

# ST.PHILOMENA'S COLLEGE (AUTONOMOUS), MYSURU (AFFILIATED TO UNIVERSITY OF MYSORE) REACCREDITED BY NAAC WITH A GRADE

Three-year six semesters Choice Based Credit System (CBCS) with Learning Outcome Based Curriculum framework (LOCF) and Continuous Assessment & Grading Pattern (CAGP) Undergraduate Programme under Autonomous Structure

# Programme- B.Sc.

The academic year 2018-19 onwards

# **DEPARTMENT OF BIOTECHNOLOGY**

# VISION AND MISSION OF THE COLLEGE

# **VISION:**

The college is guided by the visionary zeal of providing value- based education to everyone irrespective of religion, caste, creed or sex by which the character is formed, intellect is explained and one can stand on his/her feet.

# **MISSION:**

To transform young men and women who come to learn not from books, but also from life and to share the experience of working and playing together, this inculcates life skills to become good citizens with integrity and discipline.

# **Programme Educational Objective (PEO)**

	- · · · · · · · · · · · · · · · · · · ·
PEO-1	Graduates will be able to master and display competency and leadership to become successful professionals, employees and entrepreneurs or pursue higher education and research.
PEO-2.	Graduates will be able to demonstrate the commitment towards professional ethics, gender sensitivity, preservation of environment and sustainable development.
PEO-3	Graduates will continue to learn and advance their careers through activities such as participation in professional organizations, attainment of professional certification and seeking higher education.

# Programme Outcomes (PO): BSc. Programme

PO-1	<b>Disciplinary Knowledge:</b> The BSc. graduates will acquire the knowledge with facts and figures related to pure and applied sciences. Understand the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevancies in the day-to-day life.
PO-2	Cognitive and Communicative skills: Students learn two languages along with three major subjects. At the end of the programme, the students would have developed reading, writing, speaking, interpretive and composition skills. They would be able to communicate with others using appropriate media; confidently share one's views and express themselves
PO-3	<b>Research Related Skills:</b> The BSc. students will acquire the skills in handling scientific instruments, planning and performing in laboratory experiments.
PO-4	<b>Ethics</b> : The BSc. students will be imbibed ethical, moral and social values in personal and social life leading to highly cultured and civilized personality.
PO-5	<b>Problem Solving:</b> The BSc. graduates will develop the ability to analyze and solve Course-related problems and also the ability to evaluate situations and react responsibly to communicate, cooperate and lead a team among peers and others.
PO-6	<b>Critical Thinking:</b> The qualities of a science student – observation, precision, analytical mind, logical thinking, clarity of thought and expression, systematic approach, qualitative and quantitative decision making are enhanced.
PO-7	<b>Social Interaction:</b> The BSc. graduates shall appreciate the role of science in society; and its personal, social and global importance.
PO-8	Analytical Skills: The graduates will master the skills of observations and drawing logical inferences from the scientific experiments. Analyzed the given

	scientific data critically and systematically and the ability to draw the objective conclusions.
PO-9	Environment and Sustainability: Graduates will be able to understand the issues
	of environment and work towards sustainable development.
PO-10	Employability: After completing the programme, graduates will have the
	competency to be employed or to be an entrepreneur.
PO-11	Leadership Quality: In the graduation programme students are inculcated moral
	and ethical values, managerial skills, adoptability, problem solving, taking
	initiative, decision making, risk taking to make them confident leaders.

# Programme Specific Outcomes (PSO)- BSc. Programme

PSO-No	After the completion of BSc. programme by studying BtCZ/BtBMb students will be able to							
PSO-1	Demonstrate and apply their knowledge of cell biology, biochemistry, microbiology and molecular biology to solve the problems related to the field of <b>Biotechnology</b> .							
PSO-2	Develop analytical skills and problem solving skills required for the application of <b>chemical principles</b> . They will be able to perform scientific experiments skillfully by application of procedural knowledge							
PSO-3	Understand the basic concepts of Taxonomy, Physiology, Genetics, Cytology, Histology, Embryology, Ecology and Evolution. Be able to apply their knowledge of classical and applied aspects of <b>Zoology</b> in allied fields like Economic Zoology, Biotechnology, Pathology, Public Health, Environmental Toxicology and Wildlife conservation	Analyse						
PSO-4	To acquire in-depth theoretical and practical knowledge of Biochemistry and the ability to apply the acquired knowledge to provide cost efficient solutions in Biochemistry. And to bridge the gap between academia and industry	Understand &Apply						
PSO-5	Apply the scientific method and hypothesis testing in the design and execution of experiments related to isolation, identification, cultivation and control of microorganisms from/in food, human body, environmental sources.	Understand and apply						

Mapping of Mission of the College with PEO							
Mission	PEO-1	PEO-2	PEO-3				
Mission -1	$\checkmark$	$\checkmark$	$\checkmark$				

Mapping of PEOs with Programme Outcocomes(PO)											
PEO	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	PO-4	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	PO-9	PO-10	PO-11
No.											
PEO-1		~	~		~					~	~
PEO-2	✓			~					~		
PEO-3						~	~	~			

# PREAMBLE

The syllabus for undergraduate biotechnology is framed in such a way that it is appt for today and also an emphasis on the basic principles of biotechnology. As biotechnology is a **multidisciplinary field** various branches connected to it, is also part of the syllabi. This syllabus is framed to give sound knowledge with an understanding of Biotechnology to undergraduate students of three years of B.Sc. degree course. The program endeavours to provide students with broad-based training in biotechnology with a solid background of basic concepts as well as exposing them to the exciting advancements in the field. In addition to theoretical knowledge, significant emphasis has been given to provide hands-on experience to the students in the forefront areas of experimental biotechnology.

The goal of the syllabus is to make the study of Biotechnology, interesting and encouraging the students for higher studies including **research**. The new and updated syllabus is based on:

- To develop an understanding of **industrial processes** for the production of antibiotics, enzymes, etc.
- To develop an understanding of **techniques** for tissue culture, cell culture and organ transplantation.
- To develop an understanding of, **proper interpretation of scientific data generated** in the biology, public health and other health sciences (i.e., the biomedical sciences).

The syllabus is prepared after discussion at length with several faculty members of the subject from industries and research fields. The units of the syllabus are well defined, taking into consideration the level and capacity of students. The course will take an in-depth look at various aspects of the industry and research. Emphasis will focus on established Biotechnology and Biopharma companies.

The Board resolved to implement the following changes in the syllabus from the academic year 2018 - 2019.

# **GENERAL SCHEME for TEACHING & EVALUATION**

# **Discipline-Specific Core (DSC) or Hard Core (HC) Papers**

Semester	Title of the Paper	Course Code	E	Teaching Hours per Week	Credits Exam Duration in Hours		Max. Marks Theory/ Practical						
			TYP	Theory/ Practical	Theory/ Practical	Theory/ Practical	Theory/Practical	A Theory/Practical	Total Marks				
	Paper I: Biomolecules and Microbiology	MA240	DSC	03	03	03	50	20					
Ι	Practical I	MA242	DSC	03	1.5	03	20	10	100				
II	Paper-II: Cell Biology and Genetics	MB240	DSC	03	03	03	50	20	100				
	Practical II	MB242	DSC	03	1.5	03	20	10	100				
	Paper III: Enzymology and Cellular Metabolism	MC240	DSC	03	03	03	50	20					
III	Practical III	MC242	DSC	03	1.5	03	20	10	100				
IV	Paper IV: Plant tissue culture and Animal Cell culture	MD240	DSC	03	03	03	50	20	100				
1 V	Practical IV	MD242	DSC	03	1.5	03	20	10	100				
	Paper V: Molecular Biology and Genetic Engineering	ME240	DSC	03	03	03	70	30					
₹7	Practical V	ME242	DSC	03	1.5	03	35	15	200				
V	Paper VI: Immunology and Medical Biotechnology	ME244	DSC	03	03	03	70	30	300				
	Practical VI	ME246	DSC	03	1.5	03	35	15					
VI	Paper VII: Microbial Technology and Agricultural	MF240	DSC	03	03	03	70	30	300				
• =	Practical VII	MF242	DSC	03	1.5	03	70	30					

St. Philomena's College (Autonomous) Mysore. B.Sc., Biotechnology Revised CBCS Syllabus 2018 -19 onwards. Page 6

Paper VIII: Environmental Biotechnology, Biophysics and Biostatistics	MF244	DSC	03	03	03	70	30	
Practical VIII	<b>MF246</b>	DSC	03	1.5	03	35	15	
		DSE 1	02	02	02	30	20	100
		DSE 2	02	02	02	30	20	
				38	-	760	340	1100

# **Discipline Specific Elective (DSE or Soft Core (SC)**

	<b>_</b>							,		
							Theory Scheme	ninatio	n	
SL. No	Title of the Paper	TYPE	Course Code	Semester	Theory	Credits	Exam Duration in Hours	Theory Max. Marks	I A Max Marks	Total Marks
1.	Medical & Nano Biotechnology	DSE	M24Y03	II	2	2	02	30	20	50
2.	Pharmaceutical	DSE	M24Y01	То	2	2	02	30	20	50
3.	Genomics & Proteomics	DSE	M24Y04	IV	2	2	02	30	20	50
4.	Molecular Plant	DSE	M24Y05	1.4	2	2	02	30	20	50
5.	Project Work	DSE	M24Y06	V	2	2	02	30	20	50
6.	Research Methodology	DSE	M24Y02	to	2	2	02	30	20	50
7.	Epigenetic and Cancer	DSE	M24Y07	10	2	2	02	30	20	50
8.	PR, Patenting and	DSE	M24Y08	VI	2	2	02	30	20	50
9.	Molecular Virology and	DSE	M24Y09		2	2	02	30	20	50

# Note:

Sl .No	Туре	
1.	DSC or HC	Discipline Specific Core (DSC) or Hard Core (HC)
2.	DSE or SC	Discipline Specific Elective (DSE or /Soft Core (SC)
3.	SEC or OE	Skill Enhancement Course (SEC) or Open Elective

\*\*\*\*\*

St. Philomena's College (Autonomous) Mysore. B.Sc., Biotechnology Revised CBCS Syllabus 2018 -19 onwards. Page 7

#### FIRST SEMESTER

#### **BIOTECHNOLOGY PAPER-I**

### Title: BIOMOLECULES AND MICROBIOLOGY

**CLASS DURATION – 03 HOURS PER WEEK** 

48 Hours

Marks-Theory - 50 + Internal Assessment -20= 70

# **Course Objectives:**

1.To impart basic knowledge of structure and functions of major bio-molecules

2.To Understand the organic chemical principles in life processes.

3.To Understand the structure and function of important biological molecules such as DNA, RNA and some enzymes.

4. To Apply fundamental synthetic chemistry to biological molecules.

5. To gain Knowledge on Landmark discoveries in Microbiology and different domains classification of living organisms.

6. To discuss the general characters of prokaryotic and Eukaryotic microorganisms for conventional and molecular characterization using modern methods.

7. To impart knowledge of cellular organization, life cycle and economic importance of prokaryotic (Eubacteria, Archaea, Cyanobacteria) and Eukaryotic (Algae, Fungi and protozoans).

#### **Course Learning Outcomes:**

CO	After the completion of this course the student	Cognitive level
	will be able to	
CO-01	To understand the relationship between the properties of macromolecules and cellular activities,	Understand
CO-02	To understand the relationship between cellular activities and biological responses	Understand
CO-03	To understand the basic microbial structure and similarities and differences among various groups of microorganisms such as bacteria/archaea/cyanobacteria/fungi/protozoans.	Understand
CO-04	Acquaintance on study of microbial diversity using different methods and systematics of bacteria and archaea using polyphasic approach.	Analyze
CO-05	To Understand the various methods for identification of isolated and unculturable microorganisms.	Understand

#### PART-A

St. Philomena's College (Autonomous) Mysore. B.Sc., Biotechnology Revised CBCS Syllabus 2018 -19 onwards. Page 8

# BIOMOLECULES

Unit 1				
1.1	Carbohydrates:	2 hrs		
	Monosaccharides- ribose, glucose, galactose and fructose, reducing and non-reducing sugars.	5hm		
1.2	Stereochemistry – epimers, enantiomers, anomers, isomers concept, Fischer and Haworth structure of disaccharides- sucrose, maltose and <b>lactose.</b>	51115		
1.3	Structure of polysaccharides – starch and glycogen. Racemization.			
Unit 2				
2.1	Proteins Amino acids- generalized zwitterionic structure, essential and non-essential amino acids			
2.2	classification based on polarity, pKa value, D and L amino acids, optical activity, peptide bond, the structure of oxytocin and insulin.	5hrs		
2.3	Primary, secondary, tertiary and quaternary structural organization of proteins. Globular and fibrous proteins with special reference to the structure of haemoglobin, collagen & Myoglobin.			
Unit 3				
3.1	<b>Lipids:</b> Classification of lipids with examples. Simple and compound lipids, unsaturated and saturated fatty acids.			
3.2	Nomenclature of fatty acids.	5hrs		
3.3	Physical and chemical properties of oils and fats. Structure and role of different types of lipids – glycolipids, phospholipids, sphingolipids & cholesterol.	2hrs		
Unit 4		1		
4.1	Nucleic acids: Nomenclature of bases, nucleosides nucleotides.	5hrs		
4.2	Structure of DNA, types of DNA (A, B & Z forms), structure and types of RNA			
	PART-B			
	MICROBIOLOGY			
Unit 1				
1.1	<b>General introduction:</b> Scope and history, important discoveries by Robert Koch, Leeuwenhoek, Jenner, Pasteur, Fleming and Iwanowski.	2Hrs		
1.2	Basic microbiological techniques: sterilization, disinfection.	2Hrs		
1.3	Basic microbiological techniques: sterilization, disinfection.			
1.4	Concept of prokaryotes and eukaryotes. A general account on structure, classification and reproduction of bacteria, viruses and fungi.	4Hrs		
Unit 2				
2.1	Microbiological nutrition and growth: nutritional classes of microorganisms, culture			
	media, pure culture, microbial growth pattern and methods of growth measurements,	4Hrs		
	methods of maintenance and preservation of culture.			
2.2	<b>Fermentative types of microorganisms</b> – Aerobes, anaerobes and facultative anaerobes	1Hr		
2.3	Physical and chemical control of microorganisms; antimicrobial agents- penicillin and tetracycline	2Hrs		

St. Philomena's College (Autonomous) Mysore. B.Sc., Biotechnology Revised CBCS Syllabus 2018 -19 onwards. Page 9

	Unit-3	
3.1	Role of microbes in bio geo cycles (nitrogen, carbon, sulphur and phosphorous	211
	cycle).	ZHIS
3.2	Biological nitrogen fixation	
3.3	<b>Microbial diseases</b> : important plant diseases – downy mildew, bacterial leaf blight, TMV and animal diseases- Tuberculosis, rabies and Candidiosis. Causative agents and control.	5Hrs
3.4	Normal flora of the human body.	
3.5	Food spoilage, Microbial examination of food, food preservation, food poisoning	2Hrs

#### **Reference books:**

- 1. Biochemistry Instant notes. Hames, B. D., Hopper, N. M. and Houghton, J. D. Viva Books Pvt. Ltd., New Delhi. 1998.
- 2. A Text Book of Biotechnology. R.C. Dubey, S. Chand & Co. Ltd. New Delhi, 2001
- 3. A Textbook on Biotechnology, H. D. Kumar. Affiliated East-West Press Pvt. Ltd. New Delhi
- 4. Basic Biotechnology. Rev. Fr. Dr. S. Ignacimuthu. Tata McGraw Hill, New Delhi, 2001
- 5. Basic Biotechnology. C. Ratledge and B. Kristiansen. Cambridge, University Press, UK. 2002.
- 6. Biotechnology. Keshav Trehan, New Age International (P) Ltd, New Delhi, 2001.
- Microbiology: Dynamics and Diversity. M. J. Pelczar, R. D. Reid, Chan, E.C.S. New York, Harcout Brace College Publishers, 1997.
- Microbiology. Prescott, Lansing M, Harley, John P, Klein, Donald A.Oxford, W M.C. Brown publishers, 1993.
- 9. Microbiology. Sharma, P.D. Meerut, Rastogi Publications, 1991.
- Microbiology: An Introduction. Tortora, Gerard, J, Funke, Berdell, R, Case, Christine L. California, Cumming Publishing Company Inc, 1992.

\*\*\*\*\*

# PRACTICAL-I

### **Biomolecules and Microbiology**

# Practical Duration -03 Hours per week Examination-03 Hours MARKS=30.

Practical Proper-20 marks. Internal Assessment - Record-05+ Class Test-05=10 marks

#### **Course Objectives:**

1. To summarize the nutrient requirements for microbial growth

2. Discuss the different methods of culturing microorganisms

3. To analyse the molecular structure, conformational changes and interactions.

# **Course Learning Outcome:**

СО	After the completion of this course the student will be able to	Cognitive level
CO-01	Relate the properties of biomolecules and their significant role in living systems	Analyse
CO-02	Understand how microorganisms cause various diseases.	Remember
CO-03	Gain Knowledge about water-borne diseases help students to ensure cleanliness in the society	Understanding
CO-04	develop a knowledge on different microbial flora of soil, nitrogen fixing capacity and their use as biofertilizer	Evaluate
CO-05	Know the importance of the basic biochemicals of life and their functioning.	Analyse

### Part A

- 1. Qualitative analysis of sugars. 2 practicals
- 2. Qualitative analysis of amino acids. 2 practicals
- 3. Reducing sugar estimation by DNS method.
- 4. Protein estimation by Biuret method.
- 5. Estimation of the iodine value of lipids/ Saponification.

# Part B

- 1. Preparation of NA, NB & PDA media
- 2. Isolation of microorganisms from soil, air and water
- 3. Microbial inoculation technique- stab, point, streak pour plate & spread plate
- 4. Staining techniques simple & Gram's staining
- 5. Demonstration of microbial diseases downy mildew, bacterial leaf blight.

\*\*\*\*\*

# SECOND SEMESTER BIOTECHNOLOGY PAPER-II Title: CELL BIOLOGY & GENETICS

# **Course Objectives:**

1. To understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles

2. To understand the cellular components used to generate and utilize energy in cells.

3. To apply the knowledge of cell biology to selected examples of changes or losses in cell function.

4. To discuss the basic principles of inheritance at the molecular, cellular and organismal levels.

CO	After the completion of this course the student will be able to	Cognitive level
CO-01	Describe cytological, biochemical, physiological and genetic	Analyse
	aspects of the cell, including cellular processes common to all cells,	
	to all Eukaryotic cells as well as processes in certain specialized	
	cells	
CO-02	Understand how cells undergo mitosis	Understand
CO-03	Relate normal cellular structures to their functions.	Analyse
CO-04	Describe the intricate relationship between various cellular structures and their corresponding functions	Analyse
CO-05	Discuss the different methods available to study genetics	Create
CO-06		Analyse
	Describe genes structure, chromosomes and proteins	

# PART-A CELL BIOLOGY

Unit 1		
1.1	General Introduction:	2 hrs
	A historical perspective, the cell theory, the Ultrastructure of plant and animal cell, different types of cells.	
1.2	<b>Cytological techniques</b> – teasing, smear preparation, squash preparation, whole-mount, microtomy	3 hrs
1.3	<b>Cell organelles:</b> Structure and function of the cell wall, plasma membrane, membrane proteins, cytoplasm, nucleus, mitochondria, chloroplast, Golgi bodies, endoplasmic	
Unit 2		
2.1	Cell Division :	5hrs
	Cell cycle, phases and regulation of cell cycle, cell division, interphase nucleus	
2.2	Mitosis and meiosis, comparison between mitosis and meiosis, Achromatic apparatus, Synaptonemal complex.	3hrs
2.3	fertilization, parthenogenesis	
Unit -3		
3.1	Cell interaction and motility:	

St. Philomena's College (Autonomous) Mysore. B.Sc., Biotechnology Revised CBCS Syllabus 2018 -19 onwards. Page 12

3.1.1	Cell junctions- septate, tight and gap junctions, cell motility, flagellar and ciliary motion.	5 hrs
3.1.2	Structure and function of muscle cells, muscle contraction, nerve cell structure and	
	functions.	
3.2	Special cells	2 hrs
3.2.1	Stem cells, differentiation of stem cells and their application,	
3.2.2	Blood cells, identification, structure and different types of blood cells	
3.2.3	Cancer cells. Structure and different types of blood cells. Cancer cells.	4hrs

#### PART-B GENETICS

Unit 1		
1.1	History of genetics: Introduction and historical overview of genetics.	
1.2	Mendelian Principles: Laws of inheritance- dominance, segregation and independent assortment, test cross, back cross.	5 hrs
1.3	Deviations to Mendelian inheritance- the interaction of genes (13:3 ratio), incomplete dominance, co-dominance, epistasis, Sex-linked inheritance.	2hrs
1.4	Chromosome theory of inheritance.	
1.5	Linkage and crossing-over	
Unit	2	I
2.1	<b>Mutation</b> : Natural and induced mutations, mutagenesis- physical, Chemical, and biologic mutagens, molecular mechanisms, thymine dimers.	cal 2hrs
2.2	<b>Eukaryotic Chromosomes:</b> Types, chromatin structure, nucleosomes, higher-order chromatic organization.	n 3hrs
2.3	Karyotype, Special chromosomes- lampbrush, polytene and B- chromosome.	21115
Unit	-3	
3.1	Chromosomal aberrations: Deletion, duplication, inversion, translocation and ploidy.	5 hrs
3.2	Chromosomal disorders in humans. (Down's, Turner's, Klinefiltees, cri-du-chat, Triplo x)	
Unit	-4	
4.1	Genetic recombination in bacteria- Transformation, transduction and conjugation.	5 hrs
4.2	<b>Extra-chromosomal inheritance in plants and animals</b> – Mitochondria and chloroplast	

### **Reference books:**

- 1. Microbiology: Dynamics and Diversity. M. J. Pelczar, R. D. Reid, Chan, E.C.S. New York, Harcout Brace College Publishers, 1997.
- **2.** Microbiology. Prescott, Lansing M, Harley, John P, Klein, Donald A.Oxford, W M.C. Brown publishers, 1993.
- 3. Microbiology. Sharma, P.D. Meerut, Rastogi Publications, 1991.
- **4.** Microbiology: An Introduction. Tortora, Gerard, J, Funke, Berdell, R, Case, Christine L. California, Cumming Publishing Company Inc, 1992.
- **5.** Biological Science. 3 Edition. Taylor, D.J., Green, N.P.O. and Stout, G.W. Cambridge editions. Cambridge University Press. The U.K. in 1998.

St. Philomena's College (Autonomous) Mysore. B.Sc., Biotechnology Revised CBCS Syllabus 2018 -19 onwards. Page 13

- 6. Principles of Biochemistry. Lehninger, A. L., Nelson, D. V. and Cox, M. M. CBS publishers, Delhi. 1993.
- 7. Cell Biology, C. B. Power, III edition, Himalaya Publishing House, Mumbai.
- Cell Biology- Fundamentals and applications. M.L. Gupta and M.L. Jangir. Agrobios (India), Jodhpur, 2002.

#### PRACTICAL-II Cell Biology and Genetics Practical Duration -03 Hours per week Examination-03 Hours MARKS=30. Practical Proper-20 marks Internal Assessment - Record-05+ Class Test-05=10 marks

# **Course Learning Objective:**

- 1. To demonstrate significant cell biological principles, quantitative and analytical approaches that enable the students to translate the theoretical foundation in cell biology to be translated into practical understanding.
- 2. To differentiate the cells of various living organisms and get awareness of physiological processes of cell e.g. cell divisions.
- 3. To observe and correctly identify different cell types, cellular structures using different microscopic techniques.

#### **Course Learning Outcome:**

СО	After the completion of this course the student will be able	Cognitive
	to	level
CO-01	Understand the basis of genetic hereditary at cellular level.	Analyse
CO-02	Acquire knowledge on the process of life through cell cycle	understanding
CO-03	Understand the role of genetic mechanisms in evolution	Remember
CO-04	Gain knowledge on the modern concept of genes.	Understanding
CO-05	Understand the basic functions and pathways insides cell	evaluate

#### Part-A CELL BIOLOGY

1. Cell counting methods: Haemocytometer

St. Philomena's College (Autonomous) Mysore. B.Sc., Biotechnology Revised CBCS Syllabus 2018 -19 onwards. Page 14

# 2. Measurements with the help of the light microscope

- a. Calibration of ocular micrometre
- b. Finding out average cell size

# 3. Temporary preparation of stained samples for

- a. mitosis (onion root tips),
- b. meiosis (grasshopper testis)

### Part-B

### GENETICS

- 1. Study of the morphology of wild type male and female *Drosophila* and Study of at least five simple mutants of *Drosophila*
- 2. Temporary preparation of stained polytene chromosomes from Drosophila salivary glands
- 3. Demonstration of laws of inheritance by using coloured beads
  - a. Law of segregation
  - b. Law of independent assortment.

\*\*\*\*\*\*

# THIRD SEMESTER BIOTECHNOLOGY PAPER-III Title: ENZYMOLOGY AND CELLULAR METABOLISM CLASS DURATION – 03 HOURS PER WEEK MARKS-Theory - 50 + Internal Assessment -20= 70

**48 Hours** 

### **Course Objectives:**

- 1. To understand the theories of enzyme kinetics.
- 2. To understand the mechanisms of enzyme catalysis.
- 3. To prepare students to confidently and competently work with enzyme systems in both Academia and Industry.
- 4. To make students aware of metabolism.
- 5. To study different types of metabolism and its study.
- 6. To understand the concepts of metabolism of Biomolecules.

### **Course Learning Outcomes:**

CO	After the completion of this course the studentwill be able to	<b>Cognitive level</b>
CO-01	Gain the knowledge about, Principle & types of metabolism.	Analyse
CO-02	Understand th parameters used to study metabolism	Understand
CO-03	Plan and execute an enzyme assay	Create
CO-04	Analyse enzyme kinetic data	Analyse
CO-05	Analyse kinetic inhibition data and to determine the mechanism of inhibition	Analyse

St. Philomena's College (Autonomous) Mysore. B.Sc., Biotechnology Revised CBCS Syllabus 2018 -19 onwards. Page 15

# PART-A

# ENZYMOLOGY

Unit 1		
1.1	<b>Role of proteins as biological catalysts,</b> isolation and purification of enzymes, Nomenclature, classification of enzymes	
1.2	<b>Enzyme kinetics</b> - Michaelis and Menten equation with derivation, the significance of Km and Vmax,	5hrs
Unit 2		
2.1	Enzyme inhibition- competitive, uncompetitive and non-competitive, LB plots	
	<b>Factors affecting enzyme activity</b> -substrate concentration, pH, temperature, metal ions, inhibitors, allosteric inhibitors, activators. the energy of activation.	6hrs
2.3	<b>Mechanism of enzyme action:</b> active and binding sites, enzyme-substrate complex formation, lock and key and induced fit theory.	
Unit -3		
3.1	Allosteric enzymes – simple sequential model, concerted or symmetry model	4hrs
3.2	Co enzymes and co-factors.	
Unit-4		
4.1	Isozymes- Definition and explanation with examples	2hrs
4.2	Multienzyme complex- Definition and explanation with examples	2hrs
4.3	Applications of enzymes: clinical, analytical and biotechnological.	5hrs

# PART-B CELLULAR METABOLISM

Unit 1		
1.1	Metabolism – Definition, catabolism and anabolism, an overview of metabolic pathways.	2 hrs
1.2	<b>Carbohydrate Metabolism:</b> Glycolysis-Reactions of the schematic pathway, Energetics and Stoichiometry. Fates of Pyruvate under aerobic and anaerobic conditions.	5hrs
1.3	Diabetes melitus, Diabetes incipidus.	
Unit 2	•	1
2.1	TCA Cycle: Reactions & Energetics	5 hrs
2.2	Gluconeogenesis: Reactions and their significance.	
2.3	<b>Photosynthesis:</b> Introduction, C3, C4 and CAM plants, Light and dark reactions, the efficiency of utilization of sunlight. Photorespiration	
Unit -3		
3.1	Amino acid metabolism:	
	Glucogenic and ketogenic amino acids, general reactions of amino acid metabolism-	5hrs
	Transamination, Deamination(oxidative & nonoxidative) & Decarboxylation with suitable examples,	2hrs
3.2	Urea cycle-Reactions and significance.	
3.3	Bioenergetics:	
	Concept of free energy and high energy compounds (ATP),	
3.4	Electron transport chain (representation only), and oxidative phosphorylation (Mechanism).	1

St. Philomena's College (Autonomous) Mysore. B.Sc., Biotechnology Revised CBCS Syllabus 2018 -19 onwards. Page 16

Unit-4		
	Lipid Metabolism:	
4.1	$\alpha$ , $\beta$ and $\omega$ oxidation of fatty acids(Definition only), $\beta$ oxidation of fatty acids containing even	
	number of carbon atoms.	5hrs
4.2	Energetics and Biosynthesis of fatty acids containing even number of carbon atoms.	
4.3	Cholesterol – Outline of biosynthesis.	
4.4	Metabolism of Nucleotides: Degradation of Purines and Pyrimidines.	

# **Reference books:**

- 1. A Text Book of Biotechnology. R.C. Dubey, S. Chand & Co. Ltd. New Delhi, 2001
- 2. A Textbook on Biotechnology, H. D. Kumar. Affiliated East-West Press Pvt. Ltd. New Delhi
- 3. Basic Biotechnology. Rev. Fr. Dr. S. Ignacimuthu. Tata McGraw Hill, New Delhi, 2001
- 4. Basic Biotechnology. C. Ratledge and B. Kristiansen. Cambridge University Press, UK. 2002.
- 5. Biotechnology. Keshav Trehan, New Age International (P) Ltd, New Delhi, 2001.

# PRACTICAL-III Practical Duration -03 Hours per week Examination-03 Hours MARKS=30. Practical Proper-20 marks Internal Assessment - Record-05+ Class Test-05=10 marks Enzymology and Cellular Metabolism Part-A Enzymology

# **Course Objectives**:

1 To understand the structure and functions of biomolecules in a cell.

2. To understand the fate of dietary constituents after digestion and absorption.

3. To gain knowledge of the metabolism of carbohydrates through various anabolic and

catabolic pathways like glycolysis, Kreb's cycle, Glycogen metabolism cycle etc

4. To distinguish enzymes based on their classification and properties.

5. To discuss the conditions for the maximum activity of enzymes.

# **Course Learning outcome:**

СО	After the completion of this course the student will be able to	Cognitive level
CO-01	Understand the mechanism of action of enzymes	Remember
CO-02	Acquire Practical knowledge on methods of production, purification, characterization and immobilization of enzymes	create
CO-03	Appreciate the industrial and medical applications of enzymes.	Evaluate
CO-04	Relate the role distinct metabolic pathways used by cells to harvest the energy.	Analyse

#### Assay of Salivary amylase-

- 1. Determination of specific activity by DNS method.
- 2. Effect of pH on enzyme activity.
- 3. Effect of Temperature on enzyme activity.
- 4. Effect of activator (Cl<sup>-</sup>) on salivary amylase activity.

## Part-B

### **Cellular Metabolism**

- 1. Tests for normal constituents of urine- urea, uric acid and Creatinine.
- 2. Tests for abnormal constituents of urine- albumin, glucose and ketone bodies.
- 3. Estimation of creatinine by Jaffe's method.
- 4. Estimation of Urea by DAMO method.

\*\*\*\*\*\*

#### FOURTH SEMESTER BIOTECHNOLOGY PAPER-IV Title: PLANT CELL AND TISSUE CULTURE AND ANIMAL CELL CULTURE CLASS DURATION – 03 HOURS PER WEEK 48 Hours MARKS-Theory - 50 + Internal Assessment -20= 70

# **Course Objectives:**

- 1. To make students aware of fundamentals of Plant Tissue culture
- 2. To study of laboratory organization for plant tissue culture.
- 3. To study of callus, organ, anther and pollen culture Technique.
- 4. To study of suspension, protoplast culture and micropropagation Technique.
- 5. To study use and application of Plant Tissue culture
- 6. To acquire the knowledge about: The organization of animal tissue culture laboratory ,Basic concepts in animal tissue culture with understanding of different physicochemical requirements, variations in techniques.

#### **Course Learning Outcomes :**

CO	After the completion of this course the student will be able to	Cognitive level
CO-01	Gain knowledge about laboratory organization for plant tissue culture.	Understand
CO-02	To Know technique of preparation of plant tissue culture media.	Analyse
CO-03	To acquire knowledge about various techniques for plant tissue culture	Analyse
CO-04	Gain skills to start or work in commercial plant tissue culture laboratory.	Create
CO-05	To gain the Knowledge about laboratory organization and safety.	Understand
CO-06	To understand the ethics of animal tissue culture techniques.	Understand

#### PART-A

### PLANT CELL AND TISSUE CULTURE

Unit 1		
1.1	Plant tissue culture introduction: 1.1 Importance, history and developments of plant tissue culture.	
1.2	Laboratory organization and culture techniques: general requirements, aseptic conditions. Media preparation, culture media, sterilization, pretreatment to explants,	5hrs
1.3	Problems and solutions associated with tissue culture.	
Unit 2		
2.1	Principles of tissue culture: callus culture-definition of callus, initiation, maintenance, subculture and organogenesis.	
2.2	Organ culture – culture protocols and importance of root, meristem, ovary and ovule culture. Factors affecting organogenesis.	5 hrs
		•

St. Philomena's College (Autonomous) Mysore. B.Sc., Biotechnology Revised CBCS Syllabus 2018 -19 onwards. Page 19

Unit -3		
3.1	Micropropagation in plants: 3.1 Advantages, methods, stages of micropropagations, applications.	2 hrs
3.2	Somaclonal variation for disease resistance and desired agronomic traits.	2hrs
3.3	Somatic embryogenesis: embryoid and embryogenesis, synthetic seeds and its applications.	2hrs
3.4	Suspension culture: batch and continuous cell suspension culture. Importance of suspension culture in the production of secondary metabolites.	2 hs
Unit-4		
4.1	Protoplast culture and fusion: Definition of protoplast, isolation of protoplasts, culture protocol, regeneration of plants, protoplast fusion, somatic cell hybridization and its application.	4hrs
4.2	Anther culture and pollen culture.	2hrs

# PART-B ANIMAL CELL CULTURE TECHNOLOGY

Unit 1		
1.1	Introduction: Importance, history and developments of animal cell culture.	2 hrs
1.2	Advantages and disadvantages of tissue culture methods, laboratory facilities.	
1.3	<b>Culture procedures</b> : Preparation and sterilization of glassware and apparatus, preparation and sterilization of regents.	4hrs
Unit 2		
2.1	Preparation and sterilization of media	5hrs
2.2	Preparation and sterilization of animal material.	

#### Unit -3 3.1 Animal tissue culture media: Culture media containing naturally occurring 5 hrs ingredients, blood plasma, blood serum, serum-free media, tissue extracts, 3.2 Complex natural media, chemically defined media. Unit-4 Primary culture, cell lines and cloning: Primary and established cell lines, somatic 4.1 cell fusion, 4hrs 4.2 Tissue cultures, (single coverslip cultures, double coverslip cultures, flask method) 4.3 Whole embryo culture. Eg. Chick embryo. 4.4 Application of animal cell culture. 4hrs

# **Reference books:**

- 1. Plant tissue culture and Molecular Biology: Applications and prospects. Srivastava PS, (ed.). Narosa Publishing House, New Delhi.
- 2. Plant cell and Tissue culture, Narayana Swamy S. Tata McGraw Hill Publishing Company New Delhi

St. Philomena's College (Autonomous) Mysore. B.Sc., Biotechnology Revised CBCS Syllabus 2018 -19 onwards. Page 20

# **PRACTICAL-IV.** Plant Cell and Tissue Culture and Animal Cell Culture Practical Duration -03 Hours per week Examination-03 Hours MARKS=30.

Practical Proper- 20 marks Internal Assessment - Record-05+ Class Test-05=10 marks

# **Course Objectives :**

- 1. To describe the requirements to initiate cell culture facility
- 2. To compare and contrast different methods of embryo transfer
- 3. To learn suitable methods for organ culture and tissue engineering
- 4. To learn Tissue culturing methods in lab
- 5. To use of plant hormone action

Course Learning Outcome:		
CO	After the completion of this course the student will be able to	Cognitive Level
CO-01	Develop methods for improved development of therapeutic plant proteins	Create
CO-02	Explain the steps involved in photosynthesis and its regulation	Understanding
CO-03	Demonstrate the differences between culture of animal and plant cells in vitro	Analyse
CO-04	Review the benefits and challenges of animal cloning	Evaluate
CO-05	Appreciate the benefits of therapeutic cloning to treat human diseases	Analyse

- 1. Media preparation and Sterilization
- 2. Callus cultures: Choice of explants, preparation of explants, callus induction, subculture, maintenance.
- 3. Regeneration of plant by growth factors.
- 4. Suspension cultures: Initiation of suspension cultures from callus.
- 5. Preparation of synthetic seeds.
- 6. Meristem culture for pathogen-free plants.
- 7. Cell viability test using the trypan blue exclusion method.
- 8. Preparation of Hank's balanced salt solution.
- 9. Isolation of PMN leucocytes from Human peripheral blood sample.

\*\*\*\*\*

#### FIFTH SEMESTER BIOTECHNOLOGY PAPER-V Title: MOLECULAR BIOLOGY AND GENETIC ENGINEERING CLASS DURATION – 03 HOURS PER WEEK 48 Hours MARKS-Theory – 70 + Internal Assessment -30= 100

# **Course Objective:**

- 1. To familiarize the students with basic concept in molecular biology.
- 2. To understand the DNA structure & Replication.
- 3. To understand the DNA alterations by Mutation & Repair. And to Understand DNA damage.
- 4. The students should acquire the knowledge about: Experiment behind the Genetic material.

# **Course Learning Outcome:**

CO	After the completion of this course the student will be able	Cognitive level
	to	
CO-01	To Understand the DNA structure & Replication	Understand
CO-02	To Understand the DNA alterations by Mutation & Repair, Functions of DNA.	Understand
CO-03	To acquire knowledge with the tools and techniques of genetic engineering-	Remember
CO-04	Apply the genetic engineering skills in biological research.	Apply
CO-05	acquire knowledge of advances in biotechnology- healthcare, agriculture and environment cleanup via recombinant DNA technology.	Understand

### PART-A

# **MOLECULAR BIOLOGY**

Unit 1		
1.1	<b>DNA as genetic material: 1.1</b> Experiments of Griffith, Avery and Hershey and chase. Semi conservative replication of DNA.	5 hrs
1.2	Prokaryotic DNA synthesis: DNA polymerases, replication forks, coding and non- coding strand, replisome. Mechanism of DNA replication.	
Unit 2		
2.1	Concept of gene: functional units, promoter, introns and exons, lac operon.	7hrs
2.2	Transcription of prokaryotic genes: RNA polymerase, initiation of transcription at promoter sites elongation and termination, inhibitors of transcription.	
Unit -3		
3.1	Genetic code: deciphering genetic code, major features of genetic code, wobble hypothesis, the universality of genetic code.	5hrs
Unit-4		
4.1	Translation: activation of amino acids, ribosome, the formation of initiation complex, initiation, elongation and termination, the fidelity of protein synthesis, inhibitors of protein synthesis, post-translational modifications.	5hrs

St. Philomena's College (Autonomous) Mysore. B.Sc., Biotechnology Revised CBCS Syllabus 2018 -19 onwards. Page 22

# PART-B GENETIC ENGENEERING

Unit 1		
1.1	Importance, history, concepts and developments of genetic engineering	
1.2	<b>Enzymes</b> - Restriction endonucleases, types of restriction enzymes, Ligases, alkaline phosphatases, polynucleotide kinase, terminal deoxynucleotidyl transferase, S1 nuclease, DNA polymerase, Klenow fragment, Taq DNA polymerase, ribonuclease, reverse transcriptase.	5hrs
Unit 2		
2.1	Gene cloning, vectors and host: Types of vectors, the importance of plasmids as	5hrs
	cloning vectors, examples of plasmid types. Different forms of plasmids, plasmids coding for phenotypic traits.	2hrs
2.2	Cloning hosts: E.coli, yeast, plant cells and mammalian cells.	
Unit -3	3	
3.1	Gene mapping, chromosome walking and jumping.	
3.2	Recombinant DNA technology: Isolation of gene and mRNA, preparation of complementary DNA, genomic and cDNA libraries, probes and hybridization.	5hrs
Unit-4		
4.1	<b>Genetic engineering techniques</b> : Agarose electrophoresis, Southern and Northern blotting, PCR, Sanger's method of DNA sequencing	7hrs
4.2	Outline of gene transfer methods.	

# **Reference Books:**

- 1. Advanced Molecular Biology. Twyman, RM. Viva Book Pvt. Ltd. New Delhi, 1998.
- 2. Molecular Biology- Instant notes. P.C. Turner, A.G. McLennan, A.D.Bates and M.R.H. White. Viva Books PVT. Ltd., New Delhi, 2001.
- 3. Molecular Biology. D. Freifelder, Narosa Publication House, New Delhi.2002
- 4. Genetic Engineering and its application. P. Joshi, Agrobios (India) Jodhpur. 2002.
- 5. Gene VII. Lewin, B. Oxford Univ. Press. Oxford. 2003
- Gene cloning An Introduction, Brown T.A. 3<sup>rd</sup> Edn. Stanley Thornes (Publishing) Ltd.., UK, 1998.

# FIFTH SEMESTER

2hrs

# BIOTECHNOLOGY PAPER-VI Title: IMMUNOLOGY AND MEDICAL BIOTECHNOLOGY CLASS DURATION – 03 HOURS PER WEEK 48 Hours MARKS-Theory – 70 + Internal Assessment -30= 100

#### **Course Objectives:**

1.To study the overview of vertebrates Immune System.

2. To study the Types and mechanism of Defence.

3.To study the Cells and Organs of immune system.

4. Getting a broad understanding of the value of biomedical research for biotechnological applications.

5. To see links with the fundamental research in biomedical sciences and industrial applications .

#### **Course Learning outcomes:**

CO	After the completion of this course the student will be able to	Cognitive level
CO-01	To compare and contrast innate and adaptive immunity	Understanding
CO-02	Apply basic techniques for identifying antigen-antibody interactions.	Apply
CO-03	use the main methodologies and instruments that characterize biotechnologies for the prevention, diagnosis and treatment of human diseases;	Understand
CO-04	Understand and apply preventive, diagnostic and therapeutic strategies, based on biotechnology, in the context of human pathology;	Understand and apply

# PART-A IMMUNOLOGY

Unit 1		
1.1	Historical account – Contributions of Edward Jenner and Louis Pasteur.	
1.2	<b>Types of immunity</b> : Innate- mechanisms of innate immunity. Adaptive – active, passive and adoptive.	5hrs
Unit 2		
2.1	Antigens: Definition, haptens, epitopes, antigenicity, blood group antigens. Immunization: passive and active, adjuvants, vaccines, primary and secondary response	
2.2	Antibodies: Definition, Types, the structure of IgG	5hrs
2.3	<b>Immunization</b> : passive and active, adjuvants, vaccines, primary and secondary immune response.	
Unit -3		
3.1	<b>Cellular basis of immunity</b> : T-cells, cell-mediated immunity and types B-cells humoral immunity and macrophages, their role in antigen recognition, clonal selection, immunological memory,	
3.2	Immunological aspects of viral (HIV), bacterial and parasitic infection	5hrs

St. Philomena's College (Autonomous) Mysore. B.Sc., Biotechnology Revised CBCS Syllabus 2018 -19 onwards. Page 24

Unit-4		
	Immune disorders: Autoimmune disorders- Grave's disease, Hashimoto's disease,	
4.1	Systemic Lupus erythromatosus. Hypersensitivity types.	5 hrs
4.2	Transplantation immunology.	
4.3	Immuno techniques: Affinity and avidity, precipitation reaction, immunodiffusion,	2hrs
	ELISA, Western blotting.	

# PART-B MEDICAL BIOTECHNOLOGY

Unit 1		
1.1	Vaccine production- new developments: introduction, advantages of subunit vaccines	
	over existing vaccines.	4 hrs
1.2	Production of vaccines by genetically engineered organisms.	
1.3	Edible vaccine.	2 hrs
Unit 2		
2.1	Nucleic acid analysis: features of DNA probe and its applications in diagnosis,	6 hrs
2.2	Diagnosis of infectious diseases, and identification of mycobacterium tuberculosis in clinical samples using PCR.	
2.3	Antibiotics: introduction, strain development and improvements of strain by genetic engineering	
Unit 3		
3.1	<b>Enzymes in diagnosis</b> : enzymes used for diagnosis, immobilized enzymes as diagnostic tools, diagnostic proteins e.g. AIDS diagnosis	4hrs
3.2	Enzymes in therapy: list of enzymes and their therapeutic applications	
3.3	<b>Hormone Therapy:</b> list of hormones produced by recombinant DNA technology and their therapeutic applications, production of interferon by recombinant DNA technology.	2hrs
Unit 4		
4.1	<b>Human Gene Therapy:</b> Definition, differences between somatic versus germline gene therapy. One example each for ex-vivo and in vivo gene therapy	6 hrs
4.2	Antisense technology: principle and applications	
4.3	Transgenic animals and plants for the production of biopharmaceuticals.	

### **Reference Books:**

- 1. Immunology. Roitt, L., Brostoff, J. and Male, D. Grower Medical Publishing, London. 1990.
- 2. Immunology –Instant notes. Lydyard, P.M., Wheldan, A., and Fanger, M.W. Viva Books Pvt. Ltd., New Delhi, 2000.
- 3. An Introduction to Immunology. C.V.Rao. Narosa Publishing House, New Delhi. 2002,

\*\*\*\*\*\*\*

# PRACTICAL V Molecular Biology, Genetic Engineering

# Practical Duration -02 Hours per week Examination -03 Hours MARKS=50.

### Practical Proper -35 marks Internal Assessment – Record-05+ Class Test-10=15 marks

# **Course Objective :**

1. To understand the working principle, instrumentation and applications of the important analytical techniques

2. To understand the concept of gene, genome, and genome organization.

3. To appreciate the intricate molecular mechanisms of the various steps in replication, transcription and translation.

- 4. To distinguish the processing of RNA and proteins after synthesis.
- 5. To gain an insight into how gene expression is regulated.
- 6. To understand the mechanism of DNA damage, repair and recombination

# **Course Learning Outcome:**

СО	After the completion of this course the student will be able to	Cognitive
CO-01	Explain the DNA repair mechanisms and expression of genes using transposable elements	Remember
CO-02	Explain the organization of chromosomes and describe the various steps involved in the process of replication, transcription and translation with illustrations.	Remember
CO-03	Predict suitable methods for isolation, purification and characterization of plasmids.	Analyse
CO-04	Understand the basics of gene amplification using PCR.	Knowledge
CO-05	Detect DNA sequences by blotting techniques	Evaluate

# PRACTICAL V Part-A MOLECULAR BIOLOGY

- 1. Preparation of stock solutions for molecular biology
- 2. Colourimetric estimation of DNA
- 3. Colourimetric estimation of RNA
- 4. Determination of Tm value of DNA
- 5. Determination of purity of DNA

### Part-B GENETIC ENGINEERING

- 1. Extraction of DNA from plant and animal sources
- 2. Quantification of DNA by Spectrophotometry
- 3. Agarose gel electrophoresis of DNA
- 4. Southern blotting (demonstration)
- 5. Gel electrophoresis of circular and linearized plasmid

# PRACTICAL VI IMMUNOLOGY & MEDICAL BIOTECHNOLOGY

### Practical Duration -02 Hours per week Examination -03 Hours MARKS=50

#### Practical Proper -35 marks Internal Assessment – Record-05+ Class Test-10=15 marks

# **Course Objectives** :

1. To provide examples of current applications of biotechnology and advances in the different areas like medical, microbial, environmental and bioremediation

2. To describe the basic structure of the cellular receptors and discuss their interactions during an immune response

3. To explain the concept and application of monoclonal antibody technology

4. To describe the basic mechanisms, distinctions and functional interplay of innate and adaptive immunity

5. To apply immunologic techniques to solve certain clinical and research problems

СО	After the completion of this course the student will be able to	Cognitive Level	
CO-01	Evaluate the mechanisms and differences between primary and	Evaluate	
	secondary responses and their relevance to immunization.		
CO-02	Understand the mechanism of action of drugs in the cellular and molecular level.	Understand	
CO-03	Interpret the pharmacokinetics of drugs	Create	
CO-04	Identify the role of antigen presenting cells, lymphocytes, and phagocytic cells in immune responses	Remember	
CO-5	Elucidate the relationship between major cellular and molecular components of the immune system.	Apply	
CO-6	Describe the basic structure of the cellular receptors and discuss their interactions during an immune response.	Understand	

# **Course Learning outcome:**

- 1. Blood grouping
- 2. Diffusion test ODD
- 3. RID
- 4. ELISA
- 5. DOT blot
- 6. Interferon production flow chart
- 7. Minimum inhibitory assay
- 8. PCR
- 9. Transgenic plants and animals of pharmaceutical importance

\*\*\*\*\*

#### SIXTH SEMESTER BIOTECHNOLOGYPAPER-VII Title: MICROBIAL TECHNOLOGY AND AGRICULTURAL BIOTECHNOLOGY

#### **Course Objectives:**

1. To understand the microbial physiology and to identify the microorganisms.

2. Understand the regulation of biochemical pathway and possible process modifications for improved control over microorganisms for microbial product synthesis.

3. To understand current barriers to gene discovery and exploitation of crop plants for crop improvement

#### **Course Learning Outcome:**

СО	After the completion of this course the student will be able to	Cognitive level
CO-01	Acquire knowledge about Industrial and food Biotechnology, industrial and food Biotechnology, applications of biotechnology in industry and food processing and safety regulations.	Understand
CO-02	Acquire knowledge about bio-processing, different microbial processes, recovery of ethanol, organic acids, antibiotics and use of industrial microorganisms.	Understand
CO-03	Develop a firm understanding in the principles and application of agriculture biotechnology	Apply
CO-04	Demonstrate the ability to develop, interpret, and critically evaluate modern approaches to scientific investigation.	Create

### PART-A

### MICROBIAL TECHNOLOGY

Unit 1		
1.1	Introduction to biotechnological importance of microorganisms.	
1.2	Metabolic pathways involved in microbial products, primary and secondary metabolites, enzymes and microbial biomass.	6 hrs
Unit 2		
2.1	<b>Microbial production:</b> use of microbes in the production of vitamins, enzymes, organic acids, amino acids, polysaccharides, growth regulators, colourants, flavours, sweeteners, emulsifiers, proteins, lipids and antibiotics.	6hrs
Unit 3		
3.1	Process for the production of vitamin - C and Penicillin,	5hrs
3.2	Fermenters – types, Batch & continuous cultures with examples	
Unit 4		
4.1	Microbial pesticides: fungicides and herbicides. Bacterial, fungal and viral bioagents- <i>Bacillus thuringiensis</i> (Bt). <i>Beauveria bassiana</i> ,	5hrs

baculoviruses.

St. Philomena's College (Autonomous) Mysore. B.Sc., Biotechnology Revised CBCS Syllabus 2018 -19 onwards. Page 28

#### PART-B

#### AGRICULTURAL BIOTECHNOLOGY

1.1	Introduction :	6hrs
	Conventional crop improvement techniques and their limitations, biotechnology for crop improvement, prospects of biotechnology for agriculture.	
1.2	Biological nitrogen fixation: nitrogen-fixing microorganisms, the role of nitrogen, genetics of nitrogen fixation, regulation of nif gene expression.	
Unit 2		
2.1	<b>Biofertilizers and Phyto – stimulants:</b> Mechanism of growth promotion by microbial inoculants.	5hrs
2.2	Mass production of Brady rhizobium and rhizobium, Azospirullum, Azatobacter, Mycorhizae.	
Unit	3	
3.1	<b>Genetic engineering of crop plants:</b> Gene transfer techniques for desirable traits in crop plants – agrobacterium mediated gene transfer, direct gene transfer to protoplast, biolistic gene transfer.	5hrs 2hrs
3.2	Few examples of transgenic plants obtained through gene transfer techniques- Bt cotton, herbicide-tolerant soybean, virus-resistant (papaya ringspot).	21115
Unit-4		
4.1	Food biotechnology: food processing	
	<b>B</b> iotechnological approaches, fruit ripening and its manipulation, roll-off ACC synthase, genetically modified foods, transgenic fish	6hrs
4.2	Biotechnology in the dairy industry.	

#### **Reference Books:**

- 1. Agricultural Biotechnology, Purohit
- 2. Text book of biotechnology, Jogdandh
- 3. Text book of Microbiology, Dubey and Maheshwari

# SIXTH SEMESTER BIOTECHNOLOGYPAPER-VIII Title: ENVIRONMENTAL BIOTECHNOLOGY AND BIOPHYSICS, BIOSTATISTICS CLASS DURATION – 03 HOURS PER WEEK 48 Hours MARKS-Theory - 70 + Internal Assessment -30= 100

#### **Course Objectives:**

St. Philomena's College (Autonomous) Mysore. B.Sc., Biotechnology Revised CBCS Syllabus 2018 -19 onwards. Page 29

- 1. To make students aware of Environmental Biotechnology
- 2. To Study of Environmental Impact Assessment. To study different remediation techniques for environmental pollution
- 3. To illustrate the basic principle and techniques to understand the biological problem.
- 4. TO recognize the importance of data collection and its role in determining scope of inference.
- 5. To demonstrate a solid understanding of interval estimation and hypothesis testing.
- 6. To choose and apply appropriate statistical methods for analyzing one or two variables.

CO	After the completion of this course the student will be able to	Cognitive level
CO-01	Gain knowledge about recycling, and remediation methods of different pollutants.	Understand
CO-02	Know the technique of remediation method for pollution, Knowledge about effluent treatment system.	Understand
CO-03	Recall the basic concepts of atomic structure and explain the fundamental principles and origin of spectral lines	Understand
CO-04	Recall and relate the concepts of radioactivity and its applications.	Create
CO-05	Acquire knowledge about statistical measures and tools for the analysis of agricultural data	Understand
CO-06	Aanalyze and understand the experimental data	Analyse

# **Course Learning Outcomes :**

### PART-A

#### ENVIRONMENTAL BIOTECHNOLOGY

Unit 1		
1.1	<b>Introduction:</b> major issues in environmental pollution- the role of biotechnology to solve the problem.	
1.2	<b>Biotechnological methods of pollution detections</b> : General bioassay, cell biological methods, immunoassays, DNA based methods, use of biosensors.	5hrs
Unit 2		
2.1	<b>Biotechnological methods in pollution abatement:</b> reduction of CO <sub>2</sub> emission.	5hrs
2.2	Wastewater treatment- conventional wastewater treatment.	
2.3	Use of algae, eutrophication, use of cell immobilization.	
Unit 3		
3.1	<b>Biotechnological and biodegradation</b> : degradation of xenobiotic compounds- simple, aromatic, chlorinated polyaromatic, petroleum products, pesticides and surfactant.	5hrs
3.2	<b>Bio-hydrometallurgy and biomining</b> : bioleaching, biosorption, oil degradation, the superbug.	2hrs
3.3	<b>Bioremediation</b> – in-situ and ex-situ bioremediation	
Unit 4		

4.1	Treatment of industrial waste: dairy, pulp, dye, leather and pharmaceutical	
	industries.	
4.2	Solid Waste Management	5hrs
4.3	Genetically engineered microbes for waste treatment.	2hrs
4.4	Ecofriendly bioproducts: biomass resources, biogas, alcohol as fuel, biological	
	hydrogen	

# PART-B

# **BIOPHYSICS & BIOSTATISTICS**

Unit 1		
1.1	Scope and development of Biophysics	Jhma
1.2	Analytical techniques	2015
	Principles and applications of	
	a) Chromatography (Paper, thin-layer, column and GLC)	5hrs
	b) Centrifugation (RPM and G, Ultracentrifugation)	
Unit 2		
2.1	Spectroscopic techniques, UV, visible spectroscopy, X-ray crystallography, NMR, IR,	
2.2	Isotopes - Types, the measure of radioactivity, GM counters &Scintillation counting.	5hrs

Unit 3		
3.1	<b>Statistical concepts:</b> Data structure, collection of data, classification of data and tabulation of data, diagrammatic presentation of data, graphical representation,	5hrs
3.2	A measure of Central Frequency: Mean, median and mode, Problems on Mean,	
	Median and Mode	
Unit 4		
4.1	A measure of the dispersion of data: Range, semi-interquartile range, mean	5hrs
	deviation, standard deviation, coefficient of variation.	
4.2	Sampling and Test of significance	
4.3	Chi-square test and Goodness of fit	2hrs

### **Reference Books:**

- 1. Environmental Biotechnology, Foster C.F., John Wae D.A., Ellis HorwoodLimited.
- 2. Introduction to Environmental Biotechnology. A. K. Chatterji. Prentice-Hall of India Pvt. Ltd. New Delhi, 2002
- 3. Narayanan, Essentials of Biophysics, New Age Int. Pub. New Delhi, 2000
- 4. A Text Book of Biophysics, Roy R.N. New Central Book Agency, 1999

\*\*\*\*\*

#### PRACTICAL- VII Microbial Technology & Agricultural Biotechnology

Practical Duration -02 Hours per week Examination -03 Hours

# Microbial Technology & Agricultural Biotechnology

# **Course Objectives:**

1. To Identify the sources of industrial important enzymes.

2. To analyse/apply the techniques to extract and quantify the secondary metabolites like lipids , vitamins , flavors, enzymes etc

- 3. To understand the influence of microbes in agriculture
- 4. To compare the advantages and disadvantages of genetically modified plants

# **Course Learning outcome**:

СО	After the completion of this course the student will be able to	Cognitive level
CO-01	Learn how beverages are made using biotechnological approaches.	Create
CO-02	Appreciate the economic importance of biotechnology	evaluate
CO-03	Understand the importance of industrially important microbes	Understand
CO-04	Acquire knowledge of food microbiology, packaging and fermentation industry	Understanding
CO-05	Isolate and screen industrially important microbes	remember

- 1. Identification of important microorganisms relevant to biotechnology: E.coli, saccharomyces cerevisiae, spirulina.
- 2. Demonstration of commercial microbial products- single-cell proteins, microbial flavours
- 3. Entrapment of yeast for enzyme production.
- 4. Preparation of wine
- 5. Seed inoculation with rhizobium culture and observation for root nodulation
- 6. Photographic demonstration of transgenic crop plants/animals and agriculture biotechnology innovations.
- 7. Test on in-vitro antagonism
- 8. Preparation of biocontrol formulation
- 9. Biofertilizer formulation

# **PRACTICAL-VIII**

# **Environmental Biotechnology Biophysics & Biostatistics**

# Practical Duration -02 Hours per week Examination -03 Hours MARKS=50

Practical Proper -35 marks Internal Assessment – Record-05+ Class Test-10=15 marks

# **Course Objective:**

1 .To identify strategies in biological research

2. To apply the scientific method and quantitative techniques to describe, monitor and understand environmental systems.

3.To describe about the biodegradation of xenobiotics .

### **Course Learning outcome:**

СО	After the completion of this course the student will be able to	Cognitive level
CO-01	Understand the basic concepts of eco system and types of waste management.	Remember
CO-02	Describe about the physico chemical factors that influence the environment	Analyse
CO-03	Analyse biological data using the best suited statistical tool and draw inferences from the results	Create
CO-04	Know the working principle, instrumentation and applications of the important analytical techniques	Apply
CO-5	Analyse the molecular structure conformational changes and interactions	understand

- 1. Analysis of sewage water for BOD, COD, toxic chemicals and microbial flora
- 2. Visit to biotechnology-related industries
- 3. Problems on Mean, Median, Mode
- 4. Histogram, Pie Chart, Bar Graph

\*\*\*\*\*

# DISCIPLINE SPECIFIC ELECTIVES (DSE) BIOTECHNOLOGY SEMESTER- V & VI Title: DISSERTATION

# CLASS DURATION – 02 HOURS PER WEEK 2 CREDITS

#### MARKS-Theory - 30 + Internal Assessment -20= 50

# **Course objective:**

1. Dissertation is designed in a way to teach and train the students with full practical knowledge in the different research areas of Biotechnology in order to make them

efficient researchers to start their carrier in research through Ph.D.and other R & D programmes.

#### **Course learning Outcome:**

СО	After the completion of this course	Cognitive level
CO-01	Students would gain training in the research topics selected from different fields like plant tissue culture, genetic engineering etc identification of novel genes and their expression pattern at different growth stages of plants.	Evaluate
CO-2	Students develop understanding about the literature reading and dissertation writing equired to carry out a good research in future research endeavors like Ph.D.	Understand
CO-3	Students developed understanding about the literature search, reading and dissertation writing.	Understand
CO-4	Students trained to find the resources needed to perform the research and presentation of research data.	Create

### DISSERTATION

1. Project on review article.

2. The students will carry independent project work under the supervision of the staff of the Biotechnology Department on an advanced topic assigned to him/her.

3. The Dissertation work will be in the final semester

4. The Dissertation report (also work book shall be presented at the time of presentation and

viva voce) will be submitted at the end of the Semester and evaluated.

- 5. Three copies of the project report shall be submitted to the HOD.
- 6. The evaluation will be done by ppt presentation.

# DISCIPLINE SPECIFIC ELECTIVES (DSE) BIOTECHNOLOGY

St. Philomena's College (Autonomous) Mysore. B.Sc., Biotechnology Revised CBCS Syllabus 2018 -19 onwards. Page 34

# SEMESTER- V & VI Title: RESEARCH METHODOLOGY IN BIOTECHNOLOGY

CLASS DURATION – 02 HOURS PER WEEK 2 CREDITS 32HRS

### MARKS-Theory - 30 + Internal Assessment -20= 50

Course Objective:

- **1.** To enable students to: Become knowledgeable of the research process and its different approaches.
- **2.** To develop critical thinking to find business opportunities and to solve questions related to service industries.

Course learning Outcome:

СО	After the completion of this course the student will be able	Cognitive level
	to	
CO 01		
CO-01	Apply a range of quantitative and / or qualitative research techniques to business and management problems / issues	Apply
CO-02	Understand and apply research approaches, techniques and strategies in the appropriate manner for managerial decision making	Understand
CO-03	Demonstrate knowledge and understanding of data analysis and interpretation in relation to the research process	Understand
CO-04	Develop necessary critical thinking skills in order to evaluate different research approaches utilised in the service industries	Analyse

#### UNIT 1

1.1 Introduction to Research Methodology: Meaning of Research, Objectives of Research,

Motivations in Research, Types of Research, Research Approaches, Significance of Research,

Research Methods v/s Methodology, Research and Scientific Methods, Research Process, Criteria

of Good Research

1.2 Defining the Research Problem: What is Research Problem?, Selecting

the Problem, Necessity of and Techniques in defining the problem,

1.3 Research Design: Meaning, Need, Features of Good Design, Concepts, Types.

1.4 Basic Principles of Experimental Design, Developing a Research Plan

12

hrs

UNIT 2

2.1 Sample Design: Implication, Steps. Criteria for selecting a sample procedure, Characteristics of Good sampling Procedure, Types of Sample Design, Selecting Random Samples, Complex random sampling Design.

2.2 Literature Search: Literature review, Defining the research question, Approaches and Methodology, Documentation and presentation of data, analysis and interpretation of data, Common statistical tests manuscript preparation

2.2 Tools and techniques: Brief introduction to Biochemical and Biophysical techniques.

2.3 GC-MS, LCMS, NMR.

14hrs

# UNIT-3

3.1 Use of search engines: PubMed, Google Scholar; framing query with examples.Use of databases,

3.2 Use of common software tools: Microsoft OfficeTM (Powerpoint, Excel, Word); Use of social media in research: Mendeley, ResearchGate. Bibliometrics: Citation, Impact factor, Eigen factor.

3.3 Hypothesis as a framework for scientific projects. Alternatives to hypothesis-driven research: hypothesis-generating research, Writing research hypothesis (grant). Presenting research: oral and poster.6hrs

# **Reference:**

1. Research Methods for the Biosciences. Holmes, Moody & Dine.Oxford University Press.

2. Experimental Design for the Life Sciences. Ruxton&Colegrave.Oxford University Press.

3. Experimental Design for Biologists. David J. Glass. Cold Spring Harbor Laboratory.

4. Kothari, C.R., Research Methodology (Methods and Techniques), New Age Publisher

\*\*\*\*\*\*

# DISCIPLINE SPECIFIC ELECTIVES (DSE) BIOTECHNOLOGY SEMESTER- V & VI Title: EPIGENETICS AND CANCER BIOLOGY

# **CLASS DURATION – 02 HOURS PER WEEK 2 CREDITS**

MARKS-Theory - 30 + Internal Assessment -20= 50

# **Course objectives:**

(1) To understand the epigenetic regulation in normal & cancer cells;

(2) To understand diphering epigenetic pathways and molecular targets in malignant transformation;

(3) To learn the impact of epigenetic alterations associated with cancers;

4) To discuss recent advances in epigenetic issues/phenomena by highlighting the growing importance of epigenetic therapeutics in cancers;

(5) Learning the scientific approaches/methods employed to define epigenetic-mediated cancer drivers and their therapeutic potential.

# **Course learning Outcome:**

СО	After the completion of this course the student will be able to	Cognitive level
CO-01	Discuss the importance of epigenetic mechanisms at key points in development.	Create
CO-02	Describe how epigenetic mechanisms are involved in genome defense.	Create
CO-03	Discuss why epigenetic mechanisms can influence disease, particularly cancer.	Create
CO-04	Critically evaluate examples of how the environment can influence the epigenome.	Evaluate

**32 Hours** 

### UNIT - 1

1.1 Introduction, growth characteristics of cancer cells; Morphological and ultrastructural properties of cancer cells.

1.2 Types of growth: hyperplasia, dysplasia, anaplasia, and neoplasia. Nomenclature of neoplasms.Differences between benign and malignant tumours.Epidemiology of cancer.

8Hrs

# UNIT –2

2.1 Cancer biology and biochemistry- Aberrant metabolism during cancer development;

Paraneoplastic syndromes; Tumor markers; cellular protooncogenes- oncogene activation. Growth factors-EGF, TNF- and TGF- and growth factor receptors.

2.2 Signal transduction in cancer. Role of transcription factors. Carcinogenesis- radiation and chemical carcinogenesis- stages in chemical

2.3 carcinogenesis- Initiation, promotion and progression. Free radicals, antioxidants in cancer; Viral carcinogenesis -DNA and RNA Viruses. Hormone mediated carcinogenesis in humans.
12hrs

### UNIT - 3

3.1 Cell Cycle Regulation-Tumor suppressor genes p53, p21. Metastasis - VEGF signalling, angiogenesis; Epigenetics-Role of DNA

Methylation in gene silencing- epigenetic silencing of tumour-suppressor genes;

3.2 Apoptosis in cancer-Cell death by apoptosis, the role of caspases; Death signalling pathways-mitochondrial and death receptor pathways.

3.3 Detection of Cancers, Prediction of aggressiveness of Cancer, Different forms of therapy, Chemotherapy, Radiation Therapy, and Immunotherapy: advantages and limitations.

St. Philomena's College (Autonomous) Mysore. B.Sc., Biotechnology Revised CBCS Syllabus 2018 -19 onwards. Page 37

3.4 Epigenetics of cancer, identification of targets for drug development. 12hrs

### **Reference :**

1. The Biological Basis of Cancer: R. G. McKinnell, et al 2nd Ed, Cambridge University Press, 2006.

2. The Biology of Cancer: R. A. Weinberg. Garland Science. 2006.

3. The Molecular Biology of Cancer: S. Pelengaris, M. Khan. Blackwell Publication.

4. Virology a practical approach, Maly B.W.J. IRL Press, Oxford, 1987.

5. Introduction to Modern Virology, Dunmock N.J and Primrose.S.B., Blackwell Scientific Publications.

# DISCIPLINE SPECIFIC ELECTIVES (DSE) BIOTECHNOLOGY SEMESTER- V & VI Title: INTELLECTUAL PROPERTY RIGHTS, PATENTING AND BIOETHICS

# CLASS DURATION – 02 HOURS PER WEEK 2 CREDITS MARKS-Theory - 30 + Internal Assessment -20= 50

# **Course Objectives:**

1. To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.

- 2. To disseminate knowledge on patents, patent regime in India and abroad and registration aspects
- 3. To disseminate knowledge on copyrights and its related rights and registration aspects
- 4. To disseminate knowledge on trademarks and registration aspects.
- 5. To aware about current trends in IPR and Govt. steps in fostering IPR

CO	After the completion of this course the student will be able to	Cognitive level
CO-01	During their research career, information in patent documents provide useful insight on novelty of their idea from state-of- the art search. This provide further way for developing their idea or innovations	Create
CO-02	Pave the way for the students to catch up Intellectual Property(IP) as an career option such as R&D IP Counsel b. Government Jobs – Patent Examiner	Apply
CO-03	During their research career, information in patent documents provide useful insight on novelty of their idea from state-of- the art search. This provide further way for developing their idea or innovations	Create

St. Philomena's College (Autonomous) Mysore. B.Sc., Biotechnology Revised CBCS Syllabus 2018 -19 onwards. Page 38

32HRS

#### Unit 1

1.1 Ethical, Social and Biosafety aspects: Socio-economic and ethical aspects of biotechnology

1.2 Introduction to Intellectual Property: Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of GMOs

IP as a factor in R&D; IPs of relevance to Biotechnology and few.

1.3 Objectives and levels of biosafety: Objectives; recombinant DNA safety; biological containment; risk groups and risk analysis. Cartagena Protocol; OECD guidelines.Govt of India guidelines for r- DNA technology and GMO's.The ecological impact and biosafety issues of GM crops.

# 12Hrs

8hrs

12hrs

### Unit 2

2.1 Research Ethics: Concept of Plagiarism., Reviewing the literature, Identification of research problem and proposal writing

2.2 Agreements and Treaties: History of GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments

# Unit 3

3.1 Patents: Basics of Patents and Concept of Prior Art. Introduction to Patents: Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; Specifications: Provisional and complete; Forms and feesInvention in context of "prior art"; Patent databases; Searching International Databases; Country-wise patent searches (USPTO, esp@cenet(EPO), PATENTScope(WIPO), IPO, etc.)

3.2 Patent filing procedures: National & PCT filing procedure; Time frame and cost.

3.3 Status of the patent applications filed; Precautions while patenting – disclosure/non-disclosure.

3.4 Financial assistance for patenting - introduction to existing schemes Patent licensing and agreement

3.5 Patent infringement- meaning, scope, litigation, case studies

#### **Reference:**

 BARE ACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007

St. Philomena's College (Autonomous) Mysore. B.Sc., Biotechnology Revised CBCS Syllabus 2018 -19 onwards. Page 39

2. Kankanala C., Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution

Pvt. Ltd., 2007

Important Links:

http://www.w3.org/IPR/

http://www.wipo.int/portal/index.html.en

http://www.ipr.co.uk/IP\_conventions/patent\_cooperation\_treaty.html

http://www.patentoffice.nic.in

# DISCIPLINE SPECIFIC ELECTIVES (DSE) BIOTECHNOLOGY SEMESTER- V & VI Title:- MOLECULAR VIROLOGYAND INFECTIOUS DISEASES CLASS DURATION – 02 HOURS PER WEEK 2 CREDITS MARKS-Theory - 30 + Internal Assessment -20= 50

# **Course Objectives:**

1. To understand the nature of viruses, including their structure, replication and classification.

2.To explore how infection and replication of viruses is constrained by the viral genome and host immune defenses.

3.To learn how transmission strategies, immune evasion and host responses contribute to viral pathogenesis

# **Course Outcome:**

CO	After the completion of this course the student will be able to	Cognitive level
CO-01	To understand viral evolution mechanisms and how they contribute to emergence and re-emergence of viral disease	understand
CO-02	Understand and analyse biological, environmental and human behavior that contributes to transmission of viruses, particularly emerging and re-emerging disease	Apply
CO-03	To comprehend and appreciate the major and varied laboratory techniques and research approaches employed in the field of virology.	Create

# **32 Hours**

# UNIT –1

1.1 History of Virology and Biosafety: History and principles of virology, virus taxonomy.

1.2 Structures of animal and plant viruses and their morphology.

1.3 Principles of biosafety, containment facilities, maintenance and handling of laboratory animals, and requirements of virology laboratory.8hrs

# **UNIT** – 2

2.1 Virus Replication: Structure and replication strategies of bacteriophages - T7,  $\lambda$ ,  $\Phi$ X174, and plant viruses - ss RNA virus (TMV) and ds DNA virus (CaMV).

2.2 Structure and replication strategies of animal viruses - Influenza virus, Adenovirus and Retrovirus. 12hrs

# **UNIT – 3**

3.1 Interferon and Antiviral Agents: Viral Interference and Interferons.

3.2 Nature and source of interferons, Classification of interferons. Induction of interferon. Antiviral agents (chemical and biological) and their mode of actions.

3.3 Cultivation of Viruses and Viral Vaccines: Cultivation of viruses in embryonated egg, tissue culture and laboratory animals. Conventional vaccines - Killed and attenuated.

3.4 Modern vaccines - Recombinant proteins, subunits, DNA vaccines, peptides,

immunomodulators (cytokines). Vaccine delivery and adjuvants, large-scale manufacturing.

12Hrs

### Reference:

- 1. General Virology Luria and Darnel Virology and Immunology Jokli
- 2. Text book of Virology Rhodes and Van Royen
- 3. Plant Virology Smith
- 4. Genetics of bacteria and their viruses W. Hayes
- 5. Molecular Biology of the Gene Watson, Roberts, Steitz and Weiner

# DISCIPLINE SPECIFIC ELECTIVES (DSE) BIOTECHNOLOGY SEMESTER-II, III & IV Title:- Pharmaceutical Biotechnology CLASS DURATION – 02 HOURS PER WEEK 2 CREDITS MARKS-Theory - 30 + Internal Assessment -20= 50

**32 Hours** 

# **Course Objectives:**

- 1. To evaluate different pharmaceutical parameters of current biotechnology products.
- 2. To determine parameters related to stability and formulation of biotechnology products
- 3. To discuss quality control procedures related to biotechnology products.
- 4. To discuss novel formulation methods for better delivery of biotechnology derived drugs

5. To discuss the delivery of biotechnology products by the parenteral, oral, transdermal and nasal routes of administration

**Course Learning Outcome:** 

CO	After the completion of this course the student will be able to	<b>Cognitive level</b>
CO-01	to understand and evaluate the different pharmaceutical parameters of the current and future biotechnology related products on the market.	Understand
CO-02	Improve the pharmaceutical theoretical skills to be able to formulate dosage forms and evaluate preparations for drug contents and purity assessment.	Evaluate
CO-03	Investigate biotechnology applications in the pharmaceutical field	Create
CO-04	Evaluate different techniques related to separation and purification of cell types; conduct techniques for measuring cell turnover and growth, conduct cytotoxicity assays.	Evaluate

# UNIT 1

1.1 Pharmaceutics: Introduction and Scope of the Pharma industry and biopharmaceuticals,

1.2 Biotechnology and drug design: Development and economics, Preclinical studies and principles of process development, early proof -of- concept of chemical and biological entities, Orphan drugs.

1.3Provisions for and use of unlicensed medicines.Drug abuse and dependence, Prescription and<br/>non-prescription drugs.12Hrs

# UNIT 2

2.1 Metabolism of Drugs and Xenobiotics

2.2 Evolution of drug metabolism Phase I metabolism (microsomal oxidation, hydroxylation, dealkylation) Phase II metabolism (drug conjugation pathway) CYP families. Pharmacodynamic and Pharmacokinetics of protein-based drugs. **8Hrs** 

# UNIT 3

3.1 Toxicology: Introduction, Scope and importance: Basic concepts, Dose response-Fundamental issues in toxicology,

3.2 Fate of toxicants and mechanism of action of toxins, biotransformation of toxins and their clearance from the body; Toxic intermediates; Toxicokinetics and Toxicity testing-In vitro methods and in vivo methods.

3.3 Drug Manufacture and Formulation, Basic concepts and applications, composition, preparation, physicochemical considerations in the manufacture of current biotech products and herbal medicines. **12 Hrs**.

# DISCIPLINE SPECIFIC ELECTIVES (DSE) BIOTECHNOLOGY SEMESTER-II, III & IV Title:- MEDICAL & NANOBIOTECHNOLOGY CLASS DURATION – 02 HOURS PER WEEK 2 CREDITS MARKS-Theory - 30 + Internal Assessment -20= 50

# **Course Objectives:**

- 1. To apprise students about strategy to form nanostructures from nucleic acids.
- 2. To learn about various processing enzyme such as restriction enzymes, ligages, polymerase for cutting, joining nucleic acids at specific position. These strategies can generate linear or branch nucleic acids with sticky and blunt ends. Such motifs will be used for making various nanostructures such as DNA-2D lattice, DNA polyhedra, DNA origami and RNA techtosquare.
- **3.** To demonstrate some applications of the defined DNA nanostructures towards drug delivery.

CO	After the completion of this course the student will be able to	Cognitive level
CO-01	to understand Nanotechnology and gain knowledge about synthesis approaches for nanomaterial.	Understand
CO-02	To know about characterization techniques used in nanotechnology	Understand
CO-03	To know about the applications of nanotechnology	Understand
CO-04	To know about Nanotechnology involved in drug delivery system.	Understand

# **Course Learning Outcome:**

### **32 Hours**

# UNIT 1

- 1.1 Introduction to Nanoworld: The nanoscale dimension and paradigm, Definitions and historical evolution (colloids, etc.) and current practice.
- 1.2 Nanoscience and Nanotechnology Types of nanomaterials and their classifications (1D, 2D and 3D, etc.) Nanoparticles, Nanowires, thin films and multilayer.

St. Philomena's College (Autonomous) Mysore. B.Sc., Biotechnology Revised CBCS Syllabus 2018 -19 onwards. Page 43

1.3 Physical and Chemical Fundamentals of Nanomaterials, Applications in nanotechnology viz.

1.4 Biosensors, separation of cells and cell organelles, drug delivery, gene therapy, etc. 12 Hrs.
 UNIT – 2

2.1 Microbial Diseases: Normal microbial flora of the human body, host-microbe interactions.

2.2 Infection and infectious process, routes of transmission of microbes in the body. Epidemiology, description and pathology of human diseases caused by bacteria; Staphylococcus, Streptococcus, Gonococcus, E.coli, Salmonella, Pseudomonas, Klebsiella, Vibrio cholera; pathogenic anaerobes, Tetanus, Mycobacteria, syphilis, Chlamydia.

2.3 Fungi: Description and pathology of diseases Caused by Aspergillus.

Protozoa: Malaria

2.4 Laboratory diagnosis of common infective syndromes and parasitic manifestations, Methods of transmission and role of vectors - biology of vectors. Mosquitoes.Need and significance of epidemiological studies.
 12 Hrs.

# UNIT 3

Nanobiotechnology in Plant Management:

- 3.1 Nanotechnology: a new opportunity in plant sciences, Role of nanoparticles in plants
- 3.2 Nanotechnology in fertilizers, Nanotechnology in agricultural diseases and food safety.
- 3.3 Nanoparticles in sustainable agricultural crop production: applications and perspectives,
- 3.4 Nanotechnology: scope and application in plant disease management 8hrs

# **REFERENCES:**

1.Goodsell, D. S., in Bionanotechnology, John Wiley & Sons, inc.: 2004.

Dong, H.; Hu, W., Organic Nanomaterials. In Springer Handbook of Nanomaterials, Vajtai,
 R., Ed. Springer Berlin Heidelberg: 2013.

3. Gibbs, M. R. J., Nanomagnetic Materials and Devices. In Nanoscale Science and Technology , John Wiley & Sons, Ltd: 2005.

4. Mowbray, D., Inorganic Semiconductor Nanostructures. In Nanoscale Science and Technology, John Wiley & Sons, Ltd: 2005.

# DISCIPLINE SPECIFIC ELECTIVES (DSE) BIOTECHNOLOGY SEMESTER-II,III & IV Title:- GENOMICS& PROTEIOMICS

\*\*\*\*\*\*\*

St. Philomena's College (Autonomous) Mysore. B.Sc., Biotechnology Revised CBCS Syllabus 2018 -19 onwards. Page 44

# **Course Objectives:**

- 1. To organize the large amount of information about genomics, proteomics and bioinformatics
- 2. To offer basic knowledge of genome sequencing, major differences between prokaryotic and eukaryotic genomes, basic proteomics and its applications, basics in bioinformatics, comparative and evolutionary genomics and applications.
- 3. To appraise the students to the vital concepts of technologies pertinent to Genomics and Proteomics, their applications and demonstrate skills to apply the knowledge in scientific queries.

# **Course learning Outcome:**

СО	After the completion of this course the student will be able to	Cognitive level
CO-01	Discern the crucial concepts and techniques applied in genomics, transcriptomics and proteomics.	Application
CO-02	Classify the complexity of genome/ proteome structural and functional organization.	Analyse
CO-03	Formulate and assess experimental design for solving theoretical and experimental problems in Genomics and Proteomics fields.	Create
CO-04	Identify and discuss the techniques used in functional genomics such as microarrays, next generation sequencing technology, mRNA expression and miRNA expression; and Interpret data obtained through high throughput expression studies.	Evaluate

# UNIT 1

1.1 Sequencing Technology: Introduction, the scope of sequencing technology: Strategies for genome sequencing: Chaintermination method, automated sequencing, pyrosequencing.

1.2 Sequence assembly: Clone contig and shotgun approaches. Organization of genomes: main features of prokaryotic and eukaryotic genome organization.

1.3 Plant genome project, human genome project and its applications. Locating the genes: ORF<br/>scanning, homology searches.08 Hrs.

# UNIT 2

2.1 Genomics: Introduction and scope, Determination of the functions of genes: gene inactivation (knock-out, anti-sense and RNA interference) and gene overexpression.

- 1.2 Approaches to analysing global gene expression: transcriptome, Serial Analysis of Gene Expression (SAGE), Expressed Sequence Tags (ESTs), SNPs and their relevance, Massively Parallel Signature
- 1.3 Sequencing (MPSS), microarray and its applications, gene tagging.

St. Philomena's College (Autonomous) Mysore. B.Sc., Biotechnology Revised CBCS Syllabus 2018 -19 onwards. Page 45

1.4 Metagenomics: Prospecting for novel genes from metagenomes and their biotechnological applications.12

Hrs.

# UNIT 3

3.1 Proteomics: Introduction and scope, Human genome - Genomes to Proteomes – Human Proteome Organisation (HUPO).

3.2 Branches of proteomics - Protein extraction Methods: Subcellular fractionation, Density gradients, Ultrafiltration, - Protein fractionation - Affinity purification –Combined Fractional Diagonal Chromatography (COFRADIC) - Removal of interfering compounds, salts, DNA, lipids, Protein solubilization methods, chaotropic detergents, etc., Preparation of Sample - Sample handling and storage - Protein detection and quantification methods – Stable Isotope Labeling with Aminoacids in Culture (SILAC 12Hrs

### **REFERENCES**:

1. Twyman, R.M. Principles of Proteomics. BIOS Scientific Publisher, New York. 2004.

2. Liebler, D.C. Introduction to Proteomics: Tools for the New Biology. Human Press, Totowa NJ. 2002.

3. Buchanan B, Gruissem G, and Jones R (2000) Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, USA.

4..Lieber DC (2006) Introduction to Proteomics: Tools for New Biology; Humana Press, NJ.

# DISCIPLINE SPECIFIC ELECTIVES (DSE) BIOTECHNOLOGY SEMESTER-II, III & IV Title: - MOLECULAR PLANT PHYSIOLOGY

### CLASS DURATION – 02 HOURS PER WEEK 2 CREDITS 32 Hours

# MARKS-Theory - 30 + Internal Assessment -20= 50

### **Course objectives:**

**1.** To illustrates knowledge of stress adaptations in biological systems.

2. To deliver molecular understanding of primary and secondary metabolic process.

3. To present perspectives of the current tools for application in biological system for biotechnological research.

### **Course learning Outcome:**

CO	After the completion of this course the student will be able to	Cognitive level
CO-01	Know and understand the physiological processes taking place at	

St. Philomena's College (Autonomous) Mysore. B.Sc., Biotechnology Revised CBCS Syllabus 2018 -19 onwards. Page 46

	the level of the cell, organ and the whole plant, and recognizes the influence of environment.	understands
CO-02	Understand professional terms and terminology used in natural sciences and uses them together with mathematical and statistical methods to describe and interpret physiological processes.	understands
CO-03	Know and understand the relationship of plant physiology with other natural sciences, and gives examples of modification of physiological processes with the use of biotechnological tools.	understands

# UNIT – 1

1.1 Photosynthesis alternative respiration and Hexose monophosphate.

1.2 Light-harvesting complexes and light reaction. The photosynthetic carbon reduction cycle (PCR), C4 and Crassulacean acid metabolism (CAM) pathway.

1.3 Photo-inhibition and photorespiration. Synthesis, transport and storage of starch.Cyanideresistant respiration.Oxidative Pentose phosphate pathway.12Hrs

#### UNIT - 2

Mineral Nutrition in Plants :

2.1 Importance of mineral nutrition in plant growth, development and productivity.

2.2 Criteria for the essentiality of mineral nutrients, and their physiological functions. Nutrient uptake (active and passive uptake); active transport and electrogenic pumps.

2.3 Assimilation of mineral nutrients (nitrogen, sulphur and phosphorus) and their physiological functions.

2.4 Biological nitrogen fixation: nif genes, nodulin genes and nodule development. Nitrogen and Sulphur- use efficiency.

#### UNIT - 3

3.1 Phytohormones, Photoreceptor: Structure and molecular mechanism of action of phytohormones (Auxins, Gibberellins, Cytokinins, Abscisic Acid, Ethylene).

3.2 Photoreceptors: structure and function of phytochromes and cryptochromes; role in signal transduction.

3.3 Stress and Post Harvest Physiology: Abiotic stresses (drought, submergence, low and high salinity. temperature, salt and heavy metal stresses). Role of LEA proteins in stress tolerance.

3.4 Biotic stresses (insects and diseases), stress-induced gene expression. Molecular basis of senescence, ageing and programmed cell death in plants. Molecular biology of fruit ripening and control of post-harvest

deterioration of fruits, vegetables and cut flowers.

8hrs

\*\*\*\*\*\*

#### DISCIPLINE SPECIFIC ELECTIVE SCHEME FOR SETTING QUESTION PAPER SEMESTER I, II, III&IV

No of questions from Unit	2Marks	5Marks	10Marks	Total marks
Unit 1&2	3	2	-	16
Unit 3&4	3	2	1	26
Unit 5&6	-	2	1	20
Unit 7&8	1	1	1	17

#### BIOTECHNOLOGY

# BluePrint of question paper Biotechnology forI, II, III& IV sem

Time-03Hrs Max Marks-60

		Part-A	
1.	Define /Explain any five of the fo	ollowing:	2x5=10M
	a		
	b		
	c		
	D		
	Ε		
	f		
	g		
		Part-B	
	Write a note on any Six of the following:		5x6=30M
2			
3			
4			
5			
6			
7			
8			
		Part-C	
Ans	wer any TWO of the following Ques	stions:	10x2=20M
9			
10			
11			

# BIOTECHNOLOGY

#### Blue Print of question paper Biotechnology for V& VI sem Time-03Hrs Max Marks-70

Part-A						
1.	Define /Explain any five of the following:		5x2=10M			
	a					
	b					
	с					
	d					
	e					
	f					
	•	Part-B				
Write a note on any Six of the following:			6x5=30M			

St. Philomena's College (Autonomous) Mysore. B.Sc., Biotechnology Revised CBCS Syllabus 2018 -19 onwards. Page 48

	· · · · · · · · · · · · · · · · · · ·				
2					
3					
4					
5					
6					
7					
8					
Part-C					
Answe	er any Three of the following Questions:	3x10=30M			
9					
10					
11					
12					

#### BIOTECHNOLOGY Blue Print of question paper Biotechnology DSE Time-02Hrs Max Marks-30

		Part-A	
1.	Define /Explain any five of the following:		5x2=10M
	a		
	b		
	c		
	d		
	e		
	f		
		Part-B	
	Wri	te a note on any Four of the following:	4x5=20M
2			
3			
4			
5			
6			

Internal assessment =20Marks

1. Seminar-10M

2. Test/Quiz-10M