SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

Kattankulathur, Chengalpattu District 603203,

Tamil Nadu, India

ACADEMIC CURRICULA

POST GRADUATE DEGREE PROGRAMMES

MASTER OF SCIENCE

IN

BIOTECHNOLOGY

(Detailed Syllabus for Two Years Courses)

Learning Outcomes based Curriculum Framework (LOCF)

National Credit Framework (NCrF)

Regulations 2025

Faculty of Science and Humanities

Office of the Registrar, SRM IST

Control Copy

Approved in:

70th Executive Council Meeting 29.03.2025

58th Academic Council Meeting 22.02.2025

REGISTRAR

FACULTY OF SCIENCE AND HUMANITIES

ACADEMIC CURRICULA

POSTGRADUATE DEGREE PROGRAMME
(REGULATIONS - 2025)

MASTER OF SCIENCE
IN
BIOTECHNOLOGY

Two Years (Full-Time)

National Education Policy

Learning Outcomes based Curriculum Framework (LOCF)

National Credit Framework

Academic Year
2025 - 2026

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

Kattankulathur, Chengalpattu District 603203, Tamil Nadu, India

1. Department Vision Statement	
Stmt - 1	Strengthen academic programs, research initiatives, and interdisciplinary learning in biotechnology.
Stmt - 2	Foster partnerships between universities, research institutions, and biotech industries for innovation and commercialization.
Stmt - 3	Implement biosafety regulations, ethical research standards, and sustainable biotech applications for societal benefit.

2. Department Mission Statement	
Stmt - 1	Advancing Biotechnology Research & Innovation
Stmt - 2	Strengthening Infrastructure & Human Resource Development
Stmt - 3	Enhancing Biotech Industry & Entrepreneurship
Stmt - 4	Ensuring Biosafety & Ethical Biotechnology Practices
Stmt - 5	Driving Socio-Economic Development Through Biotechnology

3. Program Education Objectives (PEO)	
PEO - 1	Advanced Knowledge & Research Skills
PEO - 2	Industry & Entrepreneurship Readiness
PEO - 3	Ethical & Sustainable Biotechnology Practices
PEO - 4	Global Competency & Lifelong Learning
PEO - 5	Societal Impact & Healthcare Innovations

4. Consistency of PEO's with Mission of the Department

	Mission Stmt. - 1	Mission Stmt. - 2	Mission Stmt. - 3	Mission Stmt. - 4	Mission Stmt. - 5
PEO - 1	3	3	3	1	1
PEO - 2	3	3	3	3	3
PEO - 3	3	3	3	3	3
PEO - 4	2	2	2	2	2
PEO - 5	2	2	2	2	2

3 – High Correlation, 2 – Medium Correlation, 1 – Low Correlation

5. Consistency of PEO's with Program Learning Outcomes (PO)

	Program Learning Outcomes (PO)											
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
	Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethical Practices & Social Responsibility	Individual & Team Work	Communication	Project Management & Finance	Life Long Learning
PEO - 1	3	3	-	3	3	-	2	1	-	-	-	3
PEO - 2	3	3	2	3	3	-	2	1	2	2	1	2
PEO - 3	3	3	-	3	3	-	3	2	-	-		3
PEO - 4	3	2	-	3	3	-	2	3	-	-	-	1
PEO - 5	3	2	-	3	2	2	2	3	2	-	--	3

3 – High Correlation, 2 – Medium Correlation, 1 – Low Correlation

6. Programme Structure (Total Credits : 80 Credits)

1. Professional Core Courses (C)
(10 Courses)

Course Code	Course Title	Hours/ Week L	T	P	C
PBT25101J	Biochemistry	3	0	2	4
PBT25102J	Microbiology	3	0	2	4
PBT25103J	Enzyme Technology	3	0	2	4
PBT25201J	Molecular Biology	3	0	2	4
PBT25202J	Plant Biotechnology	3	0	2	4
PBT25203J	Genomics and Proteomics	3	0	2	4
PBT25301J	Immunotechnology	3	0	2	4
PBT25302J	Animal Biotechnology	3	0	2	4
PBT25303J	Genetic Engineering	3	0	2	4
PBT25304J	Industrial Biotechnology	3	0	2	4
Total Learning Credits					**40**

2. Discipline Elective Courses (D)
(3 Courses)

Course Code	Course Title	Hours/ Week L	T	P	C
PMS25D01T	Statistics for Biosciences	4	0	0	4
PBT25D02T	Biophysics				
PBT25D03T	Tissue Biology	4	0	0	4
PBT25D04T	Environmental Biotechnology				
PBT25D05T	Entrepreneurship in Biotechnology	4	0	0	4
PBT25D06T	Research Methodology				
Total Learning Credits					**12**

3. Generic Elective Courses (G)
(1 Courses)

Course Code	Course Title	Hours/ Week L	T	P	C
PBT25G01T	General Biology	2	0	0	2
PBT25G02T	Mushroom Cultivation				
PBT25G03T	Disease Management				
PBT25G04T	Algal Technology	2	0	0	2
PBT25G05T	Food and Nutrition				
PBT25G06T	Vermicomposting				
Total Learning Credits					**4**

4. Skill Enhancement Courses (S)
(2 Courses)

Course Code	Course Title	Hours/ Week L	T	P	C
PBT25S01T	Aquatic Biotechnology	*4*	*0*	*0*	*4*
PBT25S02T	Disease Biology				
PBT25S03T	Biomaterials	*4*	*0*	*0*	*4*
PBT25S04T	Pharmaceutical Biotechnology				
Total Learning Credits					**8**

5. Project Work, Internship in Industry/Higher Technical Institutions (P)
(2 Courses)

Course Code	Course Title	Hours/ Week L	T	P	C
PBT25P01L	Internship	0	0	0	2
PBT25P02L	Project Work	0	0	20	10
Total Learning Credits					**12**

6. Ability Enhancement Courses (AE)
(2 Courses))

Course Code	Course Title	Hours/ Week L	T	P	C
PCD25AE1T	Comprehensive Skills in Quantitative and Logical Reasoning	*2*	*0*	*0*	*2*
PCD25AE2T	Soft Skills and Verbal Mastery	*2*	*0*	*0*	*2*
Total Learning Credits					**4**

7. Implementation Plan

Semester - I					
Code	Course Title	Hours/ Week			C
		L	T	P	
PBT25101J	Biochemistry	3	0	2	4
PBT25102J	Microbiology	3	0	2	4
PBT25103J	Enzyme Technology	3	0	2	4
PMS25D01T	Statistics for Biosciences	4	0	0	4
PBT25D02T	Biophysics				
PBT25S01T	Aquatic Biotechnology	4	0	0	4
PBT25S02T	Disease Biology				
PCD25AE1T	Comprehensive Skills in Quantitative and Logical Reasoning	*2*	*0*	*0*	*2*
PBT25G01T	General Biology	*2*	*0*	*0*	*2*
PBT25G02T	Mushroom Cultivation				
PBT25G03T	Disease Management				
	Total	27			24

Semester - II					
Code	Course Title	Hours/ Week			C
		L	T	P	
PBT25201J	Molecular Biology	3	0	2	4
PBT25202J	Plant Biotechnology	3	0	2	4
PBT25203J	Genomics and Proteomics	3	0	2	4
PBT25D03T	Tissue Biology	4	0	0	4
PBT25D04T	Environmental Biotechnology				
PBT25S03T	Biomaterials	*4*	*0*	*0*	*4*
PBT25S04T	Pharmaceutical Biotechnology				
PCD25AE2T	Soft Skills and Verbal Mastery	*2*	*0*	*0*	*2*
	Total	25			22

Semester - III					
Code	Course Title	Hours/ Week			C
		L	T	P	
PBT25301J	Immunotechnology	3	0	2	4
PBT25302J	Animal Biotechnology	3	0	2	4
PBT25303J	Genetic Engineering	3	0	2	4
PBT25304J	Industrial Biotechnology	3	0	2	4
PBT25D05T	Entrepreneurship in Biotechnology	4	0	0	*4*
PBT25D06T	Research Methodology				
PBT25G04T	Algal Technology	*2*	*0*	*0*	*2*
PBT25G05T	Food and Nutrition				
PBT25G06T	Vermicomposting				
PBT25P01L	Internship	0	0	0	2
	Total	26			24

Semester - IV					
Code	Course Title	Hours/ Week			C
		L	T	P	
PBT25P02L	Project Work	0	0	20	10
	Total	20			10

Total Number of Subjects: 21
Total Number of Credits: 80

8. Program Articulation Matrix

Course Code	Course Title	Programme Learning Outcomes (PO)											
		Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethical Practices & Social Responsibility	Individual & Team Work	Communication	Project Management & Finance	Life Long Learning
PBT25101J	Biochemistry	3	1	1	2	1	-	-	-	-	-	-	2
PBT25102J	Microbiology	3	1	1	2	1	-	-	-	-	-	-	2
PBT25103J	Enzyme Technology	3	1	1	2	1	-	-	-	-	-	-	2
PBT25201J	Molecular Biology	3	3	1	2	3	3	2	2	-	-	-	2
PBT25202J	Plant Biotechnology	3	1	1	2	1	3	2	2	-	-	-	2
PBT25203J	Genomics and Proteomics	3	3	1	2	3	-	-	-	-	-	-	2
PBT25301J	Immunotechnology	3	1	1	2	2	-	-	-	-	-	-	2
PBT25302J	Animal Biotechnology	3	1	1	2	3	2	-	-	-	-	-	2
PBT25303J	Genetic Engineering	3	3	1	2	3	2	3	3	-	-	-	2
PBT25304J	Industrial Biotechnology	3	3	1	2	3	2	3	3	-	-	-	2
PMS25D01T	Statistics for Biosciences	3	3	1	2	1	-	-	-	-	-	-	2
PBT25D02T	Biophysics	3	1	1	2	3	2	3	3	-	-	-	2
PBT25D03T	Tissue Biology	3	1	1	2	1	-	-	-	-	-	-	2
PBT25D04T	Environmental Biotechnology	3	1	1	2	3	2	3	3	-	-	-	2
PBT25D05T	Entrepreneurship in Biotechnology	3	3	1	2	1	-	-	3	3	3	3	2
PBT25D06T	Research Methodology	3	1	1	2	3	2	3	3	1	3	3	2
PBT25S01T	Aquatic Biotechnology	3	1	1	2	3	2	3	3	-	-	-	2
PBT25S02T	Disease Biology	3	1	1	2	3	2	3	3	-	-	-	2
PBT25S03T	Biomaterials	3	1	1	2	3	-	3	2	-	-	-	2
PBT25S04T	Pharmaceutical Biotechnology	3	1	1	2	3	2	3	3	-	-	-	2
PBT25P01L	Internship	3	2	1	2	3	2	3	3	3	3	3	2
PBT25P02L	Project Work	3	3	1	2	3	2	3	3	3	3	3	2
PBT25G01T	General Biology	2	-	-	-	1	2	-	-	-	-	-	2
PBT25G02T	Mushroom Cultivation	2	-	-	-	1	2	3	-	-	-	2	2
PBT25G03T	Disease Management	2	-	-	-	1	2	-	-	-	-	-	2
PBT25G04T	Algal Technology	2	-	-	-	1	2	3	-	-	-	2	2
PBT25G05T	Food and Nutrition	2	-	-	-	1	2	-	-	-	-	-	2
PBT25G06T	Vermicomposting	2	-	-	-	1	2	3	-	-	-	2	2
PCD25AE1T	Comprehensive Skills in Quantitative and Logical Reasoning	3	3	1	2	3	2	3	3	3	3	3	2
PCD25AE2T	Soft Skills and Verbal Mastery	3	1	1	2	3	2	3	3	3	3	3	2
	Program Average	3	2	1	2	3	2	3	3	3	3	3	2

SEMESTER I

Course Code	PBT25101J	Course Title	Biochemistry	Category	C	Professional Core Course	L	T	P	C
							3	0	2	4

Course Offering Department	Biotechnology	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	*The purpose of learning this course is to:*
CR-1	Provide an understanding of carbohydrate structure, function, and metabolism, laying the foundation for advanced biochemistry studies
CR-2	Gain a comprehensive understanding of lipid structure, function, and metabolism emphasizing their physiological significance in biological systems
CR-3	Equip students with a thorough understanding of amino acids, their structural and chemical characteristics, metabolism and their significance in protein synthesis
CR-4	Provide a strong foundation in nucleic acid biochemistry, emphasizing their structure, function, and metabolism, crucial for understanding cellular processes
CR-5	Provide students with a strong foundation in the biochemistry of vitamins, minerals, and key metabolic disorders, emphasizing their roles in human health and disease.

Outcomes (CO)	*At the end of this course, learners will be able to:*	Depth				Attainment			Program Outcomes (PO)											
		1 Conceive	2 Design	3 Implement	4 Operate	1 Level of Thinking	2 Expected Proficiency (%)	3 Expected Attainment (%)	1 Disciplinary Knowledge	2 Problem Solving	3 Design & Development	4 Analysis, Design, Research	5 Modern Tool Usage	6 Society & Culture	7 Environment & Sustainability	8 Ethical Practices & Social Responsibility	9 Individual & Team Work	10 Communication	11 Project Management & Finance	12 Life Long Learning
CO-1	Comprehend carbohydrate structure, function, and metabolism providing a strong foundation for advanced studies in biochemistry	✓				2	85	75	3	2	1	2	1	-	-	-	-	-	-	2
CO-2	Understand lipid structure, function, and metabolism and apply this knowledge to appreciate the physiological significance of lipids in biological processes	✓	✓	✓		3	85	75	3	2	1	2	1	-	-	-	-	-	-	2
CO-3	Effectively describe amino acid structures, classify them, explain the principles of protein structure and elucidate key pathways of amino acid metabolism		✓			4	85	75	3	2	2	2	2	-	-	-	-	-	-	2
CO-4	Demonstrate a comprehensive understanding of nucleic acid structure, function, and metabolism, and apply this knowledge to elucidate their significance in cellular processes and human health.	✓	✓	✓	✓	3	85	75	3	2	1	2	1	-	-	-	-	-	-	2
CO-5	Classify vitamins and minerals, describe their functions in the human body, and understand the pathophysiology and clinical manifestations of key metabolic disorders	✓	✓			2	85	75	3	2	2	2	2	-	-	-	-	-	-	3

Sessions	CLO – 1	CLO – 2	CLO - 3	CLO - 4	CLO - 5
	15	15	15	15	15
SLO-1	Introduction to Carbohydrates - Definition, Classification and biological significance	Lipids – Definition and classification and function	Amino Acids - Structure, classification and properties	Nucleic acids – Overview, definition and types	Vitamins – Classification and functions
SLO-2	Monosaccharides – Structure and properties	Simple lipids – Structure, properties and function	Amino Acids – Structure, classification and properties	Nucleotides – Chemical structure	Vitamins – Classification and functions

SLO-3	Disaccharides and Oligosaccharides	Compound lipids – Structure, properties and function	Peptide bond formation and protein secondary structure	DNA - Structure, properties and functions	Vitamins – Classification and functions
SLO-4&5	***Practice 1: Qualitative analysis of carbohydrates***	***Practice 4: Qualitative analysis of carbohydrates***	***Practice 7: TLC separation of Amino acids***	***Practice 10: Spectrophotometric estimation of nucleic acids***	***Practice 13: Qualitative analyses of amino acids***
SLO-6	Homopolysaccharides - Structure and Function	Compound lipids – Structure, properties and function	Protein tertiary and quaternary structure	RNA – Structure, properties and functions	Minerals - Classification and functions
SLO-7	Heteropolysaccharides - Structure and Function	Derived lipids - Structure, properties and function	Biosynthesis of non-essential amino acids	Purine biosynthesis – De novo and salvage pathways	Minerals - Classification and functions
SLO-8	Metabolism of Carbohydrates - Glycolysis	Lipid Metabolism – Fatty Acid Synthesis	Biosynthesis of non-essential amino acids	Purine biosynthesis – De novo and salvage pathways	Minerals - Classification and functions
SLO-9&10	***Practice 2: Qualitative analysis of carbohydrates***	***Practice 5: Qualitative analysis of carbohydrates***	***Practice 8: Estimation of protein by Lowry's method***	***Practice 11: Estimation of DNA by diphenylamine method***	***Practice 14: Isolation & Characterization of casein from milk.***
SLO-11	Tricarboxylic Acid cycle	Lipid Metabolism – Fatty Acid Degradation (β-oxidation)	Biosynthesis of non-essential amino acids	Pyrimidine biosynthesis	Metabolic disorders – Diabetes mellitus type I, II and Gestational diabetes
SLO-12	Electron Transport Chain & ATP synthesis	Cholesterol synthesis	Urea cycle	Purine catabolism	Metabolic disorders – Diabetes mellitus type I, II and Gestational diabetes
SLO-13	Glycogen Metabolism	Testosterone and Estrogen synthesis	Urea cycle	Pyrimidine catabolism	Metabolic disorders - Atherosclerosis
SLO-14&15	***Practice 3: Estimation of glucose by DNSA method***	***Practice 6; Estimation of cholesterol by Zak's method***	***Practice 9: Qualitative analyses of amino acids***	***Practice 12: Estimation of RNA by Orcinol method***	***Practice 15: Isolation and characterization of starch from potato***

Resources

1	Nelson, D. L., & Cox, M. M. Lehninger's principles of biochemistry (7th ed.). W. H. Freeman. (2017).	3	Stryer, L. Biochemistry (8th ed.). W. H. Freeman. (2015).
2	Murray, R. K., Granner, D. K., Mayes, P. A., & Rodwell, V. W. Harper's illustrated biochemistry (30th ed.). McGraw-Hill Education (2015).	4	Voet, D., & Voet, J. G. Fundamentals of biochemistry (4th ed.). John Wiley & Sons. (2012).

Assessment													Strategies					
Bloom's Level of Thinking		Continuous Learning Assessment (CLA) (50% weightage)								Final Assessment (50 %weightage)			Technology		Pedagogy / Andragogy		Sustainable Development	
		CLA - 1		CLA - 2		CLA - 3		CLA - 4 *					Simulations	✓	Clarification/Pauses	✓	Good Health & Well Being	✓
		(10 %)		(10 %)		(20 %)		(10 %)					Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
		Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)		Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
1	Remember	10	10	20	20	10	10	20	20	10	10				Debate	✓	Life on Land	✓
2	Understand	20	20	10	10	20	20	10	10	20	20				Interactive Lecture	✓		
3	Apply	10	10	10	10	10	10	10	10	10	10				Brainstorming	✓		
4	Analyze	10	10	10	10	10	10	10	10	10	10							
5	Evaluate	-	-	-	-	-	-	-	-	-	-							
6	Create	-	-	-	-	-	-	-	-	-	-							
Total (%)		100		100		100		100		100								

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Suresh Kumar Rayala, Professor, DBT, IIT- Chennai		Dr. S. Prema Mathi Maran, Founder-Chairman, CTO, Clean Green Biosystems, Chennai		Dr. S. Samuel Joshua Pragasam, Assistant Professor, DBT, SRMIST, KTR Dr. S. Suresh, Assistant Professor, DBT, SRMIST-RMP

Course Code	PBT25102J	Course Title	Microbiology	Category	C	Professional Core Course	L	T	P	C
							3	0	2	4

Course Offering Department	Biotechnology	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	*The purpose of learning this course is to:*	Depth			
		1	2	3	4
CR-1	Understanding the classification, morphology, and identification of microbes				
CR-2	Learning bacterial cell organization and staining methods for identification				
CR-3	Exploring the structures, replication mechanisms, and impacts of viruses and Mycoplasma				
CR-4	Studying fungal characteristics, reproduction, and contributions to agriculture and industry				
CR-5	Investigating microbial roles in environment, healthcare, and industrial sectors				

Outcomes (CO)	*At the end of this course, learners will be able to:*	Conceive	Design	Implement	Operate	Attainment			Program Outcomes (PO)												
						Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethical Practices & Social	Individual & Team Work	Communication	Project Management & Finance	Life Long Learning
CO-1	Explain microbial taxonomy, nomenclature, and classification systems	✓				5	85	75	3	-	-	-	-	-	-	-	-	-	-	-	3
CO-2	Demonstrate bacterial staining techniques such as Gram's staining and capsule staining	✓	✓	✓		4	85	75	3	2	-	-	-	-	-	-	-	-	-	-	3
CO-3	Compare different viral structures, replication cycles, and Mycoplasma characteristics		✓			6	85	75	3	-	-	-	-	-	-	-	-	-	-	-	3
CO-4	Analyze fungal diversity, ecological significance, and industrial applications	✓	✓	✓	✓	3	85	75	3	2	-	-	-	-	3	-	-	-	-	-	3
CO-5	Apply microbiological concepts to bioremediation, biofertilizers, and antibiotic production	✓	✓			2	85	75	2	2	2	-	-	-	3	3	-	-	-	-	2

Sessions	CLO – 1	CLO – 2	CLO - 3	CLO - 4	CLO - 5
	15	15	15	15	15
SLO - 1	Microbiology- Introduction	Morphological types of Bacteria - Introduction	Mycoplasma	General characteristics and distribution of fungi	Role of microorganisms in ecosystem
SLO - 2	Scope of microbiology	Cell structure, size, shape and arrangement.	Endospore-Structure & Function	fungal cell ultra- structure and thallus organization	Economic importance of bacteria in Agriculture: Biofertilizers
SLO- 3	Classification of microbe	Cell wall structure and functions	Structure and organization of viruses	Nutritional types of fungi	Importance of bacteria in Industry- Beer production
SLO -4 & 5	**Cleaning of Glassware and laboratory rules**	**Smear preparation and simple staining**	**capsular staining technique**	**Enumeration of Bacteria- Serial dilution, Pour and Spread plate method**	**Biochemical tests- TSI**
SLO- 6	Nomenclatural rules and identification	Cell walls of Gram negative and Gram-positive bacteria	General property of viruses	Symbiotic fungi	Antibiotics (Penicillin production)
SLO – 7	Microbial Taxonomy: Definition and systematics	Cell wall synthesis	Viral Replication -I	**Reproduction-** sexual reproduction	Importance of bacteria in **environment-Bioremediation**
SLO - 8	Taxonomic classification systems	Cell membranes and periplamicspace -function	Viral Replication -II	**Reproduction- A**sexual reproduction	Biopesticides - (Bacillus thurengiensis)

SLO -9 & 10	**Methods of sterilizations**	**Gram's staining technique**	**Staining of Fungi – LPCB**	**Pure culture technique**	**Antibiotics sensitivity test- Disk diffusion-Kirby Bauer method**
SLO-11	Classical approach - Numerical taxonomy	Capsule types, composition, function	Sub-viral particles: Virusoids and Prions	Lichens	Biological N_2 fixation
SLO-12	Molecular taxonomy	Structure, function and arrangement of flagella	Ultra structure–Bacteriophages,	Economic Importance of fungi in food, Agriculture	N_2 fixation - genes and regulations in Rhizobium
SLO - 13	Chemical taxonomy	Cell walls of archaebacteria	Lytic and lysogenic cycle	Economic Importance of fungi in medicine and environment	Sewage treatment method
SLO-14 & 15	**Preparation of media (Solid, Semi solid and Liquid)**	**Spore staining technique**	**Demonstration of motility by hanging drop method**	**Biochemical tests- IMViC**	**Antibiotics sensitivity test- Disk diffusion-Kirby Bauer method**

Resources

1	M.J. Pelczar, E.C.S. Chan and N.R. Krieg "Microbiology"– Krieg Tata McGraw Hi Publications, 2007.	3	Jacquelyn G.Black, "Microbiology -Principles and Explorations" Wiley publications 2008.
2	Prescott, Harley and Klein, "Microbiology", McGraw Hill publications, Fifth edition, 2003.	4	Sherris Medical Microbiology: An introduction to infectious diseases (2010) Kenneth

Assessment												Strategies					
Bloom's Level of Thinking		Continuous Learning Assessment (CLA) (50% weightage)								Final Assessment (50 %weightage)		Technology		Pedagogy / Andragogy		Sustainable Development	
		CLA - 1		CLA - 2		CLA - 3		CLA - 4 *				Simulations	✓	Clarification/Pauses	✓	Good Health & Well Being	✓
		(10 %)		(10 %)		(20 %)		(10 %)				Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
		Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
1	Remember	10	10	20	20	10	10	20	20	10	10			Debate	✓	Life on Land	✓
2	Understand	20	20	10	10	20	20	10	10	20	20			Interactive Lecture	✓		
3	Apply	10	10	10	10	10	10	10	10	10	10			Brainstorming	✓		
4	Analyze	10	10	10	10	10	10	10	10	10	10						
5	Evaluate	-	-	-	-	-	-	-	-	-	-						
6	Create	-	-	-	-	-	-	-	-	-	-						
Total (%)		100		100		100		100		100							

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers

Professional Experts	Higher Institution Experts	Internal Experts
1 Dr. Suresh Kumar Rayala, Professor, DBT, IIT- Chennai	Dr.S. Prema Mathi Maran, Founder-Chairman, CTO, Clean Green Biosystems, Chennai	Dr. S. Thanigaivel .S, Assistant Professor, DBT, SRMIST

Course Code	PBT25103J	Course Title	Enzyme Technology	Category	C	Professional Core course	L	T	P	C
							3	0	2	4

Course Offering Department	Biotechnology	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	*The purpose of learning this course is to:*	Depth				Attainment		
		1	2	3	4	1	2	3
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency	Expected Attainment
CR-1	Understanding the classification of enzymes & properties.							
CR-2	Understanding the mechanism of enzyme action.							
CR-3	Gain basic knowledge on enzyme kinetics.							
CR-4	Gain knowledge on role of coenzymes in metabolic pathway.							
CR-5	Understand the impact of enzyme immobilization and industrial applications of enzymes							

Outcomes (CO)	*At the end of this course, learners will be able to:*	Depth				Attainment			Program Outcomes (PO)												
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency	Expected Attainment	Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design,	Modern Tool Usage	Society & Culture	Environment &	Ethical Practices & Social	Individual & Team Work	Communication	Project Management &	Life Long Learning
CO-1	Explain the enzyme classification.	✓				2	80	80	3	-	2	-	-	1	2	2	-	-	-	2
CO-2	Explain the mechanism of enzyme action.	✓	✓	✓		2	80	80	3	-	2	-	-	1	2	2	-	-	-	2
CO-3	Analyze the enzyme inhibition mechanism		✓			3	90	80	3	3	3	-	2	3	3	1	-	-	-	3
CO-4	Illustrate the roles and functions of coenzymes.	✓	✓	✓	✓	3	90	90	3	3	2	-	-	3	3	1	-	-	-	2
CO-5	Discuss immobilization techniques and its applications.	✓	✓			3	80	80	3	3	3	2	3	3	3	3	-	-	-	3

Sessions	CLO – 1	CLO – 2	CLO - 3	CLO - 4	CLO - 5
	15	15	15	15	15
SLO - 1	Introduction to Enzymes. Properties and Nomenclature of Enzymes.	Introduction to ES complex, Activation energy, collision theory, transition state theory.	Kinetics introduction -Steady state kinetics and pre-steady state kinetics.	Introduction-coenzymes	Enzyme isolation introduction
SLO - 2	Classification - IUB system-group I, II	Active site -3D structure.	Michaelis Menten Equation assumptions, Derivation of MM equation	Classification of coenzymes, Functions of coenzymes	Steps of enzyme purification, methods of enzyme isolation
SLO - 3	Classification - group III, IV	Activation energy	Modified MM Equation Difference between MM and modified MM equation	NADP- Precursor, Structure and reactions involving NADP	Purifications of enzymes.
SLO - 4 & 5	**Buffer preparation.**	**Determination of activity of amylase.**	**Extraction of Urease.**	**Determination of optimum temperature of Urease.**	**Determination of optimum temperature of Protease.**
SLO - 6	Classification - group V, VI.	Lock and key Hypothesis, Induced fit Hypothesis	Significance of MM equation Kcat, Kcat/Km	FAD, FMN- Structure and Reactions involving FAD & FMN.	Enzyme Immobilization and applications.
SLO - 7	Factors affecting enzyme action- Effect of temperature, pH, and substrate	Mechanism of enzyme catalysis-Acid-base catalysis, covalent catalysis.	Drawback of MM equation, Line weaver Burk plot	TPP- Structure and Reactions involving TPP	Industrial applications of enzyme-amylase

	concentration on reaction rate.				
SLO - 8	Factors affecting enzyme action- substrate and inhibitor concentration on reaction rate.	Metal ion catalysis, Proximity and orientation	Eadie-Hofstee plots, Importance of Eadie-Hofstee plot	Pyridoxal phosphate- Structure and Reactions involving PLP	Industrial applications of enzyme- protease.
SLO - 9 & 10	**Amylase isolation**	**Determination of optimum pH of amylase.**	**Determination of activity of Urease.**	**Extraction of Protease**	**Determination of optimum pH of Protease.**
SLO - 11	Enzyme specificity: Group specificity, absolute specificity, Stereospecificity, Bond Specificity	Introduction- Chymotrypsin Chymotrypsin mechanism Acylation phase	Inhibition introduction Reversible inhibition- Deviation of MM equation- in the presence of Competitive inhibitor only,	THF- Structure and Reactions involving THF	Introduction to enzyme application in clinical field
SLO - 12	Purity of enzymes- Enzyme activity, Specific activity.	Chymotrypsin mechanism deacylation phase.	Comparison of all the 3 inhibitors Line-weaver Burk plot	Lipoic acid- Structure and Reactions involving lipoic acid.	Clinical applications of enzymes LDH
SLO - 13	Enzyme units- Katal& IU, Metalloenzymes and metal activated enzymes	Lysozyme mechanism	Irreversible inhibition, Suicidal inhibition	Vitamin B12- Structure and Reactions involving Vitamin B-12	Clinical applications of enzymes SGOT, SGPT.
SLO - 14 & 15	**Dialysis**	**Determination of optimum temperature of amylase.**	**Determination of optimum pH of Urease.**	**Determination of activity of Protease.**	**Enzyme immobilisation**

Resources			
1	Nicholas C. Price., Lewis Stevens, (2003). Fundamentals of Enzymology, Oxford University Press, 2003.	3	Lehninger, A. L., Nelson, D. L., Cox, M. M. (2005). Lehninger principles of Biochemistry. UK W. H. Freeman.
2	Trevor Palmer., Philip Bonner, (2004). Enzymes - Biochemistry, Biotechnology, Clinical chemistry, 2nd edition, East-West Press Pvt. Ltd.		

Assessment																	
Bloom's Level of Thinking		Continuous Learning Assessment (CLA) (50% weightage)								Final Assessment (50 %weightage)		Strategies					
		CLA - 1		CLA - 2		CLA - 3		CLA - 4 *				Technology		Pedagogy / Andragogy		Sustainable Development	
		(10 %)		(10 %)		(20 %)		(10 %)				Simulations	✓	Clarification/Pauses	✓	Good Health & Well Being	✓
		Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
												Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
1	Remember	20	10	20	10	20	10	20	10	20	10			Debate	✓	Life on Land	✓
2	Understand	10	10	10	10	10	10	10	10	10	10			Interactive Lecture	✓		
3	Apply	10	10	10	10	10	10	10	10	10	10			Brainstorming	✓		
4	Analyze	10	20	10	20	10	20	10	20	10	20						
5	Evaluate	-	-	-	-	-	-	-	-	-	-						
6	Create																
Total (%)		100		100		100		100		100							

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Suresh Kumar Rayala, Professor, DBT, IIT- Chennai		Dr.S. Prema Mathi Maran, Founder-Chairman, CTO, Clean Green Biosystems, Chennai		Dr. S. Vijaya Bharathi, Asst. Professor, Dept. of Biotechnology, FSH, SRMIST, KTR. Dr.S.Suresh, Assistant Professor, DBT, SRMIST-RMP

Course Code	PMS25D01T	Course Title	Statistics for Biosciences	Category	D	Discipline Elective course	L	T	P	C
							4	0	0	4

Course Offering Department	Mathematics & Statistics	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	*The purpose of learning this course is to:*	Depth				Attainment		
		1	2	3	4	1	2	3
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency	Expected Attainment
CR-1	To provide foundations in Data Collection, Classification and Presentation of Data.							
CR-2	To understand the Concepts of Measures of Central Tendency							
CR-3	To understand the Concepts of Measures of Dispersion							
CR-4	To acquire the knowledge of Correlation and Regression Analysis							
CR-5	To learn and apply the Probability Theory and Distributions in Biological field							

Outcomes (CO)	*At the end of this course, learners will be able to:*	Depth				Attainment			Program Outcomes (PO)												
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency	Expected Attainment	Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design,	Modern Tool Usage	Society & Culture	Environment &	Ethical Practices & Social	Individual & Team Work	Communication	Project Management &	Life Long Learning
CO-1	To acquire the knowledge of data, classification and presentation commonly used in Health and Medical Sciences	✓	✓	-	-	2	85	75	2	2	-	1	2	*2*	2	2	-	-	-	2
CO-2	To calculate descriptive statistics - averages from these data	✓	✓	✓	-	2	85	75	3	3	-	1	2	*2*	2	2	-	-	-	2
CO-3	To calculate descriptive statistics - dispersion from these data	✓	✓	✓	✓	3	85	75	3	3	-	1	2	*2*	3	1	-	-	-	3
CO-4	To acquire the skill of analyzing the relationship between the independent and dependent variables	✓	✓	✓	✓	3	85	75	3	3	-	1	2	*2*	3	1	-	-	-	2
CO-5	To identify distribution form relating to the variable/variables.	✓	✓	✓	✓	3	85	75	3	3	-	1	2	*2*	3	3	-	-	-	3

Sessions	CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
	12	12	12	12	12
SLO-1	Introduction -Biostatistics	Measures of Dispersion-Definition-Methods of Dispersion	Definition of Bi-variate distribution, Definition of correlation, types and application	Random experiment, types of events with examples	Large sample test – Z test using single sample mean
SLO-2	Source of primary and secondary data	Range- definitions-merits and demerits-problems	Methods of Measures of correlation coefficient- Karl Pearson's formula	Definition of probability, addition and multiplication law	Large sample test – Z test using two sample mean
SLO-3	Classification of data with examples	Quartile deviations-definitions-merits and demerits	Correlation coefficient using Karl Pearson's method	Problems based on addition and multiplication law	Small sample test: t-test with comparison of single sample mean
SLO-4	Tabulation- parts of the table	Problems on Range and Quartile deviation	Applications of Correlation	Conditional probability	t-test with comparison of two sample means
SLO-5	Presentation of data through diagrams and graphs	Mean deviations-definitions-merits and demerits	Rank correlation – Definition and uses	Definition of Baye's theorem - Problems on Baye's theorem	Paired t-test for dependent samples

Sessions	CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
	12	12	12	12	12
SLO-6	Diagrammatic presentation of Statistical data	Problems on Mean deviation	Correlation coefficient using Spearman's rank method	Definition of probability distribution and its Type	Applications of t-test
SLO-7	Graphical presentation of Statistical data	Standard deviations-definitions-merits and demerits	Problems on Rank correlation	Definition of Binomial distribution and its applications	F-test: equality of two sample variances
SLO -8	Measures of Central tendency – Mean	Problems on testing consistency of data.	Applications of Rank Correlation	Problems on Binomial distribution	Chi-square test: Goodness of fit
SLO-9	Measures of Central tendency - Median	Applications of Coefficient of Variation	Concepts of regression-Properties of regression coefficients	Definition of Poisson distribution and its application	Chi-square test: independence of attributes
SLO-10	Measures of Central tendency – Mode	Measures of Skewness: Karl Pearson's	Regression lines using least square method	Problems on Poisson distribution	Applications of Chi-square test
SLO-11	Calculation of median and node through graphs	Measures of Skewness: Bowleys	Distinguish between Correlation and Regression	Definition of normal distribution, characteristics	Analysis of variance: concepts, One-way ANOVA table
SLO -12	Empirical relationship between Mean, median, and mode	Skewness and its applications	Problems on Regression analysis	Problems on normal distribution	Two-way ANOVA table-formula and problem

Resources			
1	Gupta, S.P. (2011) ,Applied Statistical Methods ,4th Edition,Sultan Chand & Sons, New Delhi.	3	Khan and Khanum, (2008), Fundamentals of Bio Statistics, 3rd Edition, Ukaaz Publications, Hyderabad.
2	Ken Black, (2013), Business Statistics for Contemporary Decision Making, 7th Edition, John Wiley Publications	4	

Assessment								Strategies					
Bloom's Level of Thinking		Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 %weightage)		Technology		Pedagogy / Andragogy		Sustainable Development	
		CLA - 1	CLA - 2	CLA - 3	CLA - 4 *			Simulations	✓	Clarification/Pauses	✓	Good Health & Well Being	✓
		(10 %)	(10 %)	(20 %)	(10 %)			Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
		Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)		Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
1	Remember	20	20	20	20	15				Debate	✓	Life on Land	✓
2	Understand	20	20	20	20	15				Interactive Lecture	✓		
3	Apply	20	20	20	20	20				Brainstorming	✓		
4	Analyze	20	20	20	20	20							
5	Evaluate	10	10	10	10	15							
6	Create	10	10	10	10	15							
Total (%)		100	100	100	100	100							

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr.N.Visvanathan, Associate Professor and Head, Department of Statistics, Presidency College, Chennai	1	Dr.D.Arivudainambi, Professor, Department of Mathematics, Anna University, Chennai	1.	Dr. J. Madhumitha, Assistant Professor, Department of Mathematics and Statistics, FSH, SRMIST
				2.	Dr. M. Kalaivani, Assistant Professor, Department of Mathematics and Statistics, FSH, SRMIST

Course Code	PBT25D02T	Course Title	Biophysics	Category	D	Discipline Specific Course	L	T	P	C
							4	0	0	4

Course Offering Department	Biotechnology	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	*The purpose of learning this course is to:*
CR-1	Understanding the spectroscopy and its applications
CR-2	Gain knowledge on XRD and NMR
CR-3	Understand the principle of cardiac and lung diagnosis
CR-4	Know how the electrical impulses are generated in the body
CR-5	Have knowledge on radiation biology and the instruments used for diagnosis

Outcomes (CO)	*At the end of this course, learners will be able to:*	Depth				Attainment			Program Outcomes (PO)											
		1 Conceive	2 Design	3 Implement	4 Operate	1 Level of Thinking	2 Expected Proficiency (%)	3 Expected Attainment (%)	1 Disciplinary Knowledge	2 Problem Solving	3 Design & Development	4 Analysis, Design, Research	5 Modern Tool Usage	6 Society & Culture	7 Environment & Sustainability	8 Ethical Practices & Social	9 Individual & Team Work	10 Communication	11 Project Management & Finance	12 Life Long Learning
CO-1	Perform experiments using the knowledge of spectroscopy	✓				2	85	75	3	1	-	3	3	-	-	-	-	-	-	2
CO-2	knowledge for basic characterization of macromolecules	✓	✓	✓		3	85	75	3	2	-	3	3	-	-	-	-	-	-	2
CO-3	Read an ECG and also know how it occurs		✓			4	85	75	3	2	-	3	2	-	-	-	-	-	-	2
CO-4	See the importance of minerals and its involvement in electrical generation	✓	✓	✓	✓	3	85	75	3	1	-	3	2	-	-	-	-	-	-	2
CO-5	Use their knowledge in radiobiology and imaging for personal and social life	✓	✓			2	85	75	3	1	-	2	1	2	-	-	-	-	-	-	2

Sessions	CLO – 1	CLO – 2	CLO - 3	CLO - 4	CLO - 5
	12	12	12	12	12
SLO-1	Molecular basis of light absorption, UV-Vis Spectroscopy:	Elementary Crystallography: External features and symmetry,	Basic Electrophysiology: Fundamental principles of electrocardiograph,	Sodium pump	Concept of radiobiology,
SLO-2	Working principle and application of UV-Vis spectrophotometer	Unit cell, Lattices, Bravais lattices,	Components of Arterial Blood Pressure,	Calcium pump	Ionizing radiation and types
SLO-3	Fluorescence Spectroscopy: Introduction,	Bragg's law	Measurement of Blood Pressure	Membrane potential of cell,	Direct and indirect effects of radiation
SLO-4	Stokes shift, fluorescence emission parameters,	Reciprocal lattice, Millers Indices	Cardiac electrical field generation during activation,	Development of Membrane potential,	In-vitro & in-vivo imaging using radioisotopes,
SLO-5	Principle of fluorescence, quenching, polarization, anisotropy	Instrumentation of XRD	Electrocardiograph lead systems	Development of Action potential	RadioImaging techniques
SLO-6	FRET	Resonance Spectroscopy: NMR-General principles,	The normal P wave,	Synaptic potential - End Plate Potential,	X-Ray, PET scan,
SLO-7	Circular dichroism: Introduction,	Resonance condition in Bloch equations, relaxation phenomena	Repolarization and depolarization,	The Nerve Stimulus and Events at the Neuromuscular Junction	Organ scans- brain, bone,

SLO-8	Principle and functions, Introduction to ORD,	Chemical shifts; Proton magnetic resonance; Instrumentation	Ventricular recovery and ST-T wave U wave	Excitation of the Skeletal Muscle Fiber,	Cardiac imaging,
SLO-9	Parameters of optical activity	Evaluate inter molecular interactions: ITC - Calorimetry,	Physics behind ventilation: Different pressure volume relationships	Muscle action potential	Medical instrumentation Basic sensors-principles, transducers, amplifiers,
SLO-10	CD spectral signatures- Proteins and DNA	Thermodynamics: Protein and Protein-Ligand interactions.	Compliance; lung resistance	Excitation contraction coupling,	Blood monitoring: Electromagnetic and Ultrasonic Doppler Flowmeter
SLO-11	Vibrational spectroscopy: Physical basis of infrared	SPR: Introduction to surface plasmons.	Phase variables, Alveolar Pressure,	Muscle fiber contraction- Cross bridging	Respiratory measurements: Spirometry, Plethysmography
SLO-12	Raman spectra, structural analyses of biological macromolecules	Factors affecting total internal reflections. Principle of SPR	Positive End Expiratory Pressure (PEEP),	Wave summation and motor unit, graded muscle contractions	Cardiac pacemakers, hemo dialysis machine

Resources	
1	**Banwell, C. N. & McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. Tata McGraw-Hill: New Delhi (2006).**
2	**Charles R. Cantor, Paul Reinhard Schimmel, Biophysical Chemistry: Techniques for the study of biological structure and function, W. H. Freeman, 1980.**
3	**John G. Webster, Medical Instrumentation application design, Houghton Mifflin Co.**

Assessment								Strategies					
	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 %weightage)		Technology		Pedagogy / Andragogy		Sustainable Development	
		CLA – 1	CLA – 2	CLA– 3	CLA– 4 *			Simulations	✓	Clarification/Pauses	✓	Good Health & Well Being	✓
		(10%)	(10%)	(20%)	(10%)			Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
		Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)		Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
1	Remember	40	30	35	20	35				Debate	✓	Life on Land	✓
2	Understand	20	30	25	20	25				Interactive Lecture	✓		
3	Apply	20	20	20	30	20				Brainstorming	✓		
4	Analyze	20	20	20	30	20							
5	Evaluate	-											
6	Create												
Total %		100	100	100	100	100							

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Suresh Kumar Rayala, Professor, DBT, IIT- Chennai		Dr.S. Prema Mathi Maran, Founder-Chairman, CTO, Clean Green Biosystems, Chennai		Dr. N. Prasanth Bhatt, Asst. Professor, Dept. of Biotechnology, FSH, SRMIST, KTR.

Course Code	PBT25S01T	Course Title	Aquatic Biotechnology	Category	S	Skill Enhancement Courses	L	T	P	C
							4	0	0	4

Course Offering Department	Biotechnology	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	*The purpose of learning this course is to:*	Depth				Attainment			Program Outcomes (PO)												
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12
CR-1	Understanding about marine environment																			
CR-2	Understanding the sustainable practices and bioremediation																			
CR-3	Knowledge on pharmaceutics from aquatic life																			
CR-4	Knowledge on fouling and its effects																			
CR-5	Learning of aquaculture management																			

Outcomes (CO)	*At the end of this course, learners will be able to:*	Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethical Practices & Social	Individual & Team Work	Communication	Project Management & Finance	Life Long Learning
CO-1	Know the marine environments, diversity and adaptation of marine organisms	✓				1	85	75	3	1	-	2	-	-	3	2	-	-	2	2
CO-2	Gathering knowledge on sustainable practices and bioremediation	✓	✓	✓		2	85	75	3	2	-	2	-	-	3	2	-	-	2	2
CO-3	Applying knowledge on development of pharmaceutics from aquatic life		✓			2	85	75	3	2	-	2	-	-	3	2	-	-	2	2
CO-4	Applying the knowledge in fouling and its effects	✓	✓	✓	✓	2	85	75	3	2	-	2	-	-	3	2	-	-	2	2
CO-5	Having knowledge on aquaculture management	✓	✓			2	85	75	3	2	-	2	-	-	3	2	-	-	2	2

Sessions	CLO – 1	CLO – 2	CLO – 3	CLO-4	CLO - 5
	12	12	12	12	12
SLO-1	Classification of marine environment	Bio-floc technology, Aquaponics	Principles & mechanisms of drug action	Biofilm formation	Broodstock management
SLO-2	Types of aquatic habitats such as coral reefs	Zero water exchange aquaculture system	Pharmacokinetics	Biofouling	Application of Cross breeding in aquaculture
SLO-3	Sand dunes, mangroves, sea grasses	Aqua mimicry, Hydroponics	pharmacodynamics	Marine fouling	Selective breeding, qualitative and quantitative traits for selection
SLO-4	Diversity of marine organisms	Raceway system of aquaculture, Bioremediation in Aquaculture systems	Marine derived pharmaceuticals	Boring organisms - biology,	Importance of coastal aquaculture
SLO-5	Taxonomy of marine organisms	Genetically modified organisms in waste water treatment	Marine bio-resources	Adaptation of Boring organisms	Aqua farms
SLO-6	Adaptations in marine organisms and energy transfer	Bioremediation for soil and water quality improvement	Secondary metabolites	Biosensor in pollution detection	Culture systems and management practices – extensive
SLO-7	Ocean acidification and impacts on marine organisms	Probiotics: Preparation and applications	Marine proteins and lipids & molecular biology approaches	Unculturable bacteria- occurrence and its characteristics,	Semi-intensive and intensive culture practices

SLO-8	Fish genetic resources- survey and distribution	Micro-algae- indoor and mass-culture methods	Marine actinobacterial metabolites & their pharmacological potential	characterization and exploitation of these bacteria	Mass production of seeds, feed formulation
SLO-9	Development of novel methods for optimization of marine aquaculture	Biotechnological approaches for production of important microalgae	Potential pharmaceuticals from soft and hard corals	Factors influencing settlement of macrofoulers	Culture of Live food organisms
SLO-10	Wildlife protection Act; International Treaties & conventions	Single cell protein from *Spirulina*, vitamins	Pharmaceutical potential of marine sponges	Antifouling and Anti boring treatments	Candidate species of phytoplankton
SLO-11	Marine protected Areas	minerals and Omega-3 fatty acids from micro-algae.	Metagenomic strategies for natural product discovery	Corrosion Process and control of marine structures	Zooplankton as live food organisms of freshwater
SLO-12	Sanctuaries and Biosphere reserves	metabolic engineering of microalgae for biofuel production	Marine biotoxins and potential pharmacological uses of phyco-toxins	Effect of foulers on economy	Zooplankton as live food organisms of marine species

Resources

1	Sverdrup, H. U., Johnson, M. W., & Fleming, R. H. (1942). *The oceans: Their physics, chemistry, and general biology*. University of California Press. Retrieved from https://publishing.cdlib.org/ucpressebooks/view?docId=kt167nb66r Ministry of Law and Justice. (2023). *The Wild Life (Protection) Act, 1972 (Updated 1-4-2023)*. India Code. Retrieved from https://www.indiacode.nic.in/bitstream/123456789/1726/1/a1972-53.pdf
2	Felix, S., & Menaga, M. (2022). *Applied aquaculture biofloc technology*. CRC Press. Retrieved from https://www.taylorfrancis.com/books/mono /10.1201/ 9781003242611
3	Chakraverty, R., Mathur, R., & Chakraborty, P. (2024). *Essentials of pharmacodynamics and drug action*. Springer. Retrieved from https://link.springer.com/book/10.1007/978-981-97-2776-6
4	Abdul, B. (2020). *Microbial biofilms: Properties and applications*. CRC Press. Retrieved from https://www.taylorfrancis.com/books/edit/10.1201/9780367415075
5	FAO. (1993). *Inbreeding and brood stock management*. Food and Agriculture Organization. Retrieved from https://www.fao.org/4/x3840e/X3840E10.htm

Assessment								Strategies					
	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 %weightage)		Technology		Pedagogy / Andragogy		Sustainable Development	
		CLA – 1	CLA – 2	CLA– 3	CLA– 4 *			Simulations	✓	Clarification/Pauses	✓	Good Health & Well Being	✓
		(10%)	(10%)	(20%)	(10%)			Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
		Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)		Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
1	Remember	30	30	30	30	30				Debate	✓	Life on Land	✓
2	Understand	30	30	30	30	30				Interactive Lecture	✓		
3	Apply	20	20	20	20	20				Brainstorming	✓		
4	Analyze	20	20	20	20	20							
5	Evaluate	-	-	-		-							
6	Create	-	-	-		-							
	Total (%)	100	100	100	100	100							

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Suresh Kumar Rayala, Professor, DBT, IIT- Chennai		Dr.S. Prema Mathi Maran, Founder-Chairman, CTO, Clean Green Biosystems, Chennai		Dr. N. Prasanth Bhatt, Asst. Professor, Dept. of Biotechnology, FSH, SRMIST, KTR.

Course Code	PBT25S02T	Course Title	Disease Biology	Category	S	Skill Enhancement courses	L	T	P	C
							4	0	0	4

Course Offering Department	Biotechnology	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	*The purpose of learning this course is to:*	Depth				Attainment			Program Outcomes (PO)												
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethical Practices & Social	Individual & Team Work	Communication	Project Management & Finance	Life Long Learning
CR-1	Understanding about bacterial diseases																			
CR-2	Understanding the metabolic disorders																			
CR-3	Knowledge on genetic diseases																			
CR-4	Knowledge on veterinary diseases																			
CR-5	Learning of aquatic diseases																			
Outcomes (CO)	*At the end of this course, learners will be able to:*																			
CO-1	Identify and have knowledge on diseases in humans caused by various pathogens	✓				1	*85*	*75*	*3*	*1*	-	-	-	-	*3*	*2*	-	-	-	*3*
CO-2	Gather knowledge on metabolic diseases	✓	✓	✓		2	*85*	*75*	*3*	*1*	-	-		-	*3*	*2*	-	-	-	*3*
CO-3	Have knowledge on genetic diseases		✓			2	*85*	*75*	*3*	*1*	-	-	-	-	*3*	*2*	-	-	-	*3*
CO-4	Have knowledge on animal diseases	✓	✓	✓	✓	2	*85*	*75*	*3*	*1*	-	-	-	-	*3*	*2*	-	-	-	*3*
CO-5	Have knowledge on the diseases affecting aquaculture	✓	✓			2	*85*	*75*	*3*	*1*	-	-	-	-	*3*	*2*	-	-	-	*3*

Sessions	CLO – 1	CLO – 2	CLO – 3	CLO – 4	CLO - 5
	12	12	12	12	12
SLO-1	Bacterial- Infectious diseases	Metabolic Diseases	Genetic Diseases and types	Animal Diseases	Aquatic Diseases
SLO-2	Meningitis	Diabetes mellitus	Single gene Disorders- Huntingtoms's Disease, PKU	Anthrax	Vibriosis
SLO-3	tuberculosis	Galactosemia	Wilson disease	Mastitis	Columnaris disease
SLO-4	Gonorrhea	Fructose intolerance	Duchenne muscular dystrophy	Brucellossis	Aeromoniasis
SLO-5	Virus related: The flu (influenza)	Hypercholesterolemia	Hypercholesterolemia	Leptospirosis	Mycobacteriosis
SLO-6	Severe dengue	Gaucher disease	Haemophilia	Trypanosomiasis	White Spot Syndrome Virus
SLO-7	Hepatitis B	Niemann-Pick disease	Sickle cell disease	Trichomoniasis	Viral Nervous Necrosis
SLO-8	Polio	Phenylketonuria	Severe combined immuno deficiency	Infectious bursal disease	Epizootic Hemorrhagic Disease
SLO-9	Fungal related: Candidiasis, Aspergillosis	Alkaptonuria	Tay-Sachs disease	Q fever	Saprolegniasis, Ichthyophonus disease
SLO-10	Parasitic: Chagas disease	Hypothyroidism, Hyperthyroidism	Down syndrome, Turner Syndrome	Foot and mouth disease	Aspergillosis

SLO-11	Leishmaniasis	Cushing's syndrome	Leigh syndrome, LHON	Rinderpest	Cryptocaryonosis, Ichthyophthiriasis
SLO-12	Malaria	Hemochromatosis	Autism spectrum disorder	Cryptococosis	Argulosis

Resources	
1	Bagchi, D., Das, A., & Downs, B. W. (2021). *Viral, parasitic, bacterial, and fungal infections: Antimicrobial, host defense, and therapeutic strategies*. Elsevier. Singh, B., Singh, A., Tripathi, S., Barwant, M. M., & Kumar, P. (2022). *Parasitic associations (Virus, bacteria, fungi, protozoan, helminth, nematodes, arthropods)*.
2	Frayn, K. N. (2021). *Understanding human metabolism: Old institutions, new challenges*. Cambridge University Press. Retrieved
3	O'Reilly, R. K. (2019). *Genetics of disease: A guide for clinicians*. Springer.
4	Constable, P. D., Hinchcliff, K. W., Done, S. H., & Gruenberg, W. (2017). *Veterinary medicine: A textbook of the diseases of cattle, horses, sheep, pigs, and goats (11th ed.)*. Elsevier.
5	Elabd, H., Othman, R., & Mahboub, H. (2024). *Diseases in aquaculture*. Springer.

Assessment								Strategies					
	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 %weightage)		Technology		Pedagogy / Andragogy		Sustainable Development	
		CLA – 1	CLA – 2	CLA– 3	CLA– 4 *			Simulations	✓	Clarification/Pauses	✓	Good Health & Well Being	✓
		(10%)	(10%)	(20%)	(10%)			Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
		Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)		Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
1	Remember	30	30	30	20	30				Debate	✓	Life on Land	✓
2	Understand	30	30	30	20	30				Interactive Lecture	✓		
3	Apply	20	20	20	30	20				Brainstorming	✓		
4	Analyze	20	20	20	30	20							
5	Evaluate	-	-	-		-							
6	Create	-	-	-		-							
	Total (%)	100	100	100	100	100							

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Suresh Kumar Rayala, Professor, DBT, IIT- Chennai		Dr.S. Prema Mathi Maran, Founder-Chairman, CTO, Clean Green Biosystems, Chennai		Dr. G. Swamynathan, Asst. Professor, Dept. of Biotechnology, FSH, SRMIST, KTR.

Course Code	PCD25AE1T	Course Title	Comprehensive Skills in Quantitative and Logical Reasoning	Category	AE	Ability Enhancement Course	L	T	P	C
							2	0	0	2

Offering Department	Career Guidance	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	The purpose of learning this course is to:
CR-1	Build a strong foundation in numerical concepts and arithmetic techniques, enabling learners to solve mathematical problems accurately and efficiently.
CR-2	Equip learners with essential skills for understanding and solving financial and proportional reasoning problems relevant to real-life scenarios and career needs.
CR-3	Develop problem-solving skills in time, work, speed, distance, and ratio-based applications, enabling learners to tackle real-world mathematical challenges efficiently..
CR-4	Enhance learners' logical reasoning and data interpretation skills, enabling them to solve real-life problems involving clocks, calendars, directions, relationships, and data analysis.
CR-5	Sharpen learners' logical thinking and problem-solving abilities, helping them develop skills in tackling number puzzles, logical puzzles, reasoning-based problems, and coding challenges.

Outcomes (CO)	At the end of this course, learners will be able to:	Depth				Attainment			Program Outcomes (PO)												
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethical Practices & Social Responsibility	Individual & Team Work	Communication	Project Management & Finance	Life Long Learning
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	
CO-1	Apply numerical methods to solve problems involving number classification, divisibility tests, progressions, HCF & LCM, simplification techniques, and vinculum-based calculations.	✓	✓	✓	✓	1	85	75	-	3	1	3	1	-	-	-	2	-	-	-	
CO-2	Calculate interest, analyze profit and loss, and solve problems related to percentages, discounts, permutations, combinations, and probability, enhancing their quantitative reasoning skills.	✓	✓	✓	✓	3	85	75	-	3	1	3	1	-	-	-	2	-	-	-	
CO-3	Solve problems related to time and work, speed and distance, boats and streams, mixtures and alligations, height and distance, and age-based calculations with accuracy and efficiency.	✓	✓	✓	✓	4	85	75	-	3	1	3	1	-	-	-	2	-	-	-	
CO-4	Solve problems related to clocks, calendars, directions, blood relations, and interpret data from various graphical representations, including tables, bar charts, pie charts, and line graphs, with accuracy and clarity.	✓	✓	✓	✓	4	85	75	-	3	1	3	1	-	-	-	2	-	-	-	
CO-5	Solve number puzzles, logical puzzles, sequential output tracing, and reasoning problems, as well as alphanumeric series and coding/decoding problems, with precision and speed.	✓	✓	✓	✓	5	85	75	-	3	1	3	1	-	-	-	2	-	-	-	

Title & Session Outcomes	Numbers and Basic Arithmetic	Business Mathematics and Applications	Applied Arithmetic Problems	Logical Reasoning and Data Interpretation	Reasoning and Puzzle Solving
Duration (hour)	6	6	6	6	6
SO-1	Classification of Numbers & Tests of Divisibility	Problems on Averages and Percentage	Time and work - Problems	Clock - Problems	Number Puzzles - Problems
SO-2	Unit Digit & Trailing Zeroes	Problems on Discount	Time, Speed and Distance Problems	Problems on Calendar	Logical Puzzles –Problems
SO-3	Arithmetic Progression Geometric Progression	Problems on Simple Interest and Compound Interest	Boats and Streams - Problems	Direction Sense - Problems	Sequential Output Tracing - Problems
SO-4	Highest Common Factor (HCF) Least Common Multiples (LCM)	Profit and Loss - Problems	Mixtures and Alligations - Problems	Blood relation-Problems	Inductive, Logical, Abstract and Diagrammatic Reasoning - Problems
SO-5	Simplification - Problems	Permutation and Combination – Problems	Height and Distance - Problems	Data Interpretation – Table and Bar chart	Alphanumeric Series - Problems
SO-6	Virnaculum - Problems	Problems on Probability	Problems based on Ages	Data Interpretation – Pie Chart and Line graph	Coding and Decoding - Problems

Assessment

Level of Thinking		Continuous Learning Assessment (CLA) (100 % weightage)							
		CLA– 1 (20%)		CLA– 2 (20%)		CLA– 3 (30%)		CLA – 4 (30%)	
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
1	Remember	40%	-	40%	-	40%	-	40%	-
2	Understand								
3	Apply	40%	-	40%	-	40%	-	40%	-
4	Analyze								
5	Evaluate	20%	-	20%	-	20%	-	20%	-
6	Create								
Total		100 %		100 %		100 %		100%	

Strategies

Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations	✓	Case Studies		No Poverty	
Emulations		Group Discussion	✓	Zero Hunger	
Prototypes		Hands-on Practice	✓	Good Health & Well Being	
Hands-on Practice Tools	✓	Inquiry Learning	✓	Quality Education	✓
Mathematical Computing Tools	✓	Interactive Lecture	✓	Gender Equality	
Field Visit		Leading Question	✓	Clean Water & Sanitation	
		Mind Map		Affordable & Clean Energy	
		Minute Paper			
		Peer Review			
		Problem Based Learning	✓		

Resources			
1	Dr. Agarwal.R.S, Quantitative Aptitude for Competitive Examinations, S. Chand and Company Limited, 2018 Edition	3	Archana Ram, PlaceMentor: Tests of Aptitude for Placement Readiness, Oxford University Press, Oxford, 2018
2	Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Tata McGraw Hill, 5th Edition	4	Edgar Thrope, Test Of Reasoning for Competitive Examinations, Tata McGraw Hill, 6th Edition

Designers					
Professional Experts		**Higher Institution Experts**		**Internal Experts**	
1	Mr. Varadha Rajan M (External Expert), Assistant Manager – Human Resources, Justdial Limited, Chennai – 600015 varadha1723@gmail.com	1	Dr. Premavathy M, Associate Professor , Department of English Center for Distance and Online Education, Bharathidasan University, Tiruchirappalli – 620024 drmpremavathy@bdu.ac.in	1	Dr. Deepalakshmi S, HoD, Department of Career Guidance Cell, FSH, SRMIST
				2	Dr. Sathish K, Assistant Professor, Department of Career Guidance Cell, FSH, SRMIST
				3	Dr. Aarthi S, Assistant Professor, Department of Career Guidance Cell, FSH, SRMIST

Course Code	PBT25G01T	Course Title	General Biology	Category	G	Generic Elective	L	T	P	C
							2	0	0	2

Course Offering Department	Biotechnology	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	*The purpose of learning this course is to:*	Depth				Attainment			Program Outcomes (PO)												
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethical Practices & Social	Individual & Team Work	Communication	Project Management & Finance	Life Long Learning
CR-1	Understanding the basic concepts of Biology																			
CR-2	Understanding the Chemical basis of life																			
CR-3	Equipping the foundational knowledge on cells																			
CR-4	Providing knowledge on various methods of cell reproduction																			
CR-5	Understanding the impact of ecology in human life																			
Outcomes (CO)	*At the end of this course, learners will be able to:*																			
CO-1	Acquire knowledge on diversity of life and evolution theories	✓				5	85	75	3	-	-	-	-	-	-	-	-	-	-	3
CO-2	Strengthen the knowledge on chemistry of biological molecules	✓	✓	✓		4	85	75	3	2	-	-	-	-	-	-	-	-	-	3
CO-3	Understand the working process of the cell		✓			6	85	75	3	-	-	-	-	-	-	-	-	-	-	3
CO-4	Understand cellular reproduction	✓	✓	✓	✓	3	85	75	3	2	-	-	-	-	3	-	-	-	-	3
CO-5	Know various approaches to ecology	✓	✓			2	85	75	2	2	2	-	-	-	3	3	-	-	-	2

Sessions	CLO - 1 6	CLO - 2 6	CLO - 3 6	CLO - 4 6	CLO - 5 6
SLO - 1	Introduction to Biology, World of living organisms	Basic chemistry: Atomic structure	Cell: Prokaryotic versus Eukaryotic cells.	Cellular reproduction: Binary fission, cell cycle: Mitosis	Approaches to ecology, Energy flow
SLO - 2	Diversity of life; history and evolution of life	Molecules and compounds, chemical bonds	The working cell: Energy, Laws of thermodynamics	Cytokinesis, Meiosis	Biogeochemical cycles: Carbon cycle
SLO - 3	Various mechanisms of evolution.	Introduction to Biological molecules.	Structure and functions of ATP	Patterns of inheritance: Medel's law	Nitrogen cycle
SLO - 4	Theories of origin of evolution	Chemistry of DNA	Structure of enzymes and role in metabolism	Patterns of inheritance: Medel's law	Nitrogen cycle
SLO - 5	Nature of the earliest organisms	Chemistry of RNA	Methods of cellular transport: Simple diffusion, facilitated diffusion,	Punnett squares: Monohybrid cross, dihybrid cross	Phosphorous cycle

SLO - 6	Living organisms and their environment; adaptation	Chemistry of carbohydrates	Methods of cellular transport: Exocytosis and Endocytosis	Family Pedigree, Testcross	Sulfur cycle

Resources			
1	Campbell, N. A., & Reece, J. B. (2005). *Biology*. Pearson Education India.	3	Atlas, R.M., & Bartha, R. (1997). *Microbial Ecology: Fundamentals and Applications*. Fourth Edition
2	Taylor, D. J., Green, N. P. O., Stout, G. W., & Soper, R. (1997). *Biological science. 2, systems, maintenance and change*. Cambridge University Press.		

Assessment							Strategies					
Bloom's Level of Thinking		Continuous Learning Assessment (CLA) (100% weightage)					Technology		Pedagogy / Andragogy		Sustainable Development	
		CLA - 1	CLA - 2	CLA - 3	CLA - 4 *		Simulations	✓	Clarification/Pauses	✓	Good Health & Well Being	✓
		(20 %)	(20 %)	(40 %)	(20 %)		Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
		Theory (%)	Theory (%)	Theory (%)	Theory (%)		Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
1	Remember	20	20	15	10				Debate	✓	Life on Land	✓
2	Understand	20	20	20	10				Interactive Lecture	✓		
3	Apply	20	25	25	25				Brainstorming	✓		
4	Analyze	20	25	25	25							
5	Evaluate	20	10	15	15							
6	Create	-	-	-	15							
Total (%)		100	100	100	100							

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Suresh Kumar Rayala, Professor, DBT, IIT- Chennai	1	Dr.S. Prema Mathi Maran, Founder-Chairman, CTO, Clean Green Biosystems, Chennai	1	Dr. D. Senbagam, Assistant Professor, Department of Biotechnology, FSH, SRMIST, KTR

Course Code	PBT25G02T	Course Title	Mushroom Cultivation	Category	G	Generic Elective	L	T	P	C
							2	0	0	2

Course Offering Department	Biotechnology	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	*The purpose of learning this course is to:*	Depth				Attainment			Program Outcomes (PO)												
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethical Practices & Social	Individual & Team Work	Communication	Project Management &	Life Long Learning
CR-1	Understanding about the mushroom cultivation																			
CR-2	Understanding about the culture preparation																			
CR-3	Knowledge on cropping of Mushroom																			
CR-4	Knowledge on Cultivation methods																			
CR-5	Understanding about the Pest and Disease Management																			
Outcomes (CO)	*At the end of this course, learners will be able to:*																			
CO-1	To understand the different types of cultivable Mushrooms	✓				5	85	75	3	-	-	-	-	-	-	-	-	-	-	3
CO-2	Having knowledge on Spawn and culture Preparation	✓	✓	✓		4	85	75	3	2	-	-	-	-	-	-	-	-	-	3
CO-3	Applying knowledge on cropping on Mushroom		✓			6	85	75	3	-	-	-	-	-	-	-	-	-	-	3
CO-4	To learn about the Cultivation Methods	✓	✓	✓	✓	3	85	75	3	2	-	-	-	-	3	-	-	-	-	3
CO-5	Having knowledge on Pest and Disease control	✓	✓			2	85	75	2	2	2	-	-	-	3	3	-	-	-	2

Sessions	CLO – 1 6	CLO – 2 6	CLO - 3 6	CLO - 4 6	CLO - 5 6
SLO - 1	Introduction to types of Mushrooms	Criteria for selection of good quality spawn	Nematodes	Value added products	Management of spent substrates
SLO - 2	History of mushroom	Spawning of compost	Mites	Value added recipes	Waste disposal of various mushroom
SLO - 3	Nutritional and medicinal properties of mushroom	Spawn run	Dry Bubble diseases	Quality assurance	Construction of mushroom growing unit
SLO - 6	Types of edible and medicinal mushroom	Casing and case-run	Wet bubble diseases	Shelf life	Market survey
SLO - 7	Sterilization methods in mushroom cultivation	Cropping of mushroom	Major diseases of cultivated mushroom	Packing and packaging	Calculation of Cost
SLO - 8	Preparation of pure culture	Harvesting of mushroom, Post harvest handling	Competitor/weed moulds encountered	Market opportunities	Discussion on various Mushroom production units near us

Resources			
1	Pandey, R.K., & Ghosh, S. K. (1996). *A Hand Book on Mushroom Cultivation*. Emkey Publications.	3	Nita Bhal. (2000). *Handbook on Mushrooms*. 2nd ed. Vol. I and II. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi .
2	Tripathi, D.P. (2005) *Mushroom Cultivation*, Oxford & IBH Publishing Co. PVT.LTD, New Delhi.		

Assessment							Strategies					
Bloom's Level of Thinking		Continuous Learning Assessment (CLA) (100% weightage)					Technology		Pedagogy / Andragogy		Sustainable Development	
		CLA - 1	CLA - 2	CLA - 3	CLA - 4 *		Simulations	✓	Clarification/Pauses	✓	Good Health & Well Being	✓
		(20 %)	(20 %)	(40 %)	(20 %)		Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
		Theory (%)	Theory (%)	Theory (%)	Theory (%)		Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
1	Remember	20	20	15	10				Debate	✓	Life on Land	✓
2	Understand	20	20	20	10				Interactive Lecture	✓		
3	Apply	20	25	25	25				Brainstorming	✓		
4	Analyze	20	25	25	25							
5	Evaluate	20	10	15	15							
6	Create	-	-	-	15							
Total (%)		100	100	100	100							

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Suresh Kumar Rayala, Professor, DBT, IIT- Chennai		Dr.S. Prema Mathi Maran, Founder-Chairman, CTO, Clean Green Biosystems, Chennai	1	Dr. Infant Santhose.B, Asst. Professor, Dept. of Biotechnology, FSH, SRMIST, KTR.

Course Code	PBT25G03T	Course Title	Disease Management	Category	G	Generic Elective	L	T	P	C
							2	0	0	2

Course Offering Department	Biotechnology	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	*The purpose of learning this course is to:*	Depth				Attainment		
		1	2	3	4	1	2	3
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)
CR-1	Understanding the human disease							
CR-2	Understanding the concepts of the disease process							
CR-3	Knowledge on the characterization of human disorders							
CR-4	Knowledge on biotechnology applications in disease management							
CR-5	Understanding the clinical and translational medicinal application							

Outcomes (CO)	*At the end of this course, learners will be able to:*	Program Outcomes (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
		Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethical Practices & Social	Individual & Team Work	Communication	Project Management & Finance	Life Long Learning
CO-1	Demonstrate a basic understanding of the concepts and elements of disease	3	-	-	-	-	-	-	-	-	-	-	3
CO-2	Demonstrate an understanding of the mechanisms of diseases, the diagnosis of diseases, and the treatment of diseases	3	2	-	-	-	-	-	-	-	-	-	3
CO-3	Understand the pharmacological treatment of diseases or conditions	3	-	-	-	-	-	-	-	-	-	-	3
CO-4	Discussing the therapeutic role and uses of translational medicine	3	2	-	-	-	-	3	-	-	-	-	3
CO-5	Identify etiology, signs, and symptoms of diseases of all body systems	2	2	2	-	-	-	3	3	-	-	-	2

Sessions	CLO - 1	CLO - 2	CLO - 3	CLO - 4	CLO - 5
	6	6	6	6	6
SLO - 1	Introduction to disease	Types of animal research	Human Disorders	Understanding Translational Medicine	Diabetes mellitus- I and II
SLO - 2	Definitions in disease	Diseases condition in animals	Recognizing Signs and Symptoms	From Discovery to Therapy	Neurological disorders
SLO - 3	Types of elements of disease.	Animal studies in the laboratory	Influence of Life Experiences and Environment	Innovative Tools and Technologies	Parkinson disease
SLO - 4	Mechanisms of diseases	Discussion-Present research	Lifestyle, Stress, and Coping Strategies	Personalized and Precision Medicine	Genetic disorders
SLO - 5	Discuss the common laboratory and diagnostic tests	Acute and Chronic disease	Overview of Treatments and Supports	Ethical, Regulatory, and Practical Challenges	Genetic disorders
SLO – 6	Diseases biomarkers	Liver diseases-types	Social Perspectives and Empathy	Future Directions and Emerging Therapies	Discussion-Present research

Resources			
1	Schrijvers, A. J. P. (2002). Book review: Disease management: a systems approach to improving patient outcomes.	3	Huber, D. (2005). *Disease management: A guide for case managers*. Elsevier Health Sciences.
2	Howe, R. S. (2005). *The disease manager's handbook*. Jones & Bartlet	4	Nuovo, J., & Nuovo, J. (2007). *Chronic disease management* (pp. 3-122). New York: Springer.

Assessment							Strategies					
Bloom's Level of Thinking		Continuous Learning Assessment (CLA) (100% weightage)					Technology		Pedagogy / Andragogy		Sustainable Development	
		CLA - 1	CLA - 2	CLA - 3	CLA - 4 *		Simulations	✓	Clarification/Pauses	✓	Good Health & Well Being	✓
		(20 %)	(20 %)	(40 %)	(20 %)		Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
		Theory (%)	Theory (%)	Theory (%)	Theory (%)		Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
1	Remember	20	20	15	10				Debate	✓	Life on Land	✓
2	Understand	20	20	20	10				Interactive Lecture	✓		
3	Apply	20	25	25	25				Brainstorming	✓		
4	Analyze	20	25	25	25							
5	Evaluate	20	10	15	15							
6	Create	-	-	-	15							
Total (%)		100	100	100	100							

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Suresh Kumar Rayala, Professor, DBT, IIT- Chennai		Dr.S. Prema Mathi Maran, Founder-Chairman, CTO, Clean Green Biosystems, Chennai	1	Dr. Raja Ganesan, Assistant Professor, Department of Biotechnology, FSH, SRMIST, KTR

SEMESTER II

Course Code	PBT25201J	Course Title	Molecular Biology	Category	C	Professional Core course	L	T	P	C
							3	0	2	4

Course Offering Department	Biotechnology	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	*The purpose of learning this course is to:*	Depth				Attainment			Program Outcomes (PO)												
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethical Practices & Social	Individual & Team Work	Communication	Project Management & Finance	Life Long Learning
CR-1	Learn about DNA, RNA and Proteins.																			
CR-2	Understand about the mechanism of replication.																			
CR-3	Gain knowledge on transcription.																			
CR-4	Analyze about protein sorting mechanisms.																			
CR-5	Gain knowledge on molecular processes.																			
Outcomes (CO)	*At the end of this course, learners will be able to:*																			
CO-1	Understand the concept of genome organization.	✓				1	85	75	3	-	1	1	-	-	-	-	-	-	-	2
CO-2	Learn about the central dogma of molecular biology.	✓	✓	✓		2	85	75	3	-	1	-	1	-	-	-	-	-	-	2
CO-3	Gain knowledge on molecular mechanisms and techniques.		✓			3	85	75	-	2	-	3	1	-	-	-	-	-	-	-
CO-4	Analyze the significance of gene expression.	✓	✓	✓	✓	3	85	75	-	3	2	1	-	-	-	-	-	-	-	1
CO-5	Apply the concepts of gene regulation.	✓	✓			1	85	75	-	3	-	1	2	-	-	-	-	-	-	3

Sessions	CLO – 1	CLO – 2	CLO - 3	CLO - 4	CLO - 5
	15	15	15	15	15
SLO - 1	Prokaryotic genome	Fine structure of gene	Transcription	Genetic Code	Gene regulation in Prokaryotes
SLO - 2	Eukaryotic genome	Types of genes	Prokaryotic Transcription – Mechanism	Translation	Regulatory elements
SLO - 3	Prokaryotic genome organization	Chromosome – structure and types	Eukaryotic Transcription - Mechanism	Prokaryotic Translation - Mechanism	Riboswitches
SLO - 4 & 5	Lab Safety and GLP	Agarose Gel Electrophoresis	Isolation of Plasmid DNA	Southern Blotting	Northern Blotting
SLO - 6	Eukaryotic genome organization	Mutagenesis	Transcription factors and regulatory elements	Eukaryotic Translation - Mechanism	Lac Operon
SLO - 7	Structure of DNA – Watson and Crick Model	Mutations and its types	Post-transcriptional modifications	Proteins involved in translation	Trp Operon
SLO - 8	Forms of DNA	DNA repair mechanisms	5’-capping and 3’-poly adenylation	Post-translational modifications	Gene regulation in Eukaryotes
SLO - 9 & 10	Isolation of genomic DNA	Quantification of DNA	Polymerase Chain Reaction	Southern Blotting	Western Blotting
SLO - 11	RNA – types and functions	DNA Replication	Splicing	Post-translational modifications	Gene regulation in Eukaryotes

SLO - 12	Proteins – types and functions	Theta replication	Alternative Splicing	Protein folding	Chromatin remodelling
SLO - 13	Protein Structure	Rolling circle replication and D – loop replication	mRNA transport	Protein sorting	Epigenetic regulation
SLO - 14 & 15	Isolation of RNA	Quantification of RNA	Polymerase Chain Reaction	Northern Blotting	Western Blotting

Resources			
1	David Freifelder. (2015). Essentials of Molecular Biology. (4th Edition). Narosa Publishing House.	3	Gerald Karp. (2015). Karp's Cell and Molecular Biology: Concepts and Experiments (8th Edition). Wiley Publishers.
2	De Robertis. (2017). Cell and Molecular Biology (8th Edition). Lea & Febiger.		

Assessment													Strategies					
Bloom's Level of Thinking		Continuous Learning Assessment (CLA) (50% weightage)								Final Assessment (50 %weightage)			Technology		Pedagogy / Andragogy		Sustainable Development	
		CLA - 1		CLA - 2		CLA - 3		CLA - 4 *					Simulations	✓	Clarification/Pauses	✓	Good Health & Well Being	✓
		(10 %)		(10 %)		(20 %)		(10 %)					Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
		Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)		Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
1	Remember	10	10	20	20	10	10	20	20	10	10				Debate	✓	Life on Land	✓
2	Understand	20	20	10	10	20	20	10	10	20	20				Interactive Lecture	✓		
3	Apply	10	10	10	10	10	10	10	10	10	10				Brainstorming	✓		
4	Analyze	10	10	10	10	10	10	10	10	10	10							
5	Evaluate	-	-	-	-	-	-	-	-	-	-							
6	Create	-	-	-	-	-	-	-	-	-	-							
Total (%)		100		100		100		100		100								

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Suresh Kumar Rayala, Professor, DBT, IIT- Chennai		Dr.S. Prema Mathi Maran, Founder-Chairman, CTO, Clean Green Biosystems, Chennai		Dr. G. Swamynathan, Asst. Professor, Dept. of Biotechnology, FSH, SRMIST, KTR. Dr. G. Priya, Assistant Professor, DBT, SRMIST-RMP

Course Code	PBT25202J	Course Title	Plant Biotechnology	Category	C	Professional Core course	L	T	P	C
							3	0	2	4

Course Offering Department	Biotechnology	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	*The purpose of learning this course is to:*	Depth				Attainment		
		1	2	3	4	1	2	3
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)
CR-1	Understand about Plant Genome							
CR-2	Study about the plant tissue culture							
CR-3	Gain knowledge on the gene transfer methods							
CR-4	Learn about the applications of plant transformation							
CR-5	Understand the scope and commercialization of Plant biotechnology							

Outcomes (CO)	*At the end of this course, learners will be able to:*	Depth				Attainment		
CO-1	Understand the basic concepts of plant and organelle genome	✓				1	85	75
CO-2	Understand the concepts of tissue culture techniques	✓	✓	✓		1	85	75
CO-3	Gain knowledge on genetic engineering of plants		✓			1	85	75
CO-4	Have overall understanding of applications of plant biotechnology	✓	✓	✓	✓	1	85	75
CO-5	Apply knowledge on plant tissue culture and genetic engineering of plants	✓	✓			1	85	75

Program Outcomes (PO)											
1	2	3	4	5	6	7	8	9	10	11	12
Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethical Practices & Social	Individual & Team Work	Communication	Project Management & Finance	Life Long Learning
3	3	-	1	-	-	1	2	-	-	-	*3*
3	3	-	-	-	-	1	2	-	-	-	*3*
3	-	3	2	-	-	2	1	-	-	-	*3*
3	-	3	3	-	-	2	1	-	-	-	*3*
3	-	3	3	-	2	3	3	-	-	-	*3*

Title & Session Outcomes	CLO – 1	CLO – 2	CLO - 3	CLO - 4	CLO - 5
SLO - 1	Introduction of plant genome	Plant biotechnology – overview	Genetic engineering in plants - Introduction	GURT	Algal Source
SLO - 2	Structural organization nuclear genome	Media Components	Physical methods of gene transfer	V- GURT	Fungal Source
SLO - 3	Structural organization of Extra nucleolar genomes	sterilization methods	Electoporation	T-GURT	Hydroponics
SLO - 4 & 5	**Isolation of plant genomic DNA**	**Isolation of total RNA from sprouting seeds**	**Shoot induction - organogenesis**	**Somatic embryogenesis**	**Protoplast isolation – enzymatic**
SLO - 6	Chloroplast genome	Micropropagation	Gene Gun	Crop improvement	Aquaponics
SLO - 7	Mitochondrial genome	Organogenesis	Microinjection	Production of transgenic plants	Plant cell bioreactors

SLO - 8	Male sterility in Maize	Caulogenesis	Chemical methods of gene transfer	Gene silencing	Plant cell as bioreactors
SLO – 9 & 10	**Isolation of plant genomic DNA**	**Preparation of Plant tissue culture media and Stock solutions**	**Root induction - organogenesis**	**Callus induction**	**Protoplast fusion by PEG**
SLO - 11	Symbiotic Associations	Rhizogenesis	Biological methods of gene transfer	GM crops	Therapeutic proteins
SLO - 12	Molecular biology of N2 fixation	Somatic Embryogenesis	Agrobacterium technology	Molecular farming	Biosafety of GM plants
SLO - 13	Genome Analysis - Arabidopsis	Protoplast technology	Chloroplast engineering	SCP Production	ELSI
SLO - 14 & 15	**Isolation of total RNA from sprouting seeds**	***In Vitro* Seed Germination**	**Somatic embryogenesis**	**Protoplast isolation – Mechanical**	**Protoplast isolation – Enzymatic**

Resources			
1	Dubey R.C.,"Textbook of Biotechnology" reprint 2005.S. Chand publishers, 2001	3	IgnacimuthuS, *"Plant Biotechnology"*, Tata Mcgraw-Hill Pub., New Delhi, 2006.
2	Slater. A, Scott.N.W, Fowler,M.R, Plant Biotechnology - The genetic manipulation of plants, Oxford University Press 2008		

Assessment													Strategies					
Bloom's Level of Thinking		Continuous Learning Assessment (CLA) (50% weightage)								Final Assessment (50 %weightage)			Technology		Pedagogy / Andragogy		Sustainable Development	
		CLA - 1		CLA - 2		CLA - 3		CLA - 4 *					Simulations	✓	Clarification/Pauses	✓	Good Health & Well Being	✓
		(10 %)		(10 %)		(20 %)		(10 %)					Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
		Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)		Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
1	Remember	10	10	10	10	10	10	10	10	10	10				Debate	✓	Life on Land	✓
2	Understand	10	10	10	10	10	10	10	10	10	10				Interactive Lecture	✓		
3	Apply	10	10	10	10	10	10	10	10	10	10				Brainstorming	✓		
4	Analyze	10	10	10	10	10	10	10	10	10	10							
5	Evaluate	10	10	10	10	10	10	10	10	10	10							
6	Create	-	-	-	-	-	-	-	-	-	-							
Total (%)		100		100		100		100		100								

The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Suresh Kumar Rayala, Professor, DBT, IIT- Chennai		Dr.S. Prema Mathi Maran, Founder-Chairman, CTO, Clean Green Biosystems, Chennai		Dr. Infant Santhose.B, Asst. Professor, Dept. of Biotechnology, FSH, SRMIST, KTR. Dr.R.Vinoth kumar, Assistant Professor, DBT, SRMIST-RMP

Course Code	PBT25203J	Course Title	Genomics and Proteomics	Category	C	Professional Core course	L	T	P	C
							3	0	2	4

Course Offering Department	Biotechnology	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	*The purpose of learning this course is to:*	Depth				Attainment			Program Outcomes (PO)												
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethical Practices & Social	Individual & Team Work	Communication	Project Management & Finance	Life Long Learning
CR-1	Gain in-depth knowledge of the structure, function, and regulation of genes and proteins.																			
CR-2	Analyse the interplay between genes and proteins in complex biological systems.																			
CR-3	Apply knowledge to address challenges in healthcare, agriculture, and Biotechnology field.																			
CR-4	Make impactful contributions to research, industry, and societal advancements.																			
CR-5	Promote interdisciplinary approaches to solve complex biological problems.																			
Outcomes (CO)	*At the end of this course, learners will be able to:*																			
CO-1	Utilize tools and techniques for annotating and interpreting biological data.		✓	-	-	2	85	75	3	2	-	-	-	2	1	1	2	-	3	-
CO-2	Explain the function of genomes and proteomes, in cellular processes.		✓	✓	-	2	85	75	3	-	-	-	-		1	1	-	-	-	2
CO-3	Employ software to analyse sequences, predict structures, and perform annotations.		✓	✓	✓	3	85	75	-	1	-	3	-	2		-	2	-	-	3
CO-4	Correlate data with various disease states to identify biomarkers and therapeutic targets.		✓	✓	✓	3	85	75	2	-	-	3	-	-	2	-	-	-	2	-
CO-5	Address real-world biological and biomedical challenges by proposing innovative solutions.		✓	✓	✓	3	85	75	-	1	-	3	-	2	-	-	2	-	-	-

Sessions	CLO – 1	CLO – 2	CLO - 3	CLO - 4	CLO - 5
	15	15	15	15	15
SLO - 1	Biological database	Multiple Sequence Alignment Methods	Gene Prediction in Eukaryotes	Basics of Phylogenetics	Drug Designing
SLO - 2	Classification of databases	Progressive alignment Method	Promoters and Regulatory elements in Prokaryotes & Eukaryotes	Phylogenetic Analysis	Drug: Definition & Properties
SLO – 3	Applications of databases	Progressive alignment Method	Promoter Prediction methods	The terminology of phylogenetics - Trees, Root, branches, Node, Leaf, Clade	Drug Discovery Pipeline Process
SLO – 4 & 5	Retrieval of Sequence from databases	Retrieval of Sequence from databases	BLAST	PDB	Molecular Docking
SLO – 6	Pairwise Sequence Alignment Methods	Iterative Alignment Method	Promoter Prediction methods	Crown vs. stem groups	ADMET
SLO – 7	Dot matrix	Iterative Alignment Method	Protein Secondary structure Prediction – Significance	Orthology, Paralogy, Xenology	Drug Discovery Pipeline Process
	Dynamic Programming	Block Based Method	Chou Fasman and GOR Method	Phylogram vs. cladogram	Drug Development Process

SLO – 8					
SLO – 9 & 10	Retrieval of Sequence from databases	Global Alignment	Clustal	Rasmol	Molecular Docking
SLO – 11	Dynamic Programming	Gene Prediction in Prokaryotes	Homology Modelling	UPGMA	Molecular Docking
SLO – 12	Word Method	Gene Prediction in Prokaryotes	Fold Recognition	NJ	Methods of Molecular Docking
SLO – 13	Word Method	Gene Prediction in Eukaryotes	Ab Initio method	Rooted vs Unrooted Tree	Applications of Molecular Docking
SLO – 14 & 15	Retrieval of Sequence from databases	Local Alignment	ORF identification	Rasmol	Molecular Docking

Resources

1	Mount, D. W. (2004). *Bioinformatics*-sequence and genome analysis	3	Baxevanis, A.D., Francis Ouellette, B.F. (2009), *Bioinformatics*, Wiley.
2	Arthur, M. (2005). *Introduction to bioinformatics*. oxford university press.	4	Zhumur Ghosh., Bibekanand Mallick. (2009). *Bioinformatics: Principles and Applications*, OUP India.

Assessment

Bloom's Level of Thinking		Continuous Learning Assessment (CLA) (50% weightage)								Final Assessment (50 %weightage)	
		CLA - 1 (10 %)		CLA - 2 (10 %)		CLA - 3 (20 %)		CLA - 4 * (10 %)			
		Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)
1	Remember	10	10	10	10	10	10	10	10	10	10
2	Understand	10	10	10	10	10	10	10	10	10	10
3	Apply	10	10	10	10	10	10	10	10	10	10
4	Analyze	10	10	10	10	10	10	10	10	10	10
5	Evaluate	10	10	10	10	10	10	10	10	10	10
6	Create	-	-	-	-	-	-	-	-	-	-
Total (%)		100		100		100		100		100	

Strategies

Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations	✓	Clarification/Pauses	✓	Quality Education	✓
Presentation Tools	✓	Group Discussion	✓	Industry, Innovation and Infrastructure	✓
Learning Management System	✓	Hands-on Practice	✓		
		Interactive Lecture	✓		

Designers

Professional Experts	Higher Institution Experts	Internal Experts
1 Dr. Suresh Kumar Rayala, Professor, DBT, IIT- Chennai	Dr.S. Prema Mathi Maran, Founder-Chairman, CTO, Clean Green Biosystems, Chennai	Dr. V.G. Vidhya, Asst. Professor, Dept. of Biotechnology, FSH, SRMIST, KTR. Dr.R.Vinoth kumar, Assistant Professor, DBT, SRMIST-RMP

Course Code	PBT25D03T	Course Title	Tissue Biology	Category	D	Discipline Elective Courses	L	T	P	C
							4	0	0	4

Course Offering Department	Biotechnology	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	*The purpose of learning this course is to:*	Depth				Attainment			Program Outcomes (PO)												
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethical Practices & Social	Individual & Team Work	Communication	Project Management & Finance	Life Long Learning
CR-1	Gain knowledge about the cells																			
CR-2	Understanding Structure and functions of the tissues																			
CR-3	Knowledge on stem cell biology																			
CR-4	Knowledge on organs printing for different treatments																			
CR-5	Learning different stem cell therapies																			
Outcomes (CO)	*At the end of this course, learners will be able to:*																			
CO-1	Understands about different types of cells	✓				*2*	*85*	*75*	3	-	3	-	-	1	-	1	-	-	-	-
CO-2	Analysis about different types of tissues and their functions	✓				*3*	*85*	*75*	3	1	3	-	-	1	-	2	-	-	-	-
CO-3	Gain Knowledge on stem cell biology	✓	✓	✓		*3*	*85*	*75*	1	-		3	-	1	-	3	-	-	-	-
CO-4	Acquire knowledge on organ printing techniques		✓	✓	✓	*3*	*85*	*75*	2	2	1	3	-	3	-	-	-	-	-	-
CO-5	Understands about the different stem cell therapy methods		✓	✓	✓	*3*	*85*	*75*	3	-	3	-	-	1	-	1	-	-	-	-

Sessions	CLO – 1	CLO – 2	CLO - 3	CLO - 4	CLO - 5
	12	12	12	12	12
SLO-1	Different types of cells- Epithelial Tissue, Connective Tissue	Structure and organization of tissues	Stem cells - Classification	3D Scaffolds- differences between 2D and 3D scaffold	Bioartificial Pancreas
SLO-2	Muscle Tissue, Nervous Tissue	Epithelial tissues	Stem cells - Properties	Types of 3D Scaffold	Regeneration of Hepatocytes
SLO-3	Cell-Cell Interaction	Glandular epithelium	Types of Stem cells	Fabrication Techniques	Breast Reconstruction
SLO-4	Cell differentiations	Connective tissues	Embryonic stem cells	Scaffold Material and its sources	Regeneration of Bone
SLO-5	Extra cellular matrix	Types of Connective tissues	Adult stem cells	Properties of scaffold materials	Regeneration of Cartilage
SLO-6	Biology of cells in culture	Muscle tissues- Types of Muscle tissues	Hematopoietic Stem Cells	Cell-Scaffold Interaction	Stem Cell Therapy -Introduction
SLO-7	3D cells Culture – Scaffolds based	Muscle Tissue Structure & Components	Mesenchymal Stem Cells	Stimuli-responsive, Drug-loaded scaffolds	Stem Cell Therapy for Gastrointestinal
SLO-8	3D cells Culture – Non- Scaffolds based	Muscle Disorders & Diseases	Isolation and Culture Stem Cells	Limitations in scaffold integration	Stem Cell Therapy for Kidney
SLO-9	Organ Culture - Introduction	Nerve tissues	Characterization of Stem Cells	Ethical considerations in scaffold-based therapies	Stem Cell Therapy for Heart

SLO-10	Plasma Clot Method, Agar Substrate Method, Liquid Medium Culture, **Roller Tube Method**	Tissue Interactions & Organization in Organs	Stem Cell Differentiation & Lineage Commitment	Emerging trends in scaffold technology	Stem Cell Therapy for Eye Diseases
SLO-11	Organotypic Culture- Advances in 3D Organotypic Culture	Artificial Organs	Stem Cells in Tissue Regeneration & Repair	Bioprinting of Organs and Tissue	Stem Cell Therapy for Lung Disorders
SLO-12	Applications in Disease Modeling	Tissue Grafting	Stem Cells & Aging	Bioprinting methods, AI-assisted scaffold design	stem cell therapy for skin care

Resources	
1	Robert. P.Lanza, Robert Langer & William L. Chick,, “Principles of Tissue Engineering”, Academic press, 2008
2	Palsson B., Hubbell J.A., PlonseyR.&Bronzino, “Tissue Engineering” CRC- Taylor & Francis, 2004.
3	Bernhard Palsson, Sangeeta Bhatia, “Tissue Engineering”, Pearson Prentice Hall, 2003.

Assessment								Strategies					
	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 %weightage)		Technology		Pedagogy / Andragogy		Sustainable Development	
		CLA – 1 (10%)	CLA – 2 (10%)	CLA– 3 (20%)	CLA– 4 * (10%)			Simulations	✓	Clarification/Pauses	✓	Good Health	✓
								Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
		Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)		Learning Management System	✓	Hands-on Practice	✓		
1	Remember	30	30	30	30	30				Debate	✓		
2	Understand	30	30	30	30	30				Interactive Lecture	✓		
3	Apply	20	20	20	20	20				Brainstorming	✓		
4	Analyze	20	20	20	20	20							
5	Evaluate	-	-	-	-	-							
6	Create	-	-	-	-	-							
	Total (%)	100	100	100	100	100							

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Suresh Kumar Rayala, Professor, DBT, IIT- Chennai		Dr.S. Prema Mathi Maran, Founder-Chairman, CTO, Clean Green Biosystems, Chennai		Dr. Parthipan. P, Assistant Professor, DBT, SRMIST, KTR Dr.R.Vidhya, Assistant Professor, DBT, SRMIST-RMP

Course Code	PBT25D04T	Course Title	Environmental Biotechnology	Category	D	Discipline Elective Courses	L	T	P	C
							4	0	0	4

Course Offering Department	Biotechnology	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	*The purpose of learning this course is to:*
CR-1	Understanding about renewable energy sources
CR-2	Understanding the environment problems and their management approaches
CR-3	Knowledge on waste water treatment methods
CR-4	Knowledge on bioremediation process and methods
CR-5	Learning of recent advancement in the waste management

Outcomes (CO)	*At the end of this course, learners will be able to:*	Depth				Attainment			Program Outcomes (PO)												
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethical Practices & Social	Individual & Team Work	Communication	Project Management &	Life Long Learning
CO-1	To identify the renewable energy sources and their uses	✓				2	85	75	3	-	2	1	3	-	2	1	-	-	1	1
CO-2	Gathering knowledge on environmental pollutions and pollutants, management techniques	✓				2	85	75	2	1	2	3	3	-	3	1	-	-	1	1
CO-3	Applying knowledge on waste treatments and its methodologies	✓	✓	✓	✓	3	85	80	3	3	1	3	3	-	2	1	-	-	2	1
CO-4	Applying knowledge on bioremediation process for waste management		✓	✓	✓	3	85	75	3	3	1	2	2	-	2	1	-	-	2	2
CO-5	Having knowledge on recent techniques and applications for waste managements		✓	✓	✓	3	85	80	1	2	1	3	3	-	2	1	-	-	2	2

Sessions	CLO – 1	CLO – 2	CLO - 3	CLO - 4	CLO – 5
	12	12	12	12	12
SLO-1	Sustainability – Introduction	Global environmental problems and sustainable management	Introduction to waste water treatment	Solid waste management -common sources	Heavy metal contamination- Removal of heavy metals
SLO-2	Non- Renewable energy types - Fossil Fuels, Nuclear Energy	Major Global Environmental Problems	Primary treatments and Secondary treatments methods	Waste Segregation & Classification	Phytoremediation of heavy metals contaminations
SLO-3	Environmental Impact of Non-Renewable Energy	Global warming	Activated sludge and Trickling filters	Solid waste- collection and transport	Phytoremediation of oil spills
SLO-4	Economic & Political Aspects, Conservation & Future Alternatives	Climate change	Rotating Biological Contactors,	Waste Treatment & Disposal Techniques	Nanotechnology in environmental remediation – introduction
SLO-5	Renewable energy – solar energy	Acid rain	Oxidation pond and oxidation ditch	Recycling & Resource Recovery	Nano-bioremediation of organic pollutants
SLO-6	Hydrothermal,	Sustainable management of water pollution	Tertiary treatment - Filtration and chemical treatment	Sustainable Waste Management Strategies	Photocatalysis – introduction
SLO-7	Biomass energy	Sustainable management soil pollution	Membrane technologies	Management of Micro and Nano plastics	Photocatalytic degradation of organic pollutants
SLO-8	Wind energy	Sustainable management of air pollution	Anaerobic waste water treatment-introduction	Bioleaching-importance-Mechanisms of bioleaching	Immobilization technology for bioremediation

SLO-9	Geothermal	Sustainable management marine pollution	Anaerobic filters	Oil spill impacts- Treatments of oil spill	Molecular techniques in bioremediation
SLO-10	Bioenergy	Climate Change Mitigation	Upflow anaerobic sludge blanket	Oil spill -case study	Metagenomics in Bioremediation
SLO-11	Microbial Fuel Cells and its applications	Forest Conservation & Reforestation	Nanotechnology for pollutant removal	PAHs impacts on environment and health, Sustainable treatment	Microbial Biosensors for Pollution Detection
SLO-12	Challenges & Future Directions	Water Resource Management	AI and automation in wastewater monitoring	Impact of pesticides and controlling methods	Challenges & Future Directions

Resources	
1	Metcalf, L., Eddy, H. P., &Tchobanoglous, G. (1991). Wastewater engineering: treatment, disposal, and reuse (Vol. 4). New York: McGraw-Hill.
2	Saxena, G., Kumar, V., Shah, M.P. (2021) Bioremediation for Environmental Sustainability, Elsevier.
3	Nuzhat Ahmed., Fouad M. Qureshi., Obaid Y. Khan. (2006). Industrial and Environmental Biotechnology, Horizon Press.
4	Mohamed, A.O., Paleologos, E.K., Howari, F.M. (2021) Pollution Assessment for Sustainable Practices in Applied Sciences and Engineering, Butterworth-Heinemann.

Assessment								Strategies					
	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 %weightage)		Technology		Pedagogy / Andragogy		Sustainable Development	
		CLA – 1 (10%)	CLA – 2 (10%)	CLA– 3 (20%)	CLA– 4 * (10%)			Simulations	✓	Clarification/Pauses	✓	Good Health	✓
								Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
		Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)		Learning Management System	✓	Hands-on Practice	✓	Clean Water and Sanitation	✓
1	Remember	30	30	30	20	30				Debate	✓	Responsible Consumption	✓
2	Understand	30	30	30	20	30				Interactive Lecture	✓	Renewable Energy	✓
3	Apply	20	20	20	20	20				Brainstorming	✓	Climate Action	✓
4	Analyze	20	20	20	20	20						Life Below Water	✓
5	Evaluate	-	-	-	10	-						Life on Land	✓
6	Create	-	-	-	10	-							
	Total (%)	100	100	100	100	100							

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Suresh Kumar Rayala, Professor, DBT, IIT- Chennai		Dr.S. Prema Mathi Maran, Founder-Chairman, CTO, Clean Green Biosystems, Chennai		Dr. Parthipan. P, Asst. Professor, Dept. of Biotechnology, FSH, SRMIST, KTR. Dr.G.Priya, Assistant Professor, DBT, SRMIST-RMP

Course Code	PBT25S03T	Course Title	Biomaterials	Category	S	Skill Enhancement Course	L	T	P	C
							4	0	0	4

Course Offering Department	Biotechnology	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	*The purpose of learning this course is to:*	Depth				Attainment			Program Outcomes (PO)												
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12
CR-1	Understanding the Basic concepts of material science																			
CR-2	Understanding the properties of Biomaterials																			
CR-3	Knowledge on characteristics and classifications of biomaterials																			
CR-4	Knowledge on materials and composites used for implantations																			
CR-5	Learning of recent advancement of bodily functions and applications of biomaterials health management																			

Outcomes (CO)	*At the end of this course, learners will be able to:*	Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethical Practices & Social	Individual & Team Work	Communication	Project Management & Finance	Life Long Learning
CO-1	Identify and classify the type of biomaterials according to the ASTM standards	✓				5	85	75	3	2	1	-	-	2	1	2	1	1	1	1
CO-2	Understand the structural properties of various biomaterials	✓	✓	✓		4	85	75	3	2	1	1	1	2	3	2	1	2	2	1
CO-3	Determine the characteristics of biomaterials suitable for the implantation		✓			6	85	75	3	3	2	2	2	2	1	1	1	2	2	2
CO-4	Study the functional properties of the materials implanted into the body	✓	✓	✓	✓	3	85	75	3	3	2	2	-	2	1	2	1	2	1	2
CO-5	Can design the materials specific to the body targets with biocompatible parameters	✓	✓			2	85	75	2	3	3	3	1	2	3	2	2	2	1	3

Sessions	CLO – 1	CLO – 2	CLO - 1	CLO - 1	CLO - 1
	12	12	12	12	12
SLO-1	Basics of materials and Definition of biomaterials	Metallic biomaterial	Importance of passive films for tissue adhesion	Classes and types of polymers	Medical compatibility issues
SLO-2	Need for biomaterials	Types of metallic implant materials	Hard tissue replacement implant	Thermosets, thermoplastics	Sutures, Surgical tapes
SLO-3	Generations of implants	Characterizations of biomaterials	Orthopedic implants	Elastomer and merits and demerits	Tissue compatibility
SLO-4	Types of biomaterials	Ceramic implant materials	Biocompatible factors	Viscoelastic behavior	Toxicity tests
SLO-5	Natural biomaterials	Bio ceramics, Aluminum oxide	Dental implants	Polymers as Biomaterials	Acute and chronic toxicity studies
SLO-6	PLA and PHAs,	Glass ceramics and medical use	Fixation and capping process	PTFE, PMMA, PVDF, PE, PEG and Hydrogels	Inflammation and foreign body response, Toxicological screening of biomaterials
SLO-7	Polymers, Silicone	Importance of stress-corrosion cracking	Soft tissue replacement implants	Elastomer and merits and demerits	Host tissue response
SLO-8	HA, chitosan’s	Host tissue reaction with bio metal	Percutaneous planning	Acrylic polymers	Interfacial tissue reaction
SLO-9	Alginate and fibroin	Corrosion behavior	Skin implants	fluorocarbon polymers	Hemolysis

SLO-10	Polymers, silicone biomaterials,	Importance of passive films for tissue adhesion	Skin compatibility	Silicon rubbers	Blood materials interactions,
SLO-11	Medical fibers and synthetic polymers	Hard tissue replacement implant	Heart valve materials	Viscoelastic behavior	In situ implantation
SLO-12	Ceramics	Orthopedic implants and biocompatible factors	Cardiac valve implants	Streep-recovery	Tissue culture

Resources	
1	Biomaterials Science: An Introduction to Materials in Medicine, By Buddy D. Ratner, et. al. Academic Press, San Diego, 1996.
2	Sujata V. Bhat, Biomaterials, Narosa Publishing House, 2002.
3	J B Park, Biomaterials – Science and Engineering, Plenum Press, 1984.
4	John Enderle, Joseph D. Bronzino, Susan M.Blanchard, "Introduction to Biomedical Engineering", Elsevier, 2005.

Assessment								Strategies					
	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 %weightage)		Technology		Pedagogy / Andragogy		Sustainable Development	
		CLA – 1 (10%)	CLA – 2 (10%)	CLA– 3 (20%)	CLA– 4 * (10%)			Simulations	✓	Clarification/Pauses	✓	Good Health	✓
								Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
		Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)		Learning Management System	✓	Hands-on Practice	✓		
1	Remember	30	30	30	30	30				Debate	✓		
2	Understand	30	30	30	30	30				Interactive Lecture	✓		
3	Apply	20	20	20	20	20				Brainstorming	✓		
4	Analyze	20	20	20	20	20							
5	Evaluate	-	-	-	-	-							
6	Create	-	-	-	-	-							
	Total (%)	100	100	100	100	100							

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Suresh Kumar Rayala		Dr.S. Prema Mathi Maran		Dr. Thanigaivel. S,, Asst. Professor, Dept. of Biotechnology, FSH, SRMIST, KTR.

Course Code	PBT25S04T	Course Title	Pharmaceutical Biotechnology	Category	S	Skill Enhancement Course	L	T	P	C
							4	0	0	4

Course Offering Department	Biotechnology	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	*The purpose of learning this course is to:*	Depth				Attainment			Program Outcomes (PO)												
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12
CR-1	Understand the various criteria of classification of drugs	Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethical Practices & Social	Individual & Team Work	Communication	Project Management & Finance	Life Long Learning
CR-2	Understand the importance of recombinant therapeutic proteins and phytopharmaceuticals																			
CR-3	Understand the significance of antibiotics, the various anti-microbial tests																			
CR-4	Know the drug discovery process pipeline																			
CR-5	Know the types of vaccines																			
Outcomes (CO)	*At the end of this course, learners will be able to:*																			
CO-1	Distinguish the different classifications of drugs and their different routes of administration	✓				5	85	75	3	2	-	-	-		2	1				2
CO-2	Describe the various recombinant protein expression systems and phytopharmaceuticals	✓	✓	✓		4	85	75	3	2	--	-	-		2	2				2
CO-3	Explain the role of antibiotics and various anti-microbial and pharmacological assays		✓			6	85	75	3	2	-	-	-		2	2				2
CO-4	Explain the various steps involved in the drug discovery process	✓	✓	✓	✓	3	85	75	3	2	-	-	-		3	1				2
CO-5	Comprehend the applications of different types of vaccines and other types of drugs	✓	✓			2	85	75	3	2	-	-	-		3	2				2

Sessions	CLO – 1	CLO – 2	CLO - 1	CLO - 1	CLO - 1
	12	12	12	12	12
SLO-1	Introduction	Phytopharmaceuticals	Antimicrobial agents	Process of drug discovery and development	Vaccines- Concept & Production
SLO-2	Scope of Pharmaceutical Biotechnology	General Classes, Properties	Antibiotics- Source and production	**Target Identification & Validation**	Vaccine Types
SLO-3	Sources of drugs	Extraction & Isolation Techniques	Antibiotics- Classification	**Lead Compound Identification**	Inactivated vaccines
SLO-4	Classification of pharmacological agents based on chemistry	Pharmacological Evaluation of Herbal Drugs - In-vitro and in-vivo studies	Antibiotics- Mode of action	High-Throughput Screening, Computational Drug Design	Attenuated vaccines
SLO-5	Classification of pharmacological agents based on mode of action	Toxicity studies and pharmacokinetics	Antimicrobial resistance- Anti-bacterial	Natural Product-Based Drug Discovery	Recombinant Vaccines
SLO-6	Classification of pharmacological agents based on mode of action	Nanotechnology in Herbal Drug Delivery – Liposomes, nanoparticles	Antibiotic resistance and the need for new generation antibiotics	Pre-clinical testing	Peptide vaccines
SLO-7	Classification of pharmacological agents based on dosage form	targeted drug delivery	Antimicrobial activity studies- Anti-viral	Pharmacokinetics & Pharmacodynamics	DNA Vaccines

SLO-8	Routes of drug administration	Mass Drug Administration, Biodegradable Implants	Antimicrobial activity studies-Anti-fungal	Toxicology Studies	Edible vaccines
SLO-9	Enteral administration	Genetic & RNA-Based Therapies	Antimicrobial activity studies-Anti-parasitic	Formulation Development	Nanodrugs
SLO-10	Parenteral administration	Oral Drug Delivery via Food Sources	Pharmacological Assays	Phase I: Safety & Dosage, Phase II: Efficacy & Side Effects	Prebiotics
SLO-11	Administration through Inhalation	Transdermal Patches & Sprays	*In vitro* assays	Phase III: Large-Scale Testing	Probiotics
SLO-12	Topical administration	Applications of recombinant therapeutic proteins	*In vivo* assays	Phase IV: Post-Marketing Surveillance	Nutraceuticals

Resources

1. Pharmaceutical biotechnology-Concept and applications. Gray Walsh, *Wiley John & Sons, Inc*. (2003).
2. Biotechnology, Satyanarayana U, Boooks and allied (P) lts, 2010
3. Pharmacology and Pharmacotherapeutics, 26th Edition, RS Satoskar & Nirmala Rege & SD Bhandarkar
4. Pharmaceutical Biotechnology by Dann, J.A, Crommelin& Robert D., Sindelar, Oct. 2002, *Taylor & Francis*
5. https://www.fda.gov/patients/learn-about-drug-and-device-approvals/drug-development-process

Assessment								Strategies					
	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 %weightage)		Technology		Pedagogy / Andragogy		Sustainable Development	
		CLA – 1	CLA – 2	CLA– 3	CLA– 4 *			Simulations	✓	Clarification/Pauses	✓	Good Health & Well Being	✓
		(10%)	(10%)	(20%)	(10%)			Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
		Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)		Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
1	Remember	30	30	30	30	30				Debate	✓	Life on Land	✓
2	Understand	30	30	30	30	30				Interactive Lecture	✓		
3	Apply	20	20	20	20	20				Brainstorming	✓		
4	Analyze	20	20	20	20	20							
5	Evaluate	-	-	-	-	-							
6	Create	-	-	-	-	-							
	Total (%)	100	100	100	100	100							

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers

Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Suresh Kumar Rayala		Dr.S. Prema Mathi Maran		Dr. N. Prasanth Bhatt, Asst. Professor, Dept. of Biotechnology, FSH, SRMIST, KTR.

Course Code	PCD25AE2T	Course Title	Soft Skills and Verbal Mastery	Category	AE	Ability Enhancement	L	T	P	C
							2	0	0	2

Offering Department	Career Guidance	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	

Rationale (CR)	The purpose of learning this course is to:	Depth				Attainment			Program Outcomes (PO)											
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethical practices &Social	Individual & Team Work	Communication	Project Management & Finance	Life Long Learning
CR-1	Help individuals develop key skills for personal and professional growth																			
CR-2	Prepares individuals to navigate daily challenges with confidence, professionalism, and a positive mindset																			
CR-3	Create a strong resume, participate in group discussions, and perform well in interviews																			
CR-4	Enhance vocabulary and verbal reasoning skills																			
CR-5	Develop the skills needed for effective communication and critical thinking in both written and spoken language																			
Outcomes (CO)	At the end of this course, learners will be able to:																			
CO-1	Gain a deeper understanding of self, including emotional intelligence and career aspirations	✓	✓	✓	✓	3	85	75	1	-	3	-	3	3	-	-	3	3	2	3
CO-2	Apply effective presentation skills for clear, engaging communication	✓	✓	✓	✓	6	85	75	1	3	3	-	3	2	-	-	3	3	2	3
CO-3	Participate confidently and effectively in group discussions and interviews	✓	✓	✓	✓	3	85	75	1	3	1	-	3	2	-	-	3	3	2	3
CO-4	Enhance their ability to understand and use language effectively in different contexts	✓	✓	✓	✓	2	85	75	1	-	-	-	1	-	-	-	-	3	2	2
CO-5	Improve language comprehension and accuracy	✓	✓	✓	✓	5	85	75	1	-	-	-	1	-	-	-	-	3	2	2

Title & Session Outcomes	Personal Development	Mastering Workspace Dynamics	Career Essentials	Verbal Ability	Verbal Reasoning and Comprehension
Duration (hour)	6	6	6	6	6
SO-1	Self-analysis through SWOT, The Johari Window	Personal, Professional and Social Etiquette	Resume Preparation and Activity	Synonyms and Antonyms	Statement and Assumption
SO-2	Goal Setting Importance, Goal Setting based on the Principle of SMART	Professional Communication - Presentation Skills	E-mail Drafting and Practice	One Word Substitution	Paragraph Summary
SO-3	Emotional Intelligence (Identifying, Managing and Understanding Emotions)	Presentation for Internal and External Communication - online & offline Meetings	Techniques to Follow in Group Discussion	Word Analogy	Idioms and Phrases
SO- 4	Process of Career Exploration	Time Management and Planning Tools	Mock Group Discussion	Verbal Classification	Cloze Test

SO-5	STAR Technique (situation, task, approach and response) for Facing an Interview	Decision Making Skills	Interview Techniques	Spotting Errors	Theme Detection
SO-6	Professional Attitude – Entrepreneurial, Rational, Optimistic Attitude	Teamwork in Workspace - Resilience and Stress Management	Mock Personal Interview	Sentence Correction	Reading Comprehension

Assessment

Level of Thinking		Continuous Learning Assessment (CLA) (100 % weightage)							
		CLA – 1		CLA – 2		CLA – 3		CLA – 4	
		(20 %)		(20 %)		(30 %)		(30%)	
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
1	Remember	25%	-	20%	-	30%	-	50%	-
2	Understand								
3	Apply	50%	-	50%	-	40%	-	25%	-
4	Analyze								
5	Evaluate	25%	-	30%	-	30%	-	25%	-
6	Create								
Total		100 %		100 %		100 %		100%	

Strategies

Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations	✓	Case Studies	✓	No Poverty	
Emulations	✓	Group Discussion	✓	Zero Hunger	
Prototypes		Hands-on Practice	✓	Good Health & Well Being	
Hands-on Practice Tools	✓	Inquiry Learning	✓	Quality Education	✓
Mathematical Computing Tools		Interactive Lecture	✓	Gender Equality	
Field Visit		Leading Question	✓	Clean Water & Sanitation	
		Mind Map	✓	Affordable & Clean Energy	
		Minute Paper			
		Peer Review	✓		
		Problem Based Learning	✓		

Resources

1	"The Johari Window: A Model for Self-awareness and Personal Growth" by Joseph Luft & Harrington Ingham	2	Campus Recruitment complete Reference , Praxis Groups
3	"The 7 Habits of Highly Effective People" by Stephen R. Covey	4	A Modern Approach to Verbal and Non Verbal Reasoning – Dr A S Agarwal
5	"SMART Goals: How to Set and Achieve Your Personal and Professional Goals" by S.J. Scott	6	Verbal Ability & Reading Comprehension for CAT - Arun Sharma

Designers					
Professional Experts		**Higher Institution Experts**		**Internal Experts**	
1	Mr. Varadha Rajan M (External Expert), Assistant Manager – Human Resources, Justdial Limited, Chennai – 600015 varadha1723@gmail.com	1	Dr. Premavathy M, Associate Professor , Department of English Center for Distance and Online Education, Bharathidasan University, Tiruchirappalli – 620024 drmpremavathy@bdu.ac.in	1	Dr. Deepalakshmi S, HoD, Department of Career Guidance Cell, FSH, SRMIST
				2	Dr. Muthu Deepa M, Assistant Professor, Department of Career Guidance Cell, FSH, SRMIST
				3	Dr. Sam Israel S, Assistant Professor, Department of Career Guidance Cell, FSH, SRMIST
				4	Dr Elamathiyan E, Assistant Professor, Department of Career Guidance Cell, FSH, SRMIST

SEMESTER III

Course Code	PBT25301J	Course Title	Immunotechnology	Category	C	Professional Core course	L	T	P	C
							3	0	2	4

Course Offering Department	Biotechnology	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	*The purpose of learning this course is to:*
CR-1	Understanding the basics of immune reactions
CR-2	Understanding the properties and functions of immunoglobulins
CR-3	Understanding the Ag processing and presentation, and cell communication
CR-4	Acquire knowledge about the B & T cell response
CR-5	Understanding the immune response to foreign grafts and tumours

Outcomes (CO)	*At the end of this course, learners will be able to:*	Depth				Attainment			Program Outcomes (PO)												
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethical Practices & Social	Individual & Team Work	Communication	Project Management & Finance	Life Long Learning
CO-1	Acquired basic knowledge of immune cells, organs	✓	✓	-	-	1	80	80	3	-	-	2	-	2		-	2	-	-	-
CO-2	Basic knowledge of immunoglobulins and complements	✓	✓	-	-	1	80	80	3	2	-	3	-	3	2	-	2	-	-	-
CO-3	Strong basis for understanding cell communication and Ag presentation	-	-	✓	✓	2	90	80	3	-	-	3	-	3		-	-	-	-	-
CO-4	Better knowledge gained about the different effector mechanisms of the host immune response	✓	-	✓	-	2	90	90	3	2	-	3	-	3	3	-	-	-	-	2
CO-5	Better knowledge gained about transplantation and tumour immunology	-	-	✓	✓	3	80	80	3	3	-	3	2	3	3	3	-	3	-	-

Sessions	CLO – 1	CLO – 2	CLO - 3	CLO - 4	CLO -
	15	15	15	15	15
SLO - 1	Immunology- Introduction and History	Immunoglobulin – Structure & Function	Major histocompatibility complex (MHC) types and importance	B–cell development & maturation	Autoimmunity
SLO - 2	Types of immunity-innate	Different classes of immunoglobulins	Role of MHC antigens in immune responses	B cell activation - Ti	Class of autoimmune diseases (thyrotoxicosis, Rheumatoid arthritis).
SLO - 3	Types of immunity- adaptive	Biological function of immunoglobulins	Antigen processing and presentation – Endogenous & Exogenous	B cell activation – T cell dependent	Tumour Immunology (Host immune response to tumour & Escape mechanisms of tumour)
SLO – 4 & 5	**ABO blood grouping**	**Single immunodiffusion test**	**Immunoelectrophoresis**	**Total Leukocyte Count**	**ELISA - Plate**
SLO – 6	Phagocytosis - O_2 dependent	Antibody diversity –V(D)J recombination	Antigen processing and presentation – non-peptide bacterial ag & Super ag	T–cell development & maturation	Transplantation – Grafts, Immunological basis of transplantation.

SLO - 7	Phagocytosis - O_2 dependent	Somatic Recombination	Cytokines and co-stimulatory molecules	T–cell activation	GVH reaction
SLO - 8	Cells of the immune system	Class switching- Revision of Antigen and Antibody	Cytokines and co-stimulatory molecules	Hypersensitivity – type I Allergies and anaphylaxis	Immune regulation mechanisms- immuno-induction, immuno-tolerance
SLO – 9 & 10	**Widal test**	**Double immunodiffusion test**	**Countercurrent immunoelectrophoresis**	**ELISA - Dot**	**Raising of antibodies to soluble antigen in rabbits**
SLO - 11	Organs of the immune system- Primary	Complement activation and its biological consequences	Antigen - Antibody interaction	Hypersensitivity – type II and mechanism and pathogenicity	Immune Deficiencies: Introduction, primary and secondary deficiencies.
SLO - 12	Organs of the immune system- Secondary	Complement system – Classical pathway	Agglutination reactions	Hypersensitivity – type III mechanism and pathogenicity	Cancer immunotherapy
SLO - 13	Antigen – Types & Properties, Hapten, Adjuvant	Complement system – alternative and lectin pathway	Precipitation reaction	Hypersensitivity – type IV mechanisms and pathogenicity	Cancer immunotherapy – advantages and side effects
SLO – 14 & 15	**RA/ASO/RPR test.**	**Rocket immunoelectrophoresis**	**WBC Differential count**	**ELISA - Plate**	**Raising of antibodies to soluble antigen in rabbits**

Resources			
1	Immunology: Janis Kuby, W.H. Freeman and Company, U.S.A.1992		Elements of Immunology: Fahim Halim Khan, Pearson, 2009
2	Essential Immunology: - Ivan Roitt, Blackwell scientific publications, London Edinburgh Boston, Australia, 1997.		

Assessment													Strategies					
Bloom's Level of Thinking		Continuous Learning Assessment (CLA) (50% weightage)								Final Assessment (50 %weightage)			Technology		Pedagogy / Andragogy		Sustainable Development	
		CLA - 1		CLA - 2		CLA - 3		CLA - 4 *					Simulations	✓	Clarification/Pauses	✓	Good Health & Well Being	✓
		(10 %)		(10 %)		(20 %)		(10 %)					Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
		Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)		Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
1	Remember	20	10	20	10	20	10	20	10	20	10				Debate	✓	Life on Land	✓
2	Understand	10	10	10	10	10	10	10	10	10	10				Interactive Lecture	✓		
3	Apply	10	10	10	10	10	10	10	10	10	10				Brainstorming	✓		
4	Analyze	10	20	10	20	10	20	10	20	10	20							
5	Evaluate																	
6	Create																	
Total (%)		100		100		100		100		100								

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Suresh Kumar Rayala, Professor, DBT, IIT- Chennai		Dr. S. Prema Mathi Maran, Founder-Chairman, CTO, Clean Green Biosystems, Chennai		Dr. D. Thirumurugan, Asst. Professor, Dept. of Biotechnology, FSH, SRMIST, KTR. Dr.G.Rajendran, Assistant Professor, DBT, SRMIST-RMP

Course Code	PBT25302J	Course Title	Animal Biotechnology	Category	C	Professional Core course	L	T	P	C
							3	0	2	4

Course Offering Department	Biotechnology	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	*The purpose of learning this course is to:*
CR-1	Know about the culturing of animal cells.
CR-2	Learn the methods of gene transfer.
CR-3	Understand about assisted reproductive techniques.
CR-4	Apply knowledge on the use of animal models for human genetic disorders.
CR-5	Gain knowledge on human genome project.

Outcomes (CO)	*At the end of this course, learners will be able to:*	Depth				Attainment			Program Outcomes (PO)												
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethical Practices & Social	Individual & Team Work	Communication	Project Management & Finance	Life Long Learning
CO-1	Understand the basics of animal cell culture.	✓	✓	-	-	2	90	85	2	1	-	1	-	-	-	-	-	-	-	3
CO-2	Gain knowledge on the uses of transgenic animals.	✓	✓	-	-	2	90	85	3	1	-	-	1	-	-	-	-	-	-	2
CO-3	Apply knowledge on gene editing techniques.	-	-	✓	✓	3	85	80	-	2	-	3	1	-	-	-	-	-	-	-
CO-4	Learn the various applications of animal biotechnology.	✓	-	-	✓	3	85	80	-	3	1	2	-	-	-	-	-	-	-	2
CO-5	Apply concepts on advancements in animal biotechnology techniques.	-	-	✓	✓	3	85	80	-	3	2	-	2	-	-	-	-	-	-	1

Sessions	CLO – 1	CLO – 2	CLO - 3	CLO - 4	CLO - 5
	15	15	15	15	15
SLO - 1	Animal cell culture media – composition	Methods of gene transfer	Pregnancy diagnosis	Animal Biotechnology – Medical applications	Hybridoma technique
SLO - 2	Types of animal cell culture media	Methods of gene transfer	Testing of foetus for genetic defects	Animal Biotechnology – Industrial applications	Hybridoma technique – applications
SLO - 3	Serum containing and serum-free media	Transgenic animals – development	Assisted Reproductive Techniques	Use of animal models for research	DNA vaccines
SLO - 4 & 5	**Lab Safety and GLP**	**Development of cell culture**	**Quantitation of animal cells using hemocytometer**	**Cell viability assay**	**Human lymphocyte culture**
SLO - 6	Setup of animal cell culture laboratory	Transgenic animals – uses	IVF	Use of animal models for research	DNA fingerprinting
SLO - 7	Characterization of animal cells	Transgenic mice	Cryopreservation	Animal cells for transplantation	Gene therapy
SLO - 8	Viability measurements	Transgenic fish	Gene Editing Tools	Animal system as bioreactors	Gene therapy

SLO - 9 & 10	**Preparation of animal cell culture media**	**Development of cell culture**	**Quantitation of animal cells using hemocytometer**	**Differential counting of WBC**	**Chick embryo fibroblast**
SLO - 11	Cell Bank preparation	Preservation of germplasm	Gene knockout technology	Anchored fusion proteins	Molecular markers
SLO - 12	Recombinant cells	*In-situ* and *Ex-situ* preservation	Gene knockin technology	Probes for disease diagnosis	Molecular markers in clinical diagnosis
SLO - 13	Recombinant cells - applications	Aquafarming	Gene knockdown technology	Probes for disease diagnosis	Human genome project
SLO - 14 & 15	**Filter sterilization of animal cell culture media**	**Sub-culturing of cells**	**Cell viability assay**	**Human lymphocyte culture**	**Chick embryo fibroblast**

Resources

1	Ian Freshney. (2015). Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications (6th Edition). John Wiley & Sons	3	P Ramadass. (2015). Animal Biotechnology: Recent Concepts and Developments. MJP Publications.
2	Nigel Jenkins. (2010). Animal Cell Biotechnology: Methods and Protocols (Methods in Biotechnology). Humana Press		

Assessment												Strategies					
Bloom's Level of Thinking		Continuous Learning Assessment (CLA) (50% weightage)								Final Assessment (50 %weightage)		Technology		Pedagogy / Andragogy		Sustainable Development	
		CLA - 1		CLA - 2		CLA - 3		CLA - 4 *				Simulations	✓	Clarification/Pauses	✓	Good Health & Well Being	✓
		(10 %)		(10 %)		(20 %)		(10 %)				Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
		Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
1	Remember	10	10	10	10	10	10	10	10	10	10			Debate	✓	Life on Land	✓
2	Understand	10	10	10	10	10	10	10	10	10	10			Interactive Lecture	✓		
3	Apply	10	10	10	10	10	10	10	10	10	10			Brainstorming	✓		
4	Analyze	10	10	10	10	10	10	10	10	10	10						
5	Evaluate	10	10	10	10	10	10	10	10	10	10						
6	Create	-	-	-	-	-	-	-	-	-	-						
Total (%)		100		100		100		100		100							

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers

Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Suresh Kumar Rayala, Professor, DBT, IIT- Chennai		Dr.S. Prema Mathi Maran, Founder-Chairman, CTO, Clean Green Biosystems, Chennai		Dr. G. Swamynathan, Asst. Professor, Dept. of Biotechnology, FSH, SRMIST, KTR. Dr. R. Vidhya, Assistant Professor, DBT, SRMIST-RMP

Course Code	PBT25303J	Course Title	Genetic Engineering	Category	C	Profession core course	L	T	P	C
							3	0	2	4

Course Offering Department	Biotechnology	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	*The purpose of learning this course is to:*
CR-1	Understanding the enzymes involved in Genetic engineering
CR-2	Understanding the properties and functions of restriction enzymes
CR-3	Understanding the importance of vectors
CR-4	Understanding the DNA amplification techniques
CR-5	Knowledge on screening methods

Outcomes (CO)	*At the end of this course, learners will be able to:*	Depth				Attainment			Program Outcomes (PO)												
		1 Conceive	2 Design	3 Implement	4 Operate	1 Level of Thinking	2 Expected Proficiency (%)	3 Expected Attainment (%)	1 Disciplinary Knowledge	2 Problem Solving	3 Design & Development	4 Analysis, Design, Research	5 Modern Tool Usage	6 Society & Culture	7 Environment & Sustainability	8 Ethical Practices & Social	9 Individual & Team Work	10 Communication	11 Project Management & Finance	12 Life Long Learning
CO-1	Acquire basic Knowledge of enzymes in genetic engineering	✓				1	85	80	3	-	-	2	-	2		-	2	-	-	-
CO-2	Basic Knowledge on restriction enzyme role in genetic engineering				✓	2	85	80	3	2	-	3	-	3	2	-	2	-	-	-
CO-3	Understanding the vectors types		✓	✓		3	85	80	3	-	-	3	-	3		-	-	-	-	-
CO-4	Gain knowledge on PCR techniques	✓		✓		3	85	80	3	2	-	3	-	3	3	-	-	-	-	2
CO-5	Gain knowledge on gene transfer methods					1	85	80	3	3	-	3	2	3	3	3	-	3	-	-

Sessions	CLO – 1	CLO – 2	CLO - 3	CLO - 4	CLO - 5
	15	15	15	15	15
SLO - 1	Impact of genetic engineering in modern society	Introduction to cloning vectors	Cloning strategy and Screening methods	DNA fingerprinting, RFLP	Micro RNA- Introduction
SLO - 2	Restriction enzymes-introduction and types	Vectors: Prokaryotic Vectors: Plasmids	Screening methods	AFLP, SNP,	miRNA- functions
SLO - 3	Star activity of restriction enzymes	Phagemid, artificial chromosomes,	Gene transfer techniques: Bacterial Conjugation, Transformation	Site directed mutagenesis	miRNA in human Cancer
SLO - 4 & 5	**Isolation of plasmid DNA from bacterial culture**	**Ligation technique**	**Preparation of competent cell and transformation**	**Gene Cloning**	**DNA Fingerprinting practical**
SLO - 6	DNA modifying enzymes	**Yeast vectors**	Transduction, Microinjection	DNA-protein Interaction	Gene silencing techniques;
SLO - 7	Linkers and adapters	Animal viral vectors	Electroporation, Microprojectile, Shot Gun	DNA-protein Interaction	Gene knockouts
SLO - 8	Homopolymer tailing	Plant vectors	Ultrasonication, Liposome fusion	introduction to siRNA	Gene therapy
SLO - 9 & 10	**Isolation of plasmid DNA from bacterial culture**	**Restriction Digestion**	**Identification of recombinants – antibiotic markers, Blue-white colony selection**	**Extraction of PCR product**	**Quantification after extraction of PCR Product**

SLO - 11	RNases-RNaseI, RNaseA, RNaseH -	Expression vectors	designing of primers	Engineering of siRNA	Southern Hybridization
SLO - 12	Nucleases – RNase free DNAse-Exonuclease I,	Shuttle vectors	types of PCR – multiplex, nested; reverse-transcription PCR	Applications of siRNA	Western blotting
SLO - 13	Nuclease. Kinases - T4 polynucleotide kinase. Phosphatases, Topoisomerase	Modifications in vectors	Real-time PCR, touchdown PCR, hot-start PCR	construction of siRNA vectors	CRISPR-CAS- Introduction application
SLO - 14 & 15	**Restriction Digestion**	**Preparation of competent cell and transformation**	**Gene Cloning**	**DNA Fingerprinting practical**	**Gene Cloning**

Resources			
1	Brown, T. A. (2016). *Gene cloning and DNA analysis: An introduction* (7th ed.). Wiley-Blackwell.	3	Verma, P. S., & Agarwal, V. K. (2017). *Advanced human genetics*. S. Chand Publishing
2	Primrose, R. W., & Old, S. B. (2009). *Principles of gene manipulation and genomics* (7th ed.). Wiley-Blackwell.		

Assessment													Strategies					
Bloom's Level of Thinking		Continuous Learning Assessment (CLA) (50% weightage)								Final Assessment (50 %weightage)			Technology		Pedagogy / Andragogy		Sustainable Development	
		CLA - 1		CLA - 2		CLA - 3		CLA - 4 *					Simulations	✓	Clarification/Pauses	✓	Good Health & Well Being	✓
		(10 %)		(10 %)		(20 %)		(10 %)					Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
		Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)		Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
1	Remember	20	10	20	10	20	10	20	10	20	10				Debate	✓	Life on Land	✓
2	Understand	10	10	10	10	10	10	10	10	10	10				Interactive Lecture	✓		
3	Apply	10	10	10	10	10	10	10	10	10	10				Brainstorming	✓		
4	Analyze	10	20	10	20	10	20	10	20	10	20							
5	Evaluate																	
6	Create	-	-	-	-	-	-	-	-	-	-							
Total (%)		100		100		100		100		100								

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Suresh Kumar Rayala, Professor, DBT, IIT- Chennai		Dr.S. Prema Mathi Maran, Founder-Chairman, CTO, Clean Green Biosystems, Chennai		Dr. N. Prasanth Bhatt, Asst. Professor, Dept. of Biotechnology, FSH, SRMIST, KTR.

Course Code	PBT25304J	Course Title	Industrial Biotechnology	Category	C	Profession core course	L	T	P	C
							3	0	2	4

Course Offering Department	Biotechnology	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	*The purpose of learning this course is to:*	Depth				Attainment		
		1	2	3	4	1	2	3
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)
CR-1	Understanding the function of fermenters and its types							
CR-2	Knowing the preparation of the strains and culture isolation and preservation							
CR-3	How the processing of the produce is performed							
CR-4	How the industry has started producing the various products							
CR-5	Learn the methods of production of nutraceuticals and products of daily use							

Outcomes (CO)	*At the end of this course, learners will be able to:*	Depth				Attainment		
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)
CO-1	Gain knowledge about the fermenter techniques	✓				1	85	80
CO-2	Observe and understand the microbial kinetics and sterilization methods in bioprocess				✓	2	85	80
CO-3	Know the process of purification and application		✓	✓		3	85	80
CO-4	Use the bioprocessing in industrial production	✓		✓		3	85	80
CO-5	Use the techniques learnt in his daily life for entrepreneurship			✓	✓	5	85	80

Program Outcomes (PO)											
1	2	3	4	5	6	7	8	9	10	11	12
Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design,	Modem Tool Usage	Society & Culture	Environment &	Ethical Practices & Social	Individual & Team Work	Communication	Project Management &	Life Long Learning
3	-	-	2	-	2		-	2	-	-	-
3	2	-	3	-	3	2	-	2	-	-	-
3	-	-	3	-	3		-	-	-	-	-
3	2	-	3	-	3	3	-	-	-	-	2
3	3	-	3	2	3	3	3	-	3	-	-

Sessions	CLO – 1	CLO – 2	CLO - 3	CLO - 4	CLO - 5
	15	15	15	15	15
SLO - 1	History and significance of fermentation	Introduction to Microbial Diversity	Introduction to Downstream Processing	Industrial production of Beer and Wine	Mushroom Cultivation & Bio-Based Products
SLO - 2	Types of fermentation: aerobic vs. anaerobic	Importance of microbial isolation in biotechnology	Cell Disruption Techniques	Fermented Alcoholic Drinks	Shiitake, Oyster, and Button mushrooms.
SLO- 3	Batch, fed-batch, and continuous fermentation	Collection from soil, water, air, and biological sources	Solid-Liquid Separation- Filtration techniques: microfiltration, ultrafiltration	Production of Distilled spirits	Medicinal mushrooms and its vertical farming
SLO – 4 & 5	Isolation of starch /cellulose degrading microorganism	Screening for Antibiotic-Producing Microorganisms	Bread- making	Wine production	Mushroom cultivation
SLO - 6	Types of bioreactors: stirred tank, airlift, packed bed	Aseptic techniques and sample preservation	Downstream processing-types/product recovery	Industrial production of Citric acid and lactic acids	Fermentation-Based Biotech Businesses
SLO - 7	Types of fermentation	Media and sterilization techniques	Biopharmaceutical Downstream Processing	Industrial production of Glutamic acid and Vit B12	**Probiotic production**
SLO - 8	Design and Components of a Fermenter	Types of media: selective, differential, enrichment	Bioprocess scale-up strategies	Industrial production of Xanthan Gum and proteases	Bioethanol & biogas

SLO – 9 &10	Optimization of culture conditions for amylase production	Taguchi Method for Strain Selection	Isolation of amylase-producing microorganisms and determination of the amylase enzyme.	Sauerkraut production	Experiment for probiotic production
SLO - 11	Introduction- Microbial growth kinetics	Microbial strains for pharmaceuticals, agriculture, and food industries	Immobilization of enzymes – Techniques -industrially important enzymes	Industrial production of Insulin	Microbial Foods – Single cell proteins (SCP), SCO
SLO - 12	Microbial growth kinetics and	Bioremediation and environmental applications	Properties of Immobilized Enzymes	Industrial production of **Probiotics**	**Lab-grown meat** and **insect protein**
SLO - 13	Factors Affecting Microbial Growth	Biosafety guidelines for microbial research	Applications of Immobilized Enzyme	Industrial production of **Bioactive Peptides**	Fermented plant-based dairy alternatives
SLO – 14 &15	Meaasurement of the growth Kinetics	Taguchi Method for Strain Selection	Immobilization of cells and enzymes using alginate and polyacrylamide	Mushroom cultivation	microalgae as a sustainable protein source

Resources			
1	Stanbury, P. F., Whitaker, A., & Hall, S. J. (2016). *Principles of fermentation technology* (3rd ed.). Elsevier.	3	Shuler, M. L., & Kargi, F. (2017). *Bioprocess engineering: Basic concepts* (3rd ed.). Prentice Hall.
2	Singh, B. D. (2018). *Biotechnology: Expanding horizons*. Kalyani Publishers		

Assessment													Strategies					
Bloom's Level of Thinking		Continuous Learning Assessment (CLA) (50% weightage)								Final Assessment (50 %weightage)			Technology		Pedagogy / Andragogy		Sustainable Development	
		CLA - 1		CLA - 2		CLA - 3		CLA - 4 *					Simulations	✓	Clarification/Pauses	✓	Good Health & Well Being	✓
		(10 %)		(10 %)		(20 %)		(10 %)					Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
		Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)		Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
1	Remember	20	10	20	10	20	10	20	10	20	10				Debate	✓	Life on Land	✓
2	Understand	10	10	10	10	10	10	10	10	10	10				Interactive Lecture	✓		
3	Apply	10	10	10	10	10	10	10	10	10	10				Brainstorming	✓		
4	Analyze	10	20	10	20	10	20	10	20	10	20							
5	Evaluate																	
6	Create																	
Total (%)		100		100		100		100		100								

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Suresh Kumar Rayala, Professor, DBT, IIT- Chennai		Dr. S. Prema Mathi Maran, Founder-Chairman, CTO, Clean Green Biosystems, Chennai		Dr. N. Prasanth Bhatt Asst. Professor, Dept. of Biotechnology, FSH, SRMIST, KTR. Dr. M. Kamaraj, Associate Professor, DBT, SRMIST-RMP

Course Code	PBT25D05T	Course Title	Entrepreneurship in Biotechnology	Category	D	DISCIPLINE ELECTIVE	L	T	P	C
							4	0	0	4

Course Offering Department	Biotechnology	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	*The purpose of learning this course is to:*	Depth				Attainment		
		1	2	3	4	1	2	3
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)
CR-1	Understanding the regulatory landscape ensures ethical and legal compliance in biotech businesses.							
CR-2	Learn investment strategies, market analysis, and intellectual property protection, helping entrepreneurs secure funding and ensure market success							
CR-3	focuses on scaling biotech innovations, ensuring quality control, and marketing strategies for successful product commercialization							
CR-4	explores waste management, biofuels, alternative proteins, and personalized medicine, integrating biotechnology with environmental and health solution, space							
CR-5	engages students in business planning, pitch presentations, and industry collaborations, ensuring practical exposure to biotech startups.							

Outcomes (CO)	*At the end of this course, learners will be able to:*	Depth				Attainment			Program Outcomes (PO)												
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethical Practices & Social Responsibility	Individual & Team Work	Communication	Project Management & Finance	Life Long Learning
CO-1	identify key biotechnology business opportunities, understand regulatory requirements, and assess the potential of innovations for commercialization.	✓				2	85	80	*3*						*3*	*3*				*3*
CO-2	develop business models, identify funding sources, and understand intellectual property rights to protect biotech innovations effectively	✓			✓	2	85	80	*3*	*2*					*3*	*3*				*3*
CO-3	gain skills in scaling biotech products, managing compliance, and developing marketing strategies to launch biotech innovations successfully		✓	✓	✓	3	85	80	*3*	*2*					*3*	*3*				*3*
CO-4	learn to design sustainable biotech enterprises, explore emerging biotech trends, and apply innovation for environmental and healthcare advancements.	✓	✓	✓		3	85	80	*3*	*2*					*3*	*3*				*3*
CO-5	develop biotech business plans, refine pitching techniques, and apply industry knowledge for successful entrepreneurship ventures	✓			✓	3	85	80	*3*	*2*					*3*	*3*				*3*

Sessions	CLO – 1	CLO – 2	CLO - 1	CLO - 1	CLO - 1
	12	12	12	12	12
SLO-1	Introduction to Biotechnology Entrepreneurship	Business Models for Biotech Ventures	Product Development Lifecycle in Biotech	Biotech for Sustainability: Biofuels,	Successful Biotech Startups
SLO-2	Scope and importance of biotech startups	Identifying market opportunities	Feasibility and Scaling Up Innovations	Bioplastics,	Successful Biotech Startups
SLO-3	Types of Biotech Enterprises - Pharmaceuticals	Funding Sources: Venture Capital	Quality Control	Waste Management	Entrepreneurship Challenges
SLO-4	Agri-Biotech,	Grants, Crowdfunding	Compliance in Biotech Manufacturing	Agri-Biotech & Food Tech: Vertical Farming, Aquaponics,	Entrepreneurship Challenges

SLO-5	Industrial Biotech	Financial Planning	Biotech Branding and Consumer Engagement	Alternative Proteins	Hands-on Business Plan Development
SLO-6	Innovation vs. Commercialization in Biotechnology- A global scenario	Risk Assessment	Marketing Strategies- Brand Positioning, Customer Engagement	Biotech in Healthcare: Personalized Medicine,	Hands-on Business Plan Development
SLO-7	Regulatory Frameworks: FDA,	Patent Filing Process- Prior art search, Drafting, Submission	Competitive Analysis	Regenerative Therapies	Pitching Biotech Ideas to Investors- seminar 1
SLO-8	GMP, Biosafety Guidelines	National vs. International patent filing	Highlighting FDA approvals and clinical trial results	Lab-grown meat startups	Pitching Biotech Ideas to Investors- seminar 2
SLO-9	Patent Laws	Patent examination and approval process	Educating customers on GMP and biosafety standards	AI-powered diagnostics	Pitching Biotech Ideas to Investors- seminar 3
SLO-10	Intellectual Property Rights	Patent infringement and legal actions	compliance certifications as a trust-building tool	Biotech innovations for space exploration	Bioinformatics-based startups
SLO-11	Trademarks	Licensing and commercialization of patents	AI-driven drug discovery	Engineering microbes for food production in space	Biotech Startup Case Studies
SLO-12	AI-driven biotech startups, CRISPR-based business model	Compulsory licensing and patent revocation	Synthetic biology-based products	Synthetic biology for survival in extreme conditions	failed biotech ventures

Resources	
1.	Shimasaki, C. D. (2014). *Biotechnology entrepreneurship: Starting, managing, and leading biotech companies*. Elsevier.
2.	Adams, D. J., & Sparrow, J. C. (2008). *Enterprise for life scientists: Developing innovation and entrepreneurship in the biosciences*. Scion.
3.	Onetti, A., & Zucchella, A. (2014). *Business modeling for life science and biotech companies*. Routledge.

Assessment								Strategies					
	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 %weightage)		Technology		Pedagogy / Andragogy		Sustainable Development	
		CLA – 1	CLA – 2	CLA– 3	CLA– 4 *			Simulations	✓	Clarification/Pauses	✓	Good Health & Well Being	✓
		(10%)	(10%)	(20%)	(10%)			Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
		Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)		Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
1	Remember	30	30	30	30	30				Debate	✓	Life on Land	✓
2	Understand	30	30	30	30	30				Interactive Lecture	✓		
3	Apply	20	20	20	20	20				Brainstorming	✓		
4	Analyze	20	20	20	20	20							
5	Evaluate	-	-	-	-	-							
6	Create	-	-	-	-	-							
	Total (%)	100	100	100	100	100							

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Suresh Kumar Rayala, Professor, DBT, IIT- Chennai		Dr.S. Prema Mathi Maran, Founder-Chairman, CTO, Clean Green Biosystems, Chennai		Dr. Raja Ganesan, Asst. Professor, Dept. of Biotechnology, FSH, SRMIST, KTR. Dr.M.Kamaraj, Associate Professor, DBT, SRMIST-RMP

Course Code	PBT25D06T	Course Title	Research Methodology	Category	D	DISCIPLINE ELECTIVE	L	T	P	C
							4	0	0	4

Course Offering Department	Biotechnology	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	*The purpose of learning this course is to:*	Depth				Attainment			Program Outcomes (PO)												
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethical Practices & Social	Individual & Team Work	Communication	Project Management & Finance	Life Long Learning
CR-1	Provide learners with a foundational understanding of the research process and types, and equip them with skills to formulate research problems and hypotheses effectively																			
CR-2	Equip learners with the essential skills for conducting and communicating scientific research effectively																			
CR-3	Provide learners with a foundational understanding of research design principles, enabling them to select appropriate methodologies for their research projects																			
CR-4	Equip learners with the necessary statistical knowledge and analytical skills to effectively analyze and interpret research data.																			
CR-5	Equip learners with the knowledge and skills necessary to write effective research proposals and conduct research ethically																			
Outcomes (CO)	*At the end of this course, learners will be able to:*																			
CO-1	Understand the nature, scope, and types of research, and effectively formulate research problems and hypotheses.	✓				2	85	80	3	1	1	2	3	2	3	3	1	3	3	2
CO-2	Conduct literature searches, critically evaluate scientific literature, identify research gaps, and write well-structured research articles and dissertations.	✓			✓	2	85	80	3	1	1	2	3	2	3	3	1	3	3	2
CO-3	Develop skills in research design selection, experimental principles, and effective sampling/data collection.		✓	✓	✓	3	85	80	3	1	1	2	3	2	3	3	1	3	3	2
CO-4	Apply descriptive and inferential statistics, analyze and visualize data, and interpret research findings	✓	✓	✓		3	85	80	3	1	1	2	3	2	3	3	1	3	3	2
CO-5	Identify potential funding sources, draft research proposals, and conduct research ethically	✓			✓	3	85	80	3	1	1	2	3	2	3	3	1	3	3	2

Sessions	CLO – 1	CLO – 2	CLO - 3	CLO - 4	CLO - 5
	12	12	12	12	12
SLO-1	Research - Definition and Importance	Literature Review	Introduction to Research Designs	Introduction to statistical methods in research	Research Funding: Types of Grants
SLO-2	Motivation in research	Strategies for effective literature searching	Selecting appropriate research designs	Descriptive statistics –Measures of central tendency	Research Bodies
SLO-3	Types of research	Identifying Research Gaps	Variables in research	Descriptive statistics – Measures of variability	Funding Agencies – National
SLO-4	Steps in the research process	*Literature Review Mapping - Activity*	Experimental design principles	Inferential statistics - Overview	Funding Agencies – International
SLO-5	Sources of research problem	Types of scientific articles - Overview	*Experimental Design Challenge - Activity*	t-test	Drafting a research proposal for funding

SLO-6	Choice of a research problem	Review Articles & Short communications	Sampling Techniques	ANOVA	*Critiquing Research Proposals – Classroom activity*
SLO-7	Formulating Research questions	Case Reports, Textbooks & Edited Books	Data collection methods	Choosing appropriate statistical tests	Presentation Skills for Oral Presentations and Seminars
SLO-8	*Research Question - Classroom activity*	Critical evaluation of scientific literature	*Designing a questionnaire – Classroom activity*	Case study for t-test	*Preparation & Presentation of scientific posters - Classroom Activity*
SLO-9	Generating the aim and objectives (SMART)	Writing a research article – IMRaD format	Survey	Case study for ANOVA	Ethical considerations in research
SLO-10	Hypothesis – Definition and types	Referencing styles and tools	Hypothesis Testing – Core concepts	Data analysis	3Rs in research, IAEC, IEC
SLO-11	Postulating a hypothesis	*Deconstructing a Biotech Research Paper – Classroom activity*	Types of errors	Data visualization – Charts & Graphs	Ethical issues related to publishing
SLO-12	*Hypothesis Generation - Classroom Activity*	Dissertation	*Examples of hypothesis testing*	Interpreting research findings	*Ethical Dilemma Discussions in Biotech Research*

Resources

1	Kothari, C. R. Research Methodology: Methods and Techniques. (2013)	3	Mishra, S. B., & Alok, S. Handbook of Research Methodology: A Compendium for Scholars & Researchers (2011).
2	Daniel, W. W. & Cross, C. L. Biostatistics: A foundation for analysis in the health sciences. John Wiley & Sons. (2018).	4	Forthofer, R. N., & Lee, E. S. Introduction to Biostatistics: A Guide to Design, Analysis, and Discovery. (2014).

Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 %weightage)
		CLA – 1	CLA – 2	CLA– 3	CLA– 4 *	
		(10%)	(10%)	(20%)	(10%)	
		Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)
1	Remember	20	10	10	10	10
2	Understand	20	20	20	20	20
3	Apply	20	30	30	30	30
4	Analyze	20	20	20	20	20
5	Evaluate	20	20	20	20	20
6	Create	-	-	-	10	-
	Total (%)	100	100	100	100	100

Strategies

Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations	✓	Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓	Life on Land	✓
		Interactive Lecture	✓		
		Brainstorming	✓		

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Suresh Kumar Rayala		Dr.S. Prema Mathi Maran		Dr. S. Samuel Joshua Pragasam Asst. Professor, Dept. of Biotechnology, FSH, SRMIST, KTR.

Course Code	PBT25G04T	Course Title	Algal Technology	Category	G	Generic Elective	L	T	P	C
							2	0	0	2

Course Offering Department	Biotechnology	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	*The purpose of learning this course is to:*	Depth				Attainment		
		1	2	3	4	1	2	3
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)
CR-1	Learning the human friendly algae and their importance.							
CR-2	Studying the basic and applied science behind the production of mass culture.							
CR-3	Teaching students about applications and future potential of algae.							
CR-4	Educating the students on the commercial production of algae.							
CR-5	Learning about the recent technological approach in algae							

Outcomes CO)	*At the end of this course, learners will be able to:*	Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)
CO-1	To acquire the awareness and appreciation of human friendly algae and their economic importance.	✓				5	85	75
CO-2	Demonstrate algal growth in different types of natural water	✓	✓	✓		4	85	75
CO-3	Analyze emerging areas of algal biotechnology for identifying commercial potentials of algal products and their uses		✓			6	85	75
CO-4	Analyze emerging areas of algal biotechnology for identifying therapeutic importance of algal products and their uses	✓	✓	✓	✓	3	85	75
CO-5	Identify etiology, signs, and symptoms of diseases of all body systems	✓	✓			2	85	75

Program Outcomes (PO)											
1	2	3	4	5	6	7	8	9	10	11	12
Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethical Practices & Social	Individual & Team Work	Communication	Project Management &	Life Long Learning
3	-	-	-	-	-	-	-	-	-	-	3
3	2	-	-	-	-	-	-	-	-	-	3
3	-	-	-	-	-	-	-	-	-	-	3
3	2	-	-	-	-	3	-	-	-	-	3
2	2	2	-	-	-	3	3	-	-	-	2

Sessions	CLO – 1 6	CLO – 2 6	CLO - 3 6	CLO - 4 6	CLO - 5 6
SLO-1	Introduction to Algae	Types of algal culture medium	Resource potential of algae	Algae products overview	Recombinant DNA technology in algae
SLO-2	Structure	Bold basal medium	Application of algae as fuel	Therapeutic uses - antioxidant	Transformation systems in algae.
SLO-3	General characteristics,	Algal cultivation methods	Application of algae as food (fish, poultry and animals)	Anti-ulcerogenic	Algal immobilization and its applications
SLO-4	Major classes,	Algal production systems	Application of algae in agriculture	Antifungal	Algae as indicators in assessing water quality and pollution
SLO-5	Range of thallus structure	Indoor cultivation methods	Application of algae in pharmaceutical.	Antitumor	Algal plastics
SLO-6	Life cycle patterns	Large-scale cultivation of algae	Phycoremediation	Antiviral compounds	Uses and application

Resources			
1	Bold, H.C., & Wynne, M.J. (1978). *Introduction to the Algae: Structure and Function*. Prantice Hall of India New Delhi.	3	Sahoo, D. (2000). *Farming the Ocean: Seaweed Cultivation and Utilization*. Aravali International, New Delhi.
2	Trivedi, P.C. (2001). *Algal Biotechnology*. Point publisher, Jaipur. India.	4	Dinabandhu, S., & Kaushik. B.D. (2012). *Algal Biotechnology and Environment*. I.K. International, New Delhi.

Assessment							Strategies					
Bloom's Level of Thinking		Continuous Learning Assessment (CLA) (100% weightage)					Technology		Pedagogy / Andragogy		Sustainable Development	
		CLA - 1	CLA - 2	CLA - 3	CLA - 4 *		Simulations	✓	Clarification/Pauses	✓	Good Health & Well Being	✓
		(20 %)	(20 %)	(40 %)	(20 %)		Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
		Theory (%)	Theory (%)	Theory (%)	Theory (%)		Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
1	Remember	20	20	15	10				Debate	✓	Life on Land	✓
2	Understand	20	20	20	10				Interactive Lecture	✓		
3	Apply	20	25	25	25				Brainstorming	✓		
4	Analyze	20	25	25	25							
5	Evaluate	20	10	15	15							
6	Create	-	-	-	15							
Total (%)		100	100	100	100							

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Suresh Kumar Rayala, Professor, DBT, IIT- Chennai		Dr.S. Prema Mathi Maran, Founder-Chairman, CTO, Clean Green Biosystems, Chennai	1	Dr. D. Thirumurugan, Assistant Professor, Dept. of Biotechnology, FSH, SRMIST, KTR

Course Code	PBT25G05T	Course Title	Food and Nutrition	Category	G	Generic Elective	L	T	P	C
							2	0	0	2

Course Offering Department	Biotechnology	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	*The purpose of learning this course is to:*
CR-1	Provide an essential foundation in the principles of nutrition, understanding food and nutrient classification for assessing dietary intake.
CR-2	Provide a comprehensive exploration of lipids and proteins as essential macronutrients in the human diet.
CR-3	Assess the importance of micronutrients and dietary components in maintaining health and preventing disease
CR-4	Understand nutritional strategies for different life stages to support growth, development, and health
CR-5	Provide students with a comprehensive understanding of nutrition as a fundamental aspect of health and disease management

Outcomes (CO)	*At the end of this course, learners will be able to:*	Depth				Attainment			Program Outcomes (PO)												
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethical Practices & Social	Individual & Team Work	Communication	Project Management & Finance	Life Long Learning
CO-1	Comprehend the fundamental principles of food science and nutrition	✓				5	85	75	3	-	-	-	-	-	-	-	-	-	-	3
CO-2	Evaluate knowledge of lipids and proteins to optimize nutritional health	✓	✓	✓		4	85	75	3	2	-	-	-	-	-	-	-	-	-	3
CO-3	Apply knowledge of micronutrients and dietary components to promote optimal health		✓			6	85	75	3	-	-	-	-	-	-	-	-	-	-	3
CO-4	Assess the impact of nutrition on maternal , fetal, infant and adolescent health	✓	✓	✓	✓	3	85	75	3	2	-	-	-	-	3	-	-	-	-	3
CO-5	Integrate nutritional science concepts to evaluate and formulate dietary interventions for health management	✓	✓			2	85	75	2	2	2	-	-	-	3	3	-	-	-	2

Sessions	CLO - 1	CLO - 2	CLO - 3	CLO - 4	CLO - 5
	6	6	6	6	6
SLO-1	Overview, scope, and significance of nutrition in human health	Classification of nutrients	Dietary Fibre - Classification, sources, composition	Nutritional requirements during pregnancy	Concept and definition of Malnutrition and Health
SLO-2	Basic concept on Food, Nutrition and Nutrients	Carbohydrates- Function and effect on human system	Dietary Fibre - Properties & nutritional significance	Modification of existing diet and supplementation	Recommended Dietary Allowances
SLO-3	Classification of foods - Based on origin	Fatty Acids - Function and effect on human system	Minerals & Trace Elements - Roles	Deficiency of nutrients during pregnancy	Dietary Guidelines Reference Man
SLO-4	Classification of foods - Based on chemical composition	Proteins- Function and effect on human system	Minerals & Trace Elements – Deficiency and Excess	Nutritional requirements during lactation	Dietary Guidelines Reference Woman
SLO-5	Classification of foods – Based on function	Role of macromolecules in metabolism	Vitamins – Types and functions	Dietary management and food supplements during lactation	Energy and energy balance

SLO-6	Classification of nutrients	Nutrition chart of each food item	Vitamins – Sources, Deficiency and Excess	Dietary management.	Adult Consumption Unit, BMR, Role of nutrition in managing diseases

Resources			
1	Gopalan, C., Rama Sastri, B. V., & Balasubramanian, S. C. (1989). *Nutritive value of Indian foods*	3	Robinson, C. H., & Lawler, M. R. (1982). *Normal and therapeutic nutrition* (No. Ed. 16.
2	Swaminathan, M. (1985). *Essentials of Foods and Nutrition,* Vol. I and II Ganesh and Co.	4	ICMR-NIN Expert Group. (2020). *Expert Group on Nutrient Requirement for Indians, Recommended Dietary Allowances (Rda) and Estimated Average Requirements (Ear*). ICMR-National Institute of Nutrition, Hyderabad.

Assessment							Strategies					
Bloom's Level of Thinking		Continuous Learning Assessment (CLA) (100% weightage)					Technology		Pedagogy / Andragogy		Sustainable Development	
		CLA - 1	CLA - 2	CLA - 3	CLA - 4 *		Simulations	✓	Clarification/Pauses	✓	Good Health & Well Being	✓
		(20 %)	(20 %)	(40 %)	(20 %)		Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
		Theory (%)	Theory (%)	Theory (%)	Theory (%)		Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
1	Remember	20	20	15	10				Debate	✓	Life on Land	✓
2	Understand	20	20	20	10				Interactive Lecture	✓		
3	Apply	20	25	25	25				Brainstorming	✓		
4	Analyze	20	25	25	25							
5	Evaluate	20	10	15	15							
6	Create	-	-	-	15							
Total (%)		100	100	100	100							

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Suresh Kumar Rayala, Professor, DBT, IIT- Chennai		Dr.S. Prema Mathi Maran, Founder-Chairman, CTO, Clean Green Biosystems, Chennai	1	Dr. S. Samuel Joshua Pragasam, Assistant Professor, Department of Biotechnology, FSH, SRMIST, KTR

Course Code	PBT25G06T	Course Title	Vermicomposting	Category	G	Generic elective	L	T	P	C
							2	0	0	2

Course Offering Department	Biotechnology	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	*The purpose of learning this course is to:*	Depth				Attainment		
		1	2	3	4	1	2	3
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)
CR-1	Know about biology of species of earth worms							
CR-2	Have introduction into structure, properties and lifecycle of earthworm							
CR-3	Have knowledge on Earthworm farming and compost making							
CR-4	Have a basic knowledge about enemies and disease of earthworms							
CR-5	Know about basic applications and commercialization of earthworms							

Outcomes CO)	*At the end of this course, learners will be able to:*	Depth				Attainment			Program Outcomes (PO)												
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethical Practices & Social	Individual & Team Work	Communication	Project Management & Finance	Life Long Learning
CO-1	Understand the biology of some important species of earth worms	✓				5	85	75	3	-	-	-	-	-	-	-	-	-	-	3
CO-2	Know structure and reproduction Earthworms	✓	✓	✓		4	85	75	3	2	-	-	-	-	-	-	-	-	-	3
CO-3	Acquire skills on production of vermicompost		✓			6	85	75	3	-	-	-	-	-	-	-	-	-	-	3
CO-4	Explain benefits and problems with vermiculture and vermicompost	✓	✓	✓	✓	3	85	75	3	2	-	-	-	-	3	-	-	-	-	3
CO-5	Know about benefits of vermicompost	✓	✓			2	85	75	2	2	2	-	-	-	3	3	-	-	-	2

Sessions	CLO – 1	CLO – 2	CLO - 3	CLO - 4	CLO - 5
	6	6	6	6	6
SLO-1	Vermicompost	Earthworms – Taxonomic position,	Earthworm farming for home gardens	Vermi wash collection,	Benefits of vermicompost,
SLO-2	Introduction to Vermiculture	External features- shape, size, colour, segmentation, setae & clitellum.	Commercial composting	Composition and use.	Use of vermicompost in agriculture.
SLO-3	Definition, history	Body wall, coelom, locomotion, digestive,	Earthworm composting larger scale (pit, brick)	Enemies of earthworms,	Basic characteristics of earthworm suitable for vermicomposting.
SLO-4	Habitat diversity, Ecology	Circulatory respiratory, Excretory & Nervous system	Earthworm composting larger scale (heap systems).	Sickness and worm's enemies	Problems in vermicomposting, Vermicomposting of dairy waste
SLO-5	Various species of Earthworms (Endemic) suitable for vermicomposting	Reproductive system-Male, Female	Earthworm composting larger scale (Kadapa slab method)	Frequent problems	Hands on harvesting anf Packaging

SLO-6	Various species of Earthworms (Exotic) suitable for vermicomposting	Demonstration of life cycle and development.	Application - Earthworm farming, Vermicomposting harvest and processing	Problem prevention and Fixation.	Packaging, transport and storage of Vermicompost

Resources			
1	Chaudhuri, P.S. (2005). Vermiculture and vermicomposting.as biotechnology for conversion of organic wastes into animal protein and organic fertilizer. Asian Journal of Microbiology and Biotechnology and Environmental Science., 7(3):35937A	3	Das, M.C. QAD. *Charles Darrvin's Plough*. *Tools for Vermitechnology*. I K International Publishing House, ISBN: 978-93-81 141-27.
2	Isrnail, S.A. (i997). *Vermicology - The Biology of Earthworms*. Orient Longman.		

Assessment							Strategies					
Bloom's Level of Thinking		Continuous Learning Assessment (CLA) (100% weightage)					Technology		Pedagogy / Andragogy		Sustainable Development	
		CLA - 1	CLA - 2	CLA - 3	CLA - 4 *		Simulations	✓	Clarification/Pauses	✓	Good Health & Well Being	✓
		(20 %)	(20 %)	(40 %)	(20 %)		Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
		Theory (%)	Theory (%)	Theory (%)	Theory (%)		Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
1	Remember	20	20	15	10				Debate	✓	Life on Land	✓
2	Understand	20	20	20	10				Interactive Lecture	✓		
3	Apply	20	25	25	25				Brainstorming	✓		
4	Analyze	20	25	25	25							
5	Evaluate	20	10	15	15							
6	Create	-	-	-	15							
Total (%)		100	100	100	100							

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Suresh Kumar Rayala, Professor, DBT, IIT- Chennai		Dr.S. Prema Mathi Maran, Founder-Chairman, CTO, Clean Green Biosystems, Chennai	1	Dr. D. Thirumurugan, Assistant Professor, Dept. of Biotechnology, FSH, SRMIST, KTR

Course Code	PBT25P01L	Course Title	Internship	Category	P	PROJECT WORK/ INTERNSHIP	L	T	P	C
							0	0	0	2

Offering Department	Biotechnology	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	*The purpose of learning this course is to:*	Depth				Attainment			Program Outcomes (PO)												
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12
						Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethical Practices & Social	Individual & Team Work	Communication	Project Management & Finance	Life Long Learning
CR-1	To test the ability to identify research gap																			
CR-2	To test the ability to identify the problem																			
CR-3	To test the ability to devise a plan of study																			
CR-4	To teach how to determine the methodology																			
CR-5	To test the practical knowledge																			
Outcomes (CO)	*At the end of this course, learners will be able to:*	Conceive	Design	Implement	Operate															
CO-1	Knowledge on reading the review of literature	✓				3	85	80	*3*		-	-	-	-	*3*	*3*	-	2	2	*3*
CO-2	Knowledge on problem solving methods	✓			✓	3	85	80	*3*	*2*	-	-	-	-	*3*	*3*	-	2	2	*3*
CO-3	Knowledge on devising methodologies		✓	✓	✓	3	85	80	*3*	*2*	-	-	-	-	*3*	*3*	-	2	2	*3*
CO-4	Hands- on knowledge on various techniques	✓	✓	✓		3	85	80	*3*	*2*	-	-	-	-	*3*	*3*	-	2	2	*3*
CO-5	Knowledge to interpret the results	✓			✓	3	85	80	*3*	*2*	-	-	-	-	*3*	*3*	-	2	2	*3*

Learning Assessment			
Internship	Continuous Learning Assessment (50% weightage)	Final Evaluation (50% weightage)	
	Review	Project Report	Viva-Voce
	50%	30 %	20 %

SEMESTER IV

Course Code	PBT25P02L	Course Title	Project Work	Category	P	PROJECT WORK/ INTERNSHIP	L	T	P	C
							0	0	20	10

Offering Department	Biotechnology	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CR)	*The purpose of learning this course is to:*	Depth				Attainment		
		1	2	3	4	1	2	3
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)
CR-1	To test the ability to identify research gap							
CR-2	To test the ability to identify the problem							
CR-3	To test the ability to devise a plan of study							
CR-4	To teach how to determine the methodology							
CR-5	To test the practical knowledge							

Outcomes (CO)	*At the end of this course, learners will be able to:*	Depth				Attainment			Program Outcomes (PO)											
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Problem Solving	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethical Practices & Social	Individual & Team Work	Communication	Project Management & Finance	Life Long Learning
CO-1	Knowledge on reading the review of literature	✓				3	85	80	*3*				3		*3*	*3*	3	2	3	*3*
CO-2	Knowledge on problem solving methods	✓			✓	3	85	80	*3*	*2*	3	3	3		*3*	*3*	3	2	3	*3*
CO-3	Knowledge on devising methodologies		✓	✓	✓	3	85	80	*3*	*2*	3	3	3		*3*	*3*	3	2	3	*3*
CO-4	Hands- on knowledge on various techniques	✓	✓	✓		3	85	80	*3*	*2*	-	3	3		*3*	*3*	3	2	3	*3*
CO-5	Knowledge to interpret the results	✓			✓	3	85	80	*3*	*2*			3		*3*	*3*	3	3	1	*3*

Learning Assessment			
Project Work / Internship	Continuous Learning Assessment (50% weightage)	Final Evaluation (50% weightage)	
	Review	Project Report	Viva-Voce
	50%	30 %	20 %