPAGATION 12

Micro grafting, advantages of hairy root culture and culturing of meristem and shoot tip. Establishment and maintenance of callus and suspension culture. Somatic embryogenesis-Synthetic seeds.

UNIT III: HAPLOID PLANT PRODUCTION 12

Anther and microspore culture, triploid production, embryo culture and embryo rescue. In vitro pollination and fertilization. Protoplast isolation – fusion and culture regeneration. Somatic hybrids and cybrids. Somaclonal and gametoclonal variation.

UNIT IV: PLANT GENOME ORGANIZATION 12

Role of RFLP in plant breeding. DNA bar-coding in plants. Transposable elements in plant. Plant transformation technology: Ti and Ri plasmids, Gene transfer methods in plants – Direct DNA transfer methods, Agrobacterium mediated gene transfer. Chloroplast transformation and transient expression by viral vectors

UNIT V: APPLICATION OF GENE TRANSFORMATION IN PLANT 12

Insect resistance, fungus resistance, virus resistance, drought, cold resistance, saline resistance, Genetic engineering for male sterility- Delayed fruit ripening - polygalacturonase, ACC synthase, ACC oxidase. Engineering for nutritional quality - Improved seed storage proteins. Extraction of secondary metabolites using plant tissue culture, germplasm conservation.

Total: 60 Hours

COURSE OUTCOME

CO-1: Acquire a complete knowledge about molecular marker-aided breeding and apply that for effective crop improvement.

CO-2: Obtain a comprehensive knowledge about the concepts of plant tissue culture and its applications.

CO-3: Distinguish between different plant tissue culture techniques

CO-4: Understand the methods of plant genetic transformation and use such acquaintance to develop transgenic plants with improved traits.

CO-5: Demonstrate the application of transgenic technology and apply that knowledge effectively in relevant areas.

CO-6: Analyze the mechanisms involved in haploid plant production, such as anther and microspore culture, embryo culture, and protoplast fusion.

CO-7: Develop protocols for germplasm conservation and secondary metabolite extraction through plant tissue culture techniques.

TEXT & REFERENCE BOOKS

1. Razdan, M.K. (2019). Plant tissue culture, (3rd edition). New Delhi. Oxford & IBH Publishing company, ISBN-13: 978-8120417939.
2. Das, H.K. (2018), Text Book of Biotechnology, (5th edition). New Jersey, Wiley Dreamtech, India Pvt. Ltd.
3. Chawla, H.S. (2010), Introduction to Plant Biotechnology. New Delhi. Oxford & IBH Publishing company, ISBN 13: 9781578081301 3. Satyanarayana, U. (2017), Biotechnology, (2nd edition). Kolkata. Books & Allied (P) Ltd, ISBN-13: 978-8187134909.
4. Slater, (2008), Plant Biotechnology- The Genetic Manipulation of Plants, (2nd edition), New Jersey. Humana Press.
5. J. Hammond, P. McGarvey, & V. Yusibov. (2000). Plant Biotechnology. Springer-Verlag.
6. U. Satyanarayana. (2005). Biotechnology (3rd revised edition). Books and Allied (P) Ltd.
7. S. S. Bhojwani & M. K. Razdan. (2004). Tissue Culture: Theory and Practice. Elsevier.
8. P. Christou & H. Klee. (2004). Handbook of Plant Biotechnology (Vol. I & II). John Wiley

& Sons.

9. Slater, N. W. Scott, & M. R. Fowler. (2003). Plant Biotechnology: The Genetic Manipulation of Plants. Oxford University Press, UK.

24CMBT32 **ANIMAL BIOTECHNOLOGY**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE

The Animal Biotechnology course aims to provide students with advanced knowledge and practical skills in the field of biotechnology as applied to animals. It covers various aspects of animal cell culture, genetic engineering, reproductive biotechnology, and the development of transgenic animals. Through theoretical instruction and hands-on laboratory sessions, students will gain insights into the latest techniques and applications in animal biotechnology.

UNIT I: FUNDAMENTALS OF ANIMAL CELL CULTURE 12

Introduction to animal cell culture techniques, Aseptic techniques and laboratory safety, Media preparation and optimization, Cell culture maintenance and subculturing, Cryopreservation techniques, Cell viability and proliferation assays

UNIT II: GENETIC ENGINEERING IN ANIMALS 12

Basics of genetic engineering and gene transfer methods, Transfection techniques in animal cells, Generation of stable cell lines, Molecular markers and reporter genes, CRISPR/Cas9 genome editing in animals, Ethics and regulatory considerations in genetic engineering

UNIT III: REPRODUCTIVE BIOTECHNOLOGY 12

In vitro fertilization (IVF) techniques Embryo manipulation and transfer, Somatic cell nuclear transfer (cloning), Germplasm preservation and cryobanking, Assisted reproductive technologies in animals, Applications of reproductive biotechnology in conservation and breeding programs

UNIT IV: TRANSGENIC ANIMALS 12

Production of transgenic animals, Transgene integration and expression analysis, Applications of transgenic animals in research and biomedicine, Functional genomics and gene expression profiling.

UNIT V: STEM CELL TECHNOLOGY 12

Stem cell technology and regenerative medicine, Gene therapy approaches in animal models, Biopharming and production of recombinant proteins in animals, Disease modeling using genetically modified animals, Emerging trends and future directions in animal biotechnology, Case studies presentations

Total: 60 Hours

COURSE OUTCOME

CO-1: Demonstrate on Animal tissue culture techniques and about Medium used in Animal Biotechnology

CO-2: Understand the various Gene transfer methods in animals and CRISPR technology

CO-3: Explain about Artificial insemination and IVF and well versed with organ culture

CO-4: Discuss and gain knowledge about Transgene integration and expression analysis

CO-5: Elaborate on Stem cell technology and regenerative medicine

CO-6: Design innovative approaches for biopharming and the production of recombinant proteins in animals, considering current and emerging trends in animal biotechnology

CO-7: Critique the ethical and regulatory considerations surrounding genetic engineering and transgenic animal production.

TEXT & REFERENCE BOOKS

1. Singh, B. (2016). Textbook of Animal Biotechnology. The Energy and Resources Institute (TERI) Press.
2. Verma, A. S., & Singh, A. (Eds.). (2018). Animal Biotechnology: Models in Discovery and Translation. Academic Press.
3. Choudhary, R. K., & Choudhary, S. (2022). Stem Cells in Veterinary Science. Springer.
4. M. M. Ranga. (2003). Animal Biotechnology (2nd Edition). Agrobios India, Jodhpur, India.
5. R. Glick & J. J. Pasternack. (2003). Molecular Biotechnology (3rd Edition). Blackwell Science, U.K.
6. Gordon. (2003). Laboratory Production of Cattle Embryos (2nd Edition). CAB International, New Delhi.
7. LK. Yagasaki, Y. Miura, M. Hatori, & Y. Nomura. (2008). Animal Cell Technology: Basic and Applied Aspects (Vol. 13). Springer-Verlag, New York.
8. S. B. Primrose, R. M. Twyman, & R. W. Old. (2001). Principles of Gene Manipulation (4th Edition). Blackwell Science Publishing Company, Germany.
9. R. Portner. (2007). Animal Cell Biotechnology: Methods and Protocols (Vol. 24). Springer-Verlag, New York, LLC.

24CMBT33 PHARMACEUTICAL BIOTECHNOLOGY

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVES

Provide a comprehensive understanding of pharmaceutical biotechnology principles, applications, and regulations to equip students for careers in drug discovery, development, production, and regulatory affairs within the pharmaceutical industry.

UNIT I: INTRODUCTION TO PHARMACEUTICAL BIOTECHNOLOGY 12

Overview of biotechnology and its relevance to pharmaceuticals, Historical perspectives and milestones in pharmaceutical biotechnology, Current trends and future prospects in the field

UNIT II: DRUG DISCOVERY AND DEVELOPMENT 12

Principles of drug discovery using biotechnological tools, Application of genomics, proteomics, and bioinformatics in target identification and validation, Preclinical and clinical phases of drug development for biopharmaceuticals

UNIT III: BIOPHARMACEUTICAL PRODUCTION 12

Basics of recombinant DNA technology and protein expression systems, Manufacturing processes for biologics - monoclonal antibodies, recombinant proteins, and vaccines, Quality control measures and regulatory requirements in biopharmaceutical production

UNIT IV: CONTROLLED DRUG DELIVERY SYSTEMS 12

Introduction to controlled drug delivery systems, Biotechnological approaches in the design of controlled release formulations, Novel drug delivery systems such as nanoparticles, liposomes, and implantable devices

UNIT V: REGULATORY AFFAIRS AND ETHICS 12

Overview of regulatory frameworks governing pharmaceutical biotechnology products, Ethical considerations in biopharmaceutical research and development, Compliance with safety norms and quality standards in pharmaceutical biotechnology

Total: 60 hours

COURSE OUTCOME

CO-1: Demonstrate thorough understanding of the role of biotechnology in pharmaceuticals.

CO-2: Apply biotechnological tools in drug discovery and development processes.

CO-3: Possess skills to effectively manufacture biopharmaceuticals and ensure quality control.

CO-4: Capable of designing and implementing controlled drug delivery systems using biotechnological approaches.

CO-5: Understand regulatory frameworks and ethical considerations associated with pharmaceutical biotechnology products.

CO-6: **Apply** biotechnological techniques in drug target identification, validation, and the development phases for biopharmaceuticals.

CO-7: **Design** biopharmaceutical production processes that comply with regulatory requirements and ensure safety and quality standards.

TEXT & REFERENCE BOOKS

1. Gola, D. (2019). Pharmaceutical Biotechnology: Fundamentals and Applications. Elsevier Publishing.
2. Walsh, G. (2018). Biopharmaceuticals: Biochemistry and Biotechnology. Wiley-Blackwell.
3. Jay P Rho, Stan G Louie, (2003). Hand book of Pharmaceutical Biotechnology, Pharmaceutical products press, New York. 2003.
4. Pardridge, W. M. (2017). Pharmaceutical Biotechnology: Drug Discovery and Development. Springer.
5. Swann, R., & Bansal, A. (2017). Pharmacology and Pharmacotherapeutics. Jaypee Brothers Medical Publishers.
6. Vyas, S. P., & Khar, R. K. (2016). Pharmaceutical Drug Delivery Systems: Design and Development. CBS Publishers & Distributors.
7. Rao, M. (2020). Nanotechnology in Drug Delivery. CRC Press.
8. J. P. Rho & S. G. Louie. (2003). Handbook of Pharmaceutical Biotechnology. Pharmaceutical Products Press, New York.
9. K. Banga. (2004). Therapeutic Peptides and Proteins: Formulation, Processing, and Delivery Systems (2nd Edition). Mercer University, Macon, Georgia, USA.
10. D. J. A. Crommelin & R. D. Sindelar. (2002). Pharmaceutical Biotechnology (3rd Edition). Routledge, Taylor and Francis Inc., New York.
11. P. D. Sethi. (2005). Quantitative Analysis of Drugs in Pharmaceutical Formulations (3rd Edition). CBS Publishers and Distributors, New Delhi.

.

24PMBT31 PLANT, ANIMAL, PHARMACEUTICAL BIOTECHNOLOGY PRACTICAL

L	T	P	O	C
0	0	4	1	2

COURSE OBJECTIVE:

To Develop the capabilities of media preparation and construction of ability on scaling up of secondary metabolites.

PLANT BIOTECHNOLOGY

1. Preparation of plant tissue culture media, Surface sterilization methods of explants and seed culture
2. Establishment of callus cultures and Micro propagation
3. Anther culture – haploid production
4. Isolation of plant protoplasts enzymatic method
5. Agrobacterium mediated gene transfer (Demo)

ANIMAL BIOTECHNOLOGY

1. Sterilization Technique in Animal tissue culture.
2. Preparation of animal cell culture medium.
3. Preparation of single cell suspensions from animal tissue
4. Preparation of Animal cell monolayer and Trypsinization of monolayer
5. Cell counting and Cell viability assay

PHARMACEUTICAL BIOTECHNOLOGY

1. Preparation of different methods of medicinal plant extracts.
2. Phytochemical screening of Primary metabolites.
3. Phytochemical screening of Secondary metabolites.
4. Total antioxidant activity.
5. Separation of medicinal plant extracts by chromatography.

Total: 30 Hours

COURSE OUTCOME:

CO-1: Illustrate the basic concepts of aseptic growth conditions and propagation techniques

CO-2: Demonstrate on callus propagation of plants and Preparation of tissue culture medium

CO-3: Elaborate on Cryopreservation techniques for cell culture and gain practical training in the cell counting and viability assays.

CO-4: Develop animal cell monolayers and perform trypsinization for subculturing.

CO-5: Experiment knowledge in synthesis and identification of drugs

CO -6: Understand the basic principles of phytochemical identification and estimations

CO -7: Separate medicinal plant components using chromatographic techniques and interpret the results.

TEXT & REFERENCE BOOKS

1. H. S. Chawla. (2004). Plant Biotechnology: Laboratory Manual for Plant Biotechnology. Oxford & IBH Publishing Co. Pvt. Ltd.
2. Tahakik, R. (2021). Practical Manual - Plant Tissue Culture. Department of Plant Biotechnology
3. Chau, A. (2019). Exploring the World of Plants: General Botany Laboratory Manual. Kendall Hunt Publishing.
4. R. Mahajan, J. Sharma, & R. K. Maharajan. (2010). Practical Manual of Biotechnology. Vayu Education of India.
5. M. R. Green & J. Sambrook. (2014). Molecular Cloning: A Laboratory Manual (4th Edition). Cold Spring Harbor Laboratory Press.
6. Gahlawat, S. K., & Duhan, J. S. (2018). Advances in Animal Biotechnology and its Applications. Springer.
7. R. I. Freshney. (2005). Culture of Animal Cells: A Manual of Basic Technique. Wiley-Liss.
8. W. Wu, M. J. Welsh, P. B. Kaufman, & H. H. Zhang. (1997). Methods in Gene Biotechnology. CRC Press, New York.
9. M. S. Clark. (1997). Plant Molecular Biology: A Laboratory Manual. Springer Publication, New York.
10. Gola, D. (2019). Pharmaceutical Biotechnology: Fundamentals and Applications. Elsevier Publishing.
11. Walsh, G. (2018). Biopharmaceuticals: Biochemistry and Biotechnology. Wiley-Blackwell.

24SSKP31 **SOFT SKILL III**

L	T	P	O	C
2	0	0	1	2

COURSE OBJECTIVE:

- To enable students to develop their soft skills and Body Language
- To enhance students Reading, Writing, Listening and Speaking skills
- To develop their self-confidence to excel at Interviews

UNIT–I **06**

Powerful Presentation

UNIT–II **06**

Reinforcement

UNIT–III **06**

Using visual aids

UNIT–IV **06**

Types and Methods of Presentations

UNIT–V **06**

Obstacles to Presentation

Total: 30 Hours

Course Outcome:

CO1 To develop participants social and professional skills

CO2 To help participants manage time effectively

CO3 To build a strong resume to suit corporate requirements

CO4 To face interviews confidently

CO5 To enhance their aptitude abilities

Textbook:

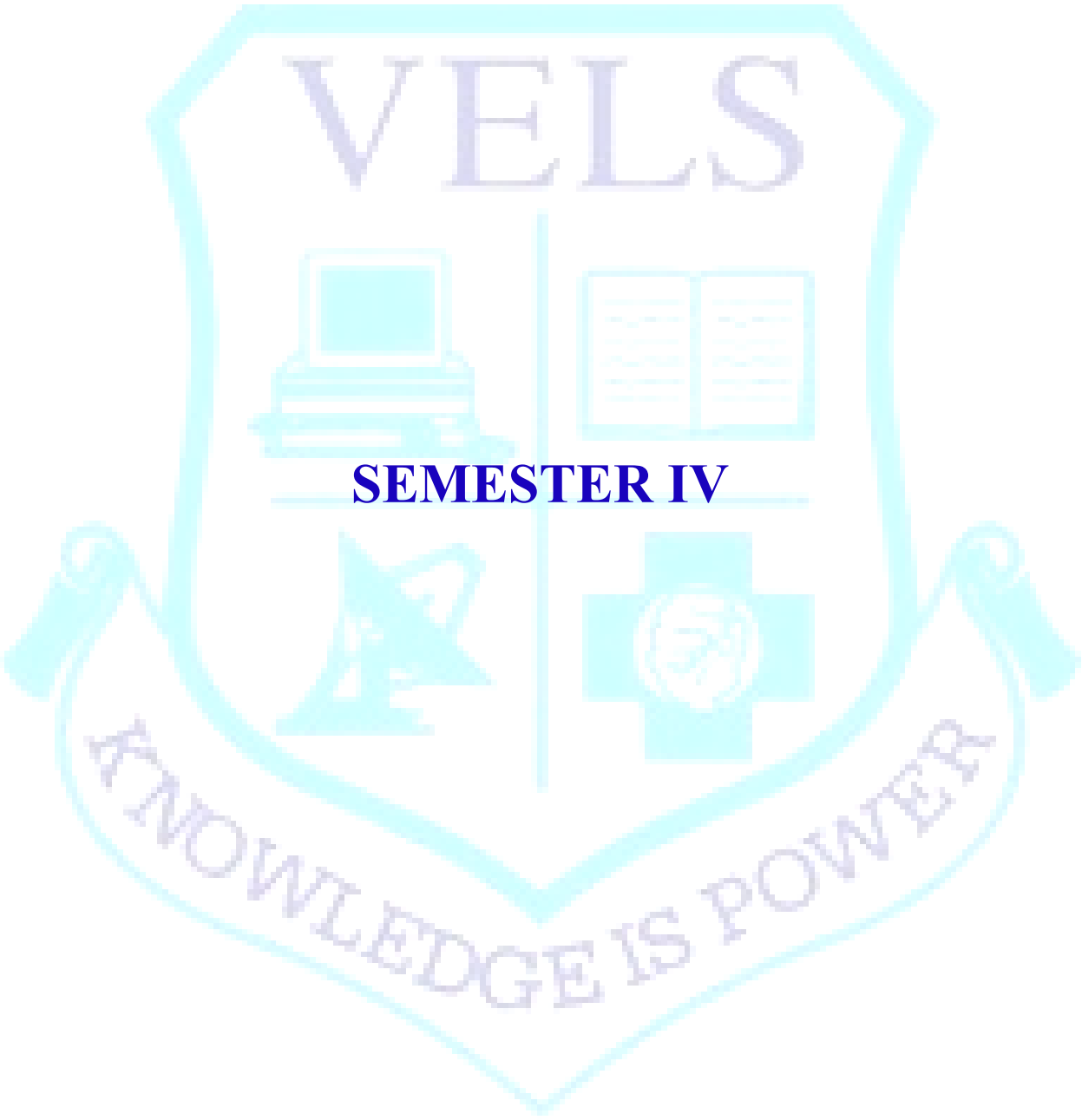
1. Roz Townsend: Presentation Skills for the Upwardly Mobile, Emerald, Chennai.
2. Prasad, H. M. How to Prepare for Group Discussion and Interview. New Delhi: Tata McGraw-Hill Publishing Company Limited, 2001.
3. Pease, Allan. Body Language. Delhi: Sudha Publications, 1998.

Web Sources:

https://www.skillsyouneed.com/ips/communication-skills.html

ttps://venngage.com/blog/presentation-skills/

https://gdpi.hitbullseye.com/Group-Discussion.php



SEMESTER IV

24CMBT41 **RESEARCH METHODOLOGY**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE:

To provide students with a comprehensive understanding of research methodology, including principles of research design, data collection, analysis, ethical considerations, and literature review, enabling them to conduct research effectively and ethically

UNIT I: INTRODUCTION TO RESEARCH METHODOLOGY 12

Definition and scope of research methodology, Basic concepts in research design, hypothesis formulation, and literature review, Historical development of research methodology, Current trends and future prospects in research methodology

UNIT II: RESEARCH DESIGN AND SAMPLING TECHNIQUES 12

Principles of experimental and non-experimental research designs, Techniques for selecting samples and populations, Advantages and limitations of different research designs, Strategies for minimizing bias in sampling techniques

UNIT III: DATA COLLECTION AND ANALYSIS 12

Methods for collecting primary and secondary data, Statistical techniques for data analysis, including descriptive and inferential statistics, Tools and software for data collection and analysis, Interpretation of research findings and drawing conclusions

UNIT IV: ETHICAL CONSIDERATIONS IN RESEARCH 12

Overview of ethical principles and guidelines in research, Responsible conduct of research, including plagiarism, data fabrication, and conflicts of interest, Ethical considerations in cross-cultural and interdisciplinary research, Ethical implications of emerging technologies in research

UNIT V: STATISTICAL METHODS 12

Measures of Central tendency -Mean, Median, Mode– Measures of Dispersion- Range, Quartile Deviation, Standard Deviation and Coefficient of variation. Correlation and regression analysis, Tests of Significance: t-test -F-test, Chi-Square tests - Analysis of Variance.

Total: 60 hours

COURSE OUTCOME

CO-1: Demonstrate proficiency in understanding fundamental concepts and principles of research methodology, including research design, data collection, analysis, and ethical

considerations.

CO-2: Apply knowledge of research methodology to formulate research questions, design studies, select appropriate sampling techniques, and collect primary and secondary data effectively.

CO-3: Acquire skills in analyzing research data using statistical techniques, interpreting findings, and drawing valid conclusions, enhancing contribution to scientific knowledge and problem-solving.

CO-4: Develop ethical awareness and responsibility in research conduct, demonstrating adherence to ethical standards, integrity, and professionalism in research activities.

CO-5: Demonstrate effective communication skills in presenting research findings, writing research proposals, and critically evaluating scientific literature, preparing for academic and professional endeavors in research-related fields.

CO-6: Evaluate research findings through the application of inferential statistical techniques such as t-tests, F-tests, chi-square tests, and ANOVA.

CO-7: Design ethical and statistically sound research studies that minimize bias and adhere to interdisciplinary guidelines.

TEXT & REFERENCE BOOKS

1. Ranjit Kumar. (2020). Research Methodology: A Step-by-Step Guide for Beginners. SAGE Publications.
2. Creswell, J. W., & Creswell, J. D. (2020). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. SAGE Publications.
3. Sekaran, U., & Bougie, R. (2020). Research Methods for Business: A Skill-Building Approach. Wiley.
4. Kothari, C. R. (2019). Research Methodology: Methods and Techniques. New Age International.
5. Neuman, W. L. (2018). Social Research Methods: Qualitative and Quantitative Approaches. Pearson Education
6. Kothari C R. (2010). Research Methodology: Methods and Techniques (2nd Edition). New Age International Publishers.

7. N. Gurumani. (2006). Research Methodology for Biological Science. MJP Publishers, Chennai.
8. S. P. Gupta. (2012). Statistical Methods. Sultan Chand & Sons, New Delhi.
9. S. C. Gupta & V. K. Kapoor. (2001). Fundamentals of Applied Statistics (3rd Edition). Sultan Chand & Sons.
10. P. R. Vital. (2012). Business Statistics (2nd Edition). Margham Publications.
11. G. Beri. (2009). Business Statistics. Tata McGraw Hill Publishing Company Limited.
12. S. P. Rajagopalan & R. Sattanathan. (2009). Business Statistics and Operations Research (2nd Edition). Vijay Nicole Pvt. Ltd.

24PMBT41 SKILLS IN BIOTECHNOLOGY PRACTICAL

L	T	P	O	C
0	0	3	1	1

COURSE OBJECTIVE:

To equip students with practical skills and scientific understanding in sustainable agriculture and environmental management through training in biofertilizer production, vermicomposting, mushroom cultivation and marketing, food and water quality analysis, and industrial/field exposure, enabling them to apply eco-friendly techniques and quality standards in real-world settings.

1. Biofertilizer Production
2. Vermicompost and Organic Manure Preparation
3. Mushroom Cultivation and its Marketing
4. Food Quality Analysis
5. Water Quality Analysis
6. Industrial / Field Visit

Total: 30 Hours

COURSE OUTCOME:

CO-1: Explain the fundamental concepts, types, and microbial processes involved in biofertilizer production and demonstrate skills in culture preparation and quality evaluation.

CO-2: Demonstrate the preparation of vermicompost and organic manure by understanding earthworm biology, substrate formulation, and composting techniques.

CO-3: Illustrate the principles and methods of mushroom cultivation, including substrate preparation, environmental control, harvesting, and basic marketing strategies.

CO-4: Perform standard procedures for food quality analysis, including physicochemical tests, microbial assessment, and interpretation of safety parameters.

CO-5: Analyze water samples using qualitative and quantitative techniques to determine physicochemical and microbiological parameters and assess overall water quality.

TEXT & REFERENCE BOOKS

1. M. K. Rai. Handbook of Microbial Biofertilizers. 2006. ood Products Press® An Imprint of The Haworth Press, Inc.
2. Borkar,S,G, and Patil N.M (2016), Mushroom,A nutritive food and its cultivation, Astral International Pvt.Ltd, New Delhi.
3. Lee, K.E. (1985) "Earthworms: Their ecology and Relationship with Soils and Land Use" Academic Press, Sydney.
4. Principles of Food Science, Vol. II- G. Borgstron, Mc. Millan Co. Ltd. London.
5. Rahman MS (2005), Handbook of Food Preservation, 2nd Ed, CRC Press, Sen DP.
6. Motsara, I.M.R., Bhattacharyya, P. and Srivastava, B (1995), Biofertilizer Technology, Marketing and Usage- A Source Book-cum-glossary. FDCO, New Delhi

24CMBT41 **PROJECT**

L	T	P	O	C
0	0	12	10	12

COURSE OBJECTIVE:

Students should do research on their own interest or research guide interest on any biotechnology topic for 6 months in the university or any industries or laboratories. After the research, he/she should submit the detailed reports about the research in a dissertation and should present it to an external examiner.

- Students should do research on their own interest or research guide interest on any biotechnology topic for 6 months in the university or any industries or laboratories.
- The candidates shall undertake the major project work in the Sixth Semester either in the Department concerned or in industries, institutes or any other organizations and the project report shall be submitted at the end of the Sixth semester.
- In case the candidate undertakes the project work outside the Department, the Staff concerned within the Department shall be the Main guide and the Staff/scientist under whom the work is carried out will be the Co-guide. The candidate shall bring the attendance certificate from the place of project work carried out.
- After the research, he/she should submit the detailed reports about the research in a dissertation and should present it to an external examiner.
- Evaluation is based on work done, quality of report, performance in viva-voce, presentation etc.
- The report will be evaluated by duly appointed teaching faculty from head of department

Discipline Specific Elective Courses

24DMBT11 **BIOINSTRUMENTATION**

L	T	P	O	C
3	0	0	2	3

COURSE OBJECTIVE:

To provide fundamental theoretical knowledge to the students about bio instruments and bio methods, its principle and operation methods.

UNIT-I: MICROSCOPIC TECHNIQUES **12**

Visualization of cell and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission electron microscope, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing method in microscopy, pH meter.

UNIT-II: BIOPHYSICAL METHOD **12**

Analysis of biomolecules, Principles, instrumentation, sample preparation and applications of IR, fluorescence, circular dichroism, NMR and ESR spectroscopy, Absorption Spectroscopy, X- ray Spectroscopy. FTIR, Raman spectroscopy.

UNIT- III CENTRIFUGATION **12**

Principle and Applications of various types of centrifuges, Chromatography Techniques: Principle and Application of Paper, TLC, Gel Filtration, Ion Exchange, Affinity, GC & HPLC. Cell Sorting, FACS.

UNIT-IV: ELECTROPHORESIS **12**

Theory of electrophoresis and types of electrophoresis zonal, moving boundary and pulse field – their principles and applications. Capillary electrophoresis, 2D Gel Electrophoresis, Optical densitometry, Isoelectric Focusing

UNIT-V RADIO-ISOTOPIC TECHNIQUES **12**

Introduction to Radioisotopes, Uses and their Biological Applications, Radioactive Decay – Types and Measurement, Principles and Applications of GM Counter, Solid and Liquid Scintillation Counter, Autoradiography, RIA, Radiation Dosimetry, Health effects of radiations.

Total Hours: 60

COURSE OUTCOME:

CO-1: Understand on Basics of Microscopy, its operation and maintenance and

CO-2: Illustrate on the advanced microscopes like SEM, TEM etc and image processing for microscopical studies.

CO-3: Illustrate about the analysis of biomolecules using spectroscopy and Applications of NMR and ESR in determination of biomolecules

CO-4: Design and demonstrate adsorption and chromatography processes for the purification of biomolecules

CO-5: Analyse the separation of Biomolecules using electrophoresis

CO-6: Apply radio-isotopes in detection and measurement of biomolecules and

CO-7: Learn biological imaging of tissues using radio-isotopes

TEXT& REFERENCE BOOKS

1. L. Veerakumari.,Bioinstrumentation, Publishers; 1st edition, 2011.
2. Webster, Bioinstrumentation, Wiley India Private Limited, 2007.
3. John G Webster, Bioinstrumentation. John Wiley & Sons, New York, Physical John, 2004.
4. F. Robyt , Bernard J. White, Biochemical Technique: Theory and Practice, - Waveland PrInc; Reprint edition, 1990.
5. K. Wilson., Walker, J. E. J. Wood, K., Walker, J, Principles and techniques of practical biochemistry Cambridge University Press, Cambridge, 5th Edition, 2000.
6. Michael R. Green, Joseph Sambrook, Molecular Cloning: A Laboratory Manual, Cold Spring Harbor Laboratory Press,U.S, 4th Edition, 2014

24DMBT12 **NANO BIOTECHNOLOGY**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE:

To impart knowledge on characterization, structure, function and application of Nanobiotechnology

UNIT I INTRODUCTION TO NANOBIOTECHNOLOGY **12**

History and Scope of nanobiotechnology. Nanostructures: Quantum dot, Nanotubes, Nanorods, Nanofibres, Fullerenes, Nanocomposites and other Nanostructures. Characterization techniques: Dynamic Light Scattering (DLS), Scanning and Transmission Electron Microscope (SEM, TEM), X-ray Crystallography (XRD), Fourier Transform Infra-Red Spectrophotomer (FTIR), Brunauer Emmet Teller (BET).

UNIT II NANO BIOMATERIALS **12**

Nano Biomaterials: Lipids, Polysaccharides, DNA - Protein nano structures. Biomolecular Design, Self- assembly of nanomolecules. Molecular Modeling and Biomolecular structure determination. Chemical, physical and biological properties of biomaterials and bioresponse.

UNIT III BIOSYNTHESIS AND PROPERTIES OF NANO BIOMATERIALS **12**

Biosynthesis, structure-property relationships in polymeric materials (synthetic polymers and structural proteins); biotransformation, biomineralization, Bio-electromagnetism, Bio-mechanics, Neuro transport, Biological Rhythms.

UNIT IV CELLULAR TRANSPORTATION **12**

Functions of Bio-nanomachines. Molecular recognition, cellular communication, material transfer into and within cells. Biomolecular sensing. Effects of physical, chemical and electrical stimuli on cell function and gene regulation.

UNIT V APPLICATIONS OF BIO NANOTECHNOLOGY **12**

Microfabrication and Nanolithography. Nanoimaging, Application of nanobiotechnology in health science, Nanobiotechnology in Environmental sciences. Nanomedicine, Drug nanoparticles, Bio incompatibility and drug delivery. Gene Therapy, DNA computers, hybrid materials, artificial life and biosensors.

Total: 60 hours

COURSE OUTCOME:

CO-1: Learning the structure and characterization of Bio-Nanomaterials

CO-2: Understanding different nanobiomolecules, their molecular structure and assemblies

CO-3: Explain on the Chemical, physical and biological properties of biomaterials

CO-4: Knowledge on the biosynthesis and Bio properties of Nano Biomolecules

CO-5: Understanding the cellular transport, signal stimuli and communication between cells

CO-6: Learning different application of nanobiotechnology.in Environmental sciences.

CO-7: Illustrate on different application of nanobiotechnology.in Clinical Sciences.

TEXT& REFERENCE BOOKS

1. Claudia Nicolini. Nanobiotechnology Nanobiosciences. Pan Stanford Publishing Pte. Ltd, 2009.
2. Niemeyer, C.M. and Mirkin, C.A. Nanobiotechnology concepts, application and perspectives. WILEY-VCH, Verlag Gmb H & Co. 2004.
3. Manasi Karkare, Nanotechnology: Fundamentals and Applications, I K International Publishing House Pvt. Ltd ,2008.
4. David S. Goodsell, Bionanotechnology: Lessons from Nature, 1stEdition, Wiley-Liss, 2004.
5. Charles Poole, Frank Owens, Introduction to Nanotechnology, Wiley 2007.
6. Gero Decher, Joseph B. Schlenoff, Multilayer Thin Films, Wiley- VCH Verlag, GmbH & Co. KGaA, 2003.
7. Neelina H. Malsch, Biomedical Nanotechnology, 1st Edition, CRC Press, 2005.

24DMBT13 **BIOINFORMATICS**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE

This course covers bioinformatics fundamentals, including data analysis, sequence alignment, genome analysis, protein structure prediction, and medical applications like drug discovery, in an interdisciplinary approach merging biology, computer science, and medicine.

UNIT-I INTRODUCTION 12

Bioinformatics data nucleic acid sequence, protein sequence, protein structure, genomic, proteomic and metabolomic information, Bioinformatics databases types, design, file formats, access tools with examples, Bioinformatics tools and Resources free online tools, downloadable free tools, software packages, internet, Bioinformatics books and Journals, Bioinformatics web-portals

UNIT-II BIOINFORMATICS TOOLS 12

Sequence alignment basics, match, mismatch, similarity, scoring an alignment, gap penalty, protein vs DNA alignments, Dot-matrix alignment, pairwise alignment global and local alignment algorithms, Multiple sequence alignment-progressive alignment and Iterative alignment algorithms, consensus sequence, patterns and profiles, Database searching: Pairwise alignment based rigorous algorithm (Smith and Waterman) and Heuristic algorithms (FASTA and Blast). Multiple sequence alignment-based database searching PSI- Blast, PAM and Blosum matrices

UNIT-III STRUCTURE PREDICTION 12

Bioinformatics for genome sequencing, EST Clustering and analyses, finding genes in prokaryotic and eukaryotic genomes, Regulatory sequence analysis, Bioinformatics for Genome maps and markers, Bioinformatics for understanding Genome variation, Protein structure prediction and classification, Bioinformatics in support of Proteomic research

UNIT-IV VISUALIZATION 12

Molecular visualization tools Rasmol, Chime and Spdb viewer Structure analysis tools VAST and DALI, Structural biology - Homology modeling, Bioinformatics for micro array designing and transcriptional profiling, Bioinformatics for metabolic reconstruction, Bioinformatics for phylogenetic analysis.

UNIT-V DRUG DISCOVERY 12

Medical application of Bioinformatics disease genes, Drug Discovery History Steps in drug discovery Target Identification Target Validation QSAR Lead Identification Preclinical pharmacology and toxicology ADME Drug designing Rational drug design Computer aided drug design Ligand based approach Target based approach.

Total Hours: 60

COURSE OUTCOMES

CO-1: Proficiency in handling bioinformatics data and databases.

CO-2: Mastery of sequence alignment techniques and database searching methods.

CO-3: Application of bioinformatics in genome analysis and protein structure prediction.

CO-4: Utilization of molecular visualization tools and bioinformatics in biological analyses.

CO-5: Understanding the role of bioinformatics in medical applications.

CO-6: Illustrate on the role of Bioinformatics in metabolic reconstruction, phylogenetic analysis.

CO-7: Explain about the steps in drug discovery and disease gene identification.

TEXT& REFERENCE BOOKS

1. DassanayakeS.Ranil, Y.I.N. Silva Gunawardene., (2011). Genomic and Proteomic Techniques, Narosa Publishing House Pvt. Ltd, New Delhi.
2. Thiagarajan B, Rajalakshmi.P.A. , (2009). Computational Biology, MJP publishers, Chennai.
3. BosuOrpita, SimminderKaurThukral., (2007). Bioinformatics Databases Tools and Algorithms, Oxford University press, New Delhi.
4. Rastogi.S.C, Mendiratta.N, Rastogi.P., (2004). Bioinformatics methods and applications., Prentice-Hall of India private limited, New Delhi.
5. Lohar s. Prakash., (2009). Bioinformatics, MJP Publishers, Chennai.
6. Stephen misener and Stephen A. Krawetz., (2000). Bioinformatics methods and protocols, Humana press Inc, New Jersey.
7. Durbin.R, S.Eddy, A.Krogh and G.Mitchison, (1998). Biological sequence analysis, Cambridge university press, Cambridge.

Websites: www.google.co.in - Search for database or tool name and find help file.

24DMBT14 ENTREPRENEURSHIP AND MANAGEMENT IN BIOTECHNOLOGY

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE

Bio-entrepreneurship, an interdisciplinary course, revolves around the central theme of how to manage and develop life science companies and projects

UNIT I INTRODUCTION TO MANAGEMENT 12

Introduction – Meaning – nature and characteristics of Management, Scope and Functional areas of management. Management V/s Administration – Roles of Management, Levels of Management. Evolution of management thought: early, contemporary and modern.

UNIT II PLANNING AND ORGANIZATION 12

Nature, purpose and importance of planning process. Types of plans. Decision making. Importance of planning – steps in planning & planning premises. Hierarchy of plans. Components of planning. Nature and purpose of organization. Principles of organization, Types of organization. Departmentation Committees. Centralization Vs Decentralization of authority and responsibility. Nature and importance of staffing–Process of Recruitment and Selection.

UNIT III MEANING AND NATURE OF DIRECTING 12

Understanding, Supervision, motivation and leadership. Leadership styles, Motivation Theories (Abraham Maslo, Herzberg and Victor Hvrom's). Communication – Meaning and importance. Meaning and steps in controlling – Essentials of a sound control system – Methods of establishing control (in brief).

UNIT IV BIO MARKETS 12

Introduction to Bio markets - business strategy and marketing Negotiating the road from lab to the market (strategies and processes of negotiation with financiers, government and regulatory authorities), Pricing strategy, Challenges in marketing in bio business (market conditions & segments; developing distribution channels, the nature, analysis and management of customer needs), Basic contract principles, different types of agreement and contract terms typically found in joint venture and development agreements, Dispute resolution skills

UNIT V STRUCTURE OF A BIOTECHNOLOGY COMPANY 12

Start-up of Biotechnology Company, New Product Development. Entrepreneurship development

programs of public and private agencies (MSME, DBT, BIRAC, Make In India), strategic dimensions of patenting & commercialization strategies. Intellectual Property Principles in Biotechnology. Health Care Overview and Role of Government in Biotechnology. Ethical and Other Legal Issues in Biotechnology

Total: 60 Hours

COURSE OUTCOME:

CO-1: Identifying a winning business opportunity, gathering funding and launching a business. CO-

CO-2: Explain on growing and nurturing the organization and harvesting the rewards.

CO-3: Understand the various operations involved in venture creation, identify scope for entrepreneurship in biosciences.

CO-4: Illustrate the utilization of the schemes promoted through knowledge centres and various agencies.

CO-5: Knowledge on management should also help students to be able to build up a strong network within the industry.

CO-6: Critical analysis of the Indian biotech sector's development.

CO-7: Expertise in industrial management practices for biotech manufacturing.

TEXT & REFERENCE BOOKS

1. Adams, D.J., & Sparrow,J. C. (2008). Enterprise for Life Scientists: Developing Innovation and Entrepreneurship in the Biosciences.Bloxham:Scion.
2. Shimasaki, C. D. (2014). Biotechnology Entrepreneurship: Starting, Managing, and Leading BiotechCompanies.Amsterdam:Elsevier.AcademicPress isanimprint of Elsevier.
3. Jordan, J. F. (2014). Innovation, Commercialization, and Start-Ups in Life Sciences. London: CRC Press.
4. Desai, V. (2009). The Dynamics of Entrepreneurial Development and Management. New Delhi: Himalaya Pub.House.
5. Craig Shimasaki, (2014). Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies [Kindle Edition] Academic Press; 1 edition,
6. Kumawat, H. S.. (2013).Modern Entrepreneur and Entrepreneurship Theory Process Practice Neha Publishers & Distributors.

7. Erik Larson (Author), Clifford Gray, (2013). Project Management: The Managerial Process with MS Project (The Mcgraw-Hill Series Operations and Decision Sciences) 6th Edition.
8. Narasimhan S.L. McLeavey D.W and Billignton P.J. (1995), Production planning and Inventory control, 2nd Ed. Prentice Hall of India.

24DMBT21 ENVIRONMENTAL BIOTECHNOLOGY

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE: (EMPLOYABILITY)

The course aims to provide students with a comprehensive understanding of environmental microbiology and its applications in environmental biotechnology.

UNIT I SUSTAINABLE ENERGY SOURCES (BIOFUELS) 12

Introduction to sustainable energy sources and their environmental significance. Biofuels: Types, production methods, and environmental impact assessment. Conversion of biomass to biofuels: Ethanol, biodiesel, and biogas.

UNIT II BIOREMEDIATION AND SOIL HEALTH 12

Bioremediation: Principles, techniques, and applications in soil and water remediation. Role of microbial consortia in the degradation of organic pollutants. Soil health assessment: Importance, methods, and applications.

UNIT III PHYTOREMEDIATION AND ENVIRONMENTAL RESTORATION 12

Phytoremediation: Concepts, mechanisms, and applications in soil and water remediation. Plant-microbe interactions in phytoremediation. Environmental restoration: Strategies for ecological rehabilitation and conservation.

UNIT IV WASTEWATER TREATMENT AND SUSTAINABLE AGRICULTURE 12

Wastewater treatment technologies: Principles and applications in municipal and industrial settings. Biofertilizers: Types, production, and role in sustainable agriculture. Symbiotic and asymbiotic nitrogen-fixing bacteria: Applications in soil fertility and crop production.

UNIT V BIOMINERALIZATION AND ENVIRONMENTAL SUSTAINABILITY 12

Biomineralization: Mechanisms and applications in biomining and bioleaching. Microbial biomineralization of metals: Gold, copper, and uranium. Genetically modified microorganisms: Environmental implications and ethical considerations.

Total: 60 hours

COURSE OUTCOME

CO–1: Understand the principles of sustainable energy sources and evaluate their environmental impact.

CO–2: Apply bioremediation techniques to address soil and water pollution, emphasizing the role of microbial consortia in organic pollutant degradation.

CO–3: Explain the concepts and applications of phytoremediation,

CO-4: Analyse the strategies involved in environmental restoration and conservation.

CO–5: Evaluate wastewater treatment technologies and assess the role of biofertilizers in sustainable agriculture, focusing on nitrogen-fixing bacteria.

CO–6: Analyse the mechanisms of biomineralization in biomining and bioleaching

CO- 7: Assess the environmental implications of genetically modified microorganisms.

TEXT& REFERENCE BOOKS

1. Pradipta Kumar Mohapatra (2007) ,"Environmental Biotechnology",I.K. International Publishing House; 1st Edition.
2. Satyanarayana, U, (2013) "A Textbook of Biotechnology", Books and Allied (p) Limited.
3. Purohit S.S. (2010) "Agricultural Biotechnology", Agrobios, 3rd edition, 2010.
4. Alan Scragg, (2007)."Environmental Biotechnology", Oxford; Second edition.
5. Hans-Joachim Jordening and Jesef Winter, (2004) "Environmental Biotechnology – Concepts and Applications",Wiley VCH, 2004.
6. Metcalf and Eddy, (2003). "Waste Water Engineering", Tata McGraw hill, 4th edition,
7. Alicia L. Ragout De Spencer, JohnF.T. Spencer. (2004). "Environmental Microbiology: Methods and Protocols", Humana Press.
8. Milton Wainwright, (1999). "An Introduction to Environmental Biotechnology", Springer,

24DMBT22 **HERBAL DRUG TECHNOLOGY**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE (EMPLOYABILITY)

This course teaches students about the basic concept of the herbal medicine industry, the quality of raw materials, recommendation for the quality of herbal pharmaceuticals, herbal cosmetics, natural sweeteners, nutraceuticals, and so on. This subject also focuses on Good Manufacturing Practices (GMP), patenting, and regulatory difficulties for Herbal medications.

UNIT I: INTRODUCTION TO HERBS 11

Definition of herb – Source of herbs – Selection, identification, and authentication of herbal materials – Processing of raw materials – herbal drug preparation – Indian System of Medicines

UNIT II: NUTRACEUTICALS 14

Role of herb as nutraceuticals in diseases – Diabetes, Cancer, Irritable bowel syndrome and Gastro intestinal diseases. Herbs as medicinal food – Ginger, Fenugreek, Garlic, Honey, Amla, Ashwagandha, Spirulina. Herb drug and food interaction – General introduction to interaction and classification.

UNIT III: COSMETICS 10

Sources and description of raw materials of herbal origin via fixed oils, waxes, gums, colours, perfumes, protective agents, bleaching agents, antioxidants in products such as skin care, hair, and oral hygiene products. Herbal Excipients – Natural origin excipients colorants, sweetner, binder, diluents, viscosity builders, disintegrants, flavors & perfumes.

UNIT IV: EVALUATION & REGULATORY OF HERBAL DRUG 15

Evaluation - WHO & ICH guidelines for the assessment of herbal drugs Stability testing of herbal drugs. Patenting - Patenting aspects of Traditional Knowledge and Natural Products. Case study of Curcuma & Neem. Regulatory – Regulation in India, Schedule Z of drug & Cosmetic Act for ASU drugs.

UNIT V: ENTREPRENEURSHIP 10

Plant Based Industries and Institutions involved in medicinal and aromatic plant works in India. GMP in Indian system of medicine – Component of GMP (Schedule – T) and its objectives Infrastructural requirements, Working space, storage area, machinery, and equipment's, standard operating procedures, health and hygiene, documentation and records.

Total: 60 hours

COURSE OUTCOMES

CO-1: Understand the definition and sources of herbs, and the methods for selection, identification, and authentication of herbal materials

CO-2: Identify specific herbs with medicinal food properties and understand their therapeutic effects and mechanism of action.

CO-3: Describe and demonstrate the knowledge on herbal cosmetic preparation.

CO-4: Understand the competence in Evaluation and Regulatory Aspects

CO-5: Elaborate on the IPR about herbal drugs and Natural products

CO-6: Develop entrepreneurial skills for establishing and managing herbal-based businesses.

CO-7: Illustrate on GMP and its Objectives and Components

TEXT/REFERENCE BOOK

1. Textbook of Pharmacognosy by Trease & Evans.
2. Textbook of Pharmacognosy by Tyler, Brady & Robber.
3. Pharmacognosy by Kokate, Purohit and Gokhale.
4. Essential of Pharmacognosy by Dr.S.H.Ansari.
5. Pharmacognosy & Phytochemistry by V.D.Rangari.
6. Pharmacopoeal standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy).
7. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.

24DMBT31 **GENOMICS AND PROTEOMICS**

L	T	P	O	C
3	0	0	2	3

COURSE OBJECTIVE (EMPLOYABILITY)

To provide the students a broader knowledge on the structure and function of genomes, the technologies developed for genomics and proteomics.

UNIT-I: ORGANIZATION OF GENOMES **9**

Introduction to Genome, Genomics, and General Features - Gene identification and prediction rules and software - Genome databases and diversity: Taxonomy and significance of genomes (bacteria, yeast, Caenorhabditis, Arabidopsis, etc.)

UNIT-II: MAPPING GENOMES **9**

Genetic mapping techniques: Cross breeding, pedigree analysis, and DNA markers (RFLPs, SSLPs, SNPs) - Physical mapping techniques: Restriction mapping, Fluorescent *in situ* hybridization (FISH), Radiation hybrid mapping, Sequence tagged site mapping

UNIT-III: GENOMICS **9**

Overview of genome projects: The Human Genome Project, HapMap Project, The 1000 Genome Project, The ENCODE Project - Genome sequencing technologies: Sanger sequencing, Next-Generation Sequencing (NGS) and emerging techniques

UNIT-IV: INTRODUCTION TO PROTEOMICS **9**

Overview of the qualitative and quantitative proteome analysis - Proteomic technologies: two-dimensional gel electrophoresis, mass spectrometry, and protein-protein interaction studies, Post Translational Modifications

UNIT-V: PROTEOMIC ANALYSIS AND APPLICATIONS **9**

Protein structure and function prediction - Proteomic data analysis and interpretation -Introduction to Protein Engineering and Systems Biology - Applications of proteomics in medicine, agriculture, and industry.

Total: 45 Hours

COURSE OUTCOME:

CO-1: Understand the organization of genomes in multiple levels of taxanomy

CO-2: Interpret the list on various genome mapping techniques and its application

CO-3: Analyze on importance of milestone of genome project and sequencing methods

CO-4: Learn about the proteomic technologies and protein-protein interaction studies

CO-5: Understand proteomic analysis and their applications in society

CO-6: Apply genetic and physical mapping techniques, including cross-breeding, DNA markers, and FISH, for genome analysis.

CO-7: Design proteomic-based solutions for real-world applications in medicine, agriculture, and industry, incorporating protein engineering and systems biology.

TEXT & REFERENCE BOOKS

1. Ghosh, S. (2017). Genomics and Proteomics: Modern Analytical Techniques. Wiley-Blackwell.
2. Brown T. A., Genomes (2017). Garland Science Publishing, 4th Edition. New York,
3. T. A. Brown. (2007). Genomes 3. Garland Science Publishing, New York.
4. Dunham. (2003). Genome Mapping and Sequencing. Horizon Scientific.
5. L. H. Hartwell, L. Hood, M. L. Goldberg, A. E. Reynolds, L. M. Silver, & R. G. Veres. (2004). Genetics: From Genes to Genomes. McGraw Hill.
6. B. Lewin. (2003). Genes VIII. Oxford University Press, Oxford.
7. S. B. Primrose & R. M. Twyman. (2006). Principles of Gene Manipulation and Genomics (7th Edition). Blackwell Publishing, MA, USA.
8. D. C. Liebler. (2002). Introduction to Proteomics: Tools for the New Biology. Humana Press Inc.; Softcover reprint of the original 1st Edition.
9. N. C. M. & G. B. (2010). Introduction to Proteomics: Principles and Applications. Springer.
10. S. Sanjeeva. (2022). From Proteins to Proteomics: Basic Concepts, Techniques, and Applications. CRC Press.

24DMBT32 STEM CELL BIOLOGY AND TISSUE ENGINEERING

L	T	P	O	C
3	0	0	2	3

COURSE OBJECTIVE

This course aims to teach students about stem cell biology and tissue engineering, covering stem cell classification, properties, and therapeutic applications, along with the fundamentals of tissue engineering and the creation of bioartificial organs. Ethical considerations in stem cell research will also be emphasized.

UNIT I INTRODUCTION 9

Stem cells-Introduction Definition and basics of stem cells- Classification of stem cells different types of stem cells, human embryonic stem cells, adult stem cells etc. Sources of Stem cells Foetus and various adult tissues. Advantages of stem cells. Blastocyst culture – various stages of embryonic development. In vitro fertilization. Cryopreservation of stem cells- Conventional slow-freezing method and vitrification method.

UNIT II PROPERTIES OF STEM CELLS 10

Properties of stem cells self-renewal, clonality and plasticity. - Pluripotent nature of stem cells- Extrinsic and Intrinsic factors. Characterization of human embryonic stem cells- expression of cell surface marker, karyotyping etc. Stem cell niche- bone marrow microenvironment and stem cell niche. Stem cells and their developmental potential. Characteristics of stem cells- trans differentiation of stem cells. In vivo and In vitro differentiation of human embryonic stem cells.

UNIT III THERAPEUTIC APPLICATIONS 8

Therapeutic applications of Embryonic stem cells, Bone marrow stem cells, Adipose derived stem cells and Hematopoietic stem cells in Heart regeneration and neural defects. Stem cell therapies in animal models. Uses and benefits of stem cell for human beings. Ethics in human stem cell research.

UNIT IV BASIC BIOLOGY OF TISSUE ENGINEERING 9

The basis of growth and differentiation- morphogenesis and tissue engineering. In vitro control of tissue development-Growth factors-Tissue engineering bioreactors - In vitro synthesis of Tissue and organs. Organotypic and histotypic models of engineered tissues-Biomaterials in tissue engineering-Approaches to transplanting engineered cells and tissue engineering.

UNIT V MEDICAL APPLICATION 9

Bioartificial pancreas-Hepatassist liver support system-Haematopoietic system: Red blood cell substitutes-Renal replacement devices- Musculoskeletal system. Structural tissue engineering-Bone regeneration through cellular engineering-Brain Implants-Neural stem cells-Periodontal applications- -Artificial Womb.

Total - 45 hrs

COURSE OUTCOME

CO-1: Understanding stem cell classification, sources, and cryopreservation techniques.

CO-2: Mastery of stem cell properties and their regulation, including self-renewal and pluripotency.

CO-3: Analysing therapeutic applications of stem cells and considering ethical concerns in research.

CO-4: Proficiency in tissue engineering principles, including growth control and biomaterial use.

CO-5: Application of tissue engineering for creating bioartificial organs across various body systems.

CO-6: Discuss ethical considerations in human stem cell research and its implications.

CO-7: Integrate advanced tissue engineering technologies for medical applications like artificial wombs and renal replacement devices.

TEXT & REFERENCE BOOKS

1. Kiessling. A A (2006). Human Embryonic Stem Cells (2nd Edition). Jones and Bartlett Publishers, Inc.
2. Mora, R., & Atala, A. (2021). Principles of Stem Cell Biology and Regenerative Medicine. Elsevier.
3. Lanza, R., & Cibelli, J. (2020). Handbook of Stem Cells: Volume 1 and 2. Academic Press.
4. R. Lanza. (2005). Essentials of Stem Cell Biology. Academic Press.
5. K. Turksen. (2004). Adult Stem Cells. Humana Press, Inc.
6. J. Thomson et al. (2004). Handbook of Stem Cells: Embryonic/Adult and Fetal Stem Cells (Vol. 1 & 2). Academic Press.
7. Lanza, R., Langer, R., Vacanti, J. P., Atala, A. (Eds.). (2020). Principles of tissue engineering. Academic press.

8. John P. F., Antonios G. M., Joseph D. B., Donald R. P. (2017). Tissue Engineering: Principles and Practices. CRC Press.
9. H. S. Micklem & J. F. Loutit. (2004). Tissue Grafting and Radiation. Academic Press, New York.
10. G. Penso & D. Balducci. (2004). Tissue Cultures in Biological Research. Elsevier, Amsterdam.

Useful Websites:

1. stemcells.nih.gov/
2. www.nature.com/nature/stemcells/
3. www.cell.com/cell-stem-cell/
4. www.nuigalway.ie/anatomy/tissue_engineering.html

24DMBT33 **CLINICAL RESEARCH**

L	T	P	O	C
3	0	0	2	3

COURSE OBJECTIVE

This course aims to provide a foundational understanding of clinical research, covering key concepts, terminologies, and regulations essential for conducting ethical and effective clinical trials. By the end of the course, students will gain insight into drug discovery, toxicity studies, clinical trial phases, ethical considerations, Indian regulations, and clinical data management standards.

UNIT I INTRODUCTION 9

Introduction to Clinical Research, Clinical Trial Terminologies, History of Clinical research, CPCSEA Guideline & Pre-clinical Trials, Drug Discovery & Development,

UNIT II TOXICITY STUDIES 9

Introduction to Toxicity Studies, Definition of clinical trial, Different Phases of clinical research: Subtypes of Phase 1,2,3, and 4, E –clinical trial, Bioavailability & Bioequivalence Studies [BA/BE]

UNIT III DRUG REGULATION 9

Drug Regulations & Ethics in Clinical Research: Background of ethics, Declaration of Helsinki, Belmont Report, Informed consent Process, Nuremberg code

UNIT IV GUIDELINES 9

History of Indian regulations, Schedule – Y- Appendices, ICMR (Indian Council of Medical Research) Guidelines, Indian GCP (Good Clinical Practice), ICH GCP (International Conference on Harmonisation)

UNIT V CLINICAL DATA 9

Drugs & magic remedies Act 1954, Drug prices control order, CTRI-Clinical trial registry of India, Regulations for AYUSH, An Introduction to Clinical Data Management, Data Management Standards.

Total: 45 Hours

COURSE OUTCOME

CO-1: Understand clinical research basics and pre-clinical trial guidelines.

CO-2: Learn about toxicity studies, clinical trial phases, and bioavailability.

CO-3: Navigate drug regulations, ethics, and consent processes.

CO-4: Comprehend Indian regulatory frameworks for clinical trials.

CO-5: Grasp legal frameworks, CTRI regulations, and clinical data management basics.

CO-6: Discuss the ethical frame work such as the drugs and magic remedies.

CO-7: Explain the principles and process involved in clinical data management

TEXT AND REFERENCE BOOKS

1. Shah, S. R., & Bhagat, P. (2020). Clinical Research: A Comprehensive Guide. Wiley-Blackwell.
2. Madhavan, S., & Rao, P. P. (2018). Clinical Research and Clinical Trials: A Step-by-Step Guide for Success. CRC Press
3. Harrington, S. W., & Stevens, M. (2021). Clinical Trials: A Practical Guide. Springer
4. Kumar, R., & Reddy, P. (2019). Regulations in Clinical Research: ICH, FDA, and GCP Guidelines. Elsevier Science
5. R. B. Ghooj & S. C. Itkar. (2010). Essentials of Clinical Research. Nirali Prakashan Publications, Mumbai.
6. T. K. Pal & S. Agarwal. (2009). Clinical Research. CBS Publishers and Distributors, New Delhi.
7. J. I. Gallin & F. P. Ognibene. (2012). Principles and Practice of Clinical Research (3rd Edition). Elsevier, London.
8. V. B. Parar. (2010). Clinical Research: Fundamentals and Practice. Medical Publishers, New Delhi.
9. Jaypee Brothers. (2009). Basic Principles of Clinical Research and Methodology. Medical Publishers (P) Ltd., New Delhi.
10. S. K. Gupta. (2009). Basic Principles of Clinical Research and Methodology (1st Edition). Jaypee Brothers, New Delhi.

24DMBT34 **AGRICULTURAL BIOTECHNOLOGY**

L	T	P	O	C
3	0	0	2	3

COURSE OBJECTIVE

The objective of this course is to provide students with a comprehensive understanding of agricultural biotechnology, its principles, techniques, and applications in enhancing crop productivity, improving plant resistance to biotic and abiotic stresses, and sustainable agricultural practices. By the end of the course, students should be equipped with theoretical knowledge and practical skills to contribute to advancements in agricultural biotechnology.

UNIT I INTRODUCTION TO AGRICULTURAL BIOTECHNOLOGY 9

Historical development of agricultural biotechnology, Modern farming practices, Applications of biotechnology in crop improvement and sustainability, Ethical considerations surrounding the use of biotechnology in agriculture, Regulatory frameworks governing genetically modified organisms (GMOs) in agriculture.

UNIT II CROP PROTECTION AND IMPROVEMENT 9

Plant-pathogen interactions and mechanisms of disease resistance, Genetic engineering for insect resistance in crops, Strategies for enhancing crop tolerance to abiotic stresses like drought and salinity, post-harvest technologies to minimize losses and improve food security.

UNIT III PLANT HORMONES AND GENETIC ENGINEERING 9

Overview of plant hormones and their roles in growth and development, Molecular mechanisms of hormone signal perception and transduction, Genetic engineering for modulating hormone biosynthesis and signalling pathways, Manipulation of plant architecture and flowering behaviour for agronomic traits improvement, enhancement of nutrient use efficiency in crops

UNIT IV MOLECULAR MARKERS AND GENOMICS 9

Types and applications of molecular markers in plant genetics, Marker-assisted selection (MAS) strategies for crop improvement, Genomic tools for trait mapping and candidate gene identification, Advances in transcriptomics and the development of expressed sequence tags (ESTs), Genome-wide association studies (GWAS) for dissecting complex traits in crops.

UNIT V EMERGING TRENDS AND FUTURE DIRECTIONS 9

Non-gel-based techniques for plant genotyping and germplasm analysis, Agrobacterium-mediated and direct gene transfer methods, Marker-assisted breeding strategies for specific traits enhancement in transgenic crops, Environmental risk assessment and biosafety considerations of transgenic crops,

Role of RNA interference (RNAi) technology in crop improvement and pest management, Future prospects of agricultural biotechnology in addressing global food security and sustainability challenges.

Total: 45 Hours

COURSE OUTCOME:

CO-1: Understand the principles and fundamentals of agricultural biotechnology.

CO-2: Gain knowledge of various techniques and tools used in agricultural biotechnology, including genetic engineering, molecular markers, and genome editing.

CO-3: Analyze the impact of biotechnology on crop improvement, food security, and sustainable agriculture.

CO-4: Evaluate the ethical, social, and environmental implications of agricultural biotechnology.

CO-5: Explore current trends and future directions in agricultural biotechnology research and industry.

CO-6: Explain the ethical considerations and regulatory frame works governing the use of GMOs in agriculture.

CO-7: Apply molecular marker technologies, including marker-assisted selection (MAS), to develop improved crop varieties with desirable traits.

TEXT & REFERENCE BOOKS

1. T. Biswas & Muherjee. (2017). *Textbook of Soil Science* (2nd Edition). McGraw-Hill Education – Europe, London.
2. Swaminathan, M. S. (2017). Agricultural Biotechnology: A Global Perspective. Springer.
3. Singh, B. D. (2020). Modern Techniques of Raising Field Crops. Oxford & IBH Publishing.
4. Rao, S. S., & Arumugam, T. (2021). Agronomy and Crop Science. Wiley-Blackwell.
5. H. D. Kumar. (2005). *Agricultural Biotechnology*. Daya Publishing House, New Delhi.
6. Rajmohan Joshi. (2006). *Agricultural Biotechnology*. Gyan Publishing House, New Delhi.
7. S. R. Reddy. (2011). *Principles of Agronomy* (4th Edition). Kalyani Publishers, New Delhi.

8. David Castle, Peter W. B. Phillips, & Stuart Smyth. (2014). *Handbook on Agriculture, Biotechnology, and Development*. Edward Elgar Publishing, Cheltenham.

9. Ahindra Nag. (2008). *Textbook of Agricultural Biotechnology*. PHL Learning Publication, New Delhi.

10. Nyle C. Brady & Ray R. Weil. (2017). *The Nature and Properties of Soils* (14th Edition). Pearson Publisher, London.

24DMBT41 **BIOTECHNOLOGY AND HUMAN WELFARE**

L	T	P	O	C
3	0	0	2	3

COURSE OBJECTIVE (Employability)

This course has been designed to introduce the various techniques in the modern era of biotechnology. It focuses on industrial biotechnology, agriculture and medical biotechnology and molecular techniques for forensic science.

UNIT I INDUSTRIAL BIOTECHNOLOGY **9**

Industry: protein engineering; enzyme and polysaccharide synthesis, activity and secretion, alcohol and antibiotic formation.

UNIT II AGRICULTURAL BIOTECHNOLOGY **9**

Agriculture: N2 fixation: transfer of pest resistance genes to plants; interaction between plants and microbes; qualitative improvement of livestock.

UNIT III ENVIRONMENTAL BIOTECHNOLOGY **9**

Environments: e.g. chlorinated and non-chlorinated organ pollutant degradation; degradation of hydrocarbons and agricultural wastes, stress management, development of biodegradable polymers such as PHB.

UNIT IV BIOTECHNOLOGY IN FORENSIC SCIENCE **9**

Forensic science: e.g. solving violent crimes such as murder and rape; solving claims of paternity and theft etc. using various methods of DNA finger printing.

UNIT V BIOTECHNOLOGY IN MEDICINE **9**

Health: e.g. development of non-toxic therapeutic agents, recombinant live vaccines, gene therapy, diagnostics, monoclonal in E.coli, human genome project.

Total: 45hrs

COURSE OUTCOME:

CO –1: Remember about the products of industrial biotechnology and gain knowledge relevant to the applications of agriculture biotechnology.

CO–2: Show interaction between plants and microbes and the various techniques involved in environmental biotechnology.

CO–3: Outline about the degradation of hydrocarbons and agricultural wastes

CO–4: Describe about the molecular techniques of forensic science and various methods of DNA finger printing

CO–5: Demonstrate Students about health care products, receive knowledge about human genome project and recombinant live vaccines

CO–6: Analyze strategies for the qualitative improvement of livestock through advanced biotechnological methods.

CO–7: Create innovative solutions using gene therapy and diagnostics to address genetic disorders and advance personalized medicine.

TEXT AND REFERENCE BOOKS

1. Patnaik. (2012). Textbook of Biotechnology. McGraw Hill Education (India) Private Limited, New Delhi.
2. Bhowmik, D., & Kumar, S. (2021). Biotechnology and Its Applications in Medicine and Agriculture. Springer.
3. Rastogi, S. C., & Pathak, N. (2022). Biotechnology and Human Welfare. CBS Publishers.
4. Dasgupta, P. N., & Mukherjee, S. (2020). Environmental Biotechnology: Biodegradation, Bioremediation, and Bioconversion. Springer.
5. Bhowmik, D., & Kumar, S. (2021). Biotechnology and Its Applications in Medicine and Agriculture. Springer.
6. Rastogi, S. C., & Pathak, N. (2022). Biotechnology and Human Welfare. CBS Publishers.
7. Dasgupta, P. N., & Mukherjee, S. (2020). Environmental Biotechnology: Biodegradation, Bioremediation, and Bioconversion. Springer.

8. U. Satyanarayana. (2013). A Textbook of Biotechnology. Books and Allied (P) Limited, Kolkata.

9. M. K. Sateesh. (2010). Bioethics and Biosafety. I. K. International Pvt Ltd, New Delhi.

10. S. S. Purohit. (2010). Agricultural Biotechnology (3rd Edition). Agrobios, Jodhpur.

11. V. Kumaresan. (2015). Biotechnology. Saras Publication, Nagercoil.

12. Sandhya Jadhav. (2012). A Textbook of Environmental Biology and Biotechnology (2nd Edition). Vision Publications, Pune.

13. D. P. Clark & N. J. Pazdernik. (2009). *Biotechnology - Applying the Genetic Revolution.* Elsevier Academic Press, USA.

24DMBT42 **DRUG DESIGNING**

L	T	P	O	C
3	0	0	2	3

COURSE OBJECTIVE:

To equip students with a comprehensive understanding of drug discovery and development processes, focusing on molecular principles and computational methods, thereby preparing them for roles in pharmaceutical research and biotechnology industries.

UNIT I INTRODUCTION 9

History of drug design, Stages of drug discovery and development; Drug properties, likeness; Role of Bioinformatics and Chemo-informatics; Classification of Protein Structures – Primary, Secondary, Super-secondary, Tertiary and Quaternary; Active Sites; Allosteric Sites; Domains; Fold; Motifs. Structural databases- PDB, PDBSUM, SCOP, CATH; Chemical and Drug Molecule Databases – PubChem, Zinc and Drug Bank.

UNIT II PREPARATION OF PROTEIN STRUCTURE 9

Introduction to in silico and experimental protein structure determination methods; In silico Structure Prediction - Homology Modelling; Threading; Fold Recognition. Ab initio modelling; Model refinement and validation; Prediction of Binding site; Structure Visualization and Analysis tools.

UNIT III HIGH THROUGHPUT VIRTUAL SCREENING AND MOLECULAR DOCKING 9

Types of Virtual Screening methods; Structure Based Virtual Screening; Ligand Based Virtual Screening. Library design; Concept of pharmacophore mapping and pharmacophore-based Screening; Molecular Docking: Rigid and Flexible docking; Analysis of Protein-Ligand interactions.

UNIT IV QUANTITATIVE STRUCTURE ACTIVITY RELATIONSHIP 9

SAR versus QSAR, History and development of QSAR, Types of physicochemical parameters, Types of QSAR methods – 2D, 3D. Descriptors classification, Application of QSAR in molecular design.

UNIT V DRUG DISCOVERY 9

Drug Discovery and Development Drug Discovery Cycle, The Lead compound, Pharmacophore, Bioinformatics in drug discovery and development, chemical databases, ADME and Toxicity, Virtual Screening, Molecular Docking, Structure and Ligand Based Drug Designing, Case studies.

Total: 45hrs

COURSE OUTCOMES

CO-1: Ability to classify protein structures and understand drug design principles.

CO-2: Explain on the different types of Structural and Drug Molecule Databases

CO-3: Proficiency in using visualization tools and modelling techniques for protein analysis.

CO-4: Understand the Concept of pharmacophore mapping andScreening

CO-5: Adeptness in conducting virtual screening and docking experiments.

CO-6: Apply structure refinement, validation techniques, and binding site prediction to analyze protein models.

CO-7: Evaluate physicochemical parameters and QSAR descriptors to optimize molecular properties for drug efficacy and safety.

TEXT BOOK AND REFFERENCE BOOKS

1. Gong, J., & Chen, L. (2022). Computational Drug Discovery and Design: An AI and Machine Learning Perspective. *Springer.*
2. Keller, T. H., & Ecker, G. (2021). Pharmaceutical Bioinformatics: Drug Discovery, Design, and Development. Wiley-VCH.

3. Kitchen, D. B., & Decornez, H. (2020). Molecular Docking and Virtual Screening in Drug Discovery: Methods and Applications. Elsevier.
4. Hughes, J. D., & Lewis, R. A. (2019). Molecular Modeling and Drug Discovery: Computational Approaches in the Pharmaceutical Sciences. Taylor & Francis.
5. Andrew R. Leach. (2001). Molecular Modeling: Principles and Applications. (2nd Edition). Prentice Hall, USA.
6. T. K. Attwood & D. J. Parry-Smith. (2005). Introduction to Bioinformatics. Pearson Education (1st Edition, 11th Reprint).
7. M. Lesk. (2002). Introduction to Bioinformatics. Oxford University Press, London.
8. R. Leach. (1996). Molecular Modeling: Principles and Applications (2nd Edition). Longman Publications.

24DMBT43 **CYBER SECURITY**

L	T	P	O	C
3	0	0	2	3

COURSE OBJECTIVE

- To introduce students to the fundamental concepts and evolving landscape of cyber security, including cyber threats, cyber warfare, and critical infrastructure protection.
- To provide in-depth knowledge about various types of cyber crimes, cyber law frameworks, and enforcement mechanisms both in India and globally.
- To equip students with an understanding of data privacy, data protection regulations, and effective cyber security management strategies including compliance and governance.

UNIT I OVERVIEW OF CYBER SECURITY 9

Cyber security increasing threat landscape, Cyber security terminologies- Cyberspace, attack, attack vector, attack surface, threat, risk, vulnerability, exploit, exploitation, hacker., Non-state actors, Cyber terrorism, Protection of end user machine, Critical IT and National Critical Infrastructure, Cyberwarfare, Case Studies

UNIT II CYBER CRIMES 9

Cyber crimes targeting Computer systems and Mobiles- data diddling attacks, spyware, logic bombs, DoS, DDoS, APTs, virus, Trojans, ransomware, data breach., Online scams and frauds- email scams, Phishing, Vishing, Smishing, Online job fraud, Online sextortion, Debit/ credit card fraud, Online payment fraud, Cyberbullying, website defacement, Cybersquatting, Pharming, Cyber espionage, Cryptojacking, Darknet- illegal trades, drug trafficking, human trafficking., Social Media Scams & Frauds- impersonation, identity theft, job scams, misinformation, fake newscyber crime against persons - cyber grooming, child pornography, cyber stalking., Social Engineering attacks, Cyber Police stations, Crime reporting procedure, Case studies.

UNIT III CYBER LAW 9

Cyber crime and legal landscape around the world, IT Act,2000 and its amendments. Limitations of IT Act, 2000. Cyber crime and punishments, Cyber Laws and Legal and ethical aspects related to new technologies- AI/ML, IoT, Blockchain, Darknet and Social media, Cyber Laws of other countries, Case Studies.

UNIT IV DATA PRIVACY AND DATA SECURITY 9

Defining data, meta-data, big data, nonpersonal data. Data protection, Data privacy and data security, Personal Data Protection Bill and its compliance, Data protection principles, Big data security issues and

challenges, Data protection regulations of other countries- General Data Protection Regulations(GDPR),2016 Personal Information Protection and Electronic Documents Act (PIPEDA)., Social media- data privacy and security issues.

UNIT V CYBER SECURITY MANAGEMENT, COMPLIANCE AND GOVERNANCE

Cyber security Plan- cyber security policy, cyber crises management plan., Business continuity, Risk assessment, Types of security controls and their goals, Cyber security audit and compliance, National cyber security policy and strategy.

Total: 45hrs

COURSE OUTCOME

CO1: To explain the key terminologies, threat vectors, and actors in the cyber security landscape.

CO2: To analyze various forms of cybercrimes and demonstrate awareness of online frauds, scams, and social engineering techniques.

CO3: To apply the relevant cyber laws and legal provisions applicable to different types of cyber offenses including AI, IoT, Blockchain and social media.

CO4: To assess data privacy concerns and apply global data protection regulations such as GDPR and PIPEDA in real-world scenarios.

CO5: To design basic cybersecurity frameworks for organizations including security policies, risk assessments, and cyber crisis management plans.

TEXTBOOK/REFERENCES

1. Cyber Security Understanding Cyber Crimes, Computer Forensics and LegalPerspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd.

2. Information Warfare and Security by Dorothy F. Denning, Addison Wesley.

3. Security in the Digital Age: Social Media Security Threats and Vulnerabilities byHenry A. Oliver, Create Space Independent Publishing Platform.

4. Data Privacy Principles and Practice by Natraj Venkataramanan and Ashwin Shriram,CRC Press.

5. Information Security Governance, Guidance for Information Security Managers byW. KragBrothy, 1st Edition, Wiley Publication.

6. Auditing IT Infrastructures for Compliance By Martin Weiss, Michael G. Solomon,2nd Edition, Jones Bartlett Learning.



Sector Skill Course

24SSCP31 **HUMAN PHYSIOLOGY AND MEDICAL CODING**

L	T	P	O	C
2	0	0	1	2

COURSE OBJECTIVE: (Employability)

The paper is designed to provide the fundamental principles of human biology with emphasis on the morphology, physiology and basics in medical coding and documentation

UNIT I: CELLULAR AND MOLECULAR PHYSIOLOGY **5**

Cell structure and function - Membrane transport and cellular communication - Cellular metabolism and energetics - Molecular basis of genetics and inheritance

UNIT II: SYSTEMS PHYSIOLOGY **7**

Nervous System: Structure, function, and control mechanisms - Musculoskeletal System: Structure and function of muscles, bones, and joints - Cardiovascular System: Structure, function, and regulation of the heart and blood vessels - Respiratory System: Mechanics of breathing, gas exchange, and transport

UNIT III: INTEGRATION AND REGULATION OF PHYSIOLOGICAL SYSTEMS **7**

Endocrine System: Hormonal control and regulation of physiological processes - Reproductive System: Male and female reproductive anatomy, physiology, and regulation - Digestive System: Digestion, absorption, and metabolism of nutrients - Urinary System: Renal function, fluid and electrolyte balance, and acid-base regulation

UNIT IV: MEDICAL CODING FUNDAMENTALS **5**

Introduction to Medical Coding Systems: ICD, CPT, HCPCS - Medical Terminology - History - Coding Guidelines and Conventions: Application of coding rules and regulations

UNIT V: ADVANCED MEDICAL CODING AND DOCUMENTATION **6**

Advanced Coding Techniques: Evaluation and Management coding, modifiers, and compliance - Medical Record Documentation: Importance of accurate documentation for coding and billing - Reimbursement and Billing Processes: Understanding insurance claims, audits, and reimbursement methodologies.

Total Hours 30

COURSE OUTCOME:

CO-1: Recall the hierarchical architecture of the human body and gain knowledge about cell and membranes.

CO-2: Understand the structure and function of the nervous system, cardiovascular system and respiratory system

CO-3: Understand the physiology of the endocrine system, reproductive system and digestive system.

CO-4: Interpret the basics in medical coding and transcription. Analyse ICD, CPT and Coding accuracy.

CO-5: Analyse the coding techniques and learn about the reimbursement and billing processes

CO-6: Apply coding conventions and rules to ensure compliance with healthcare regulations.

CO-7: Assess the importance of accurate medical documentation in coding and billing processes.

TEXT AND REFERNCE BOOKS:

1. Marieb, E. N., & Hoehn, K. (2018). Human Anatomy & Physiology (11th Edition). Pearson.
2. Guyton, A. C., & Hall, J. E. (2016). Guyton and Hall Textbook of Medical Physiology (13th Edition). Elsevier.
3. U. Silverthorn. (2011). Human Physiology: An Integrated Approach Plus Mastering A&P with e-Text. University of Texas, Austin.
4. K. S. Saladin. (2001). Anatomy and Physiology (2nd edition). McGraw-Hill, New York.
5. M. T. Fortney & O. Diehl. (2003). Medical Transcription Guide: Do's and Don'ts. W.B. Saunders Company, Philadelphia, PA.
6. Karen Smiley (2017). Medical Coding and Billing For Dummies. Wiley.
7. Ann Ehrlich and Carol L. Schroeder. (2019). Medical Terminology for Health Professions. Cengage Learning

24SSCP31 **FOOD AND NUTRACEUTICALS**

L	T	P	O	C
2	0	0	1	2

COURSE OBJECTIVE:

To develop comprehensive understanding of different nutraceuticals and functional Foods and Understanding the molecular level interaction between nutrients and other dietary bioactive with genomics

UNIT I: INTRODUCTION TO FOOD **6**

Food - definition, classification of food, basic five food groups classification of nutrients, RDA-reference man and women, factors influencing RDA. Macronutrients and micronutrients. Development of functional foods, challenges and safety considerations, Future trends of functional foods.

UNIT II: NUTRACEUTICALS **6**

Types of nutraceutical compounds – Phytochemicals, phytosterols and other bioactive compounds, peptides and proteins, carbohydrates (dietary fibers, oligosaccharides and resistant starch), prebiotics, probiotics and synbiotics, lipids (Conjugated Linoleic Acid, omega-3 fatty acids, fat replacers), vitamins and minerals; their sources and role in promoting human health.

UNIT III: FUNCTIONAL FOODS, PROBIOTICS AND PREBIOTICS: **7**

Definition, History, Classification of Functional Foods: Probiotics, Prebiotics and Synbiotics; Probiotic Micro- Organisms in Fermented Milk Products and Non-Milk Products. Functional foods from fruits, vegetables, cereals, legumes, animal sources and Algae and their health effects.Nutraceutical Rich Supplements - Green Tea, Grape Tea, Wheat Grass, Lecithin, Mushroom Extract, Chlorophyll, Aloe Vera.

UNIT IV: FOOD GENOMICS AND NUTRITIONAL GENOMICS: **5**

Definition and terms, Nutrigenomics Benefits of Nutrigenomics Technologies involved in nutrigenomics, The added value of foodomics in the food industry Personalized nutrition. Plants as an alternative for biotransformation of raw materials into special chemicals. Plants as 'bioreactors' as a tool for production of Nutraceuticals.

UNIT V: FOOD AS REMEDIES: **6**

Nutraceuticals Bridging the Gap between Food and Drug, Medicinal Plant Derived Nutraceuticals: Anti -Aging, Anti- Inflammatory Compound. Arthritis, Bronchitis, Circulatory Problems, Hypoglycemia Nutraceutical Remedies for Nephrological Disorders, Liver Disorders, Osteoporosis, Psoriasis and Ulcers

Total Hours: 30

COURSE OUTCOME:

CO-1: Understand the history of nutraceuticals and its role as a functional food.

CO-2: Evaluate the role of commercial nutraceuticals and functional foods in the community

CO-3: Gain knowledge about functional foods, nutraceutical and nutragenomics.

CO-4: Know the applications of Nutrigenomics in wellness and disease management.

CO-5: Evaluate the future prospects of development of functional foods based on the needs of the growing world.

CO-6: Explain how nutraceuticals bridge the gap between food and medicine.

CO-7: Describe the sources and roles of these compounds in promoting human health.

TEXT & REFERENCE BOOKS

1. Rani, S. (2021). Advances in Food Biotechnology: Processing, Preservation, and Safety. Springer Nature
2. R. E. C. Wildman (2001), Handbook of Nutraceutical and Functional Foods, CRC Press.
3. Y. V. Pathak (2011), Handbook of Nutraceuticals Volume 2, CRC Press.
4. Goldberg (1999), Functional Foods (Designer Foods, Pharmafoods, Nutraceuticals), Aspen Publications.
5. S. N. Shakuntalamanay and M. Shadaksharaswam (2008), Food Facts and Principles (3rd Edition), New Age International.
6. M. V. Krause and L. K. Mahan (2009), Food, Nutrition and Diet Therapy (14th Edition), W. B. Saunders Company, Philadelphia.
7. L. K. Mahan and M. T. Arlin (2016), Krause's Food, Nutrition and Diet Therapy (14th Edition), W. B. Saunders Company, London.

24SSCP31 **MEDICAL LAB TECHNOLOGY**

L	T	P	O	C
2	0	0	1	2

COURSE OBJECTIVE:

To acquire the knowledge about various types of specimens received in the diagnostic laboratory and understand the procedures carried out in different laboratories

UNIT I HEMATOLOGY 6

Hematology: Smearing and staining Methods, Osmotic fragility test, Cell counting variations- RBC, WBC, Platelets, Eosinophil & Reticulocyte count, ESR, LE Cell. Haemopoeisis- Erythrocytes, Hemoglobin – Estimation, Packed Cell Volume, indices. Anemia, Coagulation Factors, Blood collection

UNIT II HISTOLOGY AND CYTOLOGY 6

Histological Procedures Biopsy, Autopsy, Collection, Preservation &Labeling of Slides, Blocks, Specimens, Techniques, Grossing Methods, Fixatives, Processing of the tissues including Bone, Embedding, Section Cutting, Staining & Mounting, Special Stains Preservation of reports & records.

UNIT III BIOCHEMICAL ANALYSIS 6

Biochemical Analysis Blood sugar and cholesterol estimation, urine routine examination –physical, chemical and microbiological examination. Analysis of sputum and faecal matter for Infection, examination of CSF, Semen analysis.

UNIT IV LABORATORY DIAGNOSIS OF INFECTION 6

Bacterial diseases: Tuberculosis and Typhoid (widal). Viral diseases: AIDS and Covid. Protozoan diseases: Amoebiasis and Malaria. Nematodes diseases: Filariasis and Ascaris. Common serological tests - Rheumatoid arthritis, Pregnancy test,

UNIT V MOLECULAR DIAGNOSTICS 6

Molecular techniques for analysis of biochemical disorders. Bioinformatics tools for molecular diagnosis. Antibody based diagnosis –monoclonal antibodies as diagnostic reagents. Diagnosis of diseases by using ELISA and Western blot. DNA diagnostics – PCR and array-based diagnosis. Clinical proteomics - protein microarray for disease diagnosis.

Total Hours: 30

COURSE OUTCOME:

CO-1: Describe the basis of clinical and haematological tests

CO-2: Explain various techniques in histopathological laboratory.

CO-3: Outline the process to diagnose common infections

CO-4: Recite the recent rapid diagnostic tests

CO-5: Discuss and classify the diagnostic techniques that uses immuno-cytochemistry

CO-6: Describe diagnostic methods for bacterial, viral, protozoan, and nematode infections.

CO-7: Analyze the laboratory findings for infectious diseases like tuberculosis, AIDS, and malaria.

TEXT & REFERENCE BOOKS

1. K. L. Mukherjee (2010), Medical Laboratory Technology - A Procedure Manual for Routine Diagnostic Tests Vol. I, Hill Publishing Company Limited, New Delhi. ISBN: 9780070076594 / ISBN: 9780070076631.
2. Turgeon, M. L. (2017). Linne & Ringsrud's Clinical Laboratory Science: Concepts, Procedures, and Clinical Applications (8th ed.). Elsevier.
3. Pagana, K. D., Pagana, T. J., & Pagana, T. N. (2019). Mosby's Diagnostic and Laboratory Test Reference (14th ed.). Elsevier.
4. McPherson, R. A., & Pincus, M. R. (2017). Henry's Clinical Diagnosis and Management by Laboratory Methods (23rd ed.). Elsevier.
5. Pradeepkumar. (2011). NS.Manual of Practical Pathology, CBS Publishers and Distributors Pvt Ltd, Chennai.
6. Naigaonkar.A.V .and M.D.Burande (2004), A Manual of Medical Laboratory Technology, Nirali Prakashan. Pune.
7. K. L. Mukherjee (2010), Medical Laboratory Technology - A Procedure Manual for Routine Diagnostic Tests Vol. II, Hill Publishing Company Ltd., New Delhi. ISBN: 9780070076648.
8. R. Sood, M.D. (2006), Medical Laboratory Techniques (5th Edition), Jaypee Brothers Medical Publishers.
9. L. Buckingham and M. L. Flaws (2007), Molecular Diagnostics: Fundamentals, Methods & Clinical Applications.
10. G. F. Brooks, J. S. Butel, and S. A. Morse (2010), Medical Microbiology (23rd Edition)

Generic Elective Courses

24GMBT41 **FOOD SAFETY AND HYGIENE**

L	T	P	O	C
2	0	0	1	2

COURSE OBJECTIVE:

To Enables the students in application of basic aspects of public health and food safety and quality surveillance system

UNIT I GENERAL PRINCIPLES FOR FOOD SAFETY AND HYGIENE: 5

Principles of food safety and quality - Food Safety System - Quality attributes - Total Quality Management. Good Hygienic Practices, Good Manufacturing Practices - Risk Analysis, Risk Management, Risk Assessment, Risk Communication - Traceability and authentication.

UNIT II FOOD SAFETY AND QUALITY IN PLANT BASED INDUSTRIES 7

Quality indices of fruits - baking quality of wheat -Controlling Food Safety Hazards in Fruit and Vegetable Industry through HACCP - GAP and GMP for F&V production - Microbial safety of fresh and processed F&V - Plant sanitation - Quality assurance in Bakery Industry - Ingredients inspection - Process Control - Product Assessment

UNIT III FOOD SAFETY IN PROCESSING: 7

Characteristics of meat-Microorganisms associated with meat - spoilage of animal food - control of microbial food borne pathogens in meat chain - meat safety at pre-harvest, harvest and postharvest level - nutritive value of meat-Structure of muscle, methods of slaughtering, Ante mortem and post mortem inspection of meat, Biochemical changes in meat-Rigor mortis-Aging of meat, meat cut and grade, MPL for Meat and Meat products. Maximum Permissible Limit of additives for meat and meat products

UNIT IV FOOD SAFETY OF GMO: 6

Definition of GMOs & LMO. The safety of genetically modified organisms (GMOs). Food safety regulations of GMO and GMFoods. RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs. International rules and regulations in export and import of GMOs

UNIT V FOOD SAFETY AND QUALITY OF FINISHED PRODUCTS 5

Quality control of packaged foods - Intrinsic, extrinsic and shelf-life limiting factors, Packaging Methods - Problems in packaging - Importance of Labeling - Food safety issues related to Ready to Eat food

Total: 30 Hours

COURSE OUTCOME:

CO-1: To familiarize students to apply protocol for safe food handling techniques, water and waste management

CO-2: Understand the role of food packaging and the importance of Nutrition labeling.

CO-3: Analyse consequences of food poisoning and infection on the health of individuals

CO-4: Construct Food plant design for different categories of foods

CO-5: Implement Good Health and Hygiene Practices

CO-6: Explain good hygienic and manufacturing practices for ensuring food safety.

CO-7: Apply quality control techniques to ensure the safety of packaged and ready-to-eat foods.

TEXT & REFERENCE BOOKS

1. Y. Motarjemi and H. Lelieveld (2014), Food Safety Management - A Practical Guide for the Food Industry, 1st Edition, Academic Press, London, UK.
2. N. Rees and D. Watson (2000), International Standards for Food Safety, Aspen Publications.
3. T. Ahmed (2001), Dairy Plant Engineering and Management, CBS Publishers and Distributors, New Delhi.
4. B. Sivasankar (2011), Food Processing and Preservation, Eastern Economy Edition, BHI Publishers, New Delhi.
5. N. Khetarpaul (2005), Food Processing and Preservation, Daya Publication House, New Delhi.
6. T. Svarzakas and C. Tzia (2015), Handbook of Food Processing, Quality and Manufacturing Processes, CRC Press, ISBN: 9781498721776.

24GMBT41 **BIOFERTILIZER TECHNOLOGY**

L	T	P	O	C
2	0	0	1	2

COURSE OBJECTIVE:

To provide knowledge on biofertilizer and to develop students' technical skills on bio fertilizer production

UNIT – I BIOFERTILIZER 6

Introduction and types and importance of biofertilizers, Biopesticides and bioagents in agriculture and organic farming system, History of biofertilizers production Classification of biofertilizers microorganisms used in biofertilizers production. Importance of biofertilizers in agriculture, Strain selection, Inoculum preparation, Mass production. Plant-microbe interaction - Soil ecosystem.

UNIT – II ALGAL BIOFERTILIZERS 6

Diverse Metabolites of Algae for Biofertilizer, Algal biofertilizers in paddy farming, Cyanobacteria (BGA) as biofertilizers, *Anabaena, Nostoc* and *Tolypothrix*. Algalization, *Azolla*. Mass cultivation of *Azolla,* Cyanobacterial biofertilizers, symbiotic association, field application of cyanobacterial inoculants, algae culture and algal food.

UNIT - III: BACTERIAL BIOFERTILIZERS 7

symbiotic, Non-symbiotic, *Azospirillum*, *Azotobacter*, *Frankia*, Phosphobacteria and *Rhizobium*. Isolation - Mass production of *Azospirillum*, *Azotobacter* and Phosphobacteria. Mechanism of nitrogen fixation (free-living and symbiotic), Biochemistry and molecular basis of nitrogen fixation, Phosphate solubilization and mobilization.

UNIT - IV: FUNGAL BIOFERTILIZER 6

Mycorrhizal fungi as biofertilizers, Importance of Ecto, Endo and *Arbuscular mycorrhizae* (AM). Isolation and method of inoculation of Arbuscular mycorrhizae (AM), Legume -AM interactions, Application, Mass inoculum production of VAM, techniques of Ectomycorrhizal inoculums, Endo mycorrohizae of orchids.

UNIT - V: LIQUID BIOFERTILIZERS 5

Formulation – Advantages - Application methodology. Role of liquid biofertilizer in tissue culture. National and Regional biofertilizer production and development Centers. Methods of quality

control assessment in respect of biofertilizers, Strategies of Mass multiplication and packing Registration of biofertilizers.

Total: 30 Hours

COURSE OUTCOME:

CO-1: Understand the nitrogen fixing bacteria as bio fertilizers.

CO-2: Explain concepts, principles and significance of bio fertilizers

CO-3: Attain knowledge of algal bio fertilizers

CO-4: Understand the mechanism and production of bacterial fertilizer.

CO-5: Acquire the knowledge of mechanism, production and application of liquid bio fertilizers

CO-6: Identify diverse metabolites of algae and their applications as biofertilizers

CO-7: Evaluate quality control assessment methods and strategies for mass multiplication, packing, and registration of biofertilizers.

TEXT & REFERENCE BOOKS

1. C. R. Schwintzer and J. D. Tjepkema (2012), The Biology of Frankia and Actinorhizal Plants, Academic Press Inc., San Diego, USA.
2. N. S. Subba Rao (2017), Soil Microbiology, 4th edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
3. K. Yadav, M. R. Motsara, and S. Raychaudhuri (2001), Recent Advances in Biofertilizer Technology, SPURT Publication, New Delhi.
4. M. R. Motsara, P. Bhattacharyya, and B. Srivastava (1995), Biofertilizer Technology, Marketing and Usage: A Source Book-cum-Glossary, FDCO, New Delhi.
5. S. G. Borkar (2015), Beneficial Microbes as Biofertilizers and Its Production Technology, Woodhead Publisher, India, New Delhi.
6. S. Kannaiyan (2003), Biotechnology of Biofertilizers, CHIPS, Texas.
7. M. K. Rai (2005), Handbook of Microbial Biofertilizers, The Haworth Press, Inc., New York.

24GMBT41 BIOMEDICAL WASTE MANAGEMENT

L	T	P	O	C
2	0	0	1	2

COURSE OBJECTIVE:

This course aims to provide knowledge about source, types, handling, collection, and disposal and also ensure the proper and safe management of biomedical waste.

UNIT-I INTRODUCTION TO BIOMEDICAL WASTE **5**

Introduction, Definition, Scope and importance of biomedical waste. Categories of biomedical wastes (Human Anatomical Waste, Animal Waste, Microbiology & Biotechnology Waste, Waste sharps, Discarded Medicines and Cytotoxic drugs, Solid Waste, Liquid Waste, Incineration Ash and Chemical Waste).

UNIT-II HEALTH IMPACTS BIOMEDICAL WASTE **6**

Waste disposal management, Hospital waste management, Biosafety- regulatory framework for GMOs, bioethics and its socio-economic impact, Hazards associated with poor health care waste management. Infectious agents in the biomedical wastes. Monitoring and controlling of cross infection (protective devices)

UNIT-III HANDLING OF BIOMEDICAL WASTE **7**

Characterization of medical waste- Bio-medical wastes (Management and Handling) Rules, 1998, Amendments and guidelines, segregation, packaging, storage, transport of infectious waste. Techniques of Biomedical waste management. Health and safety rules. Protocols, issues, and challenges in transportation of Biomedical waste.

UNIT IV TREATMENT METHODS FOR BIOMEDICAL WASTE **7**

Treatment method- Autoclave, Hydroclave, Microwave, Chemical Disinfection, Solidification and stabilization, Thermal Conversion Technologies, accumulation and storage of hazardous waste, land disposal of hazardous waste, other treatment and disposal method. Common Hazardous Waste Treatment Facilities (TSDF). Disposal technologies (sharp disposal pit, deep burial pit and secured land fill).

UNIT V LEGISLATION POLICIES AND RULES OF BIOMEDICAL WASTES **5**

Environment and legislation policies and rules for handling and management of biomedical wastes.

Environmental hazards – causes and solutions. Biological hazards – AIDS, Malaria, Chemical hazards- BPA, PCB, Phthalates, Mercury, Nuclear hazards- Risk and evaluation of hazards. CPCB guidelines. WHO guidelines for biomedical wastes.

Total: 30 hours

COURSE OUTCOME:

CO–1: Understand of the basics, the Scope and importance of biomedical wastes and about types of wastes and composition.

CO–2: List about Potential health hazards of biomedical wastes.

CO–3: Summarize the principles and methods of disposal of biomedical wastes and secured land fill.

CO–4: Assess on different technologies of treatment and management of biomedical wastes and Conventional treatment technologies

CO–5: Explain about the rules, policies and guidelines of biomedical wastes and understand the WHO guidelines for biomedical wastes

CO-6: Describe the health and environmental impacts of improper biomedical waste disposal.

CO-7: Explain the legislative policies and rules related to biomedical waste management and environmental protection

TEXT AND REFERENCE BOOKS

1. Gupta, S. K., & Ghosh, S. (2020). Biomedical Waste Management: A Comprehensive Guide. Springer.
2. 2. Patel, M., & Kumar, M. (2021). Biomedical Waste Management: Principles and Practices. Springer.
3. 3. BIS, Bureau of Indian Standards. (2019). Indian Standard for Biomedical Waste Management. IS 12472.
4. 4. WHO. (2018). Safe Management of Wastes from Health-Care Activities. World Health Organization.
5. S. L. Goel (2009), Health Care System and Hospital Administration, Balaji World of Books.
6. R. Radhakrishnan (2007), Biomedical Waste Management, Neha Publishers & Distributors.

7. James T. Tweedy (2014), Healthcare Hazard Control and Safety Management, CRC Press, Taylor and Francis.
8. Anantpreet Singh and Sukhjit Kaur (2012), Biomedical Waste Disposal, Jaypee Brothers Medical Publishers (P) Ltd.
9. A. D. Bhide and B. B. Sundaresan (2001), Solid Waste Management – Collection, Processing and Disposal, Mudrashilpa Offset Printers, Nagpur.