ACADEMIC CURRICULA

POSTGRADUATE DEGREE PROGRAMME

Master of Science
in
Biochemistry

(M.Sc Biochemistry)

Two Years

Learning Outcome Based Education

Choice Based Flexible Credit System

Academic Year

2021 - 2022

SRM
INSTITUTE OF SCIENCE & TECHNOLOGY
(Deemed to be University u/s 3 of UGC Act, 1956)

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

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

Kattankulathur, Chengalpattu District, 603203, Tamil Nadu, India

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DEPARTMENT OF BIOCHEMISTRY

1. Department Vision Statement	
Stmt - 1	*Creating the most conducive environment for imparting quality education in Biotechnology*
Stmt - 2	*Contributing effectively to produce globally competent quality professionals in the field of life science*
Stmt - 3	*Contributing towards preparing young minds to serve community*

2. Department Mission Statement	
Stmt - 1	*Impart student's essential knowledge and skills required for a successful career in life science*
Stmt - 2	*Instill confidence in the students to take up new challenges by grooming them appropriately*
Stmt - 3	*Inculcate in the students a sense of commitment to professional ethics, moral values with emphasis on team work and leadership qualities*
Stmt - 4	*Instill the students with a clear awareness of environmental issues and their relevance to their profession*
Stmt - 5	*Impress upon the students the impact of their work on the nation's economic and social progress*

3. Program Education Objectives (PEO)	
PEO - 1	Graduates will have skills and knowledge to excel in their professional career in Biotechnology and related disciplines
PEO - 2	Graduates will contribute and communicate effectively within the team to grow into leaders
PEO - 3	Graduates will practice lifelong learning for continuing professional development
PEO - 4	Graduates will have the capability to continue their formal education and successfully complete an advanced degree
PEO - 5	Graduates will contribute to the growth of the nation and society by applying acquired knowledge in technical, computing and managerial skills.

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	H	H	M	H	M
PEO - 2	H	M	H	H	H
PEO - 3	M	H	M	H	H
PEO - 4	H	H	H	L	M
PEO - 5	L	H	M	H	H

H – High Correlation, M – Medium Correlation, L – Low Correlation

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

	Program Learning Outcomes (PLO)														
	1. Disciplinary Knowledge	2. Critical Thinking	3. Problem Solving	4. Analytical Reasoning	5. Research Skills	6. Team Work	7. Scientific Reasoning	8. Reflective Thinking	9. Self-Directed Learning	10. Multicultural Competence	11. Ethical Reasoning	12. Community Engagement	13. ICT Skills	14. Leadership Skills	15. Life Long Learning
PEO - 1	H	H	H	H	H	L	M	L	M	M	H	H	M	H	H
PEO - 2	H	H	H	H	H	L	M	L	M	H	M	M	H	H	M
PEO - 3	H	H	H	H	H	M	H	M	M	M	H	H	H	M	M
PEO - 4	H	M	M	H	H	H	M	H	H	H	H	L	M	M	H
PEO - 5	M	M	H	H	M	H	M	H	H	H	M	M	H	M	M

H – High Correlation, M – Medium Correlation, L – Low Correlation

6. PG Programme Structure (Total Credits:80)

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

Course Code	Course Title	Hours/ Week			
		L	T	P	C
PBC21101J	Chemistry of Biomolecules	4	0	4	6
PBC21102J	Enzyme Technology	4	0	4	6
PBC21103T	Molecular Biology	4	0	0	4
PBC21201J	Principles of Immunology	4	0	4	6
PBC21202J	Metabolism and Regulation	4	0	4	6
PBC21203T	Clinical biochemistry-I	4	0	0	4
PBC21301J	Clinical biochemistry-II	4	0	4	6
PBC21302T	Biotechnology	4	0	0	4
Total Learning Credits					**42**

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

Course Code	Course Title	Hours/ Week			
		L	T	P	C
PBC21D01L	Molecular Biology laboratory	0	0	4	2
PBC21D02T	Biophysics	4	0	0	4
PMS21D01T	Statistics For Biosciences				
PBC21D03T	Nutritional Biochemistry	4	0	0	4
PBC21D04T	Hormonal Biochemistry				
Total Learning Credits					**10**

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

Course Code	Course Title	Hours/ Week			
		L	T	P	C
PBC21G01T	Research methodology	2	0	0	2
Total Learning Credits					**2**

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

Course Code	Course Title	Hours/ Week			
		L	T	P	C
PBC21S01T	Analytical Techniques	4	0	0	4
PBC21S02T	Pharmaceutical biochemistry	2	0	0	2
PBC21S03T	Proteomics				
PBC21S04J	Bioinformatics	1	0	3	3
Total Learning Credits					**9**

5. Project Work, Internship In Industry / Higher Technical Institutions(P)

Course Code	Course Title	Hours/ Week			
		L	T	P	C
PBC21P01L	Internship	0	0	0	0
PBC21P02L	Project Work	0	0	24	12
Total Learning Credits					**12**

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

Course Code	Course Title	Hours/ Week			
		L	T	P	C
PCD21AE1T	Professional skills and problem solving	1	0	0	1
PCD21AE2T	General Aptitude for Competitive Examinations	1	0	0	1
PBC21AE1T	Entrepreneurship in life sciences	2	0	0	2
PCD21AE3T	Employability skills	1	0	0	1
Total Learning Credits					**5**

Course Structure								
Semester	**Professional Core Courses (PCC)**	**Discipline Electives Courses (DEC)**	**Generic Electives Courses (GEC)**	**Skill Enhancement Courses (SEC)**	**Ability Enhancement Courses (AEC)**	**Project Work, Internship (P)**	**Total Credits**	**Total Hours**
Sem I	PCC-1 (6) PCC-2 (6) PCC-3(4)	DEC-1 (2) DEC-2 (4)	-	-	AEC 1 (1)		**23**	**29**
Sem II	PCC-4 (6) PCC-5 (6) PCC-6 (4)	-	-	SEC 1 (4) SEC-2 (2)	AEC 2 (1)		**23**	**29**
Sem III	PCC-7 (6) PCC-8 (4)	DEC-3 (4)		SEC 3 (3)	AEC 3 (2) AEC 4 (1)	P (0)	**20**	**24**
Sem IV			GEC (2)			P (12)	**14**	**26**
Total Credits	**42**	**10**	**2**	**9**	**5**	**12**	**80**	**108**

7. Implementation Plan

Semester - I

Course Code	Course Title	Hours/ Week			C
		L	T	P	
PBC21101J	Chemistry of Biomolecules	4	0	4	6
PBC21102J	Enzyme Technology	4	0	4	6
PBC21103T	Molecular Biology	4	0	0	4
PBC21D01L	Molecular Biology laboratory	0	0	4	2
PBC21D02T	Biophysics	4	0	0	4
PMS21D01T	Statistics For Biosciences				
PCD21AE1T	Professional skills and problem solving	1	0	0	1
Total Learning Credits					23
Total working hours/week					29

Semester - II

Course Code	Course Title	Hours/ Week			C
		L	T	P	
PBC21201J	Principles of Immunology	4	0	4	6
PBC21202J	Metabolism and Regulation	4	0	4	6
PBC21203T	Clinical biochemistry-I	4	0	0	4
PBC21S01T	Analytical Techniques	4	0	0	4
PBC21S02T	Pharmaceutical biochemistry	2	0	0	2
PBC21S03T	Proteomics				
PCD21AE2T	General Aptitude for Competitive Examinations	1	0	0	1
Total Learning Credits					23
Total working hours/week					29

Semester - III

Course Code	Course Title	Hours/ Week			C
		L	T	P	
PBC21301J	Clinical biochemistry-II	4	0	4	6
PBC21302T	Biotechnology	4	0	0	4
PBC21D03T	Nutritional Biochemistry	4	0	0	4
PBC21D04T	Hormonal Biochemistry				
PBC21S04J	Bioinformatics	1	0	4	3
PBC21AE1T	Entrepreneurship in life sciences	2	0	0	2
PBC21P01L	Internship	0	0	0	0
PCD21AE3T	Employability skills	1	0	0	1
Total Learning Credits					20
Total working hours/week					24

Semester - IV

Course Code	Course Title	Hours/ Week			C
		L	T	P	
PBC21G01T	Research methodology	2	0	0	2
PBC21P02L	Project Work	0	0	24	12
Total Learning Credits					14
Total working hours/week					26

Total Learning Credits :80

8. Program Articulation Matrix

Course Code	Course Name	Programme Learning Outcomes														
		Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning
PBC21101J	Chemistry of Biomolecules	H	H	H	H	H	L	M	L	M	M	H	H	M	H	H
PBC21102J	Enzyme Technology	H	H	H	H	H	L	M	L	M	M	H	H	M	H	H
PBC21103T	Molecular Biology	H	H	H	H	H	L	M	L	M	M	H	H	M	H	H
PBC21201J	Principles of Immunology	H	H	H	H	H	L	M	L	M	M	H	H	M	H	H
PBC21202J	Metabolism and Regulation	H	H	H	H	H	L	M	L	M	M	H	H	M	H	H
PBC21203T	Clinical biochemistry-I	H	H	H	H	H	L	M	L	M	M	H	H	M	H	H
PBC21301J	Clinical biochemistry-II	H	H	H	H	H	L	M	L	M	M	H	H	M	H	H
PBC21302T	Biotechnology	H	H	H	H	H	L	M	L	M	M	H	H	M	H	H
PBC21D01L	Molecular Biology laboratory	H	H	H	H	H	L	M	L	M	M	H	H	M	H	H
PBC21D02T	Biophysics	H	H	H	H	H	M	H	M	M	M	H	H	H	M	M
PMS21D01T	Biostatistics	H	H	H	H	H	M	H	M	M	M	H	H	H	M	M
PBC21D03T	Nutritional Biochemistry	H	H	H	H	H	M	H	M	M	M	H	H	H	M	M
PBC21D04T	Hormonal Biochemistry	H	H	H	H	H	M	H	M	M	M	H	H	H	M	M
PBC21D01T	Analytical Techniques	H	H	H	H	H	L	M	L	M	M	H	H	M	H	H
PBC21S02T	Pharmaceutical biochemistry	H	H	H	H	H	M	H	M	M	M	H	H	H	M	M
PBC21S03T	Proteomics	H	H	H	H	H	M	H	M	M	M	H	H	H	M	M
PBC21S04J	Bioinformatics	H	H	H	H	H	M	H	M	M	M	H	H	H	M	M
PBC21G01T	Research methodology	H	H	H	H	H	M	H	M	M	M	H	H	H	M	M
PBC21AE1T	Entrepreneurship in life sciences	H	H	H	H	H	L	M	L	M	H	M	M	H	H	M
PBC21P01L	Internship	H	H	H	H	H	L	M	L	M	H	M	M	H	H	M
PBC21P02L	Project Work	H	H	H	H	H	L	M	L	M	H	M	M	H	H	M
PCD21AE1T	Professional skills and problem solving	-	H	H	H	-	H	-	H	H	H	H	H	H	H	H
PCD21AE2T	General Aptitude for Competitive Examinations	-	H	H	H	H	-	H	H	H	H	-	-	-	-	H
PCD21AE3T	Employability skills	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
	Program Average	H	H	H	H	H	M	M	M	M	M	M	H	H	H	H

H – High Correlation, M – Medium Correlation, L – Low Correlation

SEMESTER I

Course Code	PBC21101J	Course Name	Chemistry of Biomolecules	Course Category	C	**Professional Core Courses**	L	T	P	C
							4	0	4	6

Pre-requisite Courses	*Nil*	Co-requisite Courses	*NIL*	Progressive Courses	*NIL*
Course Offering Department	*Biochemistry*	Data Book / Codes/Standards		*NIL*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Understanding the classification and properties of biomolecules.*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Understanding the biomolecule metabolism.*			
CLR-3 :	*Knowledge on vitamins and its importance.*			
CLR-4 :	*Knowledge on energetics of oxidative pathway.*			
CLR-5 :	*Understanding the location of metabolic pathway.*			
CLR-6 :	*Knowledge on importance of all metabolic pathway.*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Scientific Knowledge	Problem Analysis	Design & Development	Analysis, Design,	Modern Tool Usage	Society & Culture	Environment &	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Students understand the fundamentals of biomolecules.*	*3*	*80*	*80*	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*Students gain knowledge about the energetics of catabolic pathway.*	*3*	*80*	*80*	*H*	*H*	*H*	*H*	*H*	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*Students understand the difference between anabolic and catabolic pathway.*	*3*	*90*	*80*	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*Students acquire knowledge on importance of essential biomolecules.*	*3*	*90*	*80*	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*Students understand the exact metabolism of biomolecules.*	*3*	*90*	*90*	*H*	*H*	*H*	*H*	*H*	-	-	-	-	-	-	-	-	-	-
CLO-6 :	*Students understand the importance and functions of minerals.*	*3*	*86*	*82*	*H*	*H*	*H*	*H*	*H*	-	-	-	-	-	-	-	-	-	-

Duration (hour)		**24**	**24**	**24**	**24**	**24**
S-1	**SLO-1**	Classification, structure, properties and function -Carbohydrates	Vitamins – Types and functions.	Oxidation – α, β of fatty acids.	Biosynthesis of non- essential amino acids	Metabolism of purines
S-2	**SLO-1**	Classification, structure, properties and function -Carbohydrates	Vitamins – Types and functions.	Oxidation – α, β of fatty acids	Biosynthesis of non- essential amino acids	Metabolism of pyrimidines
S-3	**SLO-1**	Classification, structure, properties and function -Carbohydrates	Glycolysis	ω of fatty acids.	Biosynthesis of non- essential amino acids	Metabolism of pyrimidines
S-4	**SLO-1**	Classification, structure, properties and function - Lipids	Glycolysis	Synthesis of fatty acids.	Biosynthesis of non- essential amino acids	Metabolism of pyrimidines
S 5-8	**SLO-1** **SLO-2**	Estimation of glucose by orthotoludine method.	TLC separation of Amino acids	Estimation of DNA by diphenyl amine method.	Qualitative analyses of carbohydrates.	Isolation & Characterization of casein from milk.

S-9	**SLO-1**	Classification, structure, properties and function - Lipids	Tricarboxylic acid cycle	synthesis of fatty acids.	Biosynthesis of non- essential amino acids	Minerals – Types and Functions
S-10	**SLO-1**	Classification, structure, properties and function - Lipids	Tricarboxylic acid cycle	Cholesterol synthesis	Biosynthesis of non- essential amino acids	Minerals – Types and Functions
S-11	**SLO-1**	Classification, structure, properties and function - Amino acids	Electron transport chain.	Cholesterol synthesis	Biosynthesis of non- essential amino acids	Minerals – Types and Functions
S-12	**SLO-1**	Classification, structure, properties and function - Amino acids	Electron transport chain.	Hormone synthesis – oesterogen and testosterone	Urea cycle.	Minerals – Types and Functions
S 13-16	**SLO-1** **SLO-2**	Estimation of protein by Folin Lowry method.	TLC separation of Sugars	Qualitative analyses of carbohydrates.	Qualitative analyses of carbohydrates	Isolation and characterization of starch from potato.
S-17	**SLO-1**	Classification, structure, properties and function - Nucleic Acids	HMP Shunt, Pentose phosphate pathway	Hormone synthesis – oesterogen and testosterone.	Urea cycle.	Minerals – Types and Functions
S-18	**SLO-1**	Classification, structure, properties and function - Nucleic Acids	Cori cycle; Gluconeogenesis	Heam metabolism	Metabolism of purines	Minerals – Types and Functions
S-19	**SLO-1**	Classification, structure, properties and function - Nucleic Acids	glycogenesis and glycogenolysis	Heam metabolism	Metabolism of purines	Revision
S-20	**SLO-1**	Vitamins – Types and functions.	Cycle test-1	Heam metabolism	Cycle test-2	Model exam
S21-24	**SLO-1** **SLO-2**	Estimation of protein by Folin Lowry method.	**TLC separation of Amino acids & Sugars**	**Qualitative analyses of carbohydrates.**	Qualitative analyses of carbohydrates	Revision

Learning Assessment

	Bloom's Level of Thinking	**Continuous Learning Assessment (50% weightage)**								**Final Examination (50% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (20%)**		**CLA – 4 (10%)**			
		Theory	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**
Level 1	Remember Understand	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
Level 2	Apply Analyze	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Level 3	Evaluate Create	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Total	100 %		100 %		100 %		100 %		100 %	

Course Designers

Experts from Higher Technical Institutions	**Internal Experts**
1. Dr. M. Sujatha, Associate Professor & HOD, Department of Biotechnology, Ethiraj College for Women, Chennai 2. Dr. M. Rajeshwari Hari, Associate Professor & HOD, Department of Biotechnology, MGR University	Mrs. S. Vijayabharathi

Course code	PBC21102J	Course Name	Enzyme Technology	Course Category	C	**Professional Core Courses**	L	T	P	C
							4	0	4	6

Pre-requisite Courses	*Nil*	Co-requisite Courses	*NIL*	Progressive Courses	*NIL*
Course Offering Department	Biochemistry	Data Book / Codes/Standards		*NIL*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning	Program Learning Outcomes (PLO)

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	*Understanding the classification of enzymes & properties*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Scientific Knowledge	Problem Analysis	Design & Development	Analysis, Design,	Modern Tool Usage	Society & Culture	Environment &	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLR-2 :	*Understanding the techniques used for purification of enzymes*																		
CLR-3 :	*Knowledge on enzyme involvement in lowering activation energy*																		
CLR-4 :	*Knowledge on different inhibitors and its role*																		
CLR-5 :	*Understanding the importance of coenzymes*																		
CLR-6 :	*Candidates acquire knowledge about the enzyme role and its importance*																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	*Students understand the fundamentals of enzymes.*	*3*	*80*	*80*	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*Students gain knowledge about the kinetics of enzyme activity.*	*3*	*80*	*80*	*H*	*H*	*H*	*H*	*H*	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*Students understand the difference between various inhibitors.*	*3*	*90*	*80*	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*Students acquire knowledge on industrial applications of enzymes.*	*3*	*90*	*80*	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*Students understand the mechanism of enzyme action.*	*3*	*90*	*90*	*H*	*H*	*H*	*H*	*H*	-	-	-	-	-	-	-	-	-	-
CLO-6 :	*Students understand the isolation and purification procedure of enzymes.*	*3*	*86*	*82*	*H*	*H*	*H*	*H*	*H*	-	-	-	-	-	-	-	-	-	-

Duration (hour)		***24***	***24***	***24***	***24***	***24***
S-1	***SLO-1***	*General introduction*	*Lock and key, Induced fit*	*Factors affecting the enzyme activity- Concentration, pH and temperature.*	*Reversible Inhibition- Competitive inhibition.*	*Immobilisation- methods and applications*
S-2	***SLO-1***	*Historical background.*	*Transition state Hypotheses. Mechanism of enzyme catalysis- Acid-base catalysis,*	*Kinetics of a single-substrate enzyme catalysed reaction, Michealis-Menten Equation*	*Reversible Inhibition- Competitive inhibition.*	*Immobilisation- methods and applications*
S-3	***SLO-1***	*Nomenclature and Classification of Enzymes*	*Covalent catalysis, Metal ion catalysis.*	*Kinetics of a single-substrate enzyme catalysed reaction, Michealis-Menten Equation*	*Non Competitive inhibition.*	*Industrial Enzymes- amylases, lipases*
S-4	***SLO-1***	*Nomenclature and Classification of Enzymes*	*Proximity and orientation effects etc.*	*Km, Vmax, L.B Plot*	*Non Competitive inhibition.*	*proteolytic enzymes in meat and leather industry*
S 5-8	***SLO-1*** ***SLO-2***	*Isolation of Alpha/Beta Amylase*	*Construction of Protein standard curve by Folin's Lowry method and*	*Determination of optimum pH of protease activity.*	*Determination of optimum pH of Urease activity*	*Affinity chromatography*

			Determination of specific activity of enzyme.			
S-9	***SLO-1***	*Nomenclature and Classification of Enzymes*	*Mechanism of Serine proteases*	*Turnover number, Kcat.*	*Uncompetitive inhibition.*	*proteolytic enzymes in meat and leather industry*
S-10	***SLO-1***	*Criteria of purity of enzymes- Specific activity.*	*Mechanism of -Chymotryspin,*	*Allosteric enzymes: Binding of ligands to proteins - Co-operativity,*	*Uncompetitive inhibition.*	*enzymes used in various fermentation processes*
S-11	***SLO-1***	*Enzyme units-Katal and IU*	*Mechanism of -Chymotryspin*	*Allostericenzymes- the Hill equation, equilibrium dialysis technique.*	*Feedback inhibition*	*enzymes used in various fermentation processes*
S-12	***SLO-1***	*Enzyme activity- chemical nature of enzymes.*	*Mechanism of Lysozyme*	*Sigmoidal kinetics: The MWC and KNF models.*	*Irreversible Inhibition- Suicide inhibition.*	*cellulose degrading enzymes*
S 13-16	***SLO-1*** ***SLO-2***	*Isolation of Alpha/Beta Amylase*	*Determination of substrate concentration of protease activity.*	*Determination of inhibitor of protease activity.*	*Determination of optimum temperature of Urease activity.*	*Affinity chromatography*
S-17	***SLO-1***	*Protein nature of enzymes and Non protein enzymes- Ribozymes and DNAzymes.*	*Mechanism ofCarboxypeptidase A*	*Significance of sigmoidal behaviour.*	*Examples and Mechanism of various Inhibitions like Penicillin, Iodoacetamide and DIPF.*	*cellulose degrading enzymes*
S-18	***SLO-1***	*Metalloenzymes and metal activated enzymes.*	*Mechanism ofRibonuclease.*	*Allosteric enzymes and metabolic regulation.*	*Examples and Mechanism of various Inhibitions like Penicillin, Iodoacetamide and DIPF.*	*Metal degrading enzymes.*
S-19	***SLO-1***	*Coenzymes and Cofactors- Prosthetic group, coenzymes involved in different metabolic pathways. Classification of coenzymes.*	*Proenzymes (Zymogens).*	*Study of ATCase- as typical allosteric enzyme*	*Enzyme isolation and purification*	*Metal degrading enzymes*
S-20	***SLO-1***	*Coenzymes and Cofactors- Prosthetic group, coenzymes involved in different metabolic pathways. Classification of coenzymes.*	*Cycle test-1*	*Study of ATCase- as typical allosteric enzyme*	*Cycle test-2*	*Metal degrading enzymes.*
S 21-24	***SLO-1*** ***SLO-2***	*Construction of Protein standard curve by Folin's Lowry method and Determination of specific activity of enzyme.*	*Determination of optimum temperature of protease activity.*	*Assay of Urease.*	*Determination of substrate concentration of Urease activity.*	*Model practicals*

Learning Resources	1. Nicholas C. Price and Lewis Stevens, *"Fundamentals of Enzymology"*, Oxford University Press, 2003. 2. Trevor Palmer and Philip Bonner, *"Enzymes - Biochemistry, Biotechnology, Clinical chemistry"*, 2nd edition, East-West Press Pvt. Ltd, 2004.	1. Lehninger, Nelson and Cox, *"Principles of biochemistry"*, 6th edition, W.H. Freeman & Company,2013. 2. Prakash M., DigmartiBhaskaraRao,Jena T, Enzyme Biotechnology, 1st edition, Discovery Publication, 2010.

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
	Understand										
Level 2	Apply	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
	Analyze										
Level 3	Evaluate	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

Course Designers	
Experts from Higher Technical Institutions	Internal Experts
1. Dr. M. Sujatha, Associate Professor & HOD, Department of Biotechnology, Ethiraj College for Women, Chennai 2. Dr. M. Rajeshwari Hari, Associate Professor & HOD, Department of Biotechnology, MGR University	Mrs. S. Vijayabharathi

Course Code	PBC21103T	Course Name	MOLECULAR BIOLOGY	Course Category	C	Professional Core Courses	L	T	P	C
							4	0	0	4

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Scientific Knowledge	Problem Analysis	Design & Development	Analysis, Design,	Modern Tool Usage	Society & Culture	Environment &	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLR-1 :	*Study about genome organization in prokaryotes and eukaryotes*																		
CLR-2 :	*Learn about DNA Replication and Repair*																		
CLR-3 :	*Understand about Transcription mechanisms*																		
CLR-4 :	*Understand about Translation mechanisms*																		
CLR-5 :	*Learn about gene expression and its regulation*																		
CLR-6 :	*Understand the advanced concepts in molecular biology*																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	*Understand the structure of DNA, RNA and genome packaging*	*3*	*85*	*75*	*H*	*M*	*M*	*H*	*M*	-	-	-	-	-	-	*M*	-	-	-
CLO-2 :	*Gain knowledge on replication, mutations and DNA repair mechanisms*	*3*	*80*	*75*	*H*	*M*	*M*	*H*	*M*	-	-	-	-	-	-	*M*	-	-	-
CLO-3 :	*Learn about the central dogma of molecular biology*	*3*	*80*	*70*	*H*	*M*	*M*	*H*	*H*	-	-	-	-	-	-	*H*	-	-	-
CLO-4 :	*Apply knowledge on the significance of translation and post-translational modifications*	*3*	*85*	*80*	*H*	*H*	*H*	*H*	*H*	-	-	-	-	-	-	*H*	-	-	-
CLO-5 :	*Apply knowledge on how expression of genes can be regulated*	*3*	*75*	*70*	*H*	*H*	*H*	*H*	*H*	-	-	-	-	-	-	*H*	-	-	-
CLO-6 :	*Have an overall understanding on advanced concepts in molecular biology*	*3*	*80*	*75*	*H*	*H*	*H*	*H*	*H*	-	-	-	-	-	-	*H*	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	*Structure of DNA*	*DNA Replication*	*Transcription*	*Translation*	*Gene Regulation*
S-2	SLO-1	*Watson and Crick Model*	*Mechanism of Replication*	*Mechanism of Transcription in prokaryotes*	*Genetic code*	*Operons*
S-3	SLO-1	*Forms of DNA*	*Rolling circle replication*	*Mechanism of Transcription in eukaryotes*	*Prokaryotic and eukaryotic ribosomes*	*Cis-acting regulatory elements*
S-4	SLO-1	*RNA – Structure, types and functions*	*Theta replication, D-Loop*	*RNA Polymerases*	*Prokaryotic translation*	*Trans-regulatory elements*
S-5	SLO-1	*Unusual structures of DNA & RNA*	*DNA damage*	*Transcription factors*	*Eukaryotic translation*	*Gene regulation in prokaryotes*
S-6	SLO-1	*Prokaryotic &Eukaryotic genome*	*Mutation & its types*	*Regulatory elements*	*Initiation factors*	*Transcriptional regulation*
S-7	SLO-1	*Genome organization in Prokaryotes*	*Mutagenesis*	*Post-transcriptional modifications*	*Elongation factors*	*Riboswitches*
S-8	SLO-1	*Genome organization in Eukaryotes*	*Types of mutagens*	*Processing at 5' end*	*Regulation of translation*	*Lac Operon*
S-9	SLO-1	*Mitochondrial DNA, Chloroplast DNA*	*DNA Repair mechanisms*	*Processing at 3' end*	*Protein folding*	*Trp Operon*
S-10	SLO-1	*Chromosome types and functions*	*Base Excision Repair, Nucleotide Excision Repair*	*Splicing*	*Post- translational modifications*	*Gene regulation in eukaryotes*
S-11	SLO-1	*Fine structure of gene*	*Recombination Repair*	*Alternative splicing*	*Epigenetic modifications*	*Chromatin remodeling*
S-12	SLO-1	*Types of genes*	*SOS Repair*	*mRNA transport*	*Protein sorting*	*Epigenetic gene regulation*

Learning Resources	***Text Books:*** 1. *Robert F. Weaver. "Molecular Biology". 5th edition. McGraw Hill Education, 2011.* 2. *Veer Bala Rastogi. "Fundamentals of Molecular Biology". Ane Books Pvt Ltd, 2008.*	***References:*** 1. *George M. Malacinski, David Freifelder. "Essentials of Molecular Biology". 4th Edition. Jones & Bartlett Publishers, 2003.* 2. *Harvey Lodish, Arnold Berk et al. "Molecular cell biology". 7th edition. W. H. Freeman, 2011.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40%	-	30%	-	30%	-	40%	-	30%	-
	Understand										
Level 2	Apply	30%	-	40%	-	40%	-	30%	-	40%	-
	Analyze										
Level 3	Evaluate	30%	-	30%	-	30%	-	30%	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.

Course Designers

Experts from Higher Technical Institutions	Internal Experts
1. Dr. M. Sujatha, Associate Professor & HOD, Department of Biotechnology, Ethiraj College for Women, Chennai 2. Dr. M. Rajeshwari Hari, Associate Professor & HOD, Department of Biotechnology, MGR University	Dr. N. Prasanth Bhatt

Course Code	PBC21D01L	Course Name	MOLECULAR BIOLOGY LABORATORY	Course Category	D	Discipline specific elective	L	T	P	C
							0	0	4	2

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

Course Learning Rationale (CLR):	The purpose of learning this course is to,
CLR-1 :	Understanding the basics of nucleic acid extraction
CLR-2 :	Understand the principle of blotting techniques
CLR-3 :	Knowledge on PCR technique
CLR-4 :	To understand the concept of nucleic acid purification
CLR-5 :	To know about the cDNA synthesis and ligation
CLR-6 :	Understanding the importance of techniques in molecular biology

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Principles	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Isolate genomic, plasmid DNA and RNA	2	85	80	H	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-2 :	Perform restriction digestion and blotting techniques	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-3 :	Perform amplification of desired gene	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-4 :	Carry out nucleic acids purification and quantification	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-5 :	Perform ligation of DNA and cDNA synthesis	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-6 :	Overall knowledge on molecular biology techniques	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-

Duration (hour)		12	12	12	12	12
S 1-4	SLO-1 SLO-2 SLO-3 SLO-4	Extraction of DNA from Plant/ animal tissue	Southern Blotting of DNA	Gel extraction of DNA	Purification of RNA and quantification	Ligation of DNA with T4 DNA ligase
S 5-8	SLO-1 SLO-2 SLO-3 SLO-4	Restriction digestion of DNA	Southern Blotting of DNA	Total RNA extraction from animal tissues	cDNA synthesis from the extracted RNA	Repetition
S 9-12	SLO-1 SLO-2 SLO-3 SLO-4	Southern Blotting of DNA	Polymerase Chain reaction	**Total RNA extraction from animal tissues**	Repetittion of Polymerase Chanin reaction from the cDNA	Repetition

Learning Resources		
	1. *Principles and techniques of Biochemistry and Molecular biology, Wilson and Walker, 2013*	1. Lehninger Principles of Biochemistry, W. H. Freeman, 2005

Learning Assessment						
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)				Final Examination (50% weightage)
		CLA – 1 (10%)	CLA – 2 (10%)	CLA – 3 (20%)	CLA – 4 (10%)	
		Practicals	Practicals	Practicals	Practicals	Practicals
Level 1	Remember	40	30%	30%	30%	30%
	Understand					
Level 2	Apply	40%	40%	40%	40%	40%
	Analyze					
Level 3	Evaluate	20%	30%	30%	30%	30%
	Create					
	Total	100 %	100 %	100 %	100 %	100 %

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers	
Experts from Higher Technical Institutions	Internal Experts
1. Dr. M. Sujatha, Associate Professor & HOD, Department of Biotechnology, Ethiraj College for Women, Chennai 2. Dr. M. Rajeshwari Hari, Associate Professor & HOD, Department of Biotechnology, MGR University	Dr. N. Prasanth Bhatt

Course Code	PBC21D02T	Course Name	Biophysics	Course Category	D	Discipline specific elective	L	T	P	C
							4	0	0	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to,	Learning	Program Learning Outcomes (PLO)

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	Understanding the basics of biomolecule structure	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO - 1	PSO - 2	PSO – 3
CLR-2 :	Understand the principle of various instruments																		
CLR-3 :	Understanding the physics involved in human physiology																		
CLR-4 :	To understand the concept of Membrane potential																		
CLR-5 :	To know about the radiobiology																		
CLR-6 :	Understanding the importance of physics of biology																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Knowledge on biomolecule structure	2	85	80	H	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-2 :	Knowledge on working of instruments	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-3 :	Knowledge about the human physiology	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-4 :	Knowledge on propagation of signals among cells	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-5 :	Knowledge on radiobiology and its usage in imaging	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-6 :	Overall knowledge on principles and application of physics in Biology	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction to biophysics & **Structure of Amino acids**	Bravais lattices, Braggs Law	Physics behind ventilation, pressure changes in ventilation	Membrane potential of cell, Development of Membrane potential	Concept of radiobiology, ionizing radiation and types, Direct and indirect effects
S-2	SLO-1	Structural significance of Amino acids	Millers indices, X-Ray diffraction	**pressure volume interrelationship**	Diffusion potential, Magnitude of resting Membrane potential	Tumour radiotherapy
S-3	SLO-1	**Peptide bond and its structural importance**	Light scattering & Neutron scattering	air flow resistance	Action potential	RadioImaging techniques
S-4	SLO-1	Torsional angles, its importance in secondary structure formation	Principle of NMR and Applications	**Ficks Law, Diffusion capacity**	Development of Action potential	X-Ray

S-5	**SLO-1**	**Ramachandran plot**	**Principle of Circular Dichroism**	**Hemodynamics**	**Sodium pump**	**PET scan**
S-6	**SLO-1**	Protein folding, Helix coil transition	Principle of Circular Dichroism	Excitation contraction coupling	Calcium pump	MRI
S-7	**SLO-1**	**Nucleic acids**	Application of **Circular Dichroism**	Electrical properties of heart muscles	Propagation of AP	ultrasonography
S-8	**SLO-1**	Watson and crick model	Principle of LC-MS	**Work done by heart**	Synaptic potential and End plate potential	GIMG
S-9	**SLO-1**	polymorphism in DNA	Application of LC-MS	clinical electrocardiography	Voltage gated channel	Revision

Learning Resources	***2.*** *Principles and techniques of Biochemistry and Molecular biology, Wilson and Walker, 2013*	2. Lehninger Principles of Biochemistry, W. H. Freeman, 2005

Learning Assessment

	Bloom's Level of Thinking	**Continuous Learning Assessment (50% weightage)**				**Final Examination (50% weightage)**
		CLA – 1 (10%)	**CLA – 2 (10%)**	**CLA – 3 (20%)**	**CLA – 4 (10%)**	
		Theory	**Theory**	**Theory**	**Theory**	**Theory**
Level 1	Remember	40	30%	30%	30%	30%
	Understand					
Level 2	Apply	40%	40%	40%	40%	40%
	Analyze					
Level 3	Evaluate	20%	30%	30%	30%	30%
	Create					
	Total	100 %	100 %	100 %	100 %	100 %

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Higher Technical Institutions	**Internal Experts**
1. Dr. M. Sujatha, Associate Professor & HOD, Department of Biotechnology, Ethiraj College for Women, Chennai 2. Dr. M. Rajeshwari Hari, Associate Professor & HOD, Department of Biotechnology, MGR University	Dr. N. Prasanth Bhatt

Course Code	PMS21D01T	Course Name	STATISTICS FOR BIOSCIENCES	Course Category		Elective	L	T	P	C
							4	0	0	4

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Mathematics and Statistics*	**Data Book / Codes/Standards**	*Statistical Table and Graph sheet*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	**Learning**	**Program Learning Outcomes (PLO)**

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Scientific Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLR-1 :	*To provide foundations in Data Collection, Classification and Presentation of Data*																		
CLR-2 :	*To understand the Concepts of Measures of Tendency and Measures of Dispersion*																		
CLR-3 :	*To learn and apply the Probability Theory and Distributions in Biological field*																		
CLR-4 :	*To acquire the knowledge of Correlation and Regression Analysis*																		
CLR-5 :	*To gain the knowledge of various sampling techniques and concept of point and interval estimation*																		
CLR-6 :	*To understand and interpret data using Testing of Hypothesis based on large and small sample.*																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	*To acquire the knowledge of data, classification and presentation commonly used in Health and Medical Sciences*	*3*	*85*	*80*	*L*	*L*	*-*	*L*	*M*	*-*	*-*	*-*	*M*	*M*	*-*	*M*	*-*	*-*	*-*
CLO-2 :	*To collect data relating to variable/variables which will be examined and calculate descriptive statistics from these data.*	*3*	*80*	*75*	*M*	*M*	*-*	*H*	*L*	*-*	*-*	*-*	*M*	*M*	*-*	*H*	*-*	*-*	*-*
CLO-3 :	*To identify distribution form relating to the variable/variables.*	*3*	*85*	*80*	*M*	*H*	*M*	*H*	*M*	*-*	*-*	*-*	*M*	*M*	*-*	*M*	*-*	*-*	*-*
CLO-4 :	*To acquire the skill of analysing the relationship between the independent and dependent variables*	*3*	*85*	*80*	*M*	*H*	*H*	*H*	*M*	*-*	*-*	*-*	*M*	*M*	*-*	*H*	*-*	*-*	*-*
CLO-5 :	*To apply different methods of sampling methods in Biological sciences*	*3*	*85*	*80*	*H*	*H*	*H*	*M*	*M*	*-*	*-*	*-*	*M*	*M*	*-*	*H*	*-*	*-*	*-*
CLO-6 :	*To apply hypothesis testing via some of the statistical distributions and interpret the results*	*3*	*85*	*80*	*M*	*M*	*H*	*M*	*L*	*-*	*-*	*-*	*L*	*M*		*H*	*-*	*-*	*-*

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		**14**	**12**	**12**	**12**	**12**
S-1	**SLO-1**	*Definition of Primary and secondary data with examples*	*Random experiment, types of events with examples*	*Definition of Bi-variate distribution, Definition of correlation, types and application*	*Definition of sampling, types of sampling techniques*	*Large sample test – Z test using single sample mean*
	SLO-2	*Source of primary and secondary data*	*Definition of probability, addition and multiplication law*	*Definition of scatter diagram*	*Advantages and disadvantages*	*Z test using single sample mean*
S-2	**SLO-1**	*Classification of data with examples*	*Problems based on addition and multiplication law*	*Methods of Measures of correlation coefficient- Karl Pearson's formula*	*Simple random Sampling –concept, uses and limitation*	*Large sample test – Z test using two sample mean*
	SLO-2	*Discrete and continuous data with examples*	*Conditional probability - formula*	*Correlation coefficient using Karl Pearson's method*	*Examples of Simple random sampling*	*Z test using two sample mean*

S-3	**SLO-1**	*Discrete and continuous data with examples*	*Problems on conditional probability*	*Correlation coefficient using Karl Pearson's method*	*Stratified Sampling –concept, uses and limitation*	*Z test using two sample mean*
	SLO-2	*Tabulation- parts of the table*	*Definition of Baye's theorem*	*Correlation coefficient using Karl Pearson's method*	*Examples of Stratified sampling*	*Z test using two sample mean*
S 4	**SLO-1**	*Diagrammatic presentation- simple, percentage bar diagram*	*Problems on Baye's theroem*	*Correlation coefficient using Karl Pearson's method*	*Systematic sampling – Concepts, uses, limitations*	*Small sample test :student t-test with single sample mean*
	SLO-2	*Sub-divided bar and multiple bar diagram*	*Definition of probability distribution and its Type*	*Correlation coefficient using Karl Pearson's method*	*Examples of systematic sampling*	*student t-test with single sample mean*
S-5	**SLO-1**	*Graphical presentation – histogram, frequency polygon*	*Definition of Binomial distribution and its applications*	*Correlation coefficient using Spearman's rank method*	*Non-random sampling-concepts*	*t-test with comparison of two sample means*
	SLO-2	*Frequency cure, ogives*	*Problems on Binomial distribution*	*Correlation coefficient using Spearman's rank method*	*Convenient sampling- concept, uses, limitations*	*t-test with comparison of two sample means*
S - 6	**SLO-1**	*Using Ogives locate the median*	*Problems on Binomial distribution*	*Correlation coefficient using Spearman's rank method – repeated rank*	*Convenient sampling- concept, uses, limitations*	*Paired t-test for dependent samples*
	SLO-2	*Mean, median and mode – individual and discrete series*	*Problems on Binomial distribution*	*Correlation coefficient using Spearman's rank method – repeated rank*	*Judgment sampling- concept, uses, limitations*	*Paired t-test for dependent samples*
S- 7	**SLO-1**	*Mean, median and mode –Discrete series*	*Definition of Poisson distribution and its application*	*Concepts of regression and simple linear regression models*	*Concepts of sampling and non-sampling errors*	*F-test: equality of two sample variances*
	SLO-2	*Mean, median and mode –Continuous series*	*Problems on Poisson distribution*	*Problems on regression lines*	*Central limit theorem- statement*	*F-test: equality of two sample variances*
S - 8	**SLO-1**	*Mean, median and mode –Continuous series*	*Problems on Poisson distribution*	*Problems on regression lines*	*Uses of central limit theorem*	*Chi-square test: Goodness of fit*
	SLO-2	*Range, quartile deviation, - individual and discrete series*	*Problems on Poisson distribution*	*Problems on regression lines*	*Definition of hypothesis testing, level of significance, type – I error, type-II error*	*Chi-square test: Goodness of fit*
S - 9	**SLO-1**	*Mean deviation – Individual and discrete series*	*Problems on Poisson distribution*	*Solve the two regression lines are given in the problem*	*Concepts of One tailed test and two tailed test*	*Chi-square test: independence of attributes*
	SLO-2	*Range, Quartile deviation – Continuous series*	*Definition of normal distribution, characteristics*	*Properties of regression coefficients*	*Point estimation – sample statistics, mean variance, and standard deviation*	*Chi-square test: independence of attributes*
S - 10	**SLO-1**	*Mean deviation – Continuous series*	*Importance of normal distribution*	*Concept of Simple regression lines using Least square method*	*Point estimation – sample statistics, mean variance and standard deviation*	*Chi-square test: independence of attributes*
	SLO-2	*Standard deviation, co-efficient of variation – Individual and discrete series*	*Definition of Standard Normal distribution*	*Regression lines using least square method*	*Point estimation – sample statistics, mean variance and standard deviation*	*Analysis of variance: concepts, One-way ANOVA table*
S-11	**SLO-1**	*Standard deviation, co-efficient of variation- continuous series*	*Problems on normal distribution*	*Regression lines using least square method*	*Point estimation – sample statistics, mean variance and standard deviation*	*One-way ANOVA table- formula and problem*
	SLO-2	*Standard deviation, co-efficient of variation – continuous series*	*Problems on normal distribution*	*Regression lines using least square method*	*Interval estimation with 95% los*	*One-way ANOVA table- formula and problem*
S-12	**SLO-1**	*Skewness, Bowleys coefficient of skewness- discrete series*	*Problems on normal distribution*	*Regression lines using least square method*	*Interval estimation with 95% los*	*Two-way ANOVA table- formula and problem*
	SLO-2	*Skewness, Bowleys coefficient of skewness- continuous series*	*Problems on normal distribution*	*Regression lines using least square method*	*Interval estimation with 99% los*	*Two-way ANOVA table- formula and problem*
		Bowleys coefficient of skewness – Continuous series	*Problems on normal distribution*	*Probable error*	*Interval estimation with 99% los*	*Two-way ANOVA table- formula and problem*

Learning Resources	***Theory:*** ***1.*** Gupta S.C and Kapoor V.K, Fundamentals of Mathematical Statistics, Sultan Chand, New Delhi. 2000 ***2.*** Wayne W. Daniel, Biostatistics, A Foundation for Analysis in Health Sciences, John Wiley & Sons, 2008 ***3.*** Marcello Pagano and Kimberlee Gauvreau: Principles of Biostatistics, Duxbury Printed in India by (Chennai Micro Point Pvt. Ltd, No. 34, Nelson ManickamRoad, Chennai – 29), 2000 ***4.*** Veer Bala Rastogi, Fundamentals of Biostatistics, Ane Books Pvt. Ltd, Avarthika Niwas, 1st Floor, 19, Duraisamy Road, T.Nagar, Chennai ,2009

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA_1 (10%)		CLA_2 (10%)		CLA_3 (20%)		CLA_4 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	30%	-	30%	-	30%	-	30%	-	30%	-
	Understand										
Level 2	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
	Analyze										
Level 3	Evaluate	30%	-	30%	-	30%	-	30%	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers	
Experts from Academic	Internal Experts
Dr. M.A. Baskar, Professor & Head, Dept. Of Mathematics, Loyola college, Chennai	M.Kalaivani, SRMIST
Dr. P.Dhanvanthan, Professor & Head, Dept. Of Statistics, Pondicherry University	

Course Code	PCD21AE1T	Course Name	Professional Skills and Problem Solving	Course Category	A	Ability Enhancement Course	L	T	P	C
							1	0	0	1

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Career Development Centre			Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1:	*Utilise success habits to enhance professionalism*			
CLR-2:	Enable to solve problems and to crack competitive exams.			
CLR-3:	understand and master the mathematical concepts to solve types of problem			
CLR-4:	Identify a logically sound and well-reasoned argument			
CLR-5:	*expertise in communication and problem-solving skills*			
CLR-6:	*develop problem solving skills with appropriate strategies*			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1:	*identify success habits and inculcate professional skills*	2	80	75
CLO-2:	*grasp the approaches and strategies to solve problems with speed and accuracy*	2	80	70
CLO-3:	*collectively solve problems in teams and groups*	2	75	70
CLO-4:	*construe and solve an argument through critical thinking*	2	80	75
CLO-5:	*acquire communication and problem- solving skills*	2	80	70
CLO-6:	*apply problem solving techniques and skills*	2	80	75

		Program Learning Outcomes (PLO)														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	ICT Skills	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1:	*identify success habits and inculcate professional skills*	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-2:	*grasp the approaches and strategies to solve problems with speed and accuracy*	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-3:	*collectively solve problems in teams and groups*	H	H	H	H	H	H	H	H	M	H	M	H	H	H	H
CLO-4:	*construe and solve an argument through critical thinking*	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-5:	*acquire communication and problem- solving skills*	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-6:	*apply problem solving techniques and skills*	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H

Duration (hour)		3	3	3	3	3
S-1	SLO-1	Personal profiling	Creative problem solving method	Case study analysis	Emotional Intelligence	Communication skills
	SLO-2	USP& Personal branding	Techniques	Case study analysis	Personal & social competence	Communication skills
S-2	SLO-1	Assumption and strengthening of an argument	Weakening and Inference of an argument	Conclusion and paradox of an argument	Main idea and structure of a passage	Tone and Style of a passage
	SLO-2	Assumption and strengthening of an argument	Weakening and Inference of an argument	Conclusion and paradox of an argument	Main idea and structure of a passage	Tone and Style of a passage
S-3	SLO-1	Arithmetic: Simple equations	Profit, Loss & Discount	Average	Percentage	Mixtures & alligation
	SLO-2	Equation 1 and equation 2	Interest calculation	Average	Percentage	Mixtures & alligation

Learning Resources	.Arun Sharma-Quantitative aptitude for CAT, Tata McGraw Hill 2.Dinesh Khattar-The Pearson Guide to QUANTITATIVE APTITUDE for competitive examinations	3. Manhatten Prep - GRE Reading Comprehension and Essays 4. Seven habits of highly effective people- Steven Covey 5. Manhattan Prep – Critical Reasoning Skills and Techniques

Learning Assessment											
	Bloom's Level of Thinking	**Continuous Learning Assessment (50% weightage)**								**Final Examination (50% weightage)**	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	30 %	-	30 %	-	30 %	-	30 %	-	30 %	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40 %	-
	Analyze										
Level 3	Evaluate	30 %	-	30 %	-	30 %	-	30 %	-	30 %	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Experts from Industry	Internal Experts	
1.Mr Ajay Zenne, Career Launcher, ajay.z@careerlauncher.com	Mr. P Priyanand, SRMIST	
	Mrs. Kavitha Srisarann, SRMIST	
2. Mr.Pratap Iyer, Study Abroad Mentors, Mumbai, pratap.iyer30@gmail.com	Mr. Harinarayana Rao, SRMIST	
	Dr. A Clement, SRMIST	

SEMESTER II

Course Code	PBC21201J	Course Name	PRINCIPLES OF IMMUNOLOGY	Course Category	C	*Professional Core Course*	L	T	P	C
							4	0	4	6

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

Course Learning Rationale (CLR):	The purpose of learning this course is to,	Learning
CLR-1 :	Understanding the basics of immune reactions	
CLR-2 :	Understanding the properties of antigens and function of immunoglobulins	
CLR-3 :	Understanding the importance antigrnantibogy interaction in defense action	
CLR-4 :	Knowledge on B & T cell response	
CLR-5 :	Knowledge on immunological basis of AIDS, transplantation	
CLR-6 :	Understanding the response of immune system	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	1 Level of Thinking	2 Expected Proficiency	3 Expected Attainment
CLO-1 :	Acquired basic Knowledge on immune cells, organs	2	85	80
CLO-2 :	Basic Knowledge on antigen, immunoglobulins	3	85	80
CLO-3 :	Strong basis for understanding the interactions of antigen & antibody	3	85	80
CLO-4 :	Better knowledge gained about immune response	3	85	80
CLO-5 :	Better knowledge gained about immune response in disease	3	85	80
CLO-6 :	Overall understanding of immune system in response reactions	3	85	80

Program Learning Outcomes (PLO)

1 Fundamental	2 Problem Analysis	3 Design &	4 Analysis, Design,	5 Modern Tool Usage	6 Society & Culture	7 Environment &	8 Ethics	9 Individual & Team	10 Communication	11 Project Mgt. &	12 Life Long Learning	13 PSO - 1	14 PSO – 2	15 PSO – 3
L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
L	H	H	H	H	-	-	M	M	L	-	H	-	-	-

Duration (hour)		24	24	24	24	24
S-1	SLO-1	Immunology- Introduction and History.	Immunoglobulin – structure	Kinetics of primary and secondary	role of MHC antigens in immune	Immunoprophylaxis and
	SLO-2	Scope of Immunology	Function	immune responses	responses	immunotherapy
S-2	SLO-1	Types of immunity-innate	Different classes of Immunoglobulins	complement activation and its	MHC antigens in transplantation.	Production of polyclonal and
	SLO-2			biological consequences,		monoclonal antibodies
S-3	SLO-1	Types of immunity- Acquired	Different classes of Immunoglobulins	Complement System - Pathway	Hypersensitivity-I and II	Production of polyclonal and
	SLO-2					monoclonal antibodies
S-4	SLO-1	Cells of Immune System- Introduction	Side chain and colonal selection theory	Complement System - Pathway	Hypersensitivity-III IV	Production of polyclonal and
	SLO-2					monoclonal antibodies
S 5-8	SLO-1	Lab safety rules	Separation of mononuclear cells from	Ouchterlony double immunodiffusion	Counter current	DOT ELISA
	SLO-2		peripheral blood		immunoelectrophorosis	
S-9	SLO-1	Cells of immune system- Lymphocytes	Antibody diversity –gene rearrangement and somatic recombination	Complement System - Pathway	**Autoimmunity**	Immunoprecipitation, RIA,
S-10	SLO-1			Immuno diagnosis	**Immunodeficiency diseases**	ELISA,

	SLO-2	Antigen presenting Cells and Lymphocytic traffic	Class switching- Revision of Antigen and Antibody			
S-11	SLO-1	Lymphoid organs	Immune Response: Introduction	Immuno diagnosis	**Immunodeficiency diseases**	fluorescent immunoassay,
	SLO-2					
S-12	SLO-1	Lymphoid organs – Revision	B –cell Maturation and Activation	cytokines and co-stimulatory molecules	**Tumour Immunology**	avidin-biotin mediated assay, immunohistochemistry,
	SLO-2					
S13-16	SLO-1	Agglutination: ABO Blood grouping	Single Radial immunodiffusion	Ouchterlony double immunodiffusion	Rocket immunoelectrophorosis	DOT ELISA
	SLO-2					
S-17	SLO-1	Antigen and Immunogen	B –cell Maturation and Activation	cytokines and co-stimulatory molecules	Vaccines - killed attenuated organisms, toxoid,	Iimmunoelectrophoresis,
	SLO-2					
S-18	SLO-1	Antigen – Types	T cell Maturation and Activation	cytokines and co-stimulatory molecules	recombinant vaccines, subunit vaccines	immunoelectrophoresis,
	SLO-2					
S-19	SLO-1	Antigen -properties Affinity and Avidity	T cell Maturation and Activation	Major histocompatibility complex (MHC) genes and products	DNA vaccines, synthetic peptide vaccines	Immunoblotting.
	SLO-2					
S-20	SLO-1	Adjuvant and Hapten	Kinetics of primary and secondary immune responses	Major histocompatibility complex (MHC) genes and products	antiidiotypic vaccines	Complement fixation test.
	SLO-2					
S21-24	SLO-1	Pregnancy test	Single Radial immunodiffusion	Counter current immunoelectrophorosis	Rocket immunoelectrophorosis	Model exam
	SLO-2					

Learning Resources	1. Richard A. Goldsby "Immunology" 2. Barbara, A. Osborne, Janis KubyImmunology", 5th Edition, W. H. Freeman & Company, 2006 3. Ivan Roitt. Element of Immunology. Wiley Blackwell publication, 13th edition, 2017

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	20%	20%	10%	15%	15%	10%	10%	15%	15%
	Understand										
Level 2	Apply	20%	20%	30%	20%	20%	20%	20%	30%	20%	20%
	Analyze										
Level 3	Evaluate	10%	10%	10%	10%	15%	15%	10%	10%	15%	15%
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Short Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Higher Technical Institutions	Internal Experts
1. Dr. M. Sujatha, Associate Professor & HOD, Department of Biotechnology, Ethiraj College for Women, Chennai 2. Dr. M. Rajeshwari Hari, Associate Professor & HOD, Department of Biotechnology, MGR University	Dr. N. Prasanth Bhatt

Course Code	PBC21202J	Course Name	METABOLISM AND REGULATION	Course Category	C	*Professional Core Course*	L	T	P	C
							4	0	4	6

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

Course Learning Rationale (CLR):	The purpose of learning this course is to,	Learning
CLR-1 :	Understanding the concept of metabolism of biomolecules	
CLR-2 :	Regulatory pathways involved in maintaining the metabolism	
CLR-3 :	Understand the importance of the compounds involved in the metabolism	
CLR-4 :	Understand the importance of metabolism in various diseases	
CLR-5 :	To know the mechanism of production of biomolecules	
CLR-6 :	Estimation of various metabolic products	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	1 Level of Thinking (Bloom)	2 Expected Proficiency (%)	3 Expected Attainment (%)	Program Learning Outcomes (PLO) 1 Fundamental Knowledge	2 Application of Concepts	3 Link with Related Disciplines	4 Procedural Knowledge	5 Skills in Specialization	6 Ability to Utilize Knowledge	7 Skills in Modeling	8 Analyze, Interpret Data	9 Investigative Skills	10 Problem Solving Skills	11 Communication Skills	12 Analytical Skills	13 PSO - 1	14 PSO - 2	15 PSO – 3
CLO-1 :	Students will acquire the concept of anabolism, catabolism	2	85	80	H	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-2 :	Students will acquire knowledge related to regulation of various pathways	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-3 :	Know the importance of high energy compounds	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-4 :	Perturbations in the carbon metabolism can lead to various disorder	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-5 :	student will gain insights into metabolic engineering for the production of useful biomolecules	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-6 :	preparation of buffers, estimation of glucose , proteins in serum samples, isolation of lipids from egg and estimation of serum cholesterol	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-

Duration (hour)		**24**	**24**	**24**	**24**	**24**
S-1	**SLO-1**	Anabolism and catabolism	Glycolysis Pathway and conditions required for glycolysis	Fatty acid synthesis- Introduction	General reaction of amino acid degradation	Ultra structure of mitochondrion
S-2	**SLO-1**	Laws of Thermodynamics - first and second law	Regulation of Glycolysis	Fatty acid synthase complex	Transamination,	electron transport chain
S-3	**SLO-1**	Concept of enthalpy	Oxidative decarboxylation	**Biosynthesis of Fatty acids**	Deamination	electron transport chain
S-4	**SLO-1**	Entropy and free energy	TCA pathway	**Biosynthesis of Fatty acids-Regulation**	decarboxylation	electron transport chain
S 5-8	**SLO-1**	**Preparation of acidic and basic buffers**	**Estimation of blood glucose by DNS method.**	**Protein estimation by Biuret method**	**Isolation of lipids from egg yolk and separation by TLC.**	**Estimation of serum cholesterol**

S-9	**SLO-1**	Endergonic and exergonic reactions	Role of TCA in metabolism- Gluconeogensis, transamination	Oxidation of fatty acids- Alpha and Beta	Urea cycle	ETC Complex I, II
S-10	**SLO-1**	Coupled reactions	Deamination, Fatty acid synthesis	Oxidation of fatty acids- omega	Urea cycle and significance	ETC Complex III and IV
S-11	**SLO-1**	ATP as energy source	Energetics of Glucose metabolism	Regulation of Ketogenesis	Catabolism of Asparagine, glutamine	Uncouplers and inhibitors of respiration
S-12	**SLO-1**	High energy compounds- NADH and	Glycogensis & glycogenolysis	Synthesis of Polyunsaturated fatty acids	Amino acids that form pyruvate	Uncouplers and inhibitors of respiration
S 13-16	**SLO-1** **SLO-2**	**Preparation of acidic and basic buffers**	**Estimation of blood glucose by DNS method.**	**Assay of salivary amylase**	**Isolation of lipids from egg yolk and separation by TLC.**	**Estimation of serum cholesterol**
S-17	**SLO-1**	FADH2	Role of cAMP in glycogen metabolism	Synthesis of Polyunsaturated fatty acids	Cysteine sulphonate pathway	Oxidative phosphorylation
S-18	**SLO-1**	free energy change during hydrolysis	Gluconeogenesis and its regulatory nature	Role of cyclooxygenase in eicosanoids formation	Tyrosine metabolism	Formation of ATP-Outline of Mitchell's hypothesis
S-19	**SLO-1**	pyrophosphate	Pentose Phosphate pathway	Metabolism of acylglycerol	Catabolism of Tryptophan	Substrate level phosphorylation
S-20	**SLO-1**	Revision	Regulation involved in PPP	Metabolism of phospholipids	Revision	Revision
S 21-24	**SLO-1** **SLO-2**	**Determination of pKa value of amino acid using pH meter**	**Protein estimation by Biuret method**	**Assay of salivary amylase**	**Isolation of lipids from egg yolk and separation by TLC.**	**Model Examination for practicals**

Learning Resources	***1.*** *R.K.Murray, D.K. Granner, P.A. Mayes and V.W. Rodwell, HARPER'S BIOCHEMISTRY, 22nd edn. (1990), Prentice-Hall, International, USA.* ***2.*** *Nelson and Cox, LEHNINGER's PRINCIPLES OF BIOCHEMISTRY, (2000), KalyaniPublishers,Ludhiana/Worth Publishers, Inc., New York.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
	Understand										
Level 2	Apply	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
	Analyze										
Level 3	Evaluate	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Higher Technical Institutions	Internal Experts
1. Dr. M. Sujatha, Associate Professor & HOD, Department of Biotechnology, Ethiraj College for Women, Chennai 2. Dr. M. Rajeshwari Hari, Associate Professor & HOD, Department of Biotechnology, MGR University	Dr. N. Prasanth Bhatt

Course Code	PBC21203T	Course Name	CLINICAL BIOCHEMISTRY-I	Course Category	C	*Professional Core Course*	L	T	P	C
							4	0	0	4

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning	Program Learning Outcomes (PLO)

		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Understanding the inborn errors of carbohydrate metabolism			
CLR-2 :	Understanding the inborn errors of aminoacid metabolism and liver function test			
CLR-3 :	Knowledge on GI function test, renal function test and their interpretations			
CLR-4 :	Comprehend basic concepts of diagnosis of diseases			
CLR-5 :	Knowledge on tumors and its spread			
CLR-6 :	Learn the mechanisms of carcinogenesis and knowledge on oncogenic markers			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO – 1	PSO - 2	PSO – 3
CLO-1 :	Understand biochemical mechanisms and pathophysiological processes responsible for common biochemical disorders	*4*	*85*	*80*	*H*	-	-	*H*	-	-	-	-	*L*	*M*	-	*M*	-	-	-
CLO-2 :	Aware of normal and abnormal metabolic functions	*4*	*80*	*75*	*H*	*H*	-	*H*	*H*	-	-	-	*M*	*M*	-	*M*	-	-	-
CLO-3 :	Understand impact of disorders on metabolic processes	*4*	*85*	*80*	*H*	*H*	-	*H*	*H*	-	-	-	*M*	*M*	-	*H*	-	-	-
CLO-4 :	Molecular basis of the diseases	*4*	*85*	*80*	*H*	*H*	-	*H*	-	-	-	-	*M*	*M*	-	*H*	-	-	-
CLO-5 :	Understand the biochemistry of metastasis of cancer	*4*	*85*	*80*	*H*	*H*	*H*	*H*	*H*	-	-	-	*M*	*M*	-	*M*	-	-	-
CLO-6 :	Understand the types, characteristics and classification of tumor markers	*4*	*75*	*80*	*H*	*H*	*H*	*H*	*H*	-	-	-	*M*	*M*	-	*M*	-	-	-

Duration (hour)		*12*	*12*	*12*	*12*	*12*
S-1	*SLO-1*	*Disorder of carbohydrate metabolism*	*Disorders of amino acid metabolism– amino aciduria, Phenylketonuria,*	*Detoxifying- hippuric acid, NH3, aminopyrine.*	*Alkaline phosphatases,.*	*amylase*
S-2	*SLO-1*	*Glycogen storage diseases,*	*Hartnup disease, alkaptonuria,*	*Metabolic functions- galactose. Gall stones. syndrome*	*LDH*	*CK*
S-3	*SLO-1*	*Galactosemia,*	*albinism, cystinuria, cystinosis,*	*Gastric function tests- Stimulation tests*	*Insulin and pentagastrin.*	*Cancer cell – morphology and growth characteristics*
S-4	*SLO-1*	*Fructose intolerance and fructosuria.*	*homocystinuria and maple syrup urine disease..*	*Peptic ulcer, gastritis*	*Zollinger Ellison*	*Biochemical changes in tumor cells*
S-5	*SLO-1*	*Blood sugar homeostasis: Role of tissues and hormones in the*	*Disorders of purine, pyrimidine metabolism*	*Introduction :Renal function test and metabolic disorders*	*Differences between benign and malignant tumors*	*Tumor markers – AFP, CEA and HcG*

		maintenance of blood sugar. Hypoglycemia, hyperglycemia	*Hyperuricemia and gout.*	*Kidney function- Biochemical findings in glomerulonephritis*		
S-6	*SLO-1*	*Diabetes mellitus – classification*	*Hypouricemia. Oroticaciduria.*	*Renal failure*	*nephritic syndrome.*	*Agents causing cancer – radiation, viruses, chemicals*
S-7	*SLO-1*	*Disorders of lipid metabolism – lipoproteinaemias*	*. Serology: C reactive protein test,*	*Nephrolithiasis.*	*Multistep carcinogenesis – initiation,*	*Multistep carcinogenesis Promotion, progression.*
S-8	*SLO-1*	*. Lipid storage diseases – Gaucher's,.*	*Rheumatoid arthritis (RA) test*	*Kidney function tests - Glomerular function tests – inulin, urea and creatinine clearance tests,*	*Oncogenes*	*proto oncogenes*
S-9	*SLO-1*	*TaySach'sNiemann Pick disease. Fatty liver*	*Liver function test -Jaundice- Causes, consequences Treatment in jaundice, hepatitis and cirrhosis.*	*Renal plasma flow, plasma microglobulin concentration.Tubular function tests – water load Acid excretion test*	*Mechanisms of protooncogene activation*	*Tumor suppressor genes*
S-10	*SLO-1*	*Atherosclerosis*	*Liver function test. Tests related to excretory-bile pigments*	*Abnormal constituents of urine.*	*Clinical enzymology - Serum enzymes and isoenzymes in health and disease*	*p53*
S-11	*SLO-1*	*glycosuria*	*synthetic plasma proteins ,Prothrombin time*	*Transaminases*	*Cancer treatment*	*Chemotherapy and Radiation therapy*
S-12	*SLO-1*	*Blood glucose value*	*Cycle test-1*	*AST, ALT acid*	*Cycle test-2*	*Model exam*

Learning Resources	1. Clinical Biochemistry-Allan GAW Michael J, an Illustrated Colour Text, 5th Edition, 2013 2. Textbook of Biochemistry with Clinical Correlation Thomas M Devlin 2nd ed Wiley & Sons. 2006 3. Principles of Internal Medicine. Harrison's Vol 1 & 2, 16th edition McGraw Hill.2005. 4. The Metabolic & Molecular Basis of inherited Diseases, Vol 1 - 4 8th edSerives, Vallersty, Tata McGraw Hill Companies, 2001 5. Clinical Chemistry – Principles, procedures, correlations – Bishop, Lippincott.2000

Learning Assessment

	Bloom's Level of Thinking	**Continuous Learning Assessment (50% weightage)**								**Final Examination (50% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (20%)**		**CLA – 4 (10%)**			
		Theory	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**
Level 1	Remember Understand	40%	-	30%	-	30%	-	30%	-	30%	-
Level 2	Apply Analyze	40%	-	40%	-	40%	-	40%	-	40%	-
Level 3	Evaluate Create	20%	-	30%	-	30%	-	30%	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

Course Designers

Experts from Higher Technical Institutions	**Internal Experts**
1. Dr. M. Sujatha, Associate Professor & HOD, Department of Biotechnology, Ethiraj College for Women, Chennai 2. Dr. M. Rajeshwari Hari, Associate Professor & HOD, Department of Biotechnology, MGR University	Dr.D. Sankari

Course Code	PBC21S01T	Course Name	Analytical Techniques	Course Category	*D*	. Discipline Specific Elective Course	L	T	P	C
							4	0	0	4

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning	Program Learning Outcomes (PLO)

		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Understanding the basics and theoretical principles of analytical techniques			
CLR-2 :	Learning about the concepts and theories of chromatographic techniques			
CLR-3 :	Understanding the principles, basic design and types of centrifugation			
CLR-4 :	Comprehend basic concepts of radioactivity and its measurement techniques			
CLR-5 :	Imparting knowledge on the separation of biomolecules			
CLR-6 :	Acquire skills on spectroscopic techniques			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO – 1	PSO - 2	PSO – 3
CLO-1 :	Apply knowledge on basic bioinstrumentation	*4*	*85*	*80*	*H*	-	-	*H*	-	-	-	-	*L*	*M*	-	*M*	-	-	-
CLO-2 :	Knowledge on chromatography can be value-added	*4*	*80*	*75*	*H*	*H*	-	*H*	*H*	-	-	-	*M*	*M*	-	*M*	-	-	-
CLO-3 :	Aware of methodologies available for cellular fractionation	*4*	*85*	*80*	*H*	*H*	-	*H*	*H*	-	-	-	*M*	*M*	-	*H*	-	-	-
CLO-4 :	Product quantification using various analytical methods	*4*	*85*	*80*	*H*	*H*	-	*H*	-	-	-	-	*M*	*M*	-	*H*	-	-	-
CLO-5 :	Understand the principles of electrophoretic and spectroscopic techniques	*4*	*85*	*80*	*H*	*H*	*H*	*H*	*H*	-	-	-	*M*	*M*	-	*M*	-	-	-
CLO-6 :	Understand the applications of various analytical techniques and methods of assessing their performance	*4*	*75*	*80*	*H*	*H*	*H*	*H*	*H*	-	-	-	*M*	*M*	-	*M*	-	-	-

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		12	12	12	12	12
S-1	SLO-1	Electrochemical techniques	Chromatographic techniques	GLC	Scintillation counter – Principle,	Spectroscopy: Laws of absorption and absorption spectrum
S-2	SLO-1	Electrochemical cells and reaction	General principle- chromatography	HPLC	Scintillation counter – types and applications.	CD, ORD
S-3	SLO-1	pH and buffers	adsorption chromatography	HPTLC	Use of isotopes in biological studies.	Principle, instrumentation and applications of UV-visible spectrophotometry
S 4	SLO-1	Measurement of pH	partition chromatography	Centrifugation Principles,	Electrophoresis - Principle	ESR,
S-5	SLO-1	glass electrode, titration curves	application of paper and of column chromatography	Differential and analytical centrifugation	electrophoretic mobility - factors influencing electrophoretic mobility	NMR,

S 6	SLO-1	Ion selective electrodes, gas sensing electrodes, oxygen electrode	thin layer chromatography	density gradient centrifugation	paper, disc, slab gel electrophoresis	IR
S-7	SLO-1	Applications of Electrochemical techniques	normal phase chromatography	Analysis of sub cellular fractions	Isoelectric focusing - 2D PAGE	Spectrofluorimetry
	SLO-1	Methods for studying cells and organelles.	reverse phase chromatography	ultracentrifuge and its application	blotting techniques	Basic principles of turbidimetry and nephelometry
S -9	SLO-1	Methods for lysis of plant	ion-exchange chromatography	Tracer technique	capillary electrophoresis	Principle, instrumentation and applications of luminometry
S-10	SLO-1	animal and microbial cell	exclusion chromatography	Nature of Radioactivity	Pulse field Electrophoresis	Atomic spectroscopy – principle and applications of atomic flame spectrophotometry
S-11	SLO-1	Sub-cellular fractionation	affinity chromatography	Patterns of decay, half life and its application	Isotachophoresis	Atomic spectroscopy – principle and applications of atomic flame and flameless spectrophotometry
S-12	SLO-1	purification of bio-components.	Cycle test 1	Geiger Muller Counter- principle and applications	Cycle test 2	lasers for spectroscopy - MALDI TOF

Learning Resources	Theory: Principles and Techniques of Biochemistry and Molecular Biology by Keith Wilson (Editor), John Walker (Editor) Analytical Techniques in Biochemistry and Molecular Biology By Rajan Katoch

Learning Assessment

Level	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%) #			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	30%	-	30%	-	30%	-	30%	-	30%	-
	Understand										
Level 2	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
	Analyze										
Level 3	Evaluate	30%	-	30%	-	30%	-	30%	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Higher Technical Institutions	Internal Experts
1. Dr. M. Sujatha, Associate Professor & HOD, Department of Biotechnology, Ethiraj College for Women, Chennai 2. Dr. M. Rajeshwari Hari, Associate Professor & HOD, Department of Biotechnology, MGR University	Mrs. Vijayabharathi

Course Code	PBC21S02T	Course Name	Pharmaceutical Biochemistry	Course Category	S	Skill Enhancement Courses	L	T	P	C
							2	0	0	2

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

Course Learning Rationale (CLR):	The purpose of learning this course is to,
CLR-1 :	Understanding the Drug structural features
CLR-2 :	Understanding the effects of drug
CLR-3 :	Knowledge on pharma in biotechnology
CLR-4 :	Knowledge on mechanism of drug therapy
CLR-5 :	Learning different types of drugs
CLR-6 :	Candidates understanding on drugs on synthetic and plant origin

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	To learn about drug concepts	2	85	80	H	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-2 :	Gathering knowledge on drug action	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-3 :	Applying knowledge on treating ailments using drugs	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-4 :	Applying knowledge on different diseases	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-5 :	Having knowledge on mechanism of drug action	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-
CLO-6 :	Overall understanding of drug mechanism and role	3	85	80	L	H	H	H	H	H	M	M	M	L	-	H	-	-	-

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		12	12	12	12	12
S-1	SLO-1	Drug - Structural feature	Adverse response to drugs	Biotechnology and pharmacy	Mechanism of action of drugs in therapy	Drugs of plant origin
S-2	SLO-1	pharmacology activity	Drug tolerance	Genetically engineered protein	Respiratory system – cough	Drug dependence and abuse
S-3	SLO-1	Prodrug concept	Drug intolerance	GM protein effects	bronchial – asthma	Management of self poisoning cancer
S 4	SLO-1	Absorption	Idio syneracy (pharmacogenesis)			
S-5	SLO-1	pass effect	drug allergy	Novel drug delivery systems	pulmonary tuberculosis	Chemotherapy – Cytotoxic drug
S 6	SLO-1	Distribution, metabolism	Tachyphylaxis	Non conventional routes of administration	GIT – Digestants	Immuno suppressive drug therapy

S-7	SLO-1	Phase I, II reactions	CT I	CT II	appetite suppressants	Antimicrobial drugs
S-8	SLO-1	action of cytochrome p450	vaccination against infection	Anti-AIDS drug development	Appetite improviser	sulfonamides, trimethoprim
S -9	SLO-1	elimination of drug receptor	Factor that modifies the effect of drug	peptide agents	vomiting, constipation and peptic ulcer	cotrimoxazole
S-10	SLO-1	localization, type and subtypes	Drug abuse	Oncogenes	Hypolipidemia agents	penicillin, and macrolides. Aminoglycosides
S-11	SLO-1	models and their drug – receptor interaction	Assay of drug potency	Oncogenes ras target for drugs	Cephalosporin	New Biological Targets for Drug Development
S-12	SLO-1	agonist & antagonist effect	bioassay and immunoassay	multi-drug resistance	bacterial resistance	Novel Drug Screening Strategies

Learning Resources	1.The pharmacology Vol I and II- Goodman And Gillman, Mc Graw Hill 2. Basic pharmacology- Foxtercox Bulter Worth's 1980	1.Pharmacology and pharmacotherapeutics- R.S.Satoskar. S.D.Bhandhakar & S.S.Anilapure Popular Prakashar Bombay. 2.Oxford textbook of clinicasl pharmacology and drug therapy. D.G. Burger's medicinal Chemistry & Drug Discovery.

Learning Assessment

Level	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%) #			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	30%	-	30%	-	30%	-	30%	-	30%	-
	Understand										
Level 2	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
	Analyze										
Level 3	Evaluate	30%	-	30%	-	30%	-	30%	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Higher Technical Institutions	Internal Experts
1. Dr. M. Sujatha, Associate Professor & HOD, Department of Biotechnology, Ethiraj College for Women, Chennai 2. Dr. M. Rajeshwari Hari, Associate Professor & HOD, Department of Biotechnology, MGR University	Dr. T.G. Nithya

Course Code	PBC21S03T	Course Name	Proteomics	Course Category	S	Skill Enhancement Course	L	T	P	C
							2	0	0	2

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Understand the global characterization of the proteome			
CLR-2 :	Learning the broad knowledge of methods and applications within proteomics.			
CLR-3 :	Understanding the strategies to analyze the transcriptome and the proteome			
CLR-4 :	Learning protein-protein interactions			
CLR-5 :	Understanding the protein expression patterns at a given time			
CLR-6 :	obtain a quantitative description of protein expression and its changes under the influence of biological perturbations			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	Allow greater understanding of the complexity of life and the process of evolution than the study of the genetic code alone.	*3*	*80*	*70*
CLO-2 :	Applications of technologies for the identification and quantification of overall proteins	*3*	*80*	*70*
CLO-3 :	Structural proteomics is to determine the structure of all proteins in a cell or organism	*3*	*85*	*75*
CLO-4 :	Understand protein expression profiling	*3*	*85*	*75*
CLO-5 :	Knowledge on proteomics in the drug industry	*3*	*85*	*75*
CLO-6 :	Proteomics complements genomics and is useful when scientists want to test their hypotheses that were based on genes	*3*	*80*	*70*

		Program Learning Outcomes (PLO)														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	ICT Skills	Professional Behavior	Life Long Learning
CLO-1 :		*M*	*M*	*M*	-	*M*	*H*	*M*	-	-	*H*	*H*	*H*	*M*	*H*	*H*
CLO-2 :		*M*	*M*	*M*	-	*M*	*H*	*M*	-	-	*H*	*H*	*H*	*M*	*H*	*H*
CLO-3 :		*M*	*M*	*M*	-	*M*	*H*	*M*	-	-	*H*	*H*	*H*	*M*	*H*	*H*
CLO-4 :		*M*	*M*	*M*	-	*M*	*H*	*M*	-	-	*H*	*H*	*H*	*M*	*H*	*H*
CLO-5 :		*M*	*M*	*M*	-	*M*	*H*	*M*	-	-	*H*	*H*	*H*	*M*	*H*	*H*
CLO-6 :		*M*	*M*	*M*	-	*M*	*H*	*M*	-	-	*H*	*H*	*H*	*M*	*H*	*H*

Duration (hour)		6	6	6	6	6
S-1	SLO-1	Protein structure	Homology modelling	Image analysis of 2-DE gel.	*SBDD*	Applications of docking in drug discovery
	SLO-2	Protein conformations	Swiss model	Phylogeny	*LBDD*	*ADMET*
S-2	SLO-1	Primary structure	fold recognition	*Applications of phylogenetic analysis*	*Drug Development*	*Applications of proteomics*
	SLO-2	Secondary structure	ab initio methods	*Methods to construct phylogenetic tree*	*Drug Development*	Use of proteomics for understanding diseases
S-3	SLO-1	Motifs and domains in protein structure	CASP	*Methods to construct phylogenetic tree*	*Terget identification*	new targets for anti-cancer drugs
	SLO-2	Tertiary structure	Gel-based proteomics	*UPGMA*	Target validation	Drugs that rescue mutant p53

S-4	**SLO-1**	Quarternary structure	Two dimensional gel electrophoresis (2-DE)	*UPGMA*	*Hits and Leads*	systems biology – introduction
	SLO-2	Amino acids	Sample Preparation	*NJ*	Cycle test 2	systems biology – overview
S-5	**SLO-1**	Classification of aminoacids	Solubilization	*NJ*	*ADMET*	systems biology – concepts
	SLO-2	Properties of aminoacids	Cycle test 1	*Drug*	*Molecular docking*	systems biology – applications
S-6	**SLO-1**	Cellular functions performed by proteins	Reduction, Resolution, Reproducibility of 2-DE	*Drug discovery pipeline*	*Molecular docking – methods*	systems biology – importance
	SLO-2	Computational analysis of protein structure	Detecting proteins in polyacrylamide gels	*Drug discovery pipeline*	*Molecular docking – tools*	Revision

Learning Resources	Theory 1. Introduction to Proteomics - Principles and Applications By Nawin C. Mishra, Günter Blobel 2. Principles of Proteomics By Richard Twyman

Learning Assessment

Level	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%) #			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	30%	-	30%	-	30%	-	30%	-	30%	-
	Understand										
Level 2	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
	Analyze										
Level 3	Evaluate	30%	-	30%	-	30%	-	30%	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA-1, CLA-2 and CLA-3 can be from any combination of these: Online Aptitude Tests, Classroom Activities, Case Studies, Poster Presentations, Power-point Presentations, Mini Talks, Group Discussions, Mock interviews, etc.
CLA – 4 can be from any combination of these: Assignments, Seminars, Short Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers	
Experts from Higher Technical Institutions	**Internal Experts**
1. Dr. M. Sujatha, Associate Professor & HOD, Department of Biotechnology, Ethiraj College for Women, Chennai 2. Dr. M. Rajeshwari Hari, Associate Professor & HOD, Department of Biotechnology, MGR University	Dr. V.G. Vidhya

Course Code	PCD21AE2T	Course Name	GENERAL APTITUDE FOR COMPETITIVE EXAMINATIONS	Course Category	A	ABILITY ENHANCEMENT COURSE	L	T	P	C
							1	0	0	1

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Career Development Centre		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1:	recapitulate fundamental mathematical concepts and skills			
CLR-2:	provide context - based vocabulary enhancement			
CLR-3:	sharpen logical reasoning through skilful conceptualization			
CLR-4:	familiarize with basic grammatical and syntactical rules			
CLR-5:	enable to solve problems and to crack competitive exams			
CLR-6:	develop new strategies to enhance reading comprehension			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)															
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	ICT Skills	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1:	*build a strong base in the fundamental mathematical concepts*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-2:	*acquire strategies to build vocabulary*	2	80	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-3:	*apply the learn conditions towards solving problems analytically*	2	75	70	H	H	H	H	H	H	H	H	M	H	M	H	H	H	H
CLO-4:	*learn grammatical and syntactical rules*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-5:	*grasp the approaches and strategies to solve problems with speed and accuracy*	2	80	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-6:	*improve reading comprehension strategies*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H

Duration (hour)		3	3	3	3	3
S-1	SLO-1	Logical Reasoning I	Vocabulary from inference to meaning	Numbers - I	Error Identification - I	Data Sufficiency
	SLO-2	Solving Problems	Vocabulary from inference to meaning	Numbers - I	Error Identification - I	Data sufficiency
S-2	SLO-1	Logical Reasoning - I	Cloze passage	Numbers - II	Error Identification - II	Data Interpretation
	SLO-2	Solving Problems	Cloze passage	Numbers - II	Error Identification - II	Data Interpretation
S-3	SLO-1	Logical Reasoning - I	Sentence Completion	Numbers - III	Sentence Correction - I	Sentence Correction - II
	SLO-2	Solving problems	Sentence Completion	Numbers - III	Sentence Correction - I	Sentence Correction - II

Learning Resources	1. Quantitative aptitude – r s agarwal 2. Quantitative aptitude – ARUN SARMA 3. ManhattanPrepGMAT Sentence Correction Guide–Avi Gutman	4. GRE Contextual.Vocabulary–Ken Springer

Learning Assessment

	Bloom's Level of Thinking	**Continuous Learning Assessment (50% weightage)**								**Final Examination (50% weightage)**	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	30 %	-	30 %	-	30 %	-	30 %	-	30 %	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40 %	-
Level 3	Evaluate Create	30 %	-	30 %	-	30 %	-	30 %	-	30 %	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers

Experts from Industry	Internal Experts	
1. Mr Nishith Sinha, dueNorth India Academics LLP, Dehradun,**nsinha.alexander@gmail.com**	*1. Dr.P.Madhusoodhanan SRMIST*	3. Dr. A Clement, SRMIST
2.Mr Ajay Zenner, Career Launcher, **ajay.z@careerlauncher.com**	2. Dr.M.Snehalatha SRMIST	4. Dr. J Jayapragash, SRMIST

SEMESTER III

Course Code	PBC21301J	Course Name	Clinical Biochemistry -II	Course Category	C	CORE PROFESSIONAL COURSE	L	T	P	C
							4	0	4	6

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
CLR-1 :	Understanding basics and scope of clinical biochemistry	1	2	3
CLR-2 :	Acquire skills in collection of clinical samples			
CLR-3 :	Knowledge on Hb, heme metabolism and its associated disorders			
CLR-4 :	Understanding the types and metabolism of lipoproteins, and its associated disorders			
CLR-5 :	Knowledge on the enzyme functions and their correlation in disease conditions.			
CLR-6 :	Knowledge on composition, physical and chemical characteristics of CSF and pregnancy			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bl...)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	Understand the clinical aspects of biochemistry	*4*	*85*	*80*
CLO-2 :	Aware of various methodologies for clinical samples collection	*4*	*80*	*75*
CLO-3 :	Gain knowledge on hemoglobin and its metabolic disorders	*4*	*85*	*80*
CLO-4 :	Gain knowledge on lipoprotein metabolism	*4*	*85*	*80*
CLO-5 :	Understand the diagnostic uses and applications of clinical enzymes	*4*	*85*	*80*
CLO-6 :	Gain general knowledge of the interpretative aspects of clinical biochemistry	*4*	*75*	*80*

Program Learning Outcomes (PLO)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Fundamental K...dge	Problem Analysis	Design & D...ment	Analysis, Design, R...arch	Modern Tool Usage	Society & Culture	Environment & S...ility	Ethics	Individual & Team W...k	Communication	Project Mgt. & F...ce	Life Long Learning	PSO – 1	PSO - 2	PSO – 3
H	-	-	*H*	-	-	-	-	*L*	*M*	-	*M*	-	-	-
H	*H*	-	*H*	*H*	-	-	-	*M*	*M*	-	*M*	-	-	-
H	*H*	-	*H*	*H*	-	-	-	*M*	*M*	-	*H*	-	-	-
H	*H*	-	*H*	-	-	-	-	*M*	*M*	-	*H*	-	-	-
H	*H*	*H*	*H*	*H*	-	-	-	*M*	*M*	-	*M*	-	-	-
H	*H*	*H*	*H*	*H*	-	-	-	*M*	*M*	-	*M*	-	-	-

Duration (hour)		24	24	24	24	24
S-1	SLO-1	Introduction to clinical Biochemistry	**Chemistry of haemoglobin**	**Lipoprotein metabolism**	**Clinical Enzymology**	**CSF** – chemistry and clinical significance
S-2	SLO-1	Definition and Scope of Clinical Biochemistry	Varieties of Hb	Chylomicrons and its metabolism	Enzymes as thrombolytic agents	Proteins in CSF
S-3	SLO-1	Scope of Clinical Biochemistry in Diagnosis	Derivatives of Hb	HDL and its metabolism	Enzymes as antiinflammatory agents	Chemical constituents of CSF
S-4	SLO-1	Collection and Preservation of Blood	Abnormal Hb and Haemoglobinopathies	VLDL and its metabolism	Diagnostic uses of enzymes	hypoproteinemia, Albumin, hypoalbumenia
S-5-8	SLO-1	Requirements of setting up of Clinical Laboratory, Safety measures in clinical laboratory	Estimation of blood glucose by ortho-toluidine method	Estimation of urea in urine by Diacetyl monoxime method	Alkaline Phosphatase -Serum	Estimation of creatinine in urine by Jaffe's method
S-9	SLO-1	Collection of and preservation of CSF	Porphyrins and its synthesis	LDL and its metabolism	Serum enzymes in heart diseases	Pregnancy
S-10	SLO-1	Collection of Stool	Porphyria	ApoA, apoB, apoC and their receptors	Serum enzymes in liver diseases	Hormonal imbalance and Pregnancy, symptoms

S-11	SLO-1	Complete blood count	Porphyrinuria	Clinical disorders associated with lipoprotein metabolism	Serum enzymes in GI tract diseases	Diet in pregnanacy
S-12	SLO-1	Normal values of important constituents of blood, CSF and urine	Heme catabolism	Atherosclerosis and its risk Factor	Serum enzymes in muscle diseases	HCG, HCG injection Side effects
S-13-16	SLO-1	Collection and preservation Of urine	Qualitative analysis of urine sample for normal and abnormal constituents	Estimation of urea in serum by Diacetyl monoxime method	Estimation of Alkaline phosphatase in serum	Estimation of creatinine in Serum
S-17	SLO-1	Preparation of clinical sample	Sources of bilirubin	Fatty liver	Serum enzymes in bone diseases	Pregnancy and PCOS
S-18	SLO-1	Handling of Clinical sample	Transport of bilirubin	Fat absorption and metabolism	Value of enzymes in malignancies	Pregnancy and Diabetes
S-19	SLO-1	Preservation of Clinical sample	Excretion of bilirubin	Transport and storage	Isoenzymes	Pregnancy and Hypothyroidism
S-20	SLO-1	Quality control	**Cycle test-1**	Hyperlipidemia	**Cycle test -2**	**Model exam**
S-21-24	SLO-1 SLO-2	Plasma and serum preparation	Qualitative analysis of urine sample for normal and abnormal constituents	SGPT	SGOT	Revision

Learning Resources	1. Clinical Biochemistry-Allan GAW Michael J, an Illustrated Colour Text, 5th Edition, 2013 2. Textbook of Biochemistry with Clinical Correlation Thomas M Devlin 2nd ed Wiley & Sons. 2006 3. Principles of Internal Medicine. Harrison's Vol 1 & 2, 16th edition McGraw Hill.2005. 4. The Metabolic & Molecular Basis of inherited Diseases, Vol 1 - 4 8th edSerives, Vallersty, Tata McGraw Hill Companies, 2001 5. Clinical Chemistry – Principles, procedures, correlations – Bishop, Lippincott.2000

Learning Assessment

	Bloom's Level of Thinking	**Continuous Learning Assessment (50% weightage)**								**Final Examination (50% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (20%)**		**CLA – 4 (10%)**			
		Theory	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**
Level 1	Remember Understand	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
Level 2	Apply Analyze	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Level 3	Evaluate Create	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Total	100 %		100 %		100 %		100 %		100 %	

Course Designers

Experts from Higher Technical Institutions	**Internal Experts**
1. Dr. M. Sujatha, Associate Professor & HOD, Department of Biotechnology, Ethiraj College for Women, Chennai 2. Dr. M. Rajeshwari Hari, Associate Professor & HOD, Department of Biotechnology, MGR University	Dr. D. Sankari

Course Code	PBC21302T	Course Name	Biotechnology	Course Category	A	*Professional Core Course*	L	T	P	C
							4	0	0	4

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO - 1	PSO - 2	PSO – 3
CLR-1 :	Knowledge on the concept of recombinant DNA technology.																		
CLR-2 :	Acquire skills on techniques of construction of recombinant DNA																		
CLR-3 :	Basic knowledge on gene manipulation and identification techniques																		
CLR-4 :	Knowledge on clone identification and principles of PCR and its applications																		
CLR-5 :	Understanding the various types of vectors																		
CLR-6 :	Learning about the relevance, concepts and theories of using rDNA technology for commercial applications																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	Apply knowledge about rDNA biotechnology	*3*	*80*	*70*	*H*	-	-	*H*	-	-	-	-	*H*	*H*	-	-	*M*	*H*	*H*
CLO-2 :	Have knowledge on basic principles behind DNA cloning	*3*	*85*	*75*	*H*	*H*	*H*	*H*	*H*	-	*M*	-	*H*	*H*	-	-	*M*	*H*	*H*
CLO-3 :	Aware of various methodologies for clone identification	*3*	*75*	*70*	*H*	-	-	*H*	-	-	*M*	-	*H*	*H*	-	-	*M*	*H*	*H*
CLO-4 :	Product identification using various analytical methods	*3*	*85*	*80*	*H*	-	-	*H*	-	-	-	-	*H*	*M*	-	-	*M*	*H*	*H*
CLO-5 :	Understand the various types of vectors in constructing rDNA	*3*	*85*	*75*	*H*	*H*	*H*	*H*	*H*	*M*	*M*	-	*H*	*H*	-	*M*	*M*	*H*	*H*
CLO-6 :	Understand the commercial applications of the rDNA technology	*3*	*80*	*70*	*H*	*H*	*H*	*H*	*H*	-	-	-	*H*	*H*	-	-	*M*	*H*	*H*

Duration (hour)		*24*	*24*	*24*	*24*	*24*
S-1	*SLO-1*	Overview of recombinant DNA technology	Ligation of DNA molecules	Methods of clone identification- problem of selection	Plasmids as vector	Site–directed mutagenesis
S-2	*SLO-1*	restriction endonucleases- Type I and III	DNA ligase	direct selection, marker rescue	bacteriophages as vector	Site–directed mutagenesis
S-3	*SLO-1*	restriction endonucleases- Type II	sticky ends, blunt ends	Gene libraries- identification of a clone from gene library	Cloning vectors based on *E. coli* plasmids	production of recombinant pharmaceuticals such as insulin
S-4	*SLO-1*	restriction endonucleases- Type II	linkers and adapters	Colony hybridization, plaque hybridization	Vectors for yeast,	human growth hormone
S-5	*SLO-1*	restriction	Synthetic oligonucleotides	Fundamentals of polymerase chain reaction	**Vectors for** higher plants	factor VIII

		endonucleases- Type II				
S-6	*SLO-1*	*Other DNA manipulating enzymes*	Synthesis of DNA fragment	**Designing of PCR primers**	**Vectors for animals**	Recombinant vaccines.
S-7	*SLO-1*	*Gyrase*	Uptake of DNA- methods	Conditions to be maintained during a PCR	pBR322,	Gene therapy.
S-8	*SLO-1*	*Topoisomerases- classification*	preparation of competent cells	Cloning PCR products	pUC8,	plant genetic engineering
S-9	*SLO-1*	**Function of topoisomerases**	Selection for transformed cells.	Real time PCR	pGEM3Z	herbicide resistant crops
S-10	*SLO-1*	**Mechanism of DNAase**	Identification for recombinants - insertional inactivation	Calculation of Ct value	*His tag vectors*	problems with genetically modified plants
S-11	*SLO-1*	**Mechanism of RNAase**	blue-white selection	Melting curve analysis	*Lambda bacteriophage*	*Revision*
S-12	*SLO-1*	*Revision*	electroporation	*Revision*	*M13 cloning vector*	***Revision***

Learning Resources	*REFERENCE:* 1. Biotechnology by U. Sathyanarayana 2. *A Textbook of Biotechnology – R C Dubey*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40%	-	30%	-	30%	-	30%	-	30%	-
	Understand										
Level 2	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
	Analyze										
Level 3	Evaluate	20%	-	30%	-	30%	-	30%	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Higher Technical Institutions	Internal Experts
1. Dr. M. Sujatha, Associate Professor & HOD, Department of Biotechnology, Ethiraj College for Women, Chennai 2. Dr. M. Rajeshwari Hari, Associate Professor & HOD, Department of Biotechnology, MGR University	Dr. G. Swamynathan

Course Code	PBC21D03T	Course Name	Nutritional Biochemistry	Course Category	C	Discipline Specific Elective	L	T	P	C
							4	0	0	4

Pre-requisite Courses	*Nil*	Co-requisite Courses	*NIL*	Progressive Courses	*NIL*
Course Offering Department	*Biochemistry*	Data Book / Codes/Standards	*NIL*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understanding the composition of foods and preservation methods.*			
CLR-2 :	*Understanding the calorific value of food.*			
CLR-3 :	*Students learn about dietary requirement of macro and micronutrients.*			
CLR-4 :	*Knowledge about antioxidants and its importance.*			
CLR-5 :	*Learn about nutrition requirements of different age group.*			
CLR-6 :	*Understanding the causes of obesity.*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Students gain knowledge about preservation methods.*	*3*	*80*	*80*
CLO-2 :	*Students acquire knowledge on basic concept of Nutrition.*	*3*	*90*	*80*
CLO-3 :	*Students understand the importance of nutritional requirements.*	*3*	*90*	*80*
CLO-4 :	*Students gains knowledge about antioxidants.*	*3*	*90*	*80*
CLO-5 :	*Knowledge about role of antioxidants in diseases.*	*3*	*90*	*90*
CLO-6 :	*Students understand the nutritional requirements of different age people.*	*3*	*80*	*80*

Program Learning Outcomes (PLO)															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Scientific Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment &	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO – 1	PSO - 2	PSO – 3
H	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
H	*H*	*H*	*H*	*H*	-	-	-	-	-	-	-	-	-	-
H	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
H	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
H	*H*	*H*	*H*	*H*	-	-	-	-	-	-	-	-	-	-
H	*H*	*H*	*H*	*H*	-	-	-	-	-	-	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	**SLO-1**	Food groups	Concept of nutrition	Dietary sources, nutritional requirements of macronutrients	Free Radicals and Antioxidants– Definition, classification of antioxidants	Growth and development, physiological development-Nutrition for infants
S-2	**SLO-1**	Food groups	**calorific value of foods and its determination (Bomb calorimeter) different components of energy expenditure**	Dietary sources, nutritional requirements of macronutrients	Free Radicals and Antioxidants– Definition, classification of antioxidants	Growth and development, physiological development-Nutrition for infants
S-3	**SLO-1**	Cooking Methods	components of energy expenditure	Dietary sources, nutritional requirements of macronutrients	generation of free radicals	Growth and development, physiological development-Nutrition for children
S 4	**SLO-1**	Cooking Methods	respiratory quotient	Dietary sources, nutritional requirements of micronutrients	generation of free radicals	Growth and development, physiological development-Nutrition for children
S-5	**SLO-1**	Principles and Methods of Preservation	basal metabolic rate (BMR), determination of BMR, factors affecting BMR	Dietary sources, nutritional requirements of micronutrients	role of antioxidants in prevention of degenerative disorders(cancer,CVD and Diabetes Mellitus).	Growth and development, physiological development-Nutrition for adult and old age
S 6	**SLO-1**	Principles and Methods of Preservation	basal metabolic rate (BMR), determination of BMR, factors affecting BMR	Dietary sources, nutritional requirements of micronutrients	role of antioxidants in prevention of degenerative disorders(cancer,CVD and Diabetes Mellitus).	Growth and development, physiological development-Nutrition for adult

S-7	**SLO-1**	Composition of Food	basal metabolic rate (BMR), determination of BMR, factors affecting BMR	Dietary sources, nutritional requirements of micronutrients	role of antioxidants in prevention of degenerative disorders(cancer,CVD and Diabetes Mellitus).	Growth and development, physiological development-Nutrition for age
S -8	**SLO-1**	Composition of Food	Specific dynamic action of foods	Protein-calorie malnutrition.	Definition of Functional Foods and Nutraceuticals	Growth and development, physiological development-Nutrition for old age
S -9	**SLO-1**	Food Additives, Food Adulteration	Specific dynamic action of foods	Protein-calorie malnutrition.	Classifying nutraceuticals	Growth and development, physiological development-Nutrition for Pregnancy and lactation
S-10	**SLO-1**	Food Additives, Food Adulteration	Energy expenditure at rest and work.	Obesity – Definition, Genetic and environmental factors leading to obesity.	Classifying nutraceuticals	Growth and development, physiological development-Nutrition for Pregnancy and lactation
S-11	SLO-1	Food Laws, Food Processing.	Energy expenditure at rest and work.	Obesity – Definition, Genetic and environmental factors leading to obesity.	Food source: plant, animal, microbial	Growth and development, physiological development-Nutrition for Pregnancy and lactation
S-12	SLO-1	Food Laws, Food Processing.	***Cycle test -1***	Obesity – Definition, Genetic and environmental factors leading to obesity.	***Cycle test -2***	***Model exam***

Learning Resources	1. Clinical Biochemistry-Allan GAW Michael J, an Illustrated Colour Text, 5th Edition, 2013 2. Textbook of Biochemistry with Clinical Correlation Thomas M Devlin 2nd ed Wiley & Sons. 2006 3. Principles of Internal Medicine. Harrison's Vol 1 & 2, 16th edition McGraw Hill.2005. 4. The Metabolic & Molecular Basis of inherited Diseases, Vol 1 - 4 8th edSerives, Vallersty, Tata McGraw Hill Companies, 2001 5. Clinical Chemistry – Principles, procedures, correlations – Bishop, Lippincott.2000

Learning Assessment

	Bloom's Level of Thinking	**Continuous Learning Assessment (50% weightage)**								**Final Examination (50% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (20%)**		**CLA – 4 (10%)**			
		Theory	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**
Level 1	Remember	40%	-	30%	-	30%	-	30%	-	30%	-
	Understand										
Level 2	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
	Analyze										
Level 3	Evaluate	20%	-	30%	-	30%	-	30%	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

Course Designers

Experts from Higher Technical Institutions	**Internal Experts**
1. Dr. M. Sujatha, Associate Professor & HOD, Department of Biotechnology, Ethiraj College for Women, Chennai 2. Dr. M. Rajeshwari Hari, Associate Professor & HOD, Department of Biotechnology, MGR University	Mrs. S. Vijayabharathi

Course Code	PBC21D04T	Course Name	Hormonal Biochemistry	Course Category	C	Discipline Specific Elective course	L	T	P	C
							4	0	0	4

Pre-requisite Courses	*Nil*	Co-requisite Courses	*NIL*	Progressive Courses	*NIL*
Course Offering Department	*Biochemistry*	**Data Book / Codes/Standards**		*NIL*	

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***	**Learning**
CLR-1 :	*Understanding cell communication process.*	
CLR-2 :	*Knowledge on types of receptors.*	
CLR-3 :	*Knowledge on mechanism of hormonal action.*	
CLR-4 :	*Understanding the importance of hormonal balance.*	
CLR-5 :	*Understanding the hierarchy of hormone secretion.*	
CLR-6 :	*Understanding the physiological and biochemical role of hormones.*	

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	1 Level of Thinking (Bloom)	2 Expected Proficiency (%)	3 Expected Attainment (%)
CLO-1 :	*Students gains knowledge on different modes of communication between cells*	*3*	*80*	*80*
CLO-2 :	*Students understand biochemical mechanisms of all hormones*	*3*	*80*	*80*
CLO-3 :	*Students acquire knowledge about calcium homeostasis*	*3*	*90*	*80*
CLO-4 :	*Students can understand the difference between hypo and hyper level causes, symptoms of different hormones.*	*3*	*90*	*80*
CLO-5 :	*Students understand the impact of cross talk in communication.*	*3*	*90*	*90*
CLO-6 :	*Students understand the importance of signal transmission pathway.*	*3*	*80*	*90*

Program Learning Outcomes (PLO)

	1 Scientific Knowledge	2 Problem Analysis	3 Design & Development	4 Analysis, Design, Research	5 Modern Tool Usage	6 Society & Culture	7 Environment & Sustainability	8 Ethics	9 Individual & Team Work	10 Communication	11 Project Mgt. & Finance	12 Life Long Learning	13 PSO - 1	14 PSO - 2	15 PSO – 3
CLO-1 :	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*H*	*H*	*H*	*H*	*H*	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*H*	*H*	*H*	*H*	*H*	-	-	-	-	-	-	-	-	-	-
CLO-6 :	*H*	*H*	*H*	*H*	*H*	-	-	-	-	-	-	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	**SLO-1**	Hormones: Chemical classification of hormones.	Protein kinases (PKA, PKB, PKC, PKG).	Physiological and biochemical actions of hypothalamic hormones	Pathophysiology of thyroxine secretion: Hyper and hypothyroidism	Hormones of adrenal gland: Physiology and Biochemical actions of Cortisol and aldosterone.
S-2	**SLO-1**	Functions of hormones and their regulation.	Protein kinases (PKA, PKB, PKC, PKG).	Physiological and biochemical actions of hypothalamic hormones	Pathophysiology of thyroxine secretion: Hyper and hypothyroidism.	Hormones of adrenal gland: Physiology and Biochemical actions of Cortisol and aldosterone.
S-3	**SLO-1**	Chemical signaling - endocrine, paracrine, autocrine, intracrine and neuroendocrine mechanisms.	Receptor tyrosine kinases – EGF	Physiological and biochemical actions of hypothalamic hormones	Regulation of calcium homeostasis: PTH, Vitamin D and calcitonin.	Hormones of adrenal gland: Physiology and Biochemical actions of Cortisol and aldosterone.
S-4	**SLO-1**	Chemical signaling - endocrine, paracrine, autocrine, intracrine and neuroendocrine mechanisms.	insulin and Ras - MAP kinase cascade	Physiological and biochemical actions of anterior pituitary hormones	Regulation of calcium homeostasis: PTH, Vitamin D and calcitonin.	Adrenal medullary Hormones: Epinephrine and Norepinephrine.
S-5	**SLO-1**	Hormone receptors - extracellular and	insulin and Ras - MAP kinase cascade	Physiological and biochemical actions of	Mechanism of Ca2+ regulation.	Adrenal medullary Hormones: Epinephrine

		intracellular.		anterior pituitary hormones		and Norepinephrine.
S-6	**SLO-1**	Hormone receptors - extracellular and intracellular.	Non receptor tyrosine kinase- erythropoietin receptor JAK - STAT pathway	Physiological and biochemical actions of anterior pituitary hormones	Mechanism of Ca2+ regulation.	Adrenal medullary Hormones: Epinephrine and Norepinephrine.
S-7	**SLO-1**	Receptor - hormone binding, G protein coupled receptors	Non receptor tyrosine kinase- erythropoietin receptor JAK - STAT pathway	Physiological and biochemical actions of posterior pituitary hormones	Regulation of Growth: growth hormone and somatomedin.	Hyper and hypo secretion of adrenal cortex and adrenal medullary hormones.
S-8	**SLO-1**	Receptor - hormone binding, G protein coupled receptors	Steroid hormone Receptor	Physiological and biochemical actions of posterior pituitaryhormones	Physiology and biochemical actions of Growth factors- EGF, PDGF and Erythropoietin.	Hyper and hypo secretion of adrenal cortex and adrenal medullary hormones.
S-9	**SLO-1**	second messengers - cAMP, cGMP, IP3, DAG, Ca2+	Steroid hormone Receptor, Receptor regulation	Physiological and biochemical actions of posterior pituitary hormones	Physiology and biochemical actions of Growth factors- EGF, PDGF and Erythropoietin.	Male and female sex hormones.
S-10	**SLO-1**	Effector systems –adenylcyclase	Receptor regulation	Biosynthesis of thyroid hormone and its regulation, Role of TRH and TSH in T4 synthesis and response.	Physiology and biochemical actions of Growth factors- EGF, PDGF and Erythropoietin.	Male and female sex hormones.
S-11	**SLO-1**	Guanylcyclase	crosstalk.	Biosynthesis of thyroid hormone and its regulation, Role of TRH and TSH in T4 synthesis and response.	Endocrine disorders - gigantism, acromegaly, dwarfism, pygmies.	Biochemical functions of sex hormones.
S-12	**SLO-1**	Phospholipase-C	Cycle Test-1	Physiological and biochemical action of Thyroxine.	Cycle test-2	Biochemical functions of sex hormones.

Learning Resources	1. Lehninger: Principles of Biochemistry(2017)7thed., Nelson,D.L.andCox,M.M. W.H. Freeman & Company (New York) 2. Vander'sHumanPhysiology(2019)15thed.,Widmaier,E.P.,Raff,H.andStrang, K.T. McGraw Hill International Publications (USA)	1. Endocrinology (2007) 6thed., Hadley, M.C. and Levine, J.E. Pearson Education (New Delhi), Inc. 2. The Cell: A Molecular Approach (2009) 5th Ed. Cooper, G.M. and Hausman, R.E. ASM Press & Sunderland, (Washington DC), Sinauer Associates. (MA).

Learning Assessment

	Bloom's Level of Thinking	**Continuous Learning Assessment (50% weightage)**								**Final Examination (50% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (20%)**		**CLA – 4 (10%)**			
		Theory	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**
Level 1	Remember Understand	40%	-	30%	-	30%	-	30%	-	15%	-
Level 2	Apply Analyze	40%	-	40%	-	40%	-	40%	-	20%	-
Level 3	Evaluate Create	20%	-	30%	-	30%	-	30%	-	15%	-
	Total	100 %		100 %		100 %		100 %		100 %	

Course Designers

Experts from Higher Technical Institutions	**Internal Experts**
1. Dr. M. Sujatha, Associate Professor & HOD, Department of Biotechnology, Ethiraj College for Women, Chennai 2. Dr. M. Rajeshwari Hari, Associate Professor & HOD, Department of Biotechnology, MGR University	Mrs. S. Vijayabharathi

Course Code	PBC21S04J	Course Name	Bioinformatics	Course Category	D	. Discipline Specific Elective Course	L	T	P	C
							1	0	4	3

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Understanding the methodologies used for database searching, and determining the accuracies of database search.			
CLR-2 :	Knowledge on Basic algorithms used in Pair wise and Multiple alignments			
CLR-3 :	Learning about Prediction of structure from sequence and subsequently testing the accuracy of predicted structures.			
CLR-4 :	Determining the protein function from sequence through analyzing data			
CLR-5 :	Application of probabilistic model to determine important patterns.			
CLR-6 :	Learn various bioinformatics tools of genomic data analysis			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	Understanding the existing software effectively to extract information from large databases	3	80	70
CLO-2 :	Candidates understanding on computer modeling	3	80	70
CLO-3 :	Develop problem-solving skills, including the ability to develop new algorithms and analysis methods	3	85	75
CLO-4 :	Analysis and development of models for better interpretation of biological data	3	85	75
CLO-5 :	Understanding the structural and functional relationships, and molecular evolution.	3	85	75
CLO-6 :	Applying basic principles of biology, computer science and mathematics to address complex biological problems	3	80	70

		Program Learning Outcomes (PLO)														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	ICT Skills	Professional Behavior	Life Long Learning
CLO-1 :		M	M	M	-	M	H	M	-	-	H	H	H	M	H	H
CLO-2 :		M	M	M	-	M	H	M	-	-	H	H	H	M	H	H
CLO-3 :		M	M	M	-	M	H	M	-	-	H	H	H	M	H	H
CLO-4 :		M	M	M	-	M	H	M	-	-	H	H	H	M	H	H
CLO-5 :		M	M	M	-	M	H	M	-	-	H	H	H	M	H	H
CLO-6 :		M	M	M	-	M	H	M	-	-	H	H	H	M	H	H

Duration (hour)		6	6	6	6	6
S-1	SLO-1	Introductiuon to bioinformatics	*KEGG*	*PAM*	*clustal x*	Neural network
	SLO-2	*Biological databases*	*EcoCyc*	*BLOSUM*	*PHYLIP*	HMM
S-2	SLO-1	*Primary databases*	*PDB*	*local alignment*	*PAUP*	*Trans-membrane proteins*
	SLO-2	*secondary databases*	*Similarity*	*Global alignment*	*Phylogenetic analysis*	Neural network
S-3	SLO-1	*structure databases*	*Identity*	*BLAST*	*Construction of phylogenetic tree*	Coiled coil prediction
	SLO-2	*specialized databases*	*Homology*	*FASTA*	*UPGMA*	*Protein Tertiary structure*
S-4	SLO-1	*Metabolic pathway databases*	Importance of sequence alignment	*Multiple sequence alignment methods,*	*NJ*	*Protein Tertiary structure prediction*

	SLO-2	*GenBank*	*Pair-wise sequence alignment*	*Applications of MSA*	*Protein secondary structure*	*Homology modelling*
S-5	**SLO-1**	*EMBL*	Dot matrix	*Methods of MSA*	*Protein secondary structure prediction*	Swiss model
	SLO-2	*DDBJ*	Gap penalty	*Progressive alignment*	*Globular proteins*	Swiss model
S-6	**SLO-1**	*PDB*	Cycle test 1	*Iterative alignment*	Chou fasman method	*Fold recognition*
	SLO-2	*Uniprot*	*scoring matrices*	*Block based alignment*	GOR	*Ab-initio methods*

Learning Resources	***Theory*** 1. Essential Bioinformatics by Jin Xiong 2. Bioinformatics: Principles and Applications by Zhumur Ghosh

Learning Assessment

	Bloom's Level of Thinking	**Continuous Learning Assessment (50% weightage)**								**Final Examination (50% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (20%)**		**CLA – 4 (10%)**			
		Theory	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**
Level 1	Remember Understand	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
Level 2	Apply Analyze	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Level 3	Evaluate Create	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Total	100 %		100 %		100 %		100 %		100 %	

CLA-1, CLA-2 and CLA-3 can be from any combination of these: Online Aptitude Tests, Classroom Activities, Case Studies, Poster Presentations, Power-point Presentations, Mini Talks, Group Discussions, Mock interviews, etc.
CLA – 4 can be from any combination of these: Assignments, Seminars, Short Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers	
Experts from Higher Technical Institutions	**Internal Experts**
1. Dr. M. Sujatha, Associate Professor & HOD, Department of Biotechnology, Ethiraj College for Women, Chennai 2. Dr. M. Rajeshwari Hari, Associate Professor & HOD, Department of Biotechnology, MGR University	Dr. V.G. Vidhya

Course Code	PBC21AE1T	**Course Name**	**ENTREPRENEURSHIP IN LIFE SCIENCES**	**Course Category**	***AE***	**Ability Enhancement Courses**	**L**	**T**	**P**	**C**
							2	0	0	2

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	*Understand about managerial functions*
CLR-2 :	*Learn about the traits of an entrepreneur*
CLR-3 :	*Learn about IPR, Patents and Copyright laws*
CLR-4 :	*Understand about bio-entrepreneurship*
CLR-5 :	*Learn about generating business ideas*
CLR-6 :	*Develop the qualities of becoming an entrepreneur*

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)															
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO – 2	PSO – 3
CLO-1 :	*Understand the principles of management*	2	70	65	*H*	*H*	*M*	*M*	*L*	-	*L*	-	*L*	-	*L*	*H*	-	-	-
CLO-2 :	*Analyze the ways of entrepreneurial development*	2	80	75	*H*	*H*	*H*	*M*	*L*	-	*L*	-	*L*	-	*M*	*H*	-	-	-
CLO-3 :	*Learn about setting up of business organization*	2	75	65	*H*	*M*	*H*	*M*	*H*	-	*L*	-	*H*	-	*H*	*H*	-	-	-
CLO-4 :	*Acquire knowledge about business opportunities in life sciences*	2	75	70	*H*	*M*	*H*	*H*	*H*	-	*L*	-	*H*	-	*H*	*H*	-	-	-
CLO-5 :	*Learn about how to commercialize biotechnology products*	2	75	70	*H*	*H*	*H*	*H*	*H*	-	*M*	-	*H*	-	*H*	*H*	-	-	-
CLO-6 :	*Analyze and understand about running a business model*	2	70	65	*H*	*H*	*H*	*H*	*M*	-	*M*	-	*H*	-	*H*	*H*	-	-	-

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		6	6	6	6	6
S-1	SLO-1	*Principles of Management*	*Entrepreneurship*	*Types of business organizations*	*Business opportunities in life sciences*	*Business Idea generation*
S-2	SLO-1	*Managerial functions*	*Scope and Importance of Entrepreneurship*	*Business models*	*Agro-based industries*	*Product commercialization*
S-3	SLO-1	*Planning, Organizing*	*Entrepreneur*	*Setting up of start-ups*	*Food processing industries*	*Packaging*
S 4	SLO-1	*Staffing, Directing and Controlling*	*Entrepreneurial traits*	*Funding agencies promoting business set up*	*Pharmaceutical industries*	*Pricing strategies*
S-5	SLO-1	*Sales Management*	*Entrepreneurial development*	*Intellectual Property Rights*	*Dairy industry*	*International marketing*
S 6	SLO-1	*Marketing and Advertising*	*Training and government institutions promoting entrepreneurship*	*Patents, Trademarks and Copyrights*	*Waste management*	*Case studies*

Learning Resources	***Text Books:***	***References:***
	1. *Craig Shimasaki. "Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies". Academic Press, 2014.* 2. *David H. Holt. "Entrepreneurship: New Venture Creation" Prentice-Hall, 1991.*	1. *Jack M. Kaplan. "Getting started in Entrepreneurship". John Wiley & Sons, 2001.* 2. *H. Koontz, H. Weihrich. "Essentials of Management". McGraw Hill Education, 1990.*

Learning Assessment						
Level	**Bloom's Level of Thinking**	**Continuous Learning Assessment (50% weightage)**				**Final Examination (50% weightage)**
		CLA – 1 (10%)	**CLA – 2 (10%)**	**CLA – 3 (20%)**	**CLA – 4 (10%) #**	

		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	30%	-	30%	-	30%	-	30%	-	30%	-
	Understand										
Level 2	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
	Analyze										
Level 3	Evaluate	30%	-	30%	-	30%	-	30%	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers	
Experts from Higher Technical Institutions	**Internal Experts**
1. Dr. M. Sujatha, Associate Professor & HOD, Department of Biotechnology, Ethiraj College for Women, Chennai 2. Dr. M. Rajeshwari Hari, Associate Professor & HOD, Department of Biotechnology, MGR University	Dr. G. Swamynathan

Course Code	PBC21P01L	Course Name	INTERNSHIP	Course Category	P	Project Work, Internship In Industry/Higher Technical Instititutions	L	T	P	C
							0	0	0	0

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	BIOCHEMISTRY			Nil	

Assessment type- only internals

Assessment type	Marks
Continuous Learning Assessment –I (CLA-I)	*20 Marks*
Continuous Learning Assessment –II (CLA-II)	*30 Marks*
Continuous Learning Assessment –III (CLA-III)	*30 Marks*
Continuous Learning Assessment –IV (CLA-IV)	*20 Marks*
Total Marks	*100 Marks*

Course Code	PCD21AE3T	Course Name	*Employability Skills*	Course Category	A	Ability Enhancement Course	L	T	P	C
							1	0	0	1

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Career Development Centre			Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	*develop contextual approach to acquire new vocabulary*
CLR-2:	*establish clear relationship between words*
CLR-3:	*identify problems*
CLR-4:	*learn the fundamental skills to solve problems*
CLR-5:	*acquire experience of attending group discussion and personal interview*
CLR-6:	*equipping students with necessary employability skills*

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	ICT Skills	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1:	*determine the accurate meanings of words*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-2:	*recognise parallel relationship between words*	2	80	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-3:	*learn to solve problems*	2	75	70	H	H	H	H	H	H	H	H	M	H	M	H	H	H	H
CLO-4:	*understand and applies problem solving skills learned.*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-5:	*inculcate professional communication through Interviews & Group Discussions*	2	80	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-6:	*acquirenecessary skills for successful career*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H

Duration (hour)		3	3	3	3	3
S-1	SLO-1	Time & work	Time, speed, distance	Permutation and combination	Probability	Geometry and Mensuration
	SLO-2	Solving problems	Solving problems	Solving problems	Solving problems	Solving problems
S-2	SLO-1	Perspective on Issues	Critical Reasoning	Synonyms	Antonyms	Word Analogy
	SLO-2	Perspective on Issues	Critical Reasoning	Synonyms	Antonyms	Word Analogy
S-3	SLO-1	Resume preparation	Group Discussion	Mock GD	Interview Techniques	Mock PI
	SLO-2	Resume preparation	Group Discussion	Mock GD	Interview Techniques	Mock PI

Learning Resources	
5. Quantitative aptitude by Dinesh Khattar 6. Ramachandran and Karthik, From Campus to Corporate, India, PEARSON Publication, 2016.	7. Verbal Advantage – Ten Easy Steps to a Powerful Vocabulary – Charles Harrington Elster 8. Barron's GRE

Learning Assessment											
	Bloom's Level of Thinking	**Continuous Learning Assessment (50% weightage)**								**Final Examination (50% weightage)**	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	30 %	-	30 %	-	30 %	-	30 %	-	30 %	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40 %	-
Level 3	Evaluate Create	30 %	-	30 %	-	30 %	-	30 %	-	30 %	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Experts from Industry	Internal Experts	
1.Mr. Ajay Zenne, Career Launcher,ajay.z@careerlauncher.com	*1.* Dr.P.Madhusoodhanan, SRMIST	2. Dr. A Clement, SRMIST
	3. Dr.M.Snehalatha, SRMIST	4. Dr.Jayapragash J, SRMIST
2.Mr.Pratap Iyer, Study Abroad Mentors, Mumbai,pratap.iyer30@gmail.com	5. Mr. Harinarayana Rao, SRMIST	6. Mr. P Priyanand, SRMIST
	7. Mrs. Kavitha Srisarann, SRMIST	

SEMESTER IV

Course Code	PBC21G01T	Course Name	RESEARCH METHODOLOGY	Course Category	G	Generic Elective Courses	L	T	P	C
							2	0	0	2

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

Course Learning Rationale (CLR):	The purpose of learning this course is to,	Learning		
		1	2	3
CLR-1 :	Understanding the aspects of research	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Understanding the methods of framing a research plan			
CLR-3 :	Understanding the importance of literature survey			
CLR-4 :	To know the method of writing thesis			
CLR-5 :	Knowledge on scientific writing			
CLR-6 :	Knowing the concept of funding agencies			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Fundamental Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO – 2	PSO – 3
CLO-1 :	Acquired basic Knowledge on research and its implications	2	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-2 :	Basic Knowledge on scientific writing	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-3 :	Strong basis for understanding variables and data needed for research	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-4 :	Better knowledge on choosing a research problem	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-5 :	Better knowledge gained about funding agencies	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-
CLO-6 :	Overall understanding of methods in doing a reserach	3	85	80	L	H	H	H	H	-	-	M	M	L	-	H	-	-	-

Duration (hour)		6	6	6	6	6
S-1	SLO-1	Definition and objectives of Research	Literature review	Scientific document: Organization	Tables and graphs of frequency data of one variable	Funding agencies: National and international funding agencies for R & D projects
	SLO-2					
S-2	SLO-1	Types of research	Surveying	writing of a research paper	Tables and graphs that show the relationship between two variables	Preparation of R & D projects for funding
	SLO-2					
S-3	SLO-1	Various Steps in Research Process	synthesizing, critical analysis	short communications, review articles	Mean median mode	Organization of a research project,
	SLO-2					
S-4	SLO-1	Postulating a hypothesis	reading materials, reviewing, rethinking			

	SLO-2			monographs, technical and survey reports	Relation between frequency distributions	identification of gap areas in the subject
S-5	SLO-1 SLO-2	Developing a research question	critical evaluation, interpretation	, authored books and edited books	other graphs	aims and objectives of the projects,
S-6	SLO-1 SLO-2 SLO-2	Choice of a problem	Research Purposes, Ethics in research.	Dissertation	preparing data for analysis.	possible outcome of the project, funds requirements and justification(s).

Learning Resources	1. Dr.RajendrakumarC.*"Research Methodology*" APH Publishing corporation, 2008. 2. Kothari C.R.*"Research Methodology*". New Age International, 2004. 3. KhanzodeV.V*"Research Methodology*". APH Publication, 2004.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	20%	20%	10%	15%	15%	10%	10%	15%	15%
	Understand										
Level 2	Apply	20%	20%	30%	20%	20%	20%	20%	30%	20%	20%
	Analyze										
Level 3	Evaluate	10%	10%	10%	10%	15%	15%	10%	10%	15%	15%
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Short Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Higher Technical Institutions	Internal Experts
1. Dr. M. Sujatha, Associate Professor & HOD, Department of Biotechnology, Ethiraj College for Women, Chennai 2. Dr. M. Rajeshwari Hari, Associate Professor & HOD, Department of Biotechnology, MGR University	Dr. T.G. Nithya

Course Code	PBC21P02L	Course Name	PROJECT WORK	Course Category	P	PROJECT WORK AND INTERNSHIPS	L	T	P	C
							0	0	24	12

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

Course Learning Rationale (CLR):	The purpose of learning this course is to,	Learning
CLR-1 :	To test the ability to identify research gap	
CLR-2 :	To test the ability to idetify the problem	
CLR-3 :	To test the ability to devise a plan of study	
CLR-4 :	To teach how to determine the methodology	
CLR-5 :	To test the practical knowledge	
CLR-6 :	To teach how to write a dissertation	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	1 Level of Thinking (Bloom)	2 Expected Proficiency (%)	3 Expected Attainment (%)
CLO-1 :	Knowledge on reading the review of literature	2	85	80
CLO-2 :	Knowledge on problem solving methods	3	85	80
CLO-3 :	Knowledge on devising methodologies	3	85	80
CLO-4 :	Hands- on knowledge on various techniques	3	85	80
CLO-5 :	Knowlwdge to interpret the results	3	85	80
CLO-6 :	Understanding the importance of presentation and dissertation	3	85	80

Program Learning Outcomes (PLO)

	1 Fundamental Knowledge	2 Problem Analysis	3 Design & Development	4 Analysis, Design, Research	5 Modern Tool Usage	6 Society & Culture	7 Environment & Sustainability	8 Ethics	9 Individual & Team Work	10 Communication	11 Project Mgt. & Finance	12 Life Long Learning	13 PSO - 1	14 PSO – 2	15 PSO – 3
CLO-1 :	H	H	H	H	-	-	-	H	H	-	H	H	H	H	H
CLO-2 :	H	H	H	H	-	-	-	H	H	-	H	H	H	H	H
CLO-3 :	H	H	H	H	-	-	-	H	H	-	H	H	H	H	H
CLO-4 :	H	H	H	H	-	-	-	H	H	-	H	H	H	H	H
CLO-5 :	H	H	H	H	-	-	-	H	H	-	H	H	H	H	H
CLO-6 :	H	H	H	H	-	-	-	H	H	-	H	H	H	H	H

Learning Assessment

Project Work / Internship	Continuous Learning Assessment (50% weightage)		Final Evaluation (50% weightage)	
	Review – 1	Review – 2	Project Report	Viva-Voce
	20%	30 %	30 %	20 %