M. Sc.
BIOTECHNOLOGY
SYLLABUS - 2018

SCHOOL OF EXCELLENCE
with
CHOICE BASED CREDIT SYSTEM (CBCS)

SCHOOL OF BIOLOGICAL SCIENCES
St. JOSEPH'S COLLEGE (Autonomous)
Special Heritage Status Awarded by UGC
Accredited at 'A' Grade (3rd cycle) by NAAC
College with Potential for Excellence Conferred by UGC
DBT-STAR & DST-FIST Sponsored College
TIRUCHIRAPPALLI - 620 002, INDIA

SCHOOLS OF EXCELLENCE WITH CHOICE BASED CREDIT SYSTEM (CBCS)

POSTGRADUATE COURSES

St. Joseph's College (Autonomous), a pioneer in higher education in India, strives to work towards the academic excellence. In this regard, it has initiated the implementation of five "Schools of Excellence" from the academic year 2014-15, to standup to the challenges of the 21st century.

Each School integrates related disciplines under one roof. The school system allows the enhanced academic mobility and enriched employability of the students. At the same time this system preserves the identity, autonomy and uniqueness of every department and reinforces their efforts to be student centric in curriculum designing and skill imparting. These five schools will work concertedly to achieve and accomplish the following objectives.

- Optimal utilization of resources both human and material for the academic flexibility leading to excellence.
- Students experience or enjoy their choice of courses and credits for their horizontal mobility.
- The existing curricular structure as specified by TANSCHE and other higher educational institutions facilitate the Credit-Transfer Across the Disciplines (CTAD) - a uniqueness of the choice-based credit system.
- Human excellence in specialized areas
- Thrust in internship and / or projects as a lead towards research and
- The multi-discipline nature of the newly evolved structure (School System) caters to the needs of stake-holders, especially the employers.

What is Credit system?

Weightage to a course is given in relation to the hours assigned for the course. Generally, one hour per week has one credit. For viability and conformity to the guidelines credits are awarded irrespective of the teaching hours. The following Table shows the correlation between credits and hours. However, there could be some flexibility because of practical, field visits, tutorials and nature of project work.

For PG courses, a student must earn a minimum of 110 credits as mentioned in the table below. The total number of minimum courses offered by a department are given in the course pattern.

POSTGRADUATE COURSE PATTERN (June 2018 onwards)

Part	Semester	Specification	No. of Courses	Hours	Credits	Total Credits
1	I-IV	**Core Courses** Theory Practical	 12-14 3-6	84	68	81
	II	**Self-Paced Learning**	1	-	2	
	III	**Interdisciplinary Core**	1	6	5	
	IV	**Comprehensive Examination** **Project Work**	1 1	- 6	2 4	
2	I-III	**Core Electives**	3	12	12	12
3	II	**IDC (Soft Skills)**	1	4	4	**12**
	III	**IDC (WS)** **IDC (BS)**	1 1	4 4	4 4	
4	I	**Extra Credit Courses-1 (MOOC)**	1	-	(2)	(4)
	III	**Extra Credit Courses-2 (MOOC)**	1	-	(2)	
5	IV	Outreach Programme (SHEPHERD)	1	-	5	**5**
		TOTAL		**120**		**110 (+4 extra credits)**

Note: IDC: Inter-Departmental Courses, BS: Between School, WS: Within School

However, there could be some flexibility because of practical, field visits, tutorials and nature of project work. For PG courses, a student must earn a minimum of 110 credits. The total number of courses offered by a department is given above.

Course Pattern

The Post-Graduate degree course consists of five vital components. They are core course, core electives, IDCs, Extra credit courses, and the Outreach Programme.

Core Courses

A core course is the course offered by the parent department related to the major subjects, components like theories, practicals, Inter disciplinary core, self paced learning, comprehensive examination, Project work, field visits, library record and etc.

Inter-disciplinary Core

Inter-disciplinary Core should be shared by the various Departments of every School. This course should be opted by all the students belonging to the particular school. Each department of the respective school should allocate themselves the schedule and the units of the course.

Core Elective

The core elective course is also offered by the parent department. The objective is to provide choice and flexibility within the department. There are three core electives. They are offered in different semesters according to the choice of the school.

Extra Credit Courses

In order to facilitate the students gaining extra credits, the extra credit courses are given. According to the guidelines of UGC, the students are encouraged to avail this option of enriching by enrolling themselves in the Massive Open Online Courses (MOOC) provided by various portals such as SWAYAM, NPTEL etc.

Inter-Departmental Courses (IDC)

IDC is an interdepartmental course offered by a department / School for the students belonging to other departments / school. The objective is to provide mobility and flexibility outside the parent department / School. This is introduced to make every course multi-disciplinary in nature. It is to be chosen from a list of courses offered by various departments.

There are three IDCs. Among three, one is the Soft-Skill course offered by the JASS in the II Semester for the students of all the Departments. The other one is offered "With-in the school" (WS) and the third one is offered "Between the school" (BS). The IDCs are of application oriented and inter disciplinary in nature.

Subject Code Fixation

The following code system (9 characters) is adopted for Post Graduate courses:

Year of Revision	PG Code of the Dept	Semester	Specification of Part	Running number in the part
↓	↓	↓	↓	↓
18	P##	*x*	*x*	*xx*
18	**PBT**	**1**	**1**	**01**

For Example :

I MSc - Biotechnology, first semester '**Molecular Biology**'
The code of the paper is **18PBT1101**.
Thus, the subject code is fixed for other subjects.

Specification of the Part

I - Core Courses: (Theory, Practical, Self paced Learning, Inter-disciplinary Core, Core, Comprehensive Examination, Project work)
II - Core Electives
III - Inter Departmental Courses (WS, Soft Skill & BS)
IV - Extra credit courses
V - Outreach Programme (Shepherd)

EXAMINATION

Continuous Internal Assessment (CIA):

PG - Distribution of CIA Marks	
Passing Minimum: 50 Marks	
Library Referencing	5
3 Components	35
Mid-Semester Test	30
End-Semester Test	30
CIA	**100**

Mid-Semster & End-Semester Tests

Centralised – Conducted by the office of Controller of Examinations

1. Mid-Semester Test & End-Semester Test: (2 Hours each); will have Objective + Descriptive elements; with the existing question pattern PART-A; PART-B; and PART-C
2. CIA Component III for UG & PG will be of 15 marks and compulsorily objective multiple choice question type.
3. The CIA Component III must be conducted by the department / faculty concerned at a suitable computer centres.
4. The 10 marks of PART-A of Mid-Semester and End-Semester Tests will comprise only: OBJECTIVE MULTIPLE CHOICE QUESTIONS; TRUE / FALSE; and FILL-IN BLANKS.
5. The number of hours for the 5 marks allotted for Library Referencing/ work would be 30 hours per semester. The marks scored out of 5 will be given to all the courses (Courses) of the Semester.
6. English Composition once a fortnight will form one of the components for UG General English

SEMESTER EXAMINATION

Testing with Objective and Descriptive questions

Part-A: Objective MCQs only (30 Marks)

Answers are to be marked on OMR score-sheet. The OMR score-sheets will be supplied along with the Main Answer Book. 40 minutes after the start of the examination the OMR score-sheets will be collected

Part-B & C: Descriptive (70 Marks)

Part-B: 5 x 5 = 25 marks; inbuilt choice;

Part-C: 3 x 15 = 45 marks; 3 out of 5 questions, open choice.

The Accounts Paper of Commerce will have

Part-A: Objective = 25 marks

Part-B: 25 x 3 = 75 marks

Duration of Examination must be rational; proportional to teaching hours 90 minute-examination / 50 Marks for courses of 2/3 hours/week (all Part IV UG Courses) 3-hours examination for courses of 4-6 hours/week.

GRADING SYSTEM

1. Grading

Once the marks of the CIA and the end-semester examination for each of the courses are available, they will be added. The marks thus obtained, will then be graded as per the scheme provided in the following Table-1.

From the second semester onwards, the total performance within a semester and the continuous performance starting from the first semester are indicated by Semester **Grade Point Average (GPA)** and **Cumulative Grade Point Average (CGPA)** respectively. These two are calculated by the following formulae:

GPA = $\frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i}$ **WAM** (Weighted Averag Marks) = $\frac{\sum_{i=1}^{n} C_i M_i}{\sum_{i=1}^{n} C_i}$

where,

'C_i' is the Credit earned for the Course-*i,*
'G_i' is the Grade Point obtained by the student for the Course '*i*',
'M' is the marks obtained for the course '*i*', and
'*n*' is the number of Courses **Passed** in that semester.

CGPA: Average GPA of all the Courses starting from the first semester to the current semester.

2. Classification of Final Results

i) The classification of final results shall be based on the CGPA, as indicated in the following Table-2.

ii) For the purpose of Classification of Final Results, the candidates who earn the CGPA 9.00 and above shall be declared to have qualified for the Degree as 'Outstanding'. Similarly, the candidates who earn the CGPA between 8.00 and 8.99, 7.00 and 7.99, 6.00 and 6.99, and 5.00 and 5.99 shall be declared to have qualified for their Degree in the respective programmes as 'Excellent', 'Very Good', 'Good', and 'Above Average' respectively.

iii) Absence from an examination shall not be taken as an attempt.

Table-1: Grading of the Courses

Marks Range	Grade Point	Corresponding Grade
90 and above	10	O
80 and above but below 90	9	A+
70 and above but below 80	8	A
60 and above but below 70	7	B+
50 and above but below 60	6	B
Below 50	NA	RA

Table-2: Final Result

CGPA	Classification of Final Results	Corresponding Grade
9.00 and above	O	Outstanding
8.00 to 8.99	A+	Excellent
7.00 to 7.99	A	Very Good
6.00 to 6.99	B+	Good
5.00 to 5.99	B	Above Average
Below 5.00	RA	Re-appearance

Credit based weighted Mark System is to be adopted for individual semesters and cumulative semesters in the column 'Marks Secured' (for 100).

A Pass in Outreach Programme (SHEPHERD) will continue to be mandatory although the marks will not count for the calculation of the CGPA.

Declaration of Result:

Mr./Ms. _____ has successfully completed the Post Graduate in _____ programme. The candidate's Cumulative Grade Point Average (CGPA) is _____ and the class secured _____ by completing the minimum of 110 credits.

The candidate has also acquired _____ (if any) extra credits offered by the parent department courses.

M. Sc. BIOTECHNOLOGY

Course Pattern - 2018 Set

SEM	Code	Courses	Hours	Credits
I	18PBT1101	Core 1 - Molecular Biology	6	5
	18PBT1102	Core 2 - Biochemistry	6	5
	18PBT1103	Core 3 - Cell Biology	6	5
	18PBT1104	Core 4 - Lab Course I (Molecular Biology, Biochemistry and Cell Biology)	8	6
	18PBT1201A	Core elective I A - Developmental Biology (OR)	4	4
	18PBT1201B	Core elective I B - Stem Cell Technology		
	18PBT1401	Extra Credit Course – I (MOOC)	-	(2)
		Total for Semester I	**30**	**25 + (2)**
II	18PBT2105	Core 5 - Recombinant DNA Technology	4	4
	18PBT2106	Core 6 - Microbiology	5	4
	18PBT2107	Core 7 - Gene Expression, Genomics and Proteomics	5	4
	18PBT2108	Core 8 - Lab Course II (Recombinant DNA Technology, Microbiology and Genomics)	8	6
	18PBT2109	Self Paced Learning - Fundamental of Genetics	-	2
	18PBT2202A	Core elective II A Cell Signaling (OR)	4	4
	18PBT2202B	Core elective II B Molecular Diagnostics and Therapeutics		
	18PSS2301	IDC 1: Soft Skills	4	4
		Total for Semester II	**30**	**28**
III	18PBT3110	Core 9 - Bioinstrumentation and Research Methodology	4	3
	18PBT3111	Core 10 - Microbial Biotechnology	4	3
	18PBT3112	Core 11 - Lab Course III (Microbial Biotechnology, Bioinformatics & Biostatistics and Immunology)	4	4
	18SBS3101	Inter Disciplinary Core - Solid Waste Management	6	5
	18PBS3101B	Inter Disciplinary Core - Immunology		
	18PBT3203A	Core Elective-III A Bioinformatics (OR)	4	4
	18PBT3203B	Core Elective-III B Drug Discovery and Development		
	18PBT3301	IDC – WS Medical Biotechnology	4	4
	18PBT3302	IDC- BS Food Technology	4	4
	18PBT3402	Extra credit course II (MOOCS)	-	(2)
		Total for Semester III	**30**	**27 + (2)**
IV	18PBT4113	Core 12 - Food Biotechnology	6	5
	18PBT4114	Core 13 - Plant and Animal Biotechnology	6	4
	18PBT4115	Core 14 - Lab Course IV (Food Biotechnology)	5	5
	18PBT4116	Core 15 - Lab Course V (Plant and Animal Biotechnology)	5	5
	18PBT4117	Comprehensive Examination	-	2
	18PBT4118	Project Work	8	4
		Total for Semester IV	**30**	**25**
	18PCW4501	Outreach Programme (SHEPHERD)	-	**5**
		Total hours & credits	**120**	**110 + (4)**

Programme Outcomes (POs):

1. Graduates are prepared to be creators of new knowledge leading to innovation and **entrepreneurship employable** in various sectors such as private, government, and research organizations.
2. Graduates are trained to evolve new technologies in their own discipline.
3. Graduates are groomed to engage in lifelong learning process by exploring their knowledge independently.
4. Graduates are framed to design and conduct experiments /demos/create models to analyze and interpret data.
5. Graduates ought to have the ability of effectively communicating the findings of Biological sciences incorporating with existing knowledge.

Programme Specific Outcomes (PSOs):

1. Post graduates will earn and employ knowledge of Biotechnology and Scientific concepts to identify, understand, analyze and solve problems related to field of Biotechnology.
2. Theyt will be able design, perform experiments and interpret data for investigating complex problems in biotechnology and related fields.
3. Post graduates will be able to determine and apply appropriate tools and techniques in biotechnological manipulation.
4. Post graduates will be able to establish eco-friendly solutions to address complex environmental problems.
5. Post graduates will be able to understand the need and impact of biotechnological solutions on environment and societal context keeping in view need for sustainable solution.
6. Post graduates will have knowledge and understanding of related norms and ethics in Biotechnology product/technique development.
7. They will be able to take up a research problem, review literatures and will be able to technically solve the research oriented problem.
8. Post graduates will be fostered for higher studies, R&D activities and professional career in emerging trends of biotechnology.

_____

Semester I **Hours/Week: 6**
18PBT1101 **Credits : 5**

MOLECULAR BIOLOGY

Course Outcomes:

1. Understanding the basic structure and functioning of the genetic materials.
2. Knowledge about the changes in the genetic material and the consequences in plants & humans.
3. Critical thinking to compare and contrast the mechanisms of bacterial and eukaryotic DNA replication and, DNA repair.
4. Intellectual about the molecular mechanisms of bacterial & eukaryotic transcription, and translation respectively.
5. Understanding the chemical and molecular process that occurs in and between cells.
6. Academically gaining the most significant molecular based methods used today to expand our understanding the biology.
7. Analyze the concepts of the structure and function of genes, regulation of gene, microbial genetics, mutations and DNA repair.
8. Portrays the importance of recent discoveries and the applications of Molecular Biology and the ethics that are associated with these new technologies.

Unit – I

Experiments to prove DNA and RNA as the genetic materials, Central Dogma, Viral genome – types. Organisation of Prokaryotic and Eukaryotic genome. Types and basic structure of Chromosomes. Chromosomal Proteins – Histones and Protamines – Nucleosomes – levels in the organization of Metaphase Chromosome, Special types of Chromosome: Polytene and Lamp brush chromosomes.

Unit – II

Transposons: Discovery and Classification, Transposons in Bacteria (*Tn* elements), Maize (*Ac/Ds* and *Sp/Dsp* elements), *Drosophila* (*P* elements) and Yeast (*Ty* elements). Extra chromosomal DNA: Natural and artificial plasmids. Plasmid curing, plasmid transfer and their applications. Maternal Inheritance, Structure, gene contents and functions of Chloroplast and Mitochondrial DNA - Interaction between cpDNA and nDNA.

Unit – III

DNA replication: Models – Meselson & Stahl Experiments, Molecular mechanism of the replication of linear and circular (Rolling circle Model)

DNA. DNA polymerases – structure and function. Recombinations: Homologous and non-homologous recombination- Site specific recombination. Transformation, Conjugation, F^+, Hfr, Transduction-generalized and specialized.

Unit – IV

Transcription: RNA types, structure and functions. Transcription Mechanism in Prokaryotes and Eukaryotes – initiation, elongation and termination, Post transcriptional modifications. Antibiotic inhibitors of transcription. Translation: Genetic code and features. Wobbling hypothesis. Machinery, initiation, elongation and termination of translation in bacteria and eukaryotes. Translational proof reading, translational inhibitors, Post translational modifications, chaperones and protein targeting.

Unit – V (Online)

Changes and consequences: Changes in the chromosome number: Euploidy and aneuploidy and related genetic disorders. Changes in the chromosome structure: addition, deletion, inversion and translocation and related genetic disorders. Mutation: Types (Induced, reversed, suppressor and spontaneous mutations) Mutagens: Physical and chemical. DNA repair mechanism: Thymine dimer, Light activation, Excision, Recombinational and SOS.

Text Books for Study

1) Watson J. D., *et al*., 2006. Molecular Biology of the gene (Ed. 5) Pearson Education Inc. London.
2) Jeoffrey M. Cooper and Rober E. Hausman. 2000. The Cell: A Molecular Approach (Ed: 4). ASM Press, Washington D.C.
3) Stickberger MW *et al*. Genetics, 2008, Third edition, Macmillan and Company.

Reference

1) David Freifelder. 2008. Molecular Biology. (Ed: 2). Narosa Publications. NewDelhi.
2) De Robertis and De Robertis. 1990. Cell and Molecular Biology. Saunders College, Philadelphia.
3) Gerald Karp. 2008. Cell and Molecular Biology. (Ed: 5). John Wiley and Sons, New York.
4) Ajoy Paul. 2011. Textbook of Cell and Molecular Biology. Books and Allied Ltd.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester I	Code 18PBT1101					Title of the Paper MOLECULAR BIOLOGY								Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	2	3	5	3	3	3	3	3	3	3	3	5	3		3.2
CO2	3	3	4	5	4	5	4	3	2	2	4	3	2		3.4
CO3	3	2	3	3	3	3	3	3	2	3	3	5	5		3.2
CO4	3	3	5	3	2	4	4	5	2	2	3	3	3		3.2
CO5	4	2	3	3	1	3	4	4	2	2	3	4	3		2.9
CO6	5	4	3	4	3	4	3	5	2	3	4	3	3		3.5
CO7	4	5	3	2	4	1	5	4	3	2	3	3	3		3.2
CO8	3	5	4	3	3	4	2	4	2	5	3	2	2		3.2
														Overall Mean Score for COs	3.2

Result: The Score for this Course is 3.2 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester I **Hours/Week: 6**
18PBT1102 **Credits : 5**

BIOCHEMISTRY

Course Outcomes:

1. Knowledge about the molecular biology of life
2. Understanding the enzymes and how they catalyze reactions as well as enzyme kinetics
3. Intellectual about the structures of amino acids, their chemical properties and their organization intopolypeptides and proteins.
4. Review about the structure of fundamental monosaccharides and polysaccharides.
5. Knowledge about the structure and biological function of nucleotides and lipids.
6. Understanding the synthesis of biomolecules and their role in metabolic pathways along with their regulation
7. Understanding scientific basics of the life processes at the molecular level.
8. Explain and provide the inter-relationships of biomolecules and their consequences for interpreting & solving clinical problems.

Unit – I

The molecular logic of life: Chemical basis of life and composition of living matter. Biomolecules – chemical composition and bonding. Properties of water, acids, gases and buffer.pH, ionization and hydrophobicity. Bioenergetics – laws of thermodynamics, Gibb's Free energy, Activation energy, exergonic and endergonic reactions,Biological energy transductions. Enzymes – Nomenclature and classification. Enzyme kinetics- single and multi-substrate. Factors affecting enzyme activity- Michaelis Menten equation, Line weaver Burk plot. Enzyme inhibition- competitive, non-competitive, uncompetitive and allosteric inhibition. Enzyme Regulation: Biological role of enzymes.

Unit – II

Carbohydrates – Classification, Structure and Isomerism. Monosaccharides, Oligosaccharides, Polysaccharides– Structure and Properties. Metabolism of Carbohydrates- Glycolysis, Citric acid cycle, HMP shunt, Glucuronic acid pathway, Gluconeogenesis, Glycogenesis, Glycogenolysis, Glyoxylate cycle. Metabolism of Amino sugars, Sialic acids, Mucopolysaccharides and Glycoproteins. Metabolic disorders associated with carbohydrate metabolism.

Unit – III

Aminoacids- structures, classification, properties. Biosynthesis of Aspartate, Pyruvate and Aromatic aminoacids families. Amphibolic activity of amino acids. Protein – classification, types, characteristics and structures. Protein folding, Denaturation & Renaturation, Ramachandran plot, Solid state synthesis of peptides, Sequence determination. Degradation of Proteins and Aminoacids, Urea cycle and its significance. Metabolic disorders associated with aminoacid metabolism.

Unit – IV

Lipids – classification, sources and biological functions. Biosynthesis of fatty acids and its regulation, Hydroxy fatty acids, Acylglycerols. Membrane lipids- Phospholipids, Sphingolipids & Eicosanoids. Cholesterol biosynthesis and its regulation.Transport and storage of cholesterol.Fatty acid degradation.Lipoproteins types and its functions. Methods of inter organ transport of fatty acids. Formation of ketone bodies. Metabolic disorders associated with lipid metabolism.

Unit – V (Online)

Nucleic acids- bases, nucleosides & nucleotides, Structure of RNAs and DNA, Forces stabilizing nucleic acid structures. Fractionation, sequencing and chemical synthesis of oligonucleotides.Denaturation and Hybridization. Synthesis of Purines and Pyrimidines, salvage pathways. Biosynthesis of nucleotide coenzymes, nucleotide degradation. Intermediary metabolism.

Text Books for study

1. Lehninger, A. L. *et al*., 1993. Principles of Biochemistry, Worth Publishers. Inc. USA.
2. Stryer, I., 1988. Biochemistry (2nd Edition), W.H. Freeman & Co., New York.
3. Murray, R.K., Granner, B.K., Mayes. P.A., Rodwell, V.W., Harper's Biochemistry Prentice Hall International, 29th edition, 2012.

References

1. Zubey, G L., 1998. Biochemistry, WCB Publishers.
2. Robert K. Murray *et al*., 2000. Harper's Biochemistry (25th ed), Appleton and Lange Stainford Publishers, Connecticut.
3. White, A. *et al*., 1959. Principles of Biochemistry, McGraw Hill Book Co., New York.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester I	Code 18PBT1102					Title of the Paper BIOCHEMISTRY								Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	5	2	4	3	3	4	3	3	3	0	2	3	3		2.9
CO2	3	3	4	3	3	5	4	5	2	2	5	4	4		3.6
CO3	5	3	3	3	3	4	3	3	1	1	5	4	3		3.2
CO4	2	3	3	3	4	3	5	4	1	2	5	3	3		3.2
CO5	5	3	3	4	3	4	4	4	1	1	4	4	2		3.2
CO6	3	5	4	4	2	4	5	4	1	1	3	4	3		3.3
CO7	4	4	4	3	2	3	5	4	3	2	3	4	4		3.5
CO8	4	3	2	3	4	3	2	5	4	3	3	2	2		3.1
														Overall Mean Score for COs	3.2

Result: The Score for this Course is 3.2 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester I **Hours/Week: 6**
18PBT1103 **Credits : 5**

CELL BIOLOGY

Course Outcomes:

1. Knowledge in basic concepts of cell biology and properties about cells.
2. Ability to analyze and interpret the behaviour of cells in their microenvironment in multi-cellular organisms with emphasis on cell-cell interactions, cell - extra cellular matrix interactions, and soluble signalling.
3. Evidence-based critical thinking in cell biology.
4. Knowledge about the depth and scope of the ever developing field of cell biology.
5. Information literacy in identifying the subcellular organelles and describing their structure and function.
6. Knowledge in cell cycle, nuclear and cell division.
7. Gain an understanding of chemical and molecular processes that occur inside cells.
8. Understanding the signaling and interaction mechanisms between cells.

Unit – I

Historical origins of cell biology: Cell theory. Cell as a basic unit of living system. Different classes of cell: Prokaryotic, animal and plant cell, their characteristics. Biochemical composition of cell: protein, lipid, carbohydrate, nucleic acid. Ultrastructure of cell. Sub-cellular organization of eukaryotic cells – microscopy and cell architecture - purification of cells and their parts.

Unit – II

Steps in cell cycle, yeast as model system, cell division control and regulation yeast cdc gene. Apoptosis, necrosis. Extracellular matrix, collagen, proteoglycans, fibronectin, laminins, integrins, selectin, cadherins, role of tight junctions and gap junctions, Role of G-proteins coupled receptors, cAMP, Tyrosine kinase in cell signal transductions.

Unit – III

The structural and functional organizations of cell membrane, ionic transport (Passive and activetransport) the extracellular matrix of eukaryotes, cell wall. Structure and functions of Endoplasmic reticulum, Golgi complex, Ribosomes, Lysosomes, Peroxisomes (glyoxysomes), Plastids and Mitochondria. Biogenesis of mitochondria and chloroplast.

Unit – IV

Cytoskeleton and cell motility: Microtubules: Microtubule motors and movement, Chromosome movement. Microfilaments (Assembly and Disassembly), Actin, Myosin and Intermediate filaments, Three dimensional organization of cytoskeleton. Nuclear ingredients: Nuclear membrane, Proteins associated with nuclei.Packaging of genetic material: nucleosome model, Organization of chromatin: chromosome structure.

Unit – V (Online)

Cell cycle: Mitosis & Meiosis. Checkpoints in Cell Cycle Regulation**.** Cell-cell interaction, Cell locomotion (amoeboid, flagellar and ciliar). Muscle and Nerve cell, Cell senescence and death, Cell differentiation. Cellular basis of differentiation and development - mitosis, gametogenesis and fertilization.

Text Books for study

1. Robertis De, E.D.P. & E.M.F. De Robertis, 1987, Cell and Molecular Biology, Lea & Febiger.
2. Bruce Albert, Dannis Bray, Julian Lewis, Martin Raff. Keith Roberts, James D. Watson, 2000, Molecular Biology of Cell, 4th Edition, Garland Publishing Inc., New York, USA.
3. Cooper GM. Cell: a Molecular Approach, Fifth edition, ASM and Sinauer Associates, USA. 2011.

References

1. Harris,D (Ed.), Karp, G.1999. Cell and molecular biology - Concept and experiment. 2nd ed., JohnWiley & sons, sons, New York.
2. Mclaughlin, S., Trost,K., Mac Elree,E.(eds)., Kleinsmith, L.J.& Kish, V.M., 1995. Principles of celland molecular biology. (2nd edn)., Harper Collins Publisher, New York.
3. Alberts,B., Bray,D., Lawis,J., Raff,M., Roberta, K., Watson, J.d(eds.), 1994. Molecular biology of the cell. 3rdedn, Garland Publication, Inc., New York.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester I	Code 18PBT1103					Title of the Paper CELL BIOLOGY							Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)							Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	4	3	4	4	3	5	3	3	1	1	4	4	3	3.2
CO2	4	3	3	4	3	4	4	4	1	1	3	4	3	3.2
CO3	5	4	3	4	3	4	4	4	1	1	4	4	3	3.4
CO4	5	4	5	3	3	5	4	4	1	4	3	4	3	3.7
CO5	3	3	3	3	3	4	3	4	1	2	4	4	4	3.2
CO6	5	4	3	4	3	5	4	4	1	2	4	4	4	3.6
CO7	4	4	4	5	3	2	3	4	3	2	4	3	4	3.5
CO8	5	3	3	3	3	4	3	3	1	1	5	4	3	3.2
Overall Mean Score for COs														3.4

Result: The Score for this Course is 3.4 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Totalof Values}}{\text{TotalNo.of POs\& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester I **Hours/Week: 8**
18PBT1104 **Credits : 6**

Lab Course-I
MOLECULAR BIOLOGY, BIOCHEMISTRY AND CELL BIOLOGY

Course Outcomes:

1. Recognize that biology has a basis in chemistry, physics, and mathematics.
2. Understanding safe laboratory practices and perform basic molecular biology techniques.
3. Ability to describe how scientific method is used to explain natural phenomena with effective oral and written language skills to communicate scientific data and ideas.
4. Generate hypotheses, evaluate data, and design experiments to investigate a scientific problem, and present advanced knowledge in the specialized fields of molecular and cell biology.
5. Develop their skills in the preparation and identification of cell structures and their functions.
6. Students will be able to develop their skills in isolation of plasmid DNA, genomic DNA and RNA.

Molecular Biology

1. Calculations in Molecular biology – (a) Calculating DNA in mM and conversion to picomoles (b) Oligonucleotide Quantitation (c) Calculating Molecular weight of a vector (d) Calculations in Oligonucleotide synthesis. (e) Calculating Tm and concentration of primers
2. Isolation of extracellular DNA from biofilm matrix.
3. Induced mutation by: (a) Chemical mutagen. (b) Ultraviolet light.
4. Spectroscopic analysis of DNA/RNA and calculate dsDNA, ssDNA and RNA concentration.
5. Determination of size of Nucleic acids in Agarose gel electrophoresis.
6. SDS-PAGE and Native PAGE
7. Western blotting

Cell Biology

1. Observation of prokaryotic and eukaryotic cells – Living Cells/ Temporary/PermanentPreparations.
2. Squash preparation of giant chromosome of salivary gland of Chironomous larva.

3. Squash preparation of onion root tip.
4. Preparation of buccal smear.
5. Osmofragility and Tonicity
6. Separation of Peripheral Blood Mononuclear Cells from blood.
7. Staining Techniques (Leishman & Giemsa staining)

BIOCHEMISTRY

1. Preparation of Standard solutions (Molar & Normal) and various buffers.
2. Preparation of Titration curve & determination of pKa values for aminoacids
3. Estimation of Amino acids
4. Estimation of reducing sugars
5. Estimation of lipids
6. Estimation of Proteins by Bradford method.
7. Estimation of Vitamin C (Titration)
8. Chromatography: Column Chromatography - Separation of Photosynthetic Pigments andrecording their absorption spectra in the visible range.
9. Separation of amino acids / sugars by Ascending Paper Chromatography.
10. Separation of lipids/ sugars/amino acids by Thin Layer Chromatography.
11. Enzyme Kinetics
    - Phosphatase assay (chicken liver)
    - Assay of enzyme activity,
    - Effect of pH,
    - Temperature,
    - Enzyme concentration
    - Substrate concentration.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester I	Code 18PBT1104	Title of the Paper: Lab Course-I: MOLECULAR BIOLOGY, BIOCHEMISTRY, AND CELL BIOLOGY												Hours 8	Credits 6
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	4	4	4	4	3	3	4	3	3	2	2	4	4	3.3	
CO2	3	4	5	5	3	4	4	4	1	2	4	4	3	3.5	
CO3	4	4	4	4	5	4	4	4	1	3	3	4	4	3.7	
CO4	4	4	4	5	5	4	4	4	1	3	3	4	4	3.8	
CO5	4	4	3	4	3	4	4	4	1	3	4	4	4	3.5	
CO6	4	4	4	4	2	4	5	5	1	3	3	4	4	3.6	
										Overall Mean Score for COs				3.5	

Result: The Score for this Course is 3.5 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester I **Hours/Week: 4**
18PBT1201A **Credits : 4**

Core Elective-IA
DEVELOPMENTAL BIOLOGY

Course Outcomes:

1. Resourceful in the cellular basis of development.
2. Understanding the concepts in developmental biology related to gene regulation andepigenetics.
3. Intellectual in the developmental biology related to cell fate specification andpatterning.
4. Ability to elucidate the early development process of humans.
5. Resourceful in the concepts of cellular competence, induction, specification, commitment and differentiation in embryonic development.
6. Knowledge in embryonic patterning.

Unit – I

Basic concepts of development: Morphogenesis and organogenesis in animals (Human). Embryonic fields, potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; genomic equivalence and the cytoplasmic determinants; imprinting.

Unit – II

Fertilization, development and sex determination in humans: Gametogenesis - Sperm & Egg formation; ultrastructure of sperm and ovum, egg types, egg membrane. Fertilization, cleavage,Morula, Implantation, blastulation, gastrulation, formation of germ layers, axis formation -anterior and posterior. Sex determination - chromosomes and environment.

Unit – III

Organogenesis - I: Organogenesis: Central nervous system and the epidermis - Formation of neural tube, Differentiation of the neural tube, tissue architecture of the central nervous system,origin of cutaneous structures. Neural crest cells and axonal specificity - Specification, Trunk Neural Crest, Pattern generation in the nervous system.

Organogenesis - II: Plant meristem organization and differentiation - Organization of shoot apical meristem (SAM); Organization of root apical meristem (RAM); Pollen germination and pollen tube guidance; Phloem

differentiation; Self incompatibility and its genetic control; Embryo and endosperm development; Heterosis and apomixes.

Unit – IV

Organogenesis - III: Paraxial and intermediate mesoderm - Somites formation, Osteogenesis, Urogenital system. Lateral plate mesoderm and endoderm - Heart formation, digestive tube and its derivatives.

Unit – V (Online)

Implications of developmental biology: Medical implications of developmental biology -genetic disorders in human development, environmental assaults on human development, Future therapies and Developmental biology, Environmental regulation of animal development - Environment as a part of normal development, Polyphenisms and plasticity, Learning system.

Text Books for study

1. Gilbert S.F. 2010. Developmental Biology, (Ed: 9) Sinauer Associates Inc. Pub., Sunderland, Massachusetts.

References

1. Alberts B. *et al*., 2002. Molecular Biology of the Cell, (Ed: 3). Garland Science, New York.
2. Lodish, H. *et al*., 2000. Molecular Cell Biology. (Ed: 4). W.H.Freeman, New York.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester I	Code 18PBT1201A			Core Elective-IA: DEVELOPMENTAL BIOLOGY								Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	5	4	4	2	3	4	4	4	1	1	4	4	4	3.4
CO2	3	4	4	2	2	3	4	4	1	3	4	4	3	3.2
CO3	5	4	3	2	2	5	4	5	1	2	4	4	4	3.5
CO4	5	4	4	4	4	4	5	4	2	2	4	4	4	3.8
CO5	4	3	3	4	3	5	4	4	2	4	4	3	3	3.5
CO6	5	3	3	4	4	5	4	4	2	2	4	4	3	3.8
Overall Mean Score for COs														3.5

Result: The Score for this Course is 3.5 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester I **Hours/Week: 4**
18PBT1201B **Credits : 4**

Core Elective-IB
STEM CELL TECHNOLOGY

Course Outcomes:

1. Understanding the stem cell biology and biotech revolution;
2. Resourceful in the molecular mechanisms and applications associated with this technology.
3. Critical thinking to compare and contrast tissue specific stem cell types and the basic mechanisms that regulate them.
4. Understanding the concepts of pluripotency and self-renewal.
5. Familiar with clinical problems for which stem cells can provide novel regenerative therapies.
6. Idea about ethical and political issues related to stem cell research.

Unit – I

Basic concepts of Stem cells – definition, History; unique properties – proliferation and differentiation; Potency definitions: totipotent, pluripotent, multipotent and unipotent. Stem-cell plasticity, Regulators of pluripotency. The isolation, expansion, genetic manipulation, genomic reprogramming, and cloning of stem cells. Stem Cells and imprinted genes.

Unit – II

Differentiation & Types of Stem cells: Isolation, culture, identification and assays. Types:unlimited and limited; Embryonic and adult stem cells – bone marrow, cord blood, neural,endothelial, hematopoietic, corneal, epithelial, pancreatic, hepatic, glandular, cardiac and gastrointestinal, leukemia and cancer stem cells.Correlation between stem cells and cancer stem cells.Clinical applications of stem cells.Stem cell cryopreservation.

Unit – III

Stem cells and cloning; Identification of stem cell using specific markers. Isolation of stem cells- Fluorescence based cell sorting. Induced Pluripotent stem cells (iPS), germ line stem cells;Recruiting Donors and Banking Hes Cells; IPRs and Hes Cells. Fate mapping of stem cells in experimental systems.

Unit – IV

Genetically engineered stem cells and experimental therapies. Stem cell based therapies: stem cells and repair of heart and nervous system;

regeneration strategies. Skin replacement, brain cell transplantation and stem cells in aging.

Unit – V (Online)

Controversies and Guidelines for Hes cell research – Scientific background of Hes research; societal implications: women, low-income, Different religious views, Current Ethical Guidelines in India, Ethical views of other countries and how this affects advancement of science Policy. Current Regulation of Human Embryonic Stem Cell Research. Future of SC research.

Text Books for Study

1. Hossein Baharvand. 2009. Trends in stem cell biology and Technology. Humana Press, NY
2. Robert Paul Lanza. 2006. Essentials of Stem Cell biology**.** Elsevier Academic Press.
3. Yanhong Shi, Dennis O. Clegg. Stem Cell Research and Therapeutics. Springer edition. 2010
4. C.S. Potten. Stem Cells. Academic Press. 2008.

References

1. Verma IM and Gage FH. 2002. (Ed) Regenerative Medicine, NatlAcadSci&Engg, USA
2. The Natl Academies, USA 2007 Understanding Stem Cells (Unit - II)
3. The Natl Academies, USA 2002 Stem Cells and the Future of Regenerative Medicine (Unit–IV & V)
4. Julie Audet, Willian L. Standford. Stem Cells in Regenerative Medicine. Methods and protocols. (Springer edition). 2009
5. Robert Lanza, Irina Klimanskaya. Essential Stem Cell Methods. (Elsevier-First edition). 2009

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester I	Code 18PBT1201B					Title of the Paper Core Elective-IB: STEM CELL TECHNOLOGY							Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)							Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	4	4	5	4	3	5	4	4	0	4	4	3	3	3.6
CO2	5	4	4	4	3	4	4	4	4	3	4	3	3	3.8
CO3	4	4	4	4	3	4	3	4	1	4	4	3	3	3.5
CO4	4	3	4	4	3	4	3	3	1	4	4	3	3	3.2
CO5	4	4	3	4	3	4	4	4	1	5	5	4	4	3.5
CO6	3	3	4	3	4	3	3	4	1	5	5	4	4	3.5
Overall Mean Score for COs														3.5

Result: The Score for this Course is 3.5 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester II **Hours/Week: 4**
18PBT2105 **Credits : 4**

RECOMBINANT DNA TECHNOLOGY

Course Outcomes:

1. Knowledge in various underlying principles of genetic engineering that forms the basis of rDNA technology.
2. Resourceful in current applications of biotechnology and advances in different research areas.
3. Understanding the methodologies, and in brief the applications and related issues of rDNA technology.
4. Resourceful in strategizing research methodologies employing genetic engineering techniques.
5. Familiar with the key features of DNA, RNA and proteins and explain the inter-relationships between these molecules
6. Knowledge in bioethical issues related to this new technology

Unit – I

Introduction to Recombinant DNA technology - Enzymes in molecular biology-Restriction endonuclease, Ligases, Reverse transcriptase, Nucleases, Polymerase, Alkaline phosphatase, Terminal transferase, T4 polynucleotide kinase; Linker, Adaptors, Homopolymers. Chromatin immuno-precipitation, DNA - protein interactions, electro-mobility shift assay and methyl interference assay.

Unit – II

Expression Cassette & Viral vectors: Promoters (Constitutive, Inducible, Tissue specific),Terminators, Reporters, Markers (Antibiotic resistant, Herbicide resistant, Antimetabolite);Vectors in gene cloning – Plasmids (pBR322, pUC), Bacteriophages (Phage λ, M13), Cosmids, Phagemids, Yeast plasmid vector, Viral vectors (Adenovirus, Adeno associated virus, Baculo virus, Herpes virus, Retrovirus, Cauliflower mosaic virus, Tobacco mosaic virus, Potato virus X), Transposons (Ac-Ds, P) Artificial chromosome (BAC, YAC, HAC),Shuttle vector, Expression vector.

Unit – III

Gene transfer Methods – Transformation – Physical method (Electroporation, Microinjection, Particle bombardment, Liposome mediated transfer); Chemical method (PEG mediated, DEAE Dextran mediated, $CaPO_4$ mediated gene transfer); Biological method (*Agrobacterium* mediated gene transfer).

Expression systems – Prokaryotes (Bacteria) and Eukaryotes (Yeast, Mammalian and Insect cell lines).

Unit – IV

Screening & Selection methods – Insertional inactivation, Blue-White selection, colony– insitu hybridization, In vitro selection, In vitro translation, Radioactive antibody test,Immunological techniques, DNA labelling, dot blot hybridization, Molecular beacons. GeneSilencing, RNA interference and antisense therapy. Gene Knockout. Blotting techniques – Southern, Northern, Western and South-Western.

Unit – V (Online)

Molecular Techniques – RFLP, RAPD, AFLP, DNA Finger printing, DNA Foot printing, Microarray (DNA & Non-DNA). Libraries - Genomic library; C-DNA library & its types; BAC library; YAC library; Methyl filtration libraries; COT fractionation based libraries. Bioethics & Biosafety in genetic engineering; IPR & Patenting. Applications of genetic engineering in medicine, agriculture, veterinary and industry.

Text Books for Study

1. Glick R. and J. J. Pasternak. 2002. Molecular Biotechnology (Ed:3). ASM Press, Washington.
2. Old RW and SB Primrose. 1989. Principles of gene manipulation(Ed:4). Blackwell scientific publications, London.
3. Alberts, B., Johnson, A., Lewis, J., M., Roberts, K., and P. Walter. Molecular Biology of the Cell, Fourth Edition. Garland & Co. 2002.

References

1. Brown T. A. 1988. Gene cloning – An introduction. VNR (UK) co. Ltd, England.
2. Ernst L Winnacker. 2002. From genes to clones - Introduction to gene technology. VCR Pub., Weinheim.
3. James D Watson *et al*., 1992. Recombinant DNA (Ed:2) WH freeman and co., New York.
4. Lodish H *et al*., Molecular Cell Biology, Sixth edition, W.H Freeman & Co. 2007.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PBT2105	Title of the Paper RECOMBINANT DNA TECHNOLOGY										Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	4	4	4	3	3	4	3	4	2	2	1	4	3	3.2
CO2	4	4	4	3	2	4	4	4	4	2	2	2	2	3.2
CO3	2	3	3	4	4	3	4	5	4	3	2	2	3	3.2
CO4	4	4	3	5	3	5	4	4	3	3	2	4	3	3.6
CO5	4	4	3	2	3	4	3	3	3	4	4	2	3	3.2
CO6	2	2	3	2	2	3	2	2	5	5	5	2	2	2.8
Overall Mean Score for COs														3.2

Result: The Score for this Course is 3.2 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester II **Hours/Week: 5**
18PBT2106 **Credits : 4**

MICROBIOLOGY

Course Outcomes:

1. Familiar in the microbial ecology and role of microbes in nutrient cycles.
2. Evaluate methods of microbial control and apply the proper methods necessary in a given scenario.
3. Knowledge in microbial organisms and their relevance of infectiousdiseases.
4. Intellectual literacy in the applications of microbiology in various industries.
5. Knowledge about the medical and practical uses for microorganisms
6. Knowledge in Disease transmission and control of nosocomial infections

Unit – I General Microbiology

Introduction and scope of microbiology.Brief study of structure and organization of majorgroups of microorganisms - Archaebacteria, Cyanobacteria, Eubacteria, Fungi, Algae, Protozoa and Viruses. Microbial Taxonomy: Diversity and distribution of microbes. Control of microorganisms – physical, chemical and chemotherapeutic agents. Preservation of microorganisms.GLP for handling highly infectious disease samples and documentation. Personal safety and laboratory safety.

Unit – II Environmental Microbiology

Microbiology of soil – soil microflora – role of soil microbes in biogeochemical cycles (C,N,S) - Marine and fresh water microbiology. Contamination of domestic and marine waters. Water purification and sewage treatment. Role of microbes in waste water treatments. Microbiology of air.

Unit – III Industrial Microbiology

Microbial growth: Kinetics of growth. Effect of temperature, pH, osmotic pressure and radiation on microbial growth. Selection of industrially useful microbes. Fermentors and fermentation technology. Industrial production of alcohol, vinegar, lactic acid, antibiotics, enzymes and amino acids.Microbiology of food – sources of contamination – food spoilage – food preservation methods.

Unit – IV Clinical Microbiology

Epidemic, endemic, pandemic and sporadic diseases.Pathogenicity, virulence and infection.Epidemiology of infectious diseases.Bacterial diseases of

human (Typhoid, Cholera, Syphilis, Fungal diseases of human (superficial, cutaneous, subcutaneous and systemic mycoses).Viral diseases of human (AIDS, Hepatitis, Polio,). Mycoplasmal, Chlamydial, Rickettsial and protozoan diseases of human. Mycotoxins.

Unit – V (Online) Applied Microbiology

Role of microbes in the manufacture of antibiotics and vaccines. Microorganisms as biofertilizers. Microbes as foods - SCP production. Role of microbes in bio-gas production, petroleum industry, mining, microbial fuel cells, biodegradation and bioremediation.Microbial degradation of lignin, cellulose and pesticides. Microbial immobilization. Microbes in biological warfare.

Text Books for study

1. Pelczar *et al*., (1998): Microbiology. Tata McGraw-Hill, New Delhi
2. Prescott *et al*., (1996): Microbiology (WMC Brown Publishers, USA)
3. Tortora GJ, Funke BR, Case CL. Microbiology: An introduction 8th Edition. San Francisco: Pearson Publishers, 2004.

References

1. Martin Alexander (1969): Introduction to soil microbiology. Wiley, New York
2. Wayne *et al*., (1962): Modern microbiology
3. Adams and Moss: Food microbiology
4. Alcamo IE., Fundamentals of Microbiology, 6th Edition, Benjamin Cummings Publishing Company, Inc., 2001.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PBT2106					Title of the Paper MICROBIOLOGY								Hours 5	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	3	3	3	3	3	2	2	5	4	2	3	3		3.0
CO2	4	4	4	4	3	4	4	5	3	5	3	3	3		3.8
CO3	2	2	3	3	3	3	3	2	4	4	3	2	2		2.8
CO4	4	4	4	3	3	4	4	4	3	4	2	2	2		3.3
CO5	2	3	3	2	4	4	3	3	4	4	3	2	2		3.0
CO6	3	2	2	3	2	3	3	4	4	4	4	2	2		2.9
Overall Mean Score for COs															3.1

Result: The Score for this Course is 3.1 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester II **Hours/Week: 5**
18PBT2107 **Credits : 4**

GENE EXPRESSION, GENOMICS, AND PROTEOMICS

Course Outcomes:

1. Understand thoroughly the concepts and importance of Genes and genomes.
2. Impart knowledge on Nucleic acids and their characteristics, transcription, translation, protein sorting, regulation of gene expression
3. Understand the mechanism of gene control in prokaryotes and eukaryotes.
4. Study the basic techniques and concepts in genomics and proteomics.
5. Understand the applied fields of genomics and proteomics.
6. Knowledge about the sequencing strategies.

Unit – I

Structure of prokaryotic and eukaryotic gene transcription and translation: Transcription Mechanism in Prokaryotes and Eukaryotes – initiation, elongation and termination, Post transcriptional modification. Translation: Genetic code and features Mechanism of Translation in prokaryotes and Eukaryotes, initiation, elongation and termination of translation in bacteria and eukaryotes. Post translational Modifications.

Unit – II

Gene regulation in Prokaryotes and Eukaryotes: Prokaryotes- Gene Expression by regulatory proteins, Regulation by activators and repressors- Lac Operon-Activator and repressor together control, Combined control of CAP on other genes and *Trp* operon, - *AraC* and control of *araBAD* operon. Eukaryotes: Role of Transcription factors - Translational level control: Control of mRNA translation, control of mRNA stability, Post translational control, Transcriptional Regulation in Yeast & Mammals.

Unit – III

Comparative genomics: Bacteria, Organelles and Eukaryotes Genome Mapping-Types and uses. Human physical map. Sequencing strategies and automation: (Sanger's method) advanced methods (Automated DNA sequencing, Pyrosequencing) Human Genome Project.

Unit – IV

Functional genomics: Genetic interaction mapping, Transcriptome profiling: (Microarray, ChIP, SAGE), *RNAi* -Studying gene function through protein-

protein interaction (Phage display and yeast two hybrid), Loss of function techniques (mutagenesis and *RNAi*). Functional annotation of genes.

Unit – V (Online)

Proteomics: Protein sequencing, Protein expression analysis by 2-DE, 2D-MALDI- TOF MS, LC-MS/MS, Quantitative proteomics. Tandem Mass spectrometry, peptide mass fingerprinting. Mining the proteome, Protein expression profiling, Protein tags; protein arrays and antibody arrays.

Text Books for study

1. Daniel L. Hartl and Elizabeth W.Jones.2009.Genetics (Ed: 7) Jones and Barlett Publishers Inc, Subury.
2. Watson J.D. et al. 2006 Molecular Biology of the Gene (Ed.5), Pearson Education INC. London.

References

1. Jocelyn E Krebs *et al*., 2011. Lewin's Genes X (Ed:10). Jones and Barlett Publishers Inc, Subury.
2. Brown T.A. 2007. Genomes 3. Garland Science Publishing.
3. Cullis C.A. 2004. Plant Genomics and Proteomics. John Wiley & Sons, Inc., Hoboken, New Jersey.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PBT2107	Title of the Paper GENE EXPRESSION, GENOMICS AND PROTEOMICS											Hours 5	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)							Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	4	4	3	2	2	3	2	2	2	2	2	3	3	2.6
CO2	4	4	3	3	2	3	3	3	2	2	1	3	3	2.8
CO3	4	4	4	4	4	4	4	4	3	3	3	4	4	3.8
CO4	3	3	4	3	3	3	3	3	2	3	2	3	4	3.0
CO5	4	4	3	4	4	4	4	4	2	2	2	3	3	3.3
CO6	5	4	4	5	4	4	4	4	4	3	3	4	4	4.0
Overall Mean Score for COs														3.2

Result: The Score for this Course is 3.2 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester II **Hours/Week: 8**
18PBT2108 **Credits : 6**

Lab Course-II:

RECOMBINANT DNA TECHNOLOGY, MICROBIOLOGY, AND GENOMICS

Course Outcomes:

1. Technical know-how on versatile techniques in recombinant DNA technology.
2. Proficiency in designing and conducting experiments involving genetic manipulation.
3. The safe methods for isolation, subculture, and maintenance of bacterial and fungal specimens.
4. An understanding of fundamental stains, basic staining techniques, and related bacterial and fungal physiology.
5. An understanding of the uses of various media and testing protocols.
6. Study the basic techniques and concepts in genomics.

Recombinant DNA Technology

1. Agarose gel electrophoresis
2. Isolation of genomic and plasmid DNA from bacteria
3. Isolation of total RNA from plant tissue
4. Isolation of genomic DNA from Plant tissue
5. Restriction digestion
6. Ligation of DNA
7. Transformation of bacteria by Calcium chloride method
8. Blue-White screening method
9. GFP cloning
10. Gel elution of DNA
11. DNA fingerprinting
12. Bacterial gene expression

Microbiology

1. Sterilization techniques – physical, chemical, filtration and irradiation techniques.
2. Preparation of basal media – Solid, Liquid: Serial dilution, plating with microbial strain;
3. Isolation of single colonies.

4. Study of a compound microscope.
5. Staining methods – simple, differential, acid – fast & negative.
6. Sub-culturing of a strain using a synthetic liquid media.
7. Study of bacterial growth of E.coli by a Spectrophotometer.
8. Preservation Techniques and maintenance.
9. Assay of an antibiotic by zone-inhibition method using antibiotic impregnated discs.
10. Estimation of antimicrobial activity using standard guidelines (NCCLS/ CLSA)
11. Study of biochemical identification of microorganisms.
12. Bacterial biofilm formation by microtitre plate assay.

Genomics

1. Gene prediction using Genscan
2. Primer designing
3. Gene finding

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PBT2108	Lab Course-II: RECOMBINANT DNA TECHNOLOGY, MICROBIOLOGY AND GENOMICS											Hours 8	Credits 6
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)							Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	4	4	3	4	3	4	5	5	4	3	2	3	4	3.7
CO2	4	4	3	5	4	4	5	5	4	4	3	4	4	4.1
CO3	4	4	3	4	4	4	4	4	4	4	4	3	3	3.8
CO4	4	4	4	4	4	4	4	4	4	4	3	3	4	3.8
CO5	4	4	3	4	4	4	4	4	4	4	3	2	3	3.6
CO6	4	4	3	4	3	3	4	4	3	3	3	3	3	3.4
Overall Mean Score for COs														3.7

Result: The Score for this Course is 3.7 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester II **Hours/Week: -**
18PBT2109 **Credits : 2**

Self-paced Learning:

FUNDAMENTALS OF GENETICS

Course Outcomes:

1. Understanding the basic concepts of genetics
2. Resourceful in the concepts on Linkage and genetic mapping
3. Critical thinking about how traits are inherited and to use this understanding in analyses
4. Information literacy in the uses of population genetics techniques
5. The ability to evaluate conclusions that are based on genetic data.
6. Understanding the role of genetic mechanisms in evolution.

Unit – I

History of Genetics - Mendelism – basic principles. Extensions of Mendelism, penetrance and expressivity of genes. Non - mendelian inheritance – cytoplasmic inheritance.

Unit – II

Linkage and genetic mapping Linkage and Crossing over - Stern's hypothesis, Creighton and McClintock's experiments, single cross over, multiple cross over, two-point cross, three point cross, map distances, gene order, interference and co-efficient of coincidence. Haploid mapping (*Neurospora*).

Unit – III

Inheritance of traits in humans; pedigree analysis, determination of human genetic diseases by pedigree analysis, genetic mapping in human pedigrees. Molecular cytogenetics, molecular genetics-DNA markers – VNTR, STR and microsatellite.Quantitative genetics – Polygenic inheritance, QTL, effect of environmental factors and artificial selection on polygenic inheritance.

Unit – IV

Population genetics Gene pool, allele and genotype frequency.Hardy-Weinberg law and its applications, estimation of Allele and Genotype frequency of dominant genes, co-dominant genes, sex-linked genes and multiple alleles. Interaction of genes: incomplete dominance, co-dominance, epistasis, complementary genes, duplicate genes, polymeric genes, modifying genes; Pleotrophy, genome imprinting, inheritance and lethal genes.

Environment and gene expression: penetrance and expressivity; temperature, light, phenocopies.

Unit – V

Genetic equilibrium, genetic polymorphism. Factors that alter allelic frequencies; Mutation Genetic drift - Bottle neck effect and Founder effect, migration, selection, non-random mating, inbreeding coefficient.

Text Books for Study

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). VIII ed. Principles of Genetics. Wiley India.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.

References:

1. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. XI Edition. Benjamin Cummings.
2. Russell, P. J. (2009). Genetics 3 A Molecular Approach. III Edition. Benjam in Cummings.
3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology – 3: Principles and Applications of Recombinant DNA. ASM Press, Washington.
4. Human genetics, A. Gardner, R.T. Howell and T. Davies, Published by Vinod Vasishtha for Viva Books private limited, 2008.
5. Hartl. D.L. A primer of population genetics. 3rd edition, Sinauer Associates Inc. Sunderland, 2000

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PBT2109	Self-Paced Learning: FUNDAMENTAL OF GENETICS										Hours -	Credits 2
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	3	3	3	2	2	4	3	3	3	4	3	3	4	3.1
CO2	4	4	3	2	3	3	3	3	3	4	3	3	3	3.2
CO3	4	4	4	3	4	3	4	4	4	4	4	3	4	3.8
CO4	4	4	4	4	4	3	4	4	4	4	3	2	4	3.7
CO5	2	5	4	4	4	3	3	4	4	3	3	2	3	3.4
CO6	4	4	3	3	3	3	3	3	4	4	3	3	3	3.3
Overall Mean Score for COs														3.4

Result: The Score for this Course is 3.4 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester II **Hours/Week: 4**
18PBT2202A **Credits : 4**

Core Elective-IIA:
CELL SIGNALLING

Course Outcomes:

1. Understanding the basic knowledge in the components of the main signallingpathways and their functional properties
2. Knowledge in the regulation of target cell responsiveness.
3. Resourceful in the different mechanisms for receptor activation and regulation.
4. Understand the intracellular signalling cascades and their impact on cellular activities including cytoskeleton rearrangements, motility and changes in gene expression.
5. Resourceful in identifying the components of a general signal transduction pathway.
6. Knowledge in different messenger-receptor interactions bring about long or short-term changes in cell state.

Unit – I

Extra Cellular Matrix (ECM) and Cell Surface: Molecules in the ECM in plant and animals.Transport across cell membrane, Ficks Law. Types of transport-simple, passive, facilitated.Active transport, primary and secondary active transport system. Ionophores, gated channels (Voltage and Ligand). Cell communication and type of signalling molecules. Types of receptors and their structure. GPCR, inhibitory and stimulatory and type of down stream effectors and signal termination.Monomeric G-proteins their role.Drugs targeting signalling molecules.

Unit – II

Cell signalling: Various types cell signalling (Autocrine, paracrine, juxtacrine and endocrine). Cell signalling molecules: Hormones and growth factors, neurotransmitters, peptide hormones, steroid hormones, eicosanoids, vitamins and gases. Cell signalling cascades: Role of MAPK pathway in signalling. Cell signalling in neurons - long term potentiation, long term depression. Cell signalling in immune system. Cross talk between signalling pathways. JAK-STAT pathway, NF-kappa B signalling.

Unit – III

Concept of transducers, effectors, GTP binding proteins - Gi, Gs, Gp, Gq, ras; adenylate cyclase, guanylate cyclase, phosphodiesterases, Protein

kinase (PK) A, C and G, Calmodulin dependent PK, tyrosine kinase, stress activated PK, ribosomal S6 kinase; angiogenesis, PKs associated with cell survival and death processes.

Unit – IV

Signal Transduction and Cancer: Discovery of oncogenes, proto-oncogenes. Modes of action of oncogenes – G proteins – Ras.Growth factors – Erb, Sis. Transcription factors – Fos, Jun, AP1, V-erbA. Discovery of tumor suppressor genes.RB and retinoblastoma, APC and colon cancer.Modes of action of TS genes – p110, p16, p21, Phosphatase and tensin homolog (pTEN). p53 and cancer risk. Selected examples – c-Myc and leukemia. BRCA and breast cancer

Unit – V (Online)

Signal Transduction in Bacteria and Plants: Introduction of signalling components in bacteria, Chemotaxis, Protein kinases in bacteria, His-kinases: structure and role, Plant signalling system an over view, Stress signalling in plants (biotic), Stress signalling in plants (abiotic). Plant hormones and their mechanism of action. Signalling in yeast: STAT pathway in yeast

Text Books for Study

1. Michel Friedman and Brett Friedman. 2004. Cell communication: Understanding howinformation is stored and used in cells. Ingram International Inc.
2. John T Hancock. 2005. Cell signaling. Oxford University press

References

1. Geoffery M Cooper and Robert E Hausman. 2009. The Cell and Molecular Approach.(Ed: 5). ASM Press and Sinauer Associates Inc.
2. Gomperts, Basten D, Ijbrand M Kramer and Peter ER Tatham. 2009. Signaltransduction. (Ed:2). Academic Press.
3. Ernst JM Helmreich. 2001. The Biochemistry of cell signaling. Oxford Univ Press.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PBT2202A					Title of the Paper Core Elective-IIA: CELL SIGNALLING								Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	4	4	3	3	3	4	3	3	3	2	2	2	3		3.0
CO2	4	4	3	2	2	4	2	3	3	3	3	2	3		2.9
CO3	4	4	2	2	2	4	2	2	2	3	3	2	4		2.8
CO4	4	4	4	3	3	4	3	3	3	3	3	2	4		3.3
CO5	4	4	3	3	4	4	3	3	2	4	3	3	4		3.4
CO6	4	4	4	3	3	4	2	3	3	3	2	3	4		3.2
Overall Mean Score for COs															3.1

Result: The Score for this Course is 3.1 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester II **Hours/Week: 4**
18PBT2202B **Credits : 4**

Core Elective-IIB:

MOLECULAR DIAGNOSTICS AND THERAPEUTICS

Course Outcomes:

1. Knowledge in the molecular mechanisms of diseases.
2. Familiar with the various molecular diagnostic tools available for genetic and infectious diseases.
3. Knowledge about the DNA probes and their molecular techniques for the disease diagnosis.
4. Analyse the difference between conventional and molecular techniques.
5. In-depth idea about how genetic problems may lead to disease or lethality.
6. An impression about modern DNA technology to the application of disease gene identification and analysis.

Unit – I

Molecular mechanisms of diseases: Detection of genetic defects, Detection of infectious agents, tumor diagnosis markers and grading. Diagnosis of single gene disorders - Spinal muscular atrophy, DMD and BMD, Fragile X syndrome.

Unit—II

Use of Probes for diagnostics: Restriction Fragment Length Polymorphism (RFLP) - DNA probes detection of mutations and deletions in gene. Eg: Sickle cell anaemia, Fragile-X syndrome, Cystic Fibrosis. Chromosomal DNA probes for prenataldiagnosis of X-linked Retinitis pigmentosa, Prenatal sex determination. Molecular diagnosis for early detection of cerebral palsy, Down syndrome. Role of long non-coding RNA (IncRNA) in disease diagnosis.

Unit – III

Hereditary persistence of fetal hemoglobin: Apolipoprotein genes, DNA polymorphism and hyperlipidemia, cDNA of human protein C for diagnosis of protein C deficiency. Prenatal diagnosis and carrier detection of phenylketonuria by gene. Prenatal diagnosis - Fluorescent *in situ* hybridization (FISH) DNA probes - fluorescent labelling, chromosome painting and spectral karyotyping, peptide mapping.

Unit–IV

DNA based molecular techniques for diagnosis: DNA sequencing: Next generation sequencing methods in diagnosis- whole genomic sequencing (WGS), whole transcriptomic sequencing (WTS), exome sequencing, SNP chromosomal microarrays, relative-quantitative PCR, methylation analysis, MLPA, mutation screening panels (xTAG, Luminex), and SNP testing.PCR-based SNP detection: single-stranded conformational polymorphism analysis, heteroduplex analysis, allele-specific and multiplex PCR, competitive oligonucleotide priming.

Unit – V (Online)

Applications of molecular diagnostics in degenerative and infectious disorders: Cardiovascular diseases: CVD gene mutations - LDL and LDL receptor. Pharmacogenomic testing for cardiovascular diseases. Molecular oncology testing in malignant disease (lymphoproliferative and myeloproliferative disorders and solid tumours lung, Retinoblastoma, colorectal and endometrial cancer). Molecular based diagnosis caused by bacteria (*Streptococcu*s, *Salmonella*), virus (HIV, Influenza), fungal (Dermatophytoses, Candidiosis) and Protozoan diseases (Malaria, Leishmaniasis).

Textbooks for study

1. Koporowski, H *et al*., 1985. Biotechnology in Diagnostics, Elsevier publishers.Vol-21.
2. Tietz textbook of clinical chemistry and molecular diagnostics. Carl Burtis, Edward Ashwood, David Bruns, Elsevier Press. 2011.
3. Molecular Diagnostics: Current Technology and Applications. Juluri R Rao, Colin Craig Fleming. Horizon Scientific Press.

References

1. Fazal Ahmed, 1984, Advances in Gene technology: human genetic disorders, ICSU Stanely, A etal, 1994, Vaccines, W. B. Saunders & Co.
2. Lela Buckingham, Maribeth L. Flaws, 2007, Molecular Diagnostics - Fundamentals, Methods & Clinical Applications, F.A. Davis & Company, Philadelphia.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PBT2202B	Title of the Paper Core Elective-IIB: MOLECULAR DIAGNOSTICS AND THERAPEUTICS												Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	4	3	2	3	4	3	2	2	3	3	2	4		2.9
CO2	4	4	3	4	4	4	5	5	3	3	2	3	4		3.7
CO3	4	4	3	4	3	4	4	4	2	4	1	2	4		3.3
CO4	3	2	2	2	2	3	2	2	3	3	3	2	2		2.4
CO5	5	4	4	4	3	4	3	3	2	3	1	2	4		3.2
CO6	5	5	3	4	3	4	4	4	3	2	2	3	4		3.5
													Overall Mean Score for COs		3.2

Result: The Score for this Course is 3.2 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester II **Hours/Week: 4**
18PSS2301 **Credits : 4**

IDC: SOFT SKILLS

Course Outcomes:

1. Students are taught the various nuances of grooming such as, good manners and etiquettes and they are trained to practice them in the class rooms.
2. Students are empowered with public speaking skills via extempore speeches and prepared speeches, presented before the class and assessed by the trainer as well as the companions which eventually helps build self confidence of the students.
3. Students learn the different types of resumes and different types of interview skills and write and print their own resumes and present before the interview panel for their mock interview.
4. Students actively learn the ten parameters of group discussion, perform on the stage with their colleagues, which is videotaped, reviewed and evaluated.
5. As students go through their teenage, self discovery becomes a tool to develop their personality facilitated with scientific psychological personality tests.
6. Students are guided to knowing their SWOT (Strengths, Weaknesses, Opportunities and Threats)and setting their short term and long term goals for their lives.

Module 1: Basics of Communication: Definition of communication, Process of Communication, Barriers of Communication, Non-verbal Communication,

Effective Communication: The Art of Listening, Exercises in Kinesthetics, Production of Speech, Organization of Speech, Modes of delivery, Conversation Techniques, Dialogue, Good manners and Etiquettes, Politeness markers & Listening links.

Module II: Resume Writing: What is Resume? Types of Resume? Chronological, Functional and Mixed Resume, Steps in preparation of Resume, structure and framework for writing resume, Intensive training / personalized training on resume writing. **Interview Skills**: Common interview questions, Attitude, Body Language, The mock interviews, Phone interviews, Behavioral interviews.

Module III: Group Discussion: Group Discussion Basics, GD Topics for Practice, Points for GD Topics, Case-Based and Article based Group Discussions, Points for Case Studies, and Notes on Current Issues for GDS & Practicum with video coverage. **Team Building:** Team Vs Group – Synergy,

Stages of Team Formation, Broken Square-Exercise, Win as much as you win- Exercise, Leadership – Styles, Work ethics.

Module IV: Personal Effectiveness: Self Discovery, Self Esteem, Goal setting, Problem-solving, Conflict and Stress Management

Module V: Numerical Ability: Average, Percentage, Profit and Loss, Problems on ages, Simple Interest, Compound Interest, Area, Volume and Surface Area,Time and Work, Pipes and Cisterns, Time and Distance, Problems on Trains, Boats and Streams, Calendar, Clocks, Permutations and Combinations, Probability.

Module VI: Test of Reasoning: Series Completion, Analogy, Data Sufficiency, Blood Relations, Assertion and Reasoning, Logical Deduction, Direction. **Non-Verbal Reasoning**: Series, Classification

Text Book

1. Melchias, G., Balaiah John., John Love Joy (Eds) 2015. *Winners in the making*. St.Joseph's College, Trichy-2

References

1. Aggarwal, R. S. *Quantitative Aptitude, S.Chand & Sons*
2. Aggarwal, R.S. (2010). *A Modern Approach to Verbal and Non Verbal Reasoning*. S. Chand & Co, Revised Edition.
3. Covey, Stephen. (2004). *7 Habits of Highly effective people,* Free Press.
4. Egan Gerard (1994). *The Skilled Helper* (5th Ed). Pacific Grove, Brooks/ Cole.
5. Khera, Shiv (2003). *You Can Win.* Macmillan Books, Revised Edition.
6. Murphy, Raymond. (1998). *Essential English Grammar*. 2nd ed., Cambridge University Press.
7. Prasad, L. M. (2000). *Organizational Behaviour, S.Chand & Sons.*
8. Schuller, Robert. (2010). *Positive Attitudes*. Jaico Books.
9. Trishna's (2006). *How to do well in GDs & Interviews*, Trishna Knowledge Systems.
10. Yate, Martin. (2005). H*iring the Best: A Manager's Guide to Effective Interviewing and Recruiting*.

Modules	Topics	Examination Pattern	
		CIA	Online
I	Basics of Communication	15	5
II	Resume Writing & Interview Skills	15	5
III	Group Discussion & Team Building	10	5
IV	Personal Effectiveness	10	5
V	Numerical Ability (Common Session)	5	10
VI	Test of Reasoning (Common Session)	5	10
Total		**60**	**40**

Semester III **Hours/Week: 4**
18PBT3110 **Credits : 3**

BIOINSTRUMENTATION AND RESEARCH METHODOLOGY

Course Outcomes:

1. Beneficial to various scientific areas including life sciences, chemical sciences, material sciences and environmental science.
2. Provide scientific understanding of analytical techniques and detail interpretation of results.
3. Understand the working principles, construction and applications of the instruments often used in the studies related to various disciplines of Biological Sciences.
4. Understand the statistical concepts and applying them in data collection, analysis and interpretation.
5. Impart knowledge on different scientific research designs and methods
6. Understand the importance and the concept of Research and learn the art of paper writing and publication.

Unit – I

Electrochemical techniques – principles, electrochemical cells and reaction – pH and buffers. Measurement of pH –electrodes, types of electrodes and applications. Titration curves. Turbidometry and Nephelometry. Microscopy – Compound, Fluorescence, Phase contrast, Scanning, Transmission, Atomic force and Confocal Scanning Laser Microscopy.

Unit – II

on techniques: Centrifuges - Principles, differential and analytical centrifugation, density gradient centrifugation; Ultracentrifuge and its application. Electrophoresis: Principles, electrophoretic mobility, DGGE, TGGE. Isoelectric focussing, 2D PAGE, capillary electrophoresis.Chromatographic techniques, Types and Applications – adsorption and partition chromatography, paper, column, thin layer, Ion-exchange, exclusion, affinity, GC, HPLC and HPTLC.

Unit – III

Spectroscopy – Properties of EMR, Absorption & Emission Spectrum., Wave properties and types of sources. AAS & flame photometer, UV/VIS spectroscopy, IR, ESR, NMR, MS, GC-MS, spectrofluorimetry, CD spectroscopy, X-ray diffraction. Tracer technique: Nature of Radioactivity and Half life, Detection and measurement of radioactivity: Geiger Muller

Counter- principle, construction, applications, advantages and disadvantages. Scintillation counter – Principle, types, construction and applications.

Unit – IV

Biostatistics – Basics and uses of Measures of Central values (Mean, Median, Mode), Measures of Dispersion (Standard Deviation and coefficient of variation) in data analysis and presentation. Basic theoretical knowledge of Correlation and Probability - Sample Testing: Large samples (Z), small sample test: t, Chi-square, ANOVA - one way & two way. Experimental Design: Principles: Randomization, Replication, Local control, Size and shape of the plot. CRD and RBD.

Unit – V (Online)

Research: Selection of research problems – hypothesis – definition and characteristics. Experimental approaches – biological, physical and chemical methods. Sources of information: Journals, e-journals, books, biological abstracts, Preparation of index cards, Review writing, Thesis writing, Article writing – structure of article (title, introduction, methods, specimens and techniques of statistics, results, discussion, acknowledgements, references, abstracts), Selection of journals for publication.

Text Books for study

1. Braun, R.P. 1987. Introduction to Instrumental Analysis (McGraw Hill).
2. West, E.S. and Todd, W.R., Mason, H.S. and Van Brugan, J.T.: Textbook of Biochemistry.

References

1. Edsall, J.T and Wymen, J : Biological Chemistry- Vol. I and II (Academic Press).
2. Research methodology for biological sciences by N. Gurumani: MJP publications (2006).
3. Biophysical chemistry: Part I, Part II and Part III by Cantor and Schimmel: 2004 edition.
4. Biostatistics by Wayne W. Daniel: Seventh edition (2006).

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PBT3110	Title of the Paper BIOINSTRUMENTATION AND RESEARCH METHODOLOGY											Hours 4	Credits 3
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)							Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	4	4	3	5	4	5	4	3	5	4	3	4	5	4.1
CO2	4	3	2	3	4	3	2	5	3	4	3	4	2	3.2
CO3	3	3	2	3	4	5	5	4	4	4	3	4	4	3.7
CO4	2	3	2	2	3	3	4	2	3	3	2	3	2	2.6
CO5	3	4	3	3	3	4	3	3	2	3	4	3	5	3.3
CO6	3	2	4	4	2	2	4	4	3	2	4	2	4	3.1
Overall Mean Score for COs														3.3

Result: The Score for this Course is 3.3 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester III **Hours/Week: 4**
18PBT3111 **Credits : 3**

MICROBIAL BIOTECHNOLOGY

Course Outcomes:

1. It covers basic principles of fermentation and technologies of fermented food products.
2. The course covers the microbial growth kinetics, fermentation types, selection of microorganisms used in industry and production of different types of fermented food products.
3. The processes include traditional fermentation procedures and also those involving organisms modified by recombinant DNA technology.
4. Impart knowledge in the avenues of exploiting microbes.
5. Study the structure and types of fermentor.
6. Study the downstream processes for product recovery in fermentation.

UNIT I

Introduction to fermentation technology: Interaction between chemical engineering, Microbiology and Biochemistry. History of fermentation. Introduction to fermentation processes, Media formulation and optimization. Basic concepts- batch, Continuous and fed batch culture, selection methods for industrially important microorganisms. Strain improvement, preservation, and properties of industrial strains. Immobilization: different matrices, whole cell and enzyme immobilization.

UNIT II

Fermentor – Design & Types: Gaden's Fermentation classification, Design and operation of Fermenters, Basic concepts for selection of a bioreactor, Impellers, baffles and sparger, sterilization. Types of reactor- submerged reactor – mechanically stirred draught- tube reactor- continuous flow stir type reactor – airlift reactor- jet loop reactor, surface reactor, packed bed reactor, Fluidized bed reactor.

UNIT III

Bioprocess control and monitoring variables – O_2 requirement and uptake, Foam and antifoams, their effect on oxygen transfer, factors affecting KLa. Flow measurement and control, control system – manual and automatic. Application and the role of computers in bioprocess. Fermentation economics. Biosensors: construction and application.

UNIT IV

Down-stream processing: Introduction, recovery of microbial cells, precipitation, filtration-theory of filtration, batch and continuous filters. Centrifugation. Cell disruption - physical and chemical methods. Extraction-liquid-liquid extraction and aqueous-two phase extraction. Chromatography, membrane processes, drying and crystallization.

UNIT V (Online)

Production strategies for industrial products: (Lactic acid and Ethanol), therapeutics (Insulin and Interferon), antibiotics (Cephalosporin), Microbial enzymes (Chitinase, Glucose Oxidase, Lipase), Exopolysaccharides (Pullulan). Use of immobilized cells / enzymes to produce protease, Use of fungi in industry including food industry: fuel cells, Use of fungi in agriculture and environmental applications: Biofertilizers, Bioremediation and Biological control. Animal cell culture technology to produce recombinant vaccines.

Text Books for study

1. Stanbury P.F. *et al*. 1999. Principles of Fermentation Technology, Butterworth-Heinemann, UK.
2. El-Mansi E.M.T *et al*. 2007. Fermentation microbiology & biotechnology. CRC / Taylor & Francis.

Reference

1. Bailey J and D.F. Ollis. 1986. Biochemical Engineering Fundamentals (Ed: 2): McGraw-Hill, NY
2. Cinar A *et al*. 2003. Batch Fermentation - Modeling, Monitoring and Control. Marcel Dekker. USA.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PBT3111					Title of the Paper MICROBIAL BIOTECHNOLOGY								Hours 4	Credits 3
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	5	3	3	4	4	3	3	4	4	3	4	3	2	3.5	
CO2	4	2	3	4	3	2	4	4	3	5	3	3	3	3.3	
CO3	4	2	2	4	3	4	4	3	5	3	4	3	2	3.3	
CO4	3	2	3	4	2	2	3	2	3	4	3	2	4	2.8	
CO5	4	3	4	2	4	3	4	2	3	3	4	2	3	3.1	
CO6	2	3	4	3	4	3	2	3	4	3	2	4	4	3.1	
Overall Mean Score for COs														3.2	

Result: The Score for this Course is 3.2 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester III **Hours/Week: 4**
18PBT3112 **Credits : 4**

Lab Course-III:
MICROBIAL BIOTECHNOLOGY, BIOINFORMATICS & BIOSTATISTICS AND IMMUNOLOGY

Course Outcomes:

1. Develop the skills of large scale production of secondary metabolites.
2. Study the batch and continuous culture growth
3. Evaluate the temperature effect on culture growth
4. DNA analysis using graph Algorithms Clustering and trees.
5. Impart knowledge on statistical analysis of biological data.
6. Advanced knowledge of the underlying principles of immunology and its application in solving problems in biological systems.

Microbial Biotechnology

1. Bioassay and Chemical estimation of penicillin
2. Preparation of bioinoculants and cell count determination on time scale
3. Preparation of enzyme immobilized columns for biotransformation –e.g. yeast cells immobilized in calcium alginate beads.
4. Microbial Production of amino acids.
5. Screening and isolation of Antibiotic producing organisms from soil.
6. Isolation and screening of Enzyme producing micro organisms from soil.
7. Alcohol fermentation by Yeast.

Bioinformatics & Biostatistics

1. Data Collection on discrete and continuous variables.
2. Data classification: Discrete frequency distribution, Continuous frequency distribution and Cumulative frequency distribution.
3. Statistical Illustrations – Manual and Computer aided using Microsoft Excel.
4. Measure of central values: Minimum, Maximum, Mean, Median and Mode
5. Measure of Dispersion: Standard Deviation and coefficient of variation
6. Biological databases-file formats.
7. Data retrieval using ENTREZ
8. Sequence analysis: Pairwise alignment (BLAST)

9. Sequence analysis: Multiple alignment (Clustal W)
10. Motif and domain analysis
11. Phylogenetic analysis
12. Molecular visualization using Rasmol.

IMMUNOLOGY

1. Collection of body fluids, blood
2. Separation of serum and plasma
3. Precipitation – Agar Gel Diffusion, Counter current Immuno-electrophoresis, Single Radial Immunodiffusion, Rocket electrophoresis
4. Agglutination - blood grouping, latex agglutination, heme-agglutination, WIDAL, VDRL
5. Labeled assays - ELISA, Radio Immuno Assay and Immunoblot.
6. Total count, Differential count (RBC & WBC)
7. Blood typing
8. Isolation of DNA from leukocytes

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PBT3112	Lab Course-III: MICROBIAL BIOTECHNOLOGY, BIOINFORMATICS, BIOSTATISTICS AND IMMUNOLOGY											Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)							Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	5	5	4	3	5	4	2	5	3	4	4	4	5	4.1
CO2	3	4	4	2	4	3	4	3	4	3	5	4	4	3.6
CO3	3	5	3	3	4	1	5	3	4	5	3	4	3	3.5
CO4	4	2	3	4	3	4	3	2	3	4	3	2	4	3.2
CO5	2	4	5	3	2	4	2	3	4	2	1	5	2	3.0
CO6	4	2	4	5	3	4	3	2	5	4	3	2	5	3.5
Overall Mean Score for COs														3.5

Result: The Score for this Course is 3.5 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No.of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester III **Hours/Week: 6**
18SBS3101 **Credits : 5**

Inder Disciplinary Core:
SOLID WASTE MANAGEMENT

Course Outcomes:

1. To understand the importance of solid waste management.
2. To study the method s of collection of wastes.
3. To acquire knowledge on decomposition of organic matter.
4. To know the methods of solid waste management.
5. To learn the technology of vermicomposting.
6. To learn the technique of Mushroom cultivation.
7. To understand the importance and medicinal values of mushroom.
8. To understand the preparation of recipes of mushroom

Unit-I

Definition-scope and importance of solid waste management-Types of solid wastes-garbage, rubbish, agricultural, hospital and domestic wastes. Collection-transport and processing of solid wastes.Waste as a resource-organic compost-process of composting-Role of microbes in composting. Significance of organic compost.

Unit-II

Organic matter decomposition- Decomposition of litter, cellulose, hemicelluloses, lignin, water soluble components and proteins.Carbon assimilation and immobilization.Microbes associated with organic matter decomposition.Factors affecting organic matter decomposition.

UnitIII

Solid waste management- methods of solid waste management- open dumping, land filling, incineration, pyrolsis Biogas production-mechanism of methane gas formation. Factors affecting methane formation Utilization of Biogas.

Unit-IV

Vermicomposting-Earthworm and it's characteristics-internal anatomy-digestive, excretory, respiratory and reproductive systems.Preparatory methods of vermiculture.Economic and ecological importance of vermicompost and vermi wash.

Unit-V

Mushroom culture- classification-Tests for identification-Characteristics of common edible mushrooms-Nutritive value of mushrooms. Culture techniques-preparation of spawn- Preparation compost- spawn running and harvesting. Preservation and storage.Recipes of mushroom.

Text Book

1. Dubey, RC. (2009). A Text book of microbiology, S. Chand & Co. Ltd, New Delhi.

Reference

1. NIIR Board, 2004, The Complete Technology Book on Biofertilizers and Organic Farming, National Institute of Industrial Research.
2. Mohoney, R. Lab Techniques in Zoology, (UK: Butterworth, 1966)
3. Vasantaraj David, S. and Kumaraswamy, T. Elements of Economic Entomology, (Chennai: Popular Book Depo, 1998).

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18SBS3101					Title of the Paper SOLID WASTE MANAGEMENT								Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	5	4	5	4	3	3	4	5	3	4	4	4	4	4.0	
CO2	5	3	5	3	4	3	4	4	2	3	3	4	5	3.7	
CO3	4	3	3	5	3	3	4	3	4	4	3	3	4	3.5	
CO4	5	4	3	3	2	2	5	3	3	5	4	3	3	3.5	
CO5	4	3	5	3	3	3	3	3	3	3	3	4	3	3.3	
CO6	5	3	5	4	3	4	3	2	4	3	3	3	4	3.5	
CO7	4	3	5	2	2	5	3	5	3	4	5	4	2	3.7	
CO8	4	5	3	5	3	5	2	4	2	5	3	3	4	3.7	
													Overall Mean Score for COs		3.5

Result: The Score for this Course is 3.5 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester III **Hours/Week: 6**
18PBS3101B **Credits : 5**

Interdisciplinary Core: IMMUNOLOGY

Course Outcomes:

1. Understanding the function of the major components of the immune system in health and disease
2. Knowledge about the immune response of humans to foreign substances.
3. Familiar in the modern techniques that help determine human protection.
4. Intellectual literacy in the common immune diseases in terms of the underlying basic principles.
5. Resourceful in the structure, function, and characteristics of immunoglobulins.
6. Familiar with the immunologic responses involved in preventing, combating infections and the concepts of nonspecific and specific immunity.
7. Understanding the antigen-antibody interactions and the mechanism of the immune system to protect the body from the pathogens.

Unit – I Basics of immunology

Terminology - antigen, immunogen, hapten, antigenecity, immunogenicity, immunoglobulin, antibody, epitope, paratope, super antigen, allergen, tolerogen etc. Organs of immune system, tissues of immune system, cells of immune system & mediators of immune system. Natural & induced immunity. Vaccinology – Active, passive and combined immunization. Live, killed, attenuated, plasma derived sub-unit, recombinant DNA, protein based, plant-based, peptides, anti-idotypic and conjugate vaccines – production & applications. Role and properties of adjuvants & ISCOMS.

Unit – II Immunoglobulin

Theories of antibody formation. Structure and Functions domains, classes, Organization and expression of Immunoglobulin Light and Heavy chain genes. B cell maturation, activation and differentiation; Generation of antibody diversity; T-cell maturation, activation and differentiation. Antibody genes and antibody engineering- chimeric and hybrid monoclonal antibodies, catalytic antibodies and generation of immunoglobulin gene libraries.

Unit – III Major Histocompatibility Complex (MHC)

General organization and inheritance of MHC; MHC Haplotypes. The structure of MHC class-I and class-II molecules; organization of MHC class

I and class II genes, peptide binding of MHC molecules. Complement system-alternate and classical pathways. HLA typing. Transplantation - Immunological basis of graft rejection; Clinical transplantation and immunosuppressive therapy. Cell Mediated Immunity, Humoral immunity, Antigen Presenting Cell.

Unit – IV Antigen-antibody interactions

Precipitation, agglutination and complement mediated immune reactions; Advanced immunological techniques - RIA, ELISA, Western blotting, ELISPOT assay, Immunofluorescence, Flow cytometry and Immunoelectron Microscopy; Biosensor assays for assessing ligand - receptor interaction, CMI techniques – Lympho-proliferation assay, Mixed lymphocyte reaction, Cell Cytotoxicity assays, Apoptosis.

Unit – V (Online) Clinical Immunology

Immunity to Infection: Bacteria, viral, fungal and parasitic infections (with examples from each group); Hypersensitivity - Type I-IV; Autoimmunity; Types of autoimmune diseases; Mechanism and role of CD4+ T cells; MHC and TCR in autoimmunity; Treatment of autoimmune diseases; Tumor immunology - Tumor antigens; Immune response to tumors and tumor evasion of the immune system, Cancer immunotherapy; Immunodeficiency - Primary immunodeficiencies, Acquired or secondary immunodeficiencies.

Text Books for study

1. Kuby R.A. Goldsby *et al*., 2002. Osborne Immunology (Ed: 6) Freeman & Co., New York.
2. Roit M. Ivan. 1998. Essential Immunology (Ed: 7). Blackwell Scientific Publisher, England.
3. Tizard, Ian R. Immunology and introduction, Fourth Ed, Saunders college publishing, New Delhi, 2010 Coico R, Sunshine G. Immunology: A short course, Sixth Edition, Wiley-Blackwell publishers, Canada 2009.

References

1. Donald M. Weir and John Steward. 1993. Immunology (Ed: 7). ELBS, London.
2. Murphy et al., 2008. Janeway's Immunology the immune system in health and disease. (Ed: 7), Garland Science Publisher, New York.
3. Hudson, L. and Hay, F.C. Practical Immunology. Blackwell publishers 1989.
4. Dixon, F.J. Advances in Immunology. Academic Press 1986.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PBS3101B					Title of the Paper Interdisciplinary Core: IMMUNOLOGY								Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	5	4	2	4	4	5	4	4	4	3	4	2	4		3.8
CO2	5	3	3	4	2	2	3	1	3	4	2	5	4		3.2
CO3	4	4	4	3	2	2	4	2	3	3	4	2	5		3.2
CO4	4	3	2	3	5	3	2	2	5	3	2	4	3		3.2
CO5	3	3	4	2	3	4	5	4	3	3	2	3	3		3.2
CO6	3	3	4	2	2	3	1	3	2	2	5	3	4		2.8
CO7	5	4	4	4	3	2	3	5	2	3	3		2		3.3
CO8	3	3	4	4	4	3	4	5	3	2	4	4	4		3.6
														Overall Mean Score for COs	3.3

Result: The Score for this Course is 3.3 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Totalof Values}}{\text{TotalNo.of POs\& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester III **Hours/Week: 4**
18PBT3203A **Credits : 4**

Core Elective-IIIA: BIOINFORMATICS

Course Outcomes:

1. To give students knowledge of and competence in use of bioinformatical methods central to conduction of molecular biological research projects.
2. Emphasis on bioinformatics related to exploration of proteins and includes analyses of sequences, database searches, sequence comparison, visualization and analysis of protein structures, and introduction to phylogenetic analyses.
3. Give an introduction to analysis of DNA sequences, genes and genomes, gene expression and systems biology.
4. To give students a basic competences in the use of bioinformatical tools.
5. Emphasizes the learning of bioinformatical tools in light of the student's knowledge of molecular biology.
6. Study the meaning and structure of biological information available in the existing databases.

Unit – I

History of Bioinformatics; Role of Bioinformatics in biological sciences; Scope of Bioinformatics; Types of biological databases; Data mining and its techniques; Data warehousing. Application of Bioinformatics- gene prediction in prokaryotes, eukaryotes; other applications in the areas of health, food and medicine.

Unit – II

Nucleic acid databases – Genbank, NCBI, EMBL, DDBJ; Primary protein databases – PIR, SWISSPROT, TrEMBL; Secondary protein databases – PROSITE, PROFILES, PRINTS, Pfam; Structural classification databases – SCOP, CATH; Literature databases – PubMed, Medline; Bibliographic databases – OMIM, PubMed.

Unit – III

Sequence Annotation – Principles and tools; Sequence retrieval system – Entrez, SRS; Sequence submission tool – BANKIT, SEQUIN, WEBIN, SAKURA. Molecular phylogeny – Concepts of tree – rooted and unrooted trees; Clustering and Phenetic method, Cladistic method, Molecular Clocks; Steps in constructing phylogenetic analysis; Softwares used for phylogeny

construction, Bootstrapping strategies. Molecular viewers - Rasmol, Chime and Spdb viewer.

Unit – IV

Sequence alignment – concepts in alignment, Local & Global; Pairwise & Multiple; Tools for sequence alignment – BLAST, FASTA, Clustal W; Substitution matrices; Scoring matrices – PAM & BLOSUM; Dot plot; EST Clustering and analyses, Codon bias detection,

Unit – V (Online)

Genomics & Proteomics: Concepts in Genomics and Proteomics, Genome annotation, Homology modelling. Applications of Metabolomics & Transcriptomics; Concept of system biology.

Text Books for study

1. Arthur M Lesk. 2005. Introduction to Bioinformatics(Ed:2). Oxford university press, New York.
2. Attwood, T.K. and Parrysmith, D.J. 2001. Introduction to Bioinformatics. Pearson Education (Singapore) Pvt. Ltd., New Delhi.

References

1. Andreas D. Baxevanis and B. F. Francis Ouellette. 2005. Bioinformatics - A Practical guide to the analysis of Genes and Proteins (Ed:3). John Wiley & Sons, Inc., Publications, US.
2. David W Mount. 2004. Bioinformatics: sequence and Genome analysis(Ed:2). Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.
3. Rastogi, S.C., Menderatta, M. and Rastogi, P. 2004. Bioinformatics - concepts, skills and applications. CBS Publishers & Distributors, New Delhi.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PBT3203A					Title of the Paper Core Elective-IIIA: BIOINFORMATICS								Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	4	4	3	2	3	2	3	3	2	4	1	3		2.8
CO2	4	3	2	4	3	3	4	5	2	3	3	2	1		3.0
CO3	4	5	3	2	3	4	2	4	2	5	3	1	4		3.2
CO4	5	2	3	4	3	2	3	5	4	2	3	2	3		3.1
CO5	2	2	3	4	2	3	2	5	1	2	3	4	5		2.9
CO6	3	2	3	2	5	3	5	4	3	3	2	4	2		3.2
Overall Mean Score for COs															3.1

Result: The Score for this Course is 3.1 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester III **Hours/Week: 4**
18PBT3203B **Credits : 4**

Core Elective-IIIB: DRUG DISCOVERY AND DEVELOPMENT

Course Outcomes:

1. Make a detailed study of drugs, particularly their actions on living systems.
2. Understand the major aspects of the drug discovery process, starting with target selection, to compound screening to designing lead candidates.
3. Increase understanding of the various drug discovery tools and methods that are used for finding, identifying and designing a new drug.
4. Know their chemotherapeutic value.
5. Impart basic concepts in the field of drug design followed by advanced methodology in the molecular aspects of drug design.
6. Impart basic concepts of drug metabolism and pharmokinetics, manufacturing principles, and product development and its quality.

Unit – I

Drugs – definition, source and nature, types of classification and nomenclature, dose response curve and LD50. Role of drugs, Drug – protein interactions, routes of drug administration.

Unit – II

Drug targets – Therapeutic categories such as vitamins, laxatives, analgesics, Antibiotics, hormones. Enzymes, receptors, carrier proteins. Forces in drug – receptor interaction, Receptor theories.

Unit – III

Drug absorption and metabolism.Pharmacokinetic oriented drug design – Drug solubility and drug stability.Biological testing and bioassays – testing drugs *in vitro* and *in vivo*.Drug discovery. Lead compounds – natural sources and synthetic sources.

Unit – IV

Development of Drug and Pharmaceutical Industry: Therapeutic agents, their use and economics; Regulatory aspects. Radio activity pharmacokinetic action of drugs in human bodies.

Unit – V (Online)

Drug development. Target – oriented drug design, computer aided drug design, Quantitative structure, activity relationship – binding interaction, Functional groups and Pharmacophore. High thoroughput screening and Molecular docking.

Text Books for Study

1. Barar F S K (2004), Essentials of Pharmacotherapeutics, S Chand & Co. Ltd., New Delhi.
2. G. Patrick (2002) Medicinal Chemistry-, Instant notes series, Viva Books.

References

1. Trends in Molecular Pharmacology, Elseiver Publications.
2. Molecular graphics in drug design, Marshall and Motoc.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PBT3203B	Core Elective-IIIB: DRUG DISCOVERY & DEVELOPMENT											Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)							Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	4	3	3	4	3	4	1	3	4	3	5	2	4	3.3
CO2	5	4	2	5	4	4	2	4	3	4	3	3	1	3.4
CO3	3	4	4	4	2	3	3	3	3	4	1	2	2	2.9
CO4	4	3	4	3	3	4	4	4	5	3	2	3	5	3.6
CO5	3	1	3	3	3	2	3	5	2	4	2	3	4	2.9
CO6	2	3	4	1	4	5	4	5	1	2	3	2	3	3.0
Overall Mean Score for COs														3.2

Result: The Score for this Course is 3.2 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester III **Hours/Week: 4**
18PBT3301 **Credits : 4**

IDC (WS):
MEDICAL BIOTECHNOLOGY

Course Outcomes:

1. To provide students with basic concepts and understanding of how the various drivers of medical biotechnology interact with one another and shape the business and finance of this industry and impact the growth of medical biotechnology companies.
2. To provide students with an historical perspective in the fast emerging medical biotechnology, cancer biology and the innovative processes that ensures the success of such endeavors.
3. To cover a host of topics that will provide the students with a springboard to develop their creative thinking and explore their ideas of new vision of medical biotechnology and cancer biology.
4. By learning the basics of medical genetics and their underlying mechanisms, one can be aware of the ways to avoid them and also know the implications of the drugs and their effects.
5. Aimed at learning the genetic disorders caused due to environmental factors as well as patterns of inheritance.
6. Provide a comprehensive introduction to the clinical research process.

Unit I

Introduction to Medical biotechnology- Scope for Medical biotechnology, History of Medical Biotechnology, Molecular interactions: Protein – drug, protein-protein, protein-DNA, Enzymes Diagnostics –nucleic acid based diagnostics – PCR based diagnostics.

Unit II

Clinical Research in Drug Discovery, New Drug Application and Approval - Pharmaceutical Industry – Global and Indian Perspective - Clinical Trial market. Selection of drugs – Threats behind self medication - Monitoring the prescribed drug advised, Clinical data management, Ethical issue in clinical studies.

Unit III

Pharmaceutical product manufacturing and their control: Bulk drug manufacturers, Type of reactions in bulk drug manufacture and processes. Special requirement for bulk drug manufacture. Control: Therapeutic

categories such as vitamins, laxatives, analgesics, non-steroidal contraceptives, Antibiotics, biologicals, hormones.

Unit IV

Fundamentals of cancer biology

Regulation of Cell cycle, Mutations that cause changes in signal molecules, tumour suppressor genes, Modulation of cell cycle-in cancer, Different forms of cancers, Diet and cancer .Carcinogenesis and types.

Unit V (Online)

Oncogenes and treatment for cancer

Oncogenes, Identification of Oncogenes, Retroviruses and Oncogenes, detection of Oncogenes, Growth factor and Growth factor receptors that are Oncogenes. Different forms of therapy, Chemotherapy, Radiation Therapy, Detection of Cancers, Prediction of aggressiveness of Cancer, Advances in Cancer detection.

Text Books for study

1. Molecular cell Biology: Harvey Lodish, David Baltimore, Arnold Berk, S Lawrence Zipursky , Paul Matsudaira, James Darmell,W.H Freeman Publishers,1995
2. The Biological Basis of Cancer: R. G. McKinnell, R. E. Parchment, A. O. Perantoni, G.Barry Pierce, I. Damjanov. 2nd Edition, Cambridge University Press, 2006.
3. The Biology of Cancer: R. A. Weinberg. Garland Science. 2006.
4. Watson J.D. *et al*., 2006 Molecular Biology of the Gene (Ed.5), Pearson Education Inc., London.

References

1. Stephen Hulley (2011), Outlines & Highlights for Designing Clinical Research: An Epidemiologic Approach, Academic Internet Publishers.
2. Dan Wood, Daron Smith (2012), Research in Clinical Practice Springer Publications.
3. Robert J. Levine (2010), Ethics and Regulation of Clinical Research: Second Edition, Yale University Press.
4. The Molecular Biology of Cancer: S. Pelengaris, M. Khan. Blackwell Publication. 2002
5. The Cancer Hand Book: Malcolm R. Alison. Nature Publishing Group. 2003

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PBT3301			Title of the Paper IDC (WS): MEDICAL BIOTECHNOLOGY								Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)							Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	5	4	3	2	5	5	4	4	2	1	5	2	4	3.5
CO2	4	4	3	3	4	4	1	2	3	4	4	2	4	3.2
CO3	4	2	3	3	3	3	2	2	2	4	2	1	3	2.6
CO4	3	1	3	2	4	4	2	3	2	5	4	2	4	3.0
CO5	3	2	2	2	3	4	2	3	3	5	4	2	5	3.1
CO6	5	5	3	5	4	5	4	3	4	4	3	4	5	4.1
Overall Mean Score for COs														3.3

Result: The Score for this Course is 3.3 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester III **Hours/Week: 4**
18PBT3302 **Credits : 4**

IDC (BS):
FOOD TECHNOLOGY

Course Outcomes:

1. Understand the chemical nature and associated microbes of food.
2. Study various microbes that contaminate and spoil the foods
3. Understand the principles of food processing and preservation.
4. Study the manufacturing of basic food products
5. Critically evaluate and summarize a food science issue or problem.
6. Apply critical thinking and problem-solving skills to address current challenges in the food industry.

Unit – I: Food chemistry

Constituent of food – contribution to texture, flavour and organoleptic properties of food; food additives – intentional and non-intentional and their functions; enzymes in food processing.

Unit – II: Food Microbiology

Sources and activity of microorganisms associated with food; food fermentation; food chemicals; food borne diseases – infections and intoxications, food spoilage – causes.

Unit – III: Food processing

Raw material characteristics; cleaning, sorting and grading of foods; physical conversion operations – mixing, emulsification, extraction, filtration, centrifugation, membrane separation, crystallization, heat processing.

Unit – IV: Food preservation

Use of high temperatures – sterilization, pasteurization, blanching, canning – concept, procedure & application; Low temperature storage - freezing curve characteristics. Factors affecting quality of frozen foods; irradiation preservation of foods

Unit – V: Manufacture of food products (Online)

Bread and baked goods, dairy products – milk processing, cheese, butter, ice-cream, vegetable and fruit products; edible oils and fats; meat, poultry and fish products; confectionery, beverages.

Text Books for Study

1. Crosby, N.T.1981. Food packaging Materials Applied Science Publishers, London.
2. Sivasankar B. 2002. Food processing and preservation, Prentice Hall, New Delhi.

References

1. Brenner J G Butters J R Cowell N D and Lilly A E V. 1979. Food engineering operations, 2nd ed., Applied Sciences Pub.ltd., London.
2. Desrosier, N.W. 1996. The Technology of Food Preservation, CBS Publishers and Distributors, New Delhi.
3. Fennema O R 1976. Principles of food science: Part I, Food chemistry, Marcel Dekker, New York.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PBT3302					Title of the Paper IDC (BS): FOOD TECHNOLOGY								Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	4	4	5	2	5	4	3	4	5	4	3	2	4		3.8
CO2	5	3	4	2	3	5	1	3	4	4	3	1	4		3.2
CO3	5	2	4	1	4	4	2	4	3	5	4	2	4		3.4
CO4	4	4	5	2	4	4	4	4	4	4	5	3	4		3.9
CO5	3	2	5	2	3	5	2	4	3	5	5	1	4		3.4
CO6	3	2	3	2	4	3	2	2	3	3	2	1	3		2.5
Overall Mean Score for COs															3.4

Result: The Score for this Course is 3.4 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester IV **Hours/Week: 6**
18PBT4113 **Credits : 5**

FOOD BIOTECHNOLOGY

Course Outcomes:

1. Understand the positive role and benefits of microorganisms and enzymes in food production, processing, and preservation.
2. Understand basic biological and chemical processes of living cells, enzymes, and microbial nutrition in relation to fermentation processes.
3. Know clearly about the food microbiology and food borne diseases.
4. Critique the ethical concerns associated with modern biotechnology processes.
5. Appraise the beneficial effects of microorganisms on foods with regards to nutritional and functional properties.
6. Understand the strategies of food industrial biotechnological industries.
7. Knowledge of techniques used in food processing technology.
8. Understand the chemistry and nutritional value of food.

Unit-I: Introduction to Food Biotechnology and Food Chemistry

Biotechnology in relation to the food industry, classes of industrially important food, Characteristics of food - Nutritional value and sensory characteristics, Food chemistry – Carbohydrates, amino acids, proteins, lipids, vitamins, macro- and micro-nutrients. Nutraceuticals, probiotics, antioxidants, vitamins, organic acids, single cell proteins.

Unit-II: Spoilage of foods

Mechanisms and types of spoilage, Intrinsic and extrinsic factors affecting spoilage: water activity, pH, temperature, redox potential etc., major spoilage micro organisms and their growth conditions, effect on food.

Unit-III : Food microbiology and Food borne diseases

Bacteria, yeasts and molds – sources, types and species of importance in food processing and preservation; fermented foods and food chemicals, single cell protein. Classification – food infections – bacterial and other types; food intoxications and poisonings – bacterial and non-bacterial; food spoilage – factors responsible for spoilage, spoilage of vegetable, fruit, meat, poultry, beverage and other food products.

Unit-IV: Introduction to Food Processing

Preliminary processing methods – need and types, Raw material preparation: Cleaning, sorting, grading, peeling etc Principles and methods of food

preservation – Low temperature techniques: Refrigeration, Freezing and freeze drying, High temperature techniques: Blanching, HTST pasteurization, canning, UHT treatment, dehydration, drying, extrusion cooking, Irradiation techniques: UV light, microwave processing, gamma rays, hydrostatic pressure cooking, use of additives, modified atmosphere packaging and storage

Unit-V: Enzymes used in food industry (Online)

Microbial production of enzymes (proteases, amylases, invertases, pectinase, xylanase), immobilization, applications, production of organic acids using microbial production of novel sweeteners. Fermentation biotechnology of traditional foods of the Indian subcontinent.

Text Books for study

1. Shetty, K., Paliyath, G., Pometto, A. and Levin, R. E., "Food Biotechnology", Taylor and Francis.
2. Fellows, P. Ellis, H., "Food Processing Technology Principles and Practice", Wiley, New York

References

1. Johnson-Green, Perry, "Introduction to Food Biotechnology"
2. Roger, A., Gordan, B. and John, T., "Food Biotechnology", 1989
3. George, J. B., "Basic Food Microbiology", CBS Publishers Distributors, 1987

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester IV	Code 18PBT4113					Title of the Paper FOOD BIOTECHNOLOGY							Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)							Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	4	4	4	3	3	4	3	4	2	2	3	4	3	3.3
CO2	4	3	4	3	2	4	4	4	4	2	2	2	2	3.1
CO3	2	3	3	4	4	3	4	3	4	3	2	2	3	3.1
CO4	4	4	3	5	3	5	4	4	3	3	2	4	3	3.6
CO5	4	2	3	2	3	4	3	3	3	4	4	2	3	3.1
CO6	2	2	3	3	3	3	3	4	5	3	5	2	3	3.2
CO7	3	4	3	5	4	3	2	3	4	3	4	3	4	3.5
CO8	4	4	3	2	3	2	3	4	3	2	3	4	3	3.1
Overall Mean Score for COs														3.2

Result: The Score for this Course is 3.2 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Totalof Values}}{\text{TotalNo.of POs\& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester IV **Hours/Week: 6**
18PBT4114 **Credits : 4**

PLANT AND ANIMAL BIOTECHNOLOGY

Course Outcomes:

1. To provide students with experiences in industry appropriate applications of biotechnology related to plant and animal agriculture.
2. To propagate endangered animals and plants by modifying cell in biotechnology and to propagate cell lines for use in microbiological, medical, and biochemical research.
3. To study the basic principles and techniques involved in plant and animal cell culture.
4. To understand the concepts of transformation in Plant and Animal systems.
5. To understand the achievements of biotechnology in Plant and Animal systems.
6. To study the importance of animal models

Unit – I

Establishment of plant tissue culture: culture media (types of media), explants and its preparation, Types of culture (callus, suspension, Meristem, Embryo, Protoplast, Root cultures), Regeneration of plants (organogenesis and Somatic embryogenesis), Haploid plant production (androgenesis and gynogenesis). Isolation and fusion of Protoplast, Artificial seeds, Hardening of plants, Cryopreservation and Germplasm storage. Applications of plant tissue culture in Agriculture and Forestry.

Unit – II

Introduction of genetic engineering of plants - Vector (Viral vectors and Ti & Ri plasmids) and Gene transfer methods (Electroporation, Particle bombardment, Microinjection). Chloroplast transformation. Transgenic plants - Biotic stress resistance (Pest, Viral, Bacterial & Fungal), Abiotic stress tolerance (Herbicide, Salt, Drought), Crop improvement (Flavr Savr tomato, Golden rice, Amino acid enrichment, Preventing discolouration, Improvingflower pigmentation, Male sterility).

Unit – III

Transgenic plant as bioreactors – Plantibodies, Therapeutic proteins and Edible vaccines. Introduction to animal tissue culture - culture media. Primary cell culture. Development and maintenance of cell lines. Infinite and finite

cell lines, Suspension culture, Embryo culture, Organ and Histotypic cultures. Animal vectors.

Unit – IV

Planning and layout of cell culture laboratories, Equipments used, Media preparation, Sources of contamination. Cell synchronization. Cryobiology. Applications of animal cell culture. Gene therapy - method, gene delivery systems and applications. Production and applications of monoclonal antibodies.

Unit – V (Online)

Methods of animal cloning (Somatic nuclear transfer, Chromatin transfer, Embryo splitting) and its pros & cons. Methods of production of transgenic animals (Transfection, Retroviral vector, Microinjection, Embryonic stem cells, YAC, Gene targeting) and its applications (Human disease models, Gene knockout mice, Transgenic cattle, sheep, fish, Chickens). Transgenic animals as bioreactors - Therapeutic proteins, Vaccines, Recombinant Insulin.

Text Books for study

1. Adrian Slater *et al*., 2003. Plant Biotechnology - The genetic manipulation of plants. Oxford University press, USA.
2. Ranga M.M. 2010. Animal Biotechnology, Agrobios, India.
3. Freshney. R.I. "Culture of Animal cells: Manual of Basic technique", 4th edition. John Wiley Publications, 2000

References

1. Plant Biotechnology and Transgenic Plants, Edited by Kirsi-Marja Oksman - Caldentey and Wolfgang H. Barz. 2002, Marcel Dekker, Inc. New York.
2. Butler M. 1987. Animal cell technology- Principles and procedures. Open University press, New York.
3. Ed. Martin Clynes. 1998. Animal Cell Culture Techniques. Springer, Heidelberg.
4. Gamborg O.L and Philips, G.C. 1995. Plant Cell, Tissue and organ culture - Fundamental methods. Narosa Publishing House, New Delhi.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester IV	Code 18PBT4114					Title of the Paper PLANT AND ANIMAL BIOTECHNOLOGY								Hours 6	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	5	3	3	4	4	4	4	4	4	3	4	3	2		3.6
CO2	4	3	3	4	2	2	4	1	3	5	3	3	3		3.1
CO3	4	2	2	4	3	4	4	3	5	3	4	3	2		3.3
CO4	5	4	3	4	2	4	5	2	3	4	3	4	4		3.6
CO5	4	3	4	2	4	3	4	2	3	3	4	3	4		3.3
CO6	4	3	4	3	4	3	2	3	4	3	2	4	4		3.3
										Overall Mean Score for COs					3.4

Result: The Score for this Course is 3.4 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\textbf{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \textbf{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester IV **Hours/Week: 5**
18PBT4115 **Credits : 5**

Lab Course-IV:
FOOD BIOTECHNOLOGY

Course Outcomes:

1. Understand the microbiology of food, food-borne diseases, food spoilage, fermented food and modern microbial analysis techniques relating to food.
2. Enhance the student's technical, scientific communication and interpretive skills in food biotechnology.
3. Critically analyse and solve problems in food biotechnology, by selecting and applying practical techniques with technical competence in laboratory experiments.
4. Develop a fundamental understanding of basic concepts of food biotechnology and its uses in the society at a large extent.
5. Evaluate applications of various concepts & techniques of food biotechnology to facilitate biotechnological advancement and innovations.
6. Demonstrate knowledge of the regulatory frameworks and ethical principles relevant to food science and biotechnology.

Experiments

1. SPC count of bacteria in Foods (e.g. Chuteny, sauce etc.)
2. SPC count of Fungi in Foods
3. MPN test of food for *E.coli*
4. MBRT test of Milk.
5. Study of fats and oils (a) Iodine Value (b) Peroxide Value
6. Qualitative analysis of
   a) Glucose
   b) Fructose
   c) Starch
   d) Proteins
7. To study effect of pasteurization on Milk
8. Analysis of milk for total solid content.
9. Estimation of ascorbic acid from given food sample by titrimetric method.
10. Isolation and Characterization of food fermenting organism from idli batter.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester IV	Code 18PBT4115					Title of the Paper Lab Course-IV: FOOD BIOTECHNOLOGY								Hours 5	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	4	4	3	4	3	4	5	5	4	3	3	3	4		3.8
CO2	4	4	3	4	4	4	5	5	4	4	3	4	4		4.0
CO3	4	4	3	4	4	4	4	4	4	4	4	3	3		3.8
CO4	4	4	4	4	4	4	4	4	4	3	3	3	4		3.8
CO5	4	4	3	4	4	4	4	4	4	4	3	2	3		3.6
CO6	4	4	3	4	3	4	4	4	3	3	3	3	3		3.5
											Overall Mean Score for COs				3.7

Result: The Score for this Course is 3.7 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester IV **Hours/Week: 5**
18PBT4116 **Credits : 5**

Lab Course-V:
PLANT AND ANIMAL BIOTECHNOLOGY

Course Outcomes:

i. To explain the basics of the physiological and molecular processes that occur in plants and animals.
ii. To understand how biotechnology has been used to develop knowledge of complex processes that occur in the plants and animals.
iii. To use basic biotechnological techniques to explore molecular biology of plants and animals.
iv. To understand the processes involved in the planning, conduct and execution of plant & animal biotechnology experiments.
v. To develop their skills in the animal cell culture techniques.
vi. To understand explicitly the concepts of plant tissue culture techniques.

Plant Biotechnology

1. Organizing plant Tissue culture Laboratory
2. Preparation of Tissue Culture Media
3. Callus Induction
4. Shoot tip culture
5. Embryo/Endosperm Culture
6. Somatic Embryogenesis

Animal Biotechnology

1. Preparation of culture media and sterilization
2. Fibroblast culture.
3. Study of effect of anti cancer agent in cell culture.
4. MTT Assay
5. Live cell counting
6. Leukocyte culture
7. Culturing of spleen cells
8. Fusion of cells by PEG
9. Isolation of DNA from animal tissues.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester IV	Code 18PBT4116	Lab Course-V: PLANT AND ANIMAL BIOTECHNOLOGY											Hours 5	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)							Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	5	4	2	3	4	5	5	4	4	3	4	4	4	3.9
CO2	4	5	3	4	4	4	4	2	3	5	4	4	4	3.8
CO3	3	2	4	3	3	4	3	3	4	3	5	3	5	3.5
CO4	4	4	3	4	2	5	5	2	3	4	4	4	4	3.7
CO5	4	4	2	2	4	2	4	3	4	3	4	2	3	3.2
CO6	5	3	4	3	4	3	2	3	2	3	2	4	4	3.2
									Overall Mean Score for COs					3.6

Result: The Score for this Course is 3.6 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$