MASTER OF SCIENCE (BIOTECHNOLOGY)

VISION

- To nurture the young minds with a potential to innovate, invent and disseminate knowledge for the benefit of the society and environment.

MISSION

- To motivate the learners to take up challenging task in biotechnology and to prepare for a career of self employment through environmental friendly biotechnology enterprises.
- To innovate and explore novel solution for the existing problems in the fields of environment, agriculture, animal biotechnology and health sector.

Program educational Objectives

Graduate of the program will

1. Succeed in obtaining employment appropriate to their interest, education and will become productive and valued professional in Biotechnology domain.
2. Continues to develop professionally through life long learning, higher education in their area of interest.
3. Cater to the needs of the industry, society so as to contribute for the development of the country.

Program Outcomes

1. Graduates will use the basic knowledge towards applied Plant/ Animal/ Environmental Biotechnology.
2. Graduates will be able to design processes / products for Biotechnology Industries.-
3. Graduates will be able to gain hands on experience to design, analyze and interpret data for investigating research problems in biotechnology and other fields.

4. Graduates will be able to justify societal, health, safety and legal issues and understand his responsibilities in biotechnological practices
5. Graduates will gain hands on experience to take up independent / team research in a multidisciplinary environment.
6. The outcome of the course will make the student ready for lifelong learning of Biotechnology.

Program Specific Outcomes

1. Apply the knowledge of Biotechnology in the domain of environmental, agriculture, healthcare, molecular mechanics in Bioindustry.
2. Solve the complex problem in the field with a understanding of societal, legal and cultural impact of the solution.
3. Apply the contextual knowledge of Biotechnology to function effectively as an individual or leader in multidisciplinary domain of Biotechnology.
4. Predict, formulate, demonstrate, analyze and interpret data for integrating research problem in lifescience domain.
5. Synthesis, compare, evaluate, classify, integrate and effectively apply the basic laws, principles, phenomena, process and mechanism involved in the domain of Biotechnology.

ELIGIBILITY

A Bachelor's degree in Science, with Biotechnology/ Botany/ Zoology/ Biology/ Microbiology/ Microbial Gene technology/ Bioinstrumentation/ Bioinformatics/ Biochemistry/Chemistry/Agriculture/Marine Biology/Home Science/Farm Science/ Nutrition and Dietetics/Integrated Biology/Plant Science/Animal Science/Fisheries Science/Agriculture /Mathematics with Physics, Chemistry as Ancillary/Medical Lab Technology MBBS/BDS, B.Pharm and BSMS of a recognized Indian or Foreign University.

DURATION OF THE COURSE:

The duration of the course is TWO academic years divided into four semesters under Choice Based Credit System with OBE pattern.

OBJECTIVES OF THE COURSE

- The two year M.Sc., program is designed to help the student to become pioneering and resourceful personalities in the field of life science.

- The ultimate aim is to enable the students to develop an interdepartmental approach for understanding the life science problems at the molecular level. In addition, the present curriculum gives scope for vertical and horizontal mobility in the education system so that the students can enter different modules to update their knowledge depending upon the employment opportunities in each area.

- Various GEC and practical courses have been designed not only to enable the students to appreciate scientific basis of various life processes but also to train them for self-employment. The practical training will develop their reasoning ability to critically evaluate the results obtained from the projects.

- The present curriculum aimed to cater the global demand for skilled and trained manpower in various areas like Research and Development, Quality control labs, Industries, Biopharmaceutical companies and in field of teaching.

- The curriculum also has its module to explore the students entrepreneurial skill and help them to become a successful entrepreneur.

SCHEME OF EXAMINATION

Subject Code	Subject	Hours of Instruction	Exam Duration (Hours)	Maximum Marks			Credit Points
				CA	CE	Total	
FIRST SEMESTER							
Part-A							
21PBTM101	DSC I: Cell Biology	5	3	25	75	100	5
21PBTM102	DSC II: Molecular biology	5	3	25	75	100	5
21PBTM103	DSC III: Principles of Microbiology	5	3	25	75	100	5
21PBTM104	DSC IV: Biochemistry	5	3	25	75	100	5
21PBTM105	DSC V:Developmental Biology	5	3	25	75	100	5
21PBTMP101	DSC Practical I: Lab in Cell biology, Molecular biology, Genetics and Biochemistry	4	6	40	60	100	3
	ACC - MOOC Courses offered in SWAYAM/NPTEL/ CEC etc						
Non Credit							
21PLS101	NCC I	1	-	-	-	-	-
	Total	**30**				**600**	**28**
SECOND SEMESTER							
Part-A							
21PBTM201	DSC VI: Immunology	5	3	25	75	100	5
21PBTM202	DSC VII: Bioprocess Technology	5	3	25	75	100	5
	DSE I	5	3	25	75	100	4
21PBTMP201	DSC Practical II: Lab in Bioprocess technology and Immunology	5	6	40	60	100	3
Optional Subjects							
21PBCBTI201	GEC I: Diagnostic Biochemistry	4	3	25	75	100	2

21PBCBTIP201	GEC Practical I: Diagnostic Biochemistry	3	3	40	60	100	2
21PMBBTI201	GEC I: Clinical Microbiology	4	3	25	75	100	2
21PMBBTIP201	GEC Practical I: Clinical Microbiology	3	3	40	60	100	2
Part- B							
21PVE201	Value Education: Human Rights (ACC)	2	3	25	75	100	2
Non Credit							
21PLS201	NCC :CCS -I	1	-	-	-	-	-
	Total	**30**				**700**	**23**
THIRD SEMESTER							
Part –A							
21PBTM301	DSC VIII : Plant tissue and Animal cell culture technology	5	3	25	75	100	5
21PBTM302	DSC IX: Research Methodology, IPR and Bioethics	3	3	25	75	100	2
21PBTM303	DSC X: Biostatistics	4	3	25	75	100	3
21PBTM304	DSC XI: Genetic engineering	5	3	25	75	100	5
21PBTMP301	DSC Practical III: Lab in Plant tissue and Animal cell culture technology and Genetic Engineering	5	6	40	60	100	3
21PBTMP302	DSC Practical IV: Statistical software	2	3	40	60	100	2
Optional Subjects							
21PBCBTI301	GEC II: Pharmaceutical Biochemistry	3	3	25	75	100	2
21PBCBTIP301	GEC practical II: Pharmaceutical Biochemistry	3	3	40	60	100	2

21PMBBTI301	GEC II: Industrial Microbiology	3	3	25	75	100	2
21PMBBTIP301	GEC practical II: Industrial Microbiology	3	3	40	60	100	2
Non credit							
21PBTI301	Internship (100 % internal Evaluation)	-	-	-	-	-	-
	Total	**30**				**800**	**24**
FOURTH SEMESTER							
Part – A							
21PBTM401	DSC XII: Food and Pharmaceutical Biotechnology	5	3	25	75	100	5
	DSE II	5	3	25	75	100	4
21PBTPR401	Project & Viva-Voce	5	-	50	150	200	6
	ACC -MOOC Courses offered in SWAYAM/ NPTEL/ CEC						
Total		**15**				**400**	**15**
Grand Total						**2500**	**90**

DISCIPLINE SPECIFIC ELECTIVE COURSES (DSE) COURSES

The department offers the following four subjects as Elective courses for second and fourth semesters.

S.No	Subject Code	Semester	Subject
1.	21PBTEL201	II	Cell communication and Signaling
2.	21PBTEL202		Bioinstrumentation and Bioinformatics
3.	21PBTEL401	IV	Environmental Biotechnology
4.	21PBTEL402		Evolution and Biodiversity

FOR COURSE COMPLETION

Students Shall Completion

Human Rights in II semester
GEC in II and III semester
DSE subjects in II and III semester
Internship in III semester
Project and Viva voce in IV semester
NCC in I and II semester

TOTAL CREDIT DISTRIBUTION

S.NO	PART	COMPONENTS	TOTAL NUMBER OF SUBJECTS	MAXIMUM MARKS	TOTAL MARKS	CREDIT POINTS
		DSC Subjects	12	100	1200	56
1	PART - A	DSC Practical	4	100	400	11
		GEC Paper	2	100	200	04
		GEC Practical	2	100	200	04
		DSE	2	100	200	08
		Project & Viva voce	1	200	200	05
2	PART - B	Value Education	1	100	100	02
				Total	**2500**	**90**

DSC - Discipline Specific Course

GEC - Generic Elective Course

DSE - Discipline Specific Elective

AECC – Ability Enhancement Compulsory Course

NCC - Non- Credit Course

ACC - Additional Credit Coruse

21PBTM101	**DSC I: CELL BIOLOGY**	**SEMESTER – I**	
Objectives 1. To know about cell structure and functions and cell division. **2.** To understand the concept of genes and its inheritance.			
		Total Hours: 50	
UNIT	**CONTENTS**	**Hrs**	**CO**
Unit - I	Structure and function of prokaryotic and eukaryotic cell; Structure and organization of cell membrane – membranes model, Glyco-conjugates and proteins in membrane; Membrane dynamics- Active and passive transport; Cytoskeleton. Biogenesis of mitochondria and chloroplast, Structure and functions of cytoskeletal elements: Microtubules, microfilaments and intermediate filaments.	**10**	**CO1**
Unit - II	Structure and function of cell organelle: Mitochondria and Chloroplast- Molecular events of electron transport chain, ATP synthesis, photosynthesis and photorespiration, Endoplasmic reticulum, Golgi complex, lysosomes, peroxisomes.	**10**	**CO2**

Unit - III	Cytoskeleton - Structure and functions of cytoskeletal elements: Microtubules, microfilaments and intermediate filaments. Organization and role of microtubules and microfilaments; Cell shape and motility; Actin-binding proteins and their significance; Muscle organization and function; Molecular motors; Intermediate filaments	**10**	**CO3**
Unit - IV	The Cell Nucleus – Chromosomal DNA and packaging, Chromatin structure, genome evolution. Intracellular compartments - protein transport into mitochondria, chloroplast, peroxisome and endoplasmic reticulum. Intra cellular vesicular traffic, Cell signaling – types, Chemical signals and cellular receptors, G Protein-linked receptors, Pr ot e in Kinase-associated receptors, Growth factors as messengers.	**10**	**CO4**
Unit - V	Cell division-Mitosis, Meiosis, cell cycle control system, Cell death and renewal – Programmed cell death (Apoptosis), Necrosis and regulation. Oncogenes and Tumor Suppressor Genes - pRB and p53 tumor suppressor proteins.	**10**	**CO5**
REFERENCE BOOKS:			

1. *Gerald Karp.*, 2010. **Cell Biology**. [Sixth Edition]. John wiley and Sons (Asia) Pvt. Ltd.
2. *Sadava, D.E.,* 2004. **Cell Biology: Organelle Structure and Function.** Reprint, [First Edition]. Panima Publishing Corp., India.
3. *Geoffrey M. Cooper and Hausman, R.E.*, 2007. **The Cell - A Molecular Approach**. [Fourth Edition]. ASM Press, Washington, D.C.
4. *Lodish Berk, Kaiser Krieger, Scott Bretscher, Ploegh* and *Matsudair.* 2011. **Molecular cell Biology**. [Fifth Edition]. W. H. Freeman and Company, New York.
5. *Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts and Peter Walter.* 2007. **Molecular Biology of the Cell.** [Fourth Edition]. Garland Science, Taylor and Francis Group.

COURSE OUTCOMES:	
At the end of the course, the students will be able to	
CO1	Explain the biogenesis of cell organelles and cytoskeletal activities in cell
CO2	Differentiate the basic cellular organelles those constitute the cells
CO3	Demonstrate the cytoskeleton system and motility of the cell
CO4	Illustrate the nuclear ingredients and its arrangements
CO5	Explain the process of cell cycle and Cell death.

MAPPING

PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	M	M	M	M	M	H	M	H	H	M
CO2	M	M	M	M	M	H	M	H	H	M
CO3	M	M	M	M	M	H	M	H	M	M
CO4	M	M	M	M	M	M	M	H	H	M
CO5	M	M	M	M	M	H	M	H	M	M

H-High; M-Medium; L-Low

21PBTM102	**DSC II: MOLECULAR BIOLOGY**	**SEMESTER – I**	
OBJECTIVE: To know the molecular basis of cell and to obtain knowledge about various molecular mechanisms.			
		Total Hours: 50	
UNIT	**CONTENTS**	**Hrs**	**CO**
Unit - I	Molecular basis of life – an introduction. The structure of DNA and RNA. Chemical structure of nucleic acids- Nucleotides and Nucleosides, central dogma of molecular biology. Replication of DNA – Chemistry of DNA synthesis, Mechanisms of DNA polymerase, Replication fork, Initiation, elongation and termination of DNA replication.	**10**	**CO1**
Unit - II	The Mutability and repair of DNA. Replication errors and their repair, DNA Damage, Repair of DNA damage - DNA repair mechanism – Excision repair, recombination repair, and SOS repair. Recombination – Models for Homologous recombination and Holliday model, site-specific recombination and transposition.	**10**	**CO2**
Unit - III	Transcription – in prokaryotes – RNA polymerase and promoters. Transcription in Eukaryotes – RNA polymerase, promoters, enhancers and silencer. Mechanism of Transcription- initiation, elongation and termination. Post transcriptional modifications- capping, poly adenylation and splicing.	**10**	**CO3**

Unit - IV	Translation –Messenger RNA, Transfer RNA, Ribosome, Initiation, elongation and termination of translation. RNA splicing – Chemistry of RNA splicing, spliceosome machinery, splicing pathway, Alternative splicing, Exon shuffling, RNA editing, mRNA transport. Post translational modification, protein targeting to various cellular organelles.-The Genetic code, Wobble hypothesis.	**10**	**CO4**
Unit - V	Gene regulation – Eukaryotes –Activators, Transcriptional repressors - Prokaryotes – The operon concept: lac and trp. Transposons – types. Molecular chaperones. Molecular events in Lambda life cycle- The decision between lytic and lysogenic cycle.	**10**	**CO5**

REFERENCE BOOKS:

1. *Peter Snustad, D. and Michael J. Simmon*, 2000. **Principles of Genetics.** [Second Edition]. John Wiley and Sons Publication.
2. *Peter, J. Russell*, 1997. **Genetics.** [Fifth Edition]. Benjamin – Cummings Publishing Company.
3. *Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Anthony Bretscher, Hidde Ploegh, Paul Matsudaira*, 2007. **Molecular Cell Biology.** [Fifth Edition]. W.H. Freeman and Company. New York.
4. *Robert F. Weaver*, 1999. **Molecular Biology.** [First Edition]. Mc Graw Hill Publication Company, USA.
5. *Williams. S. Klug and Michael. R. Cummings*, 2004. **Concepts of Genetics**. [Seventh Edition]. Pearson Sons Education (Singapore) Pvt. Ltd., Indian Branch, Delhi.

COURSE OUTCOMES:	
At the end of the course, the students will be able to	
CO1	Become familiar with the concepts of central dogma of molecular concepts and structures of the genetic materials
CO2	Understand the mechanism behind the mutations and repair methods in cell
CO3	Get background of the transfer of genetic information from parent to daughter and their modification systems.
CO4	Get background of protein formations and modifications it taking for actions in cellular levels.
CO5	Develop knowledge about the genetic level changes for protein and enzyme functioning.

MAPPING

PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	M	M	M	M	M	H	M	H	M	H
CO2	M	M	M	M	M	H	M	H	M	H
CO3	M	M	H	M	M	H	M	H	M	H
CO4	M	M	M	M	M	H	M	H	M	H
CO5	M	M	M	M	M	H	M	H	M	H

H-High; M-Medium; L-Low

21PBTM103	**DSC III: PRINCIPLES OF MICROBIOLOGY**	**SEMESTER – I**	
OBJECTIVE: To know the molecular basis of cell and to obtain knowledge about various molecular mechanisms.			
		Total Hours: 50	
UNIT	**CONTENTS**	**Hrs**	**CO**
Unit - I	Origin and evolution of Microbiology: Contributions of Antony van Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner and Alexander Fleming. Microbial evolution – three Kingdom and five Kingdom concepts. Microbial Classification and Taxonomy, Taxonomic Ranks, Techniques in Taxonomy.	**10**	**CO1**
Unit - II	Microbial growth: Culture media – Complex and defined media – Nutrient media, differential media, selective media, enrichment media, minimal media. Sterilization: Types – physical and chemical methods. Aseptic techniques, Culture methods – Pure culture techniques – Streak plate and Spread Plate methods. Anaerobic culture techniques. Determination of generation time and growth curve.	**10**	**CO2**
Unit - III	Microscopy: Light Microscope - Bright Field, Dark field, phase contrast, fluorescent and confocal scanning laser. Electron Microscope – Transmission Electron Microscope, Scanning Electron Microscope, Sample preparation for electron microscopy. Stains and Staining reactions, Types of staining: Simple staining, Differential Staining - Gram's, Acid-fast, Endospore and Capsular staining. Microscopic measurement of microorganisms – Micrometry.	**10**	**CO3**

Unit - IV	Clinical significance of Microorganisms: Virulence factors of pathogens – Host-parasite interactions – Microbial pathogenicity, normal microflora and nosocomial infections in human. Antimicrobial chemotherapy – Antibiotics – Classification and mode of action. Antimicrobial susceptibility testing, Quality control in Microbiology	**10**	**CO4**
Unit - V	Classification of Archae bacteria, Eubacteria (including Cyanobacteria), Algae, Fungi and Viruses. Nature, special features of the thermophilic, methanogenic and halophilic Archaea; Culture Collection Centers and International Depository Authorities.	**10**	**CO5**

REFERENCE BOOKS:

1. *Prescott L.M., Harley, J.P. and Klein, D.A*. 2005. **Microbiology**. [Seventh Edition]. Tata McGraw Hill Publishing Company, USA.
2. *Ronald M. Atlas,* 1997. **Principles of Microbiology** [Second Edition]. McGraw hill Publication.
3. *Jacquelin Black*. 2000. **Microbiology: Principles and Explorations**. [Sixth Edition]. John Wiley & Sons publication.
4. *Salle, A.J.* 1986. **Principles of Bacteriology**. [Seventh Edition]. Tata McGraw-Hill Publishing Company Ltd., New Delhi.
5. *Anantha Narayanan, R. and Panikar, CKJ.* 2002. **Microbiology**. [Sixth Edition]. Orient Longman Pvt. Ltd., New Delhi.

COURSE OUTCOMES:	
At the end of the course, the students will be able to	
CO1	Demonstrate the origin, evolution & various contributors of microbiology.
CO2	To understand the basic concepts of microbiology and explain the microbial growth of culture media & differentiate the plating techniques.
CO3	apply the basic knowledge of microscopic types & various kinds of staining
CO4	Illustrate the clinical significance & antimicrobial activity of microorganisms.
CO5	Overview of the classification microbes &the culture collection centres.

MAPPING

PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	M	H	H	H	M	H	M	H	H	H
CO2	M	H	H	H	M	H	M	M	H	H
CO3	M	H	H	H	M	H	M	H	H	H
CO4	M	H	H	H	M	H	M	M	H	H
CO5	M	H	H	H	M	H	M	M	H	H

H-High; M-Medium; L-Low

21PBTM104	**DSC IV: BIOCHEMISTRY**	**SEMESTER – I**	
OBJECTIVE: To learn the fundamentals of Biomolecules and its function in living system			
		Total Hours: 50	
UNIT	**CONTENTS**	**Hrs**	**CO**
Unit - I	Biochemistry – Definition, Carbohydrates: – Definition and Classification – Monosaccharides, Disaccharides and Polysaccharides, structure and properties of Monosaccharides, Isomers, Epimers, Enantiomers and Anomers, structure, source and function of disaccharides and polysaccharides.	**10**	**CO1**
Unit - II	Amino acids: – Classification and structure, Proteins: - structure and classification, Lipids – classification, Nucleic acids – structure of nitrogenous bases, nucleotides and nucleosides.	10	**CO2**
Unit - III	Concepts of Metabolism, Catabolism: Glycolysis – reactions and energy yield of Glycolysis, Beta oxidation of Fatty acids, TCA cycle, Electron Transport Chain and Oxidative Phosphorylation. Anabolism: Gluconeogenesis, Cholesterol biosynthesis, De novo and Salvage pathway of Purine and Pyrimidine biosynthesis.	**10**	**CO3**
Unit - IV	Enzymes – Nomenclature, classification, properties, factors affecting enzyme activity- substrate concentration, temperature, and pH, Inhibition of enzyme activity – competitive, noncompetitive, and uncompetitive. Michaelis - Menten equation	**10**	**CO4**

Unit - V	Vitamins- Fat soluble and water soluble vitamins, Hormones - Definition, classification, biological functions and disorders of Pituitary hormone (Growth hormone), Thyroid hormone, Adrenal hormone (adrenaline), Pancreatic hormone (insulin).	**10**	**CO5**

REFERENCE BOOKS:

1. *Nelson D. L.,* and *Cox, M. M.,* 2008. **Lehninger Principles of Biochemistry.** [Fourth Edition]. W. H. Freeman and Company, New York.
2. *Champe, P. C.* and *Harvey, R. A.* 1994. **Biochemistry, Lippincott Illustrated Reviews.** [Second Edition]. Lippincott – Raven Publishers.
3. *Voet. D.* and *Voet, J.G.* 2011. **Biochemistry**. [Fourth Edition]. John Wiley & Sons (Asia) Pvt. Ltd.,
4. *Berg, J.M., John, L. T. and Stryer, L.* 2007. **Biochemistry**. [Sixth Edition]. W. H. Freeman and Company.
5. *Koolman, J. and Roehm, K. H.* 2005. **Color Atlas of Biochemistry**. [Second Edition]. Thieme Stuttgart, New York.

COURSE OUTCOMES:

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

CO1	Demonstrate he carbohydrates and its types.
CO2	know the classification of protein, lipids and nucleic acid
CO3	Explain the concept of metabolism.
CO4	Illustrate the structure, classification and activity of enzymes.
CO5	Describe the types and biological function of vitamins and hormones.

MAPPING

PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	M	H	M	H	H	M	M	M	H	H
CO2	M	H	M	H	H	M	H	M	H	H
CO3	M	H	M	H	H	M	H	M	H	H
CO4	M	H	M	H	H	M	M	M	H	H
CO5	M	H	M	H	H	M	H	M	M	H

H-High; M-Medium; L-Low

21PBTM105	**DSC V : DEVELOPMENTAL BIOLOGY**	**SEMESTER – I**	
OBJECTIVE: To learn the fundamentals of Developmental biology.			
		Total Hours: 50	
UNIT	**CONTENTS**	**Hrs**	**CO**
Unit - I	**Foundation of developmental Biology:** History of developmental biology, types of development, strategies in developmental biology, phase of animal development. Major molecular and cellular component of development: genes and proteins, and transcription factors and signal molecule.	**10**	**CO1**
Unit - II	**Basic mechanism of development: Cell division – molecular view, Morphogenetic movement – morphogenesis, cellular process, cell – cell adhesion, cell migration. Cell to cell interaction - induction, signal, competency, morphogens. Growth – mechanism, types, dynamic and factors. Differentiation: Potency, specification, differentiation.**	10	**CO2**
Unit - III	**Early phases of ontogenic development: Gametogenesis – maternal gene product, migration of germ cells, Spermatogenesis, Oogenesis – types of eggs, Fertilization – fertilization in sea urchin and mammals. Cleavage – cell division in cleavage, patterns of cleavage, cellular mechanisms in cleavage. Fate map, gastrulation and axis formation.**	10	**CO3**

Unit - IV	**Early development and organogenesis: Early development in fishes – development of zebra fish and early development in birds – development of chick, early development in mammals. Organogenesis in animals: formation of central nervous system. Development of pheripheral nervous system. Fate of neural crest cells – regions of neural crest – cranial and trunk neural crest. Organogenesis in plants: Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in *Arabidopsis* and *Antirrhinum***	**10**	**CO4**
Unit - V	**Sex determination and development: Sexual orientation, mechanisms of sex determination - chromosomal sex determination, sex determination in mammals and drosophila. Development of genital systems – early development of gonads, development of male and female genital ducts and glands. Development and evolution – developmental repatterning - heterochrony, heterotopy, heterometry and heterotypy. Origin of novelties, developmental constraints in evolution.**	**10**	**CO5**

REFERENCE BOOKS:

References

Text books:

Chattopadhyay S. An Introduction to Developmental Biology. Books and Allied (P) Ltd. Kolkata, 1st Edition, 2016.

COURSE OUTCOMES:	
At the end of the course, the students will be able to	
CO1	Explain historical perspective of Developmental biology.
CO2	Demonstrate the fundamentals of development biology.
CO3	Differentiate gametogenesis, fertilization and early development
CO4	Illustrate the Morphogenesis and organogenesis in animal.
CO5	Illustrate the Morphogenesis and organogenesis in animal.

MAPPING

PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	H	M	M	M	M	M	M	M	M	M
CO2	H	M	M	M	M	M	M	H	H	H
CO3	H	M	M	M	M	M	H	H	M	M
CO4	H	M	M	M	M	M	M	M	H	H
CO5	H	M	M	M	M	M	H	H	M	M

H-High; M-Medium; L-Low

21PBTMP101	**DSC I: Lab in Cell biology, Molecular biology, Genetics and Biochemistry**	**SEMESTER – I**

LIST OF EXPERIMENT

Cell biology, Microbiology, Genetics, Biochemistry and Bioinformatics

Lab in Cell biology, Genetics, Molecular biology, Microbiology and Biochemistry

OBJECTIVES

1. To understand basic concept about cell biology, genetics , Biochemistry

S NO	**Experiments**	**Total Hours: 50**	
1.	Micrometry-Measurement of Cell Size (Yeast, Bacteria)	**Hrs**	**CO1**
2.	Mitosis & Meiosis	**03**	
3.	Antimicrobial Susceptibility testing – Kirby-Bauer Diffusion Method	**03**	
4.	Enumeration and Isolation of bacteria from soil sample.	**03**	
5.	Determination of Growth Curve by turbidity method (temperatureoptimization)	**03**	**CO2**
6.	Biochemical test for identification of bacteria IMViC test Oxidase test Catalase test Triple Sugar Iron test	**03**	
7.	Extraction of Genomic DNA from bacteria	**03**	**CO3**
8.	Estimation of protein (Lowry's method)	**03**	
9.	Estimation of DNA (Diphenyl amine method)	**03**	
10.	Separation of protein by SDS PAGE.	**03**	**CO4**
11.	Extraction and estimation of starch from potato	**03**	
12.	Identification of amino acids by Thin-layer chromatography method	**03**	**CO5**
13.	Paper chromatography	**03**	
14.	Preparation of Buffer and calibration of pH meter	**03**	

REFERENCE BOOKS:

1. *Joseph Sambrook and David W. Russell*, 2001. **Molecular cloning – A laboratory manual Volume 1 to 3**. [Third Edition]. Cold Spring Harbor Laboratory Press, New York.
2. Aneja, K.R. 2003. **Experiments in Microbiology, Plant pathology and Biotechnology.** [Fourth Edition]. New age international.
3. *Cappucino, J.G and Sherman, N.* 2012. **Microbiology – A laboratory manual.** [Seventh Edition]. Pearson Education Inc.
4. *Andreas D Baxevanis* and *B F Francis.* 2002. **Bioinformatics- A Practical Guide to Analysis of Genes & Proteins**. John Wiley Publications.
5. *David W Mount. 2004*. **Bioinformatics: Sequence and Genome Analysis**. CSHL
6. *Harold Varley*. 1988. **Practical Biochemistry,** Volume I & II. [Fourth Edition]. CBS Publishers, New Delhi.
7. *Janarthanan,S. and Vincent,S.*2009. **Practical Biotechnology: Methods and Protocols.** [Second Edition]. Universities press, (India) Pvt Ltd, Hyderabad.

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COURSE OUTCOMES:	
At the end of the course, the students will be able to	
CO1	1.Observe the microscope and to calculate the size and number of the Bacteria Yeast. 2.Identify and interpret the different stages of mitosis & meiosis 3.Isolate the antibiotic sensitive and resistant bacteria by disc diffusion method **4.**Prepare media and isolate bacteria from the soil by serial dilution and spread plate method
CO2	1.Determine the growth rate of the bacteria by plotting a bacterial growth curve using turbidity method 2.Prepare media and characterize different types of microorganisms
CO3	1.Prepare a broth culture and genomic DNA isolate using AGE 2. Estimate the amount of protein in unknown sample **3.**Estimate the concentration of DNA from unknown sample using standard
CO4	1.Separate protein by polymerizing gel using PAGE 2.Extract a starch from the potato and estimate carbohydrate level
CO5	1.Prepare a silica gel plate and identifying ,separating amino acids 2.Separate protein in paper using electrophoresis 3.Calibrate and operate the pH meter by preparing a Na/K phosphate buffer.

MAPPING

PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	M	H	M	M	M	M	H	M
CO2	M	H	M	H	M	M	H	M	H	H
CO3	M	H	M	H	M	M	M	H	M	M
CO4	M	H	M	H	M	M	M	M	H	H
CO5	M	H	M	H	M	M	H	M	M	M

H-High; M-Medium; L-Low

21PLS101	NCC **I : CAREER COMPETENCY SKILLS**	**SEMESTER – I**	
OBJECTIVE: To know the molecular basis of cell and to obtain knowledge about various molecular mechanisms.			
		Total Hours: 15	
UNIT	**CONTENTS**	**Hrs**	**CO**
Unit - I	Solving Simultaneous Equations Faster - Number System: HCF, LCM – Decimals – Percentages- Averages	**03**	**CO1**
Unit - II	Powers and Roots -Problems on Trains- Problem on ages- Boats and Streams	**03**	**CO2**
Unit - III	Calendar-Clocks -Pipes and cisterns-Permutations and Combinations-Seating Arrangements	**03**	**CO3**
Unit - IV	Syllogism – Assertion and Reasons – Statements and Assumptions – Identifying Valid Inferences – Identifying strong arguments and weak arguments – Statements and Conclusions.	**03**	**CO4**
Unit - V	Reading comprehension – Self Introduction – News Paper Review – Book Review	**03**	**CO5**

21PBTM201	**DSC VI: IMMUNO TECHNOLOGY**	**SEMESTER – II**	
OBJECTIVE: To understand the basic principles of immunology and molecular mechanisms			
		Total Hours: 50	
UNIT	**CONTENTS**	**Hrs**	**CO**
Unit - I	History and scope of immunology, Immune response - types & mechanisms, haematopoiesis. Cells & Organs of immune system and their role in immunity. Antigens – Antigenicity & Immunogenicity, Haptens, Adjuvants, Epitope.	**10**	**CO1**
Unit - II	Immunoglobulins: Basic structure, classes and biological activities. Antigenic determinants on immunoglobulin. Organization and expression of immunoglobulin genes – variable gene rearrangements, mechanism of rearrangements. Generation of Antibody diversity. MHC organization and structure, Antigen Processing and presentation; Cytosolic and Endocytic pathway.	**12**	**CO2**
Unit - III	Complement proteins and pathways. Cell mediated immune response – T cell maturation, activation and differentiation, Cytokines; properties, types. Humoral immune response – B cell generation, activation & differentiation. Primary and Secondary humoral immune response.	10	**CO3**
Unit - IV	Hypersensitivity reactions, Immunodeficiency-Primary and Secondary immunodeficiency. Autoimmunity- Organ specific and Systemic autoimmunity. Transplantation- Immunological aspects of graft rejection Vaccines, types and vaccination.	**10**	**CO4**

Unit - V	Antigen – antibody interaction; Agglutination, Precipitation, Immuno electrophoresis, ELISA, Western blot, Immunofluorescence. Hybridism technology, FACs, HLA typing.	**08**	**CO5**

REFERENCE BOOKS:

1. *Kuby Richard. A. Goldsby, Thomas. J. Kint* and *Barbara. A. Osborne.* 2000. **Immunology** [Fourth Edition]. W.H. Freeman and Company, New York.
2. *Peter J. Delves, Seamus J. Martin, Dennis R. Burton and Ivan M. Roitt***.** 2006. **Roitt's Essential Immunology**. [Eleventh Edition]. Blackwell Publication.
3. *Tristram G. Parslow, Daniel P. Stites, Abba I.Terr and John B. Imboden*. 2001. **Medical Immunology.** [Tenth Edition]. Tata Mc Graw Hill Publication.
4. *Ian Tizard, K.* 1995. **Immunology: An Introduction.** [Fourth Edition] Saunders College Publication.
5. *Kalus D. Elgert,* 2009**. Immunology - Understanding the Immune System.** [Second Edition]. Wiley-Blackwell Publication.
6. *Kenneth Murphy, Paul Travers and Mark Walport,* 2008. **Janeway's Immunobiology. [**Seventh Edition]. Garland Science Taylor and Francis Group, New York.

COURSE OUTCOMES:	
At the end of the course, the students will be able to	
CO1	Describe the features of cells and tissues of the immune system. differentiate immunogens, antigens, haptens and adjuvants with respect to immunological functions.
CO2	Understand the developmental behaviors of B cells and study antigen and antibody interaction.
CO3	Able to draw the structure of immunoglobulin and apply the mechanism of biology of antigen processing and presentation.
CO4	Describe the injury and inflammation and the broad education necessary to understand AIDS. And understand the mechanism of immune responses with respect to transplantation and graft rejection.
CO5	Identify modern techniques to analyze tumor antigens and study autoimmune diseases. And to develop the monoclonal antibodies through hybridoma technology for humoral immunity.

MAPPING

PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	M	H	H	M	H	H	M	M
CO2	M	M	M	H	H	M	M	M	H	H
CO3	M	M	M	H	H	M	H	H	M	M
CO4	M	M	M	H	H	M	H	H	M	H
CO5	M	M	M	H	H	M	H	H	M	H

H-High; M-Medium; L-Low

21PBTM202	**DSC VII: BIOPROCESS TECHNOLOGY**	**SEMESTER – I**	
OBJECTIVE: To learn about the various bioprocess and engineering technology and to implement in Industries			
		Total Hours: 50	
UNIT	**CONTENTS**	**Hrs**	**CO**
Unit - I	Isolation of industrially important microbes. Primary and secondary screening and assay of fermentation products. Preservation of important strains. Improvement of the strain for increased yield and other desirable characters. An overview of aerobic and anaerobic fermentation process. Fermentation: Submerged and solid state fermentation and Immobilization	**10**	**CO1**
Unit - II	Medium for Industrial Fermentations: Medium formulation, Optimization, Growth kinetics. Thermal death kinetics, Batch and continuous sterilization system. Sterilization of air. Reactor engineering – Bioreactor configuration – Stirred tank, Air lift, Bubble column, Packed beds.	**10**	**CO2**
Unit - III	Mass transfer – Introduction to mass transfer between phases, Gas – liquid mass transfer in cellular system, liquid – solid mass transfer, liquid – liquid mass transfer. Oxygen transfer – introduction, Oxygen transfer process and oxygen uptake. Determination of oxygen transfer co-efficient. Biological heat transfer. Heat transfer co-efficient.	**10**	**CO3**

Unit - IV	Bioprocess control and monitoring: Methods of measuring process variables such as Temperature, Agitation, Pressure, pH and foam. Online measurement, Control system: Manual and automatic control, On/Off controls and PID Control. Computer application in Fermentation technology	**10**	**CO4**
Unit - V	Separation of microbial cells and suspended solids. Intracellular products recovery: Cell disruption – Physical and chemical method, Ultrafilteration, Centrifugation, Membrane process, Chromatography, Electrophoresis, Solvent extraction, Distillation, Crystallization, Evaporation and drying.	**10**	**CO5**

REFERENCE BOOKS:

1. *Stanbury. P.R and Whitaker,* 2002. **Principles of Fermentation Technology**. Elsevier Science Ltd.
2. *Pauline M. Doran*. 1995. **Bioprocess Engineering Principles**. Academic Press.
3. *Shuler M.L. and Kargi, F*. 2004. **Bioprocess Engineering: Basic Concepts.** [Second Edition] Prentice Hall. Pvt. Ltd., New Delhi.
4. *Crueger, W., Crueger, A*. 2002. **A Text Book of Industrial Microbiology**. [Second Edition]. Science Tech Publishers, USA.

5. Patel, A.H. 2005. **Industrial Microbiology.** [Fifth Edition]. Mac Millan India Ltd., New Delhi.

COURSE OUTCOMES:	
At the end of the course, the students will be able to	
CO1	Apply the basic knowledge of fermentation process.
CO2	Overview of the medium for Industrial fermentation & growth kinetics.
CO3	Demonstrate the different phases of mass transfer.
CO4	Illustrate the bioprocess control & monitoring.
CO5	Explain the separation of microbial cells from various techniques.

MAPPING

PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	M	H	H	H	H	M	M	M	M	H
CO2	M	H	H	H	H	M	M	H	M	H
CO3	M	H	H	H	H	M	M	H	M	H
CO4	M	H	H	H	H	H	M	M	M	H
CO5	M	H	H	H	H	H	M	M	M	H

H-High; M-Medium; L-Low

21PBTEL201	**DSE I: A) CELL COMMUNICATION AND CELL SIGNALING**	**SEMESTER – II**

OBJECTIVE:

1. To understand the basics about the Cell signaling and cell communication
2. To understand the basics about the pharmaceutical biotechnology

		Total Hours: 50	
UNIT	**CONTENTS**	**Hrs**	**CO**
Unit - I	**Host parasite interaction:** Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells, alteration of host cell behavior by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells.	**10**	**CO1**
Unit - II	**Cell signaling:** Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two component systems, light signaling in plants, bacterial chemotaxis and quorum sensing.	10	**CO2**
Unit - III	**Cellular communication:** Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.	10	**CO3**

-

Unit - IV	Toll-like receptors, Cytokines receptors, Leukocyte migration - Cell adhesion molecules, Neutrophil extravasation, Lymphocyte extravasation. Cell-mediated effector functions, immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections.	**10**	**CO4**
Unit - V	**Cancer:** Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.	**10**	**CO5**

REFERENCE BOOKS:

1. *Gerald Karp.*, 2010. **Cell Biology**. [Sixth Edition]. John wiley and Sons (Asia) Pvt. Ltd.
2. *Geoffrey M. Cooper and Hausman, R.E.*, 2007. **The Cell - A Molecular Approach**. [Fourth Edition]. ASM Press, Washington, D.C.
3. *Lodish Berk, Kaiser Krieger, Scott Bretscher, Ploegh* and *Matsudair.* 2011. **Molecular cell Biology**. [Fifth Edition]. W. H. Freeman and Company, New York.
4. *Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts and Peter Walter.* 2007. **Molecular Biology of the Cell.** [Fourth Edition]. Garland Science, Taylor and Francis Group.
5. *Kuby Richard. A. Goldsby, Thomas. J. Kint* and *Barbara. A. Osborne.* 2000. **Immunology** [Fourth Edition]. W.H. Freeman and Company, New York.
6. *Kalus D. Elgert,* 2009**. Immunology - Understanding the Immune System.** [Second Edition]. Wiley-Blackwell Publication.
7. *Kenneth Murphy, Paul Travers and Mark Walport,* 2008. **Janeway's Immunobiology. [**7 Edition]. Garland Science Taylor and Francis Group, New York.

COURSE OUTCOMES:	
At the end of the course, the students will be able to	
CO1	Apply the basic knowledge of Host parasite interaction.
CO2	Overview the cell signaling and pathway involved in plant, animal and bacterial system.
CO3	Demonstrate the different cellular communication.
CO4	Illustrate the bioprocess control & monitoring.
CO5	Explain the various responses and receptor involved in immune system

MAPPING

PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	H	M	M	H	M	M	M	M	H	H
CO2	H	M	M	H	H	M	M	M	H	H
CO3	H	M	M	H	M	M	H	H	M	M
CO4	H	M	M	H	L	M	M	M	H	H
CO5	H	M	M	H	M	M	H	H	M	M

H-High; M-Medium; L-Low

<table>
<tr><td>21PBTEL202</td><td colspan="2">ELECTIVE I: B) BIOINSTRUMENTATION AND BIOINFORMATICS</td><td>SEMESTER – II</td></tr>
<tr><td colspan="4">OBJECTIVE:
1. To understand the basic concept and analytical techniques in Bioinstrumentation.
2. To understand the basics in Bioinformatics</td></tr>
<tr><td rowspan="2">UNIT</td><td rowspan="2">CONTENTS</td><td colspan="2">Total Hours: 50</td></tr>
<tr><td>Hrs</td><td>CO</td></tr>
<tr><td>Unit - I</td><td>Introduction to Bioinstrumentation, care and maintenance of Weighing Balance, Incubators, Hot plate, Magnetic stirrer, Hot air oven, Laminar airflow and pH meter. Centrifugation Methods - Sedimentation, Centrifugation – rotor, motor, types of centrifuges- low and high speed, ultra-centrifuges, Types of centrifugation – Analytical and Preparative.</td><td>10</td><td>CO1</td></tr>
<tr><td>Unit - II</td><td>Principles, Techniques and applications of Paper, Gel, SDS PAGE Electrophoresis, Isoelectric focusing, Immuno-electrophoresis, Capillary electrophoresis. Separation Techniques - Principles, Techniques and applications of Paper Chromatography, TLC, GLC, Ion exchange Chromatography, Gel Permeation Chromatography, Affinity Chromatography,</td><td>10</td><td>CO2</td></tr>
<tr><td>Unit - III</td><td>Beer Lambert’s law - Principles, Techniques and biological applications of Colorimeter, UV – VIS Spectroscopy, IR And Raman Spectroscopy, Atomic Absorption Spectroscopy, Flame Photometry, Spectrofluorometer.</td><td>10</td><td>CO3</td></tr>
</table>

Unit - IV	Bioinformatics – Basics, Applications. Biological Database – Classification, scheme, GENBANK, SwissProt and PDB. Sequence Alignment – Concept of Alignment, Pairwise Alignment: Principle, methods and Alignment with BLAST.	**10**	**CO4**
Unit - V	Gene Prediction – Overview, Prokaryotic features for gene prediction, prediction with GENSCAN. Molecular Phylogeny – Molecular Clock Hypothesis, Neighbour Joining method, mechanism and representation of Phylogeny, tree types.	**10**	**CO5**

REFERENCE BOOKS:

1. *Boyer.R.F.* 1993. **Modern Experiments in Biochemistry**. [Second Edition]. Benjamin/ Cummings Publishing Company, Red wood City, California.
2. *Upadhyay*, 2005. **Biophysical Chemistry**, Himalaya Publications.
3. Wilson. K. and Walker. 2003, **Practical Biochemistry**. [First Edition]. Cambridge University Press.
4. *David, J.H. and Hazel Peck.* 1998. **Analytical Biochemistry**. [Third Edition]. Prentice Hall an Imprint of Pearson Education.
5. *Zhumur Gosh and Bibekanand Mallick. 2008.* **Bioinformatics Principles and Applications.** Oxford University Press.
6. *David W. Mount.* 2004. **Bioinformatics: Sequence and Genome Analysis**. Cold Spring Harbor laboratory.
7. *Rickwood D & Hames B D.* **Gel electrophoresisi of Nucleic acids**
8. *Donald pavia ,Gory M Lipmas & George S Kriz.* **Introduction to spectroscopy**

COURSE OUTCOMES:	
At the end of the course, the students will be able to	
CO1	Maintain the instruments with care and know the working principles of each basic laboratory instruments
CO2	Gain knowledge about the separation process using electrophoresis and chromatographic techniques.
CO3	Handle the instruments and measure OD value, Absorbance and concentration of specific constituents present in the unknown sample.
CO4	Intrepret the biological data in computational methods & tools for solving research problems easily
CO5	Predict the gene structure and also construct phylogenetic tree for studying the similarity and evolutionary relationship within the organism

MAPPING

PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	M	H	M	H	H	M	H	M	H	H
CO2	M	H	M	H	H	M	H	M	M	H
CO3	M	H	M	M	H	M	H	M	M	H
CO4	M	H	M	M	H	M	H	M	H	H
CO5	M	H	M	M	H	M	H	M	H	M

H-High; M-Medium; L-Low

21PBTMP201	DSC PRACTICAL II LAB IN BIOPROCESS TECHNOLOGY AND IMMUNOLOGY	SEMESTER – II	
OBJECTIVE: **Lab in Bioprocess Technology and Immunology**			
UNIT	**CONTENTS**	**Total Hours: 50**	
		Hrs	**CO**
1.	Enzyme production using fermenter (Amylase/ Protease)	**03**	**CO1**
2.	Cell disruption	**03**	
3.	Purification of protein by ammonium sulphate precipitation and Salting-out by Dialysis method	**03**	
4.	Estimation of protein by Lowry.	**03**	**CO2**
5.	SDS – PAGE	**03**	
6.	Wine production using and estimation of alcohol by potassium dichromate method	**03**	**CO3**
7.	ABO grouping	**03**	
8.	WIDAL Test (Slide and Tube methods)	**03**	**CO4**
9.	Antigen-Antibody interaction Ouchterlony Double Diffusion Radial Immunodiffusion Immunoelectrophoresis Rocket Immunoelectrophoresis CounterCurrent Immunoelectrophoresis	**03**	**CO5**
10.	Enzyme Linked Immunosorbent Assay (ELISA)	**03**	

REFERENCE BOOKS:

1. *Joseph Sambrook and David W. Russell*, 2001. **Molecular cloning – A laboratory manual Volume 1 to 3**. [Third Edition]. Cold Spring Harbor Laboratory Press, New York.

2. Aneja, K.R. 2003. **Experiments in Microbiology, Plant pathology and Biotechnology.** [Fourth Edition]. New age international.

3. *Cappucino, J.G and Sherman, N.* 2012. **Microbiology – A laboratory manual.** [Seventh Edition]. Pearson Education Inc.

4. *Ramnik Sood*. 2006. **Medical Laboratory Technology**. Jaypee Brothers Medical Publishers Ltd., New Delhi.

5. *Janarthanan,S. and Vincent,S.*2009. **Practical Biotechnology: Methods and Protocols.** [Second Edition]. Universities press, (India) Pvt Ltd, Hyderabad.

6. Dr. S. Rajan & R.. Selvi Crhisty, 2015. Experemental procedures in Life sciences, First edition. Anjanaa Book house, Koyempedu, Chennai.

21PBCBTI201	**GEC I: DIAGNOSTIC BIOCHEMISTRY**	**SEMESTER – II**

OBJECTIVE:

To enable the students to develop practical and interpretative skills to contribute effectively in diagnostic haematology and clinical biochemistry

UNIT	**CONTENTS**	**Total Hours: 40**	
		Hrs	**CO**
Unit - I	**Clinical Laboratory:** Introduction, types and set-up. Basic laboratory safety, hazards in the clinical laboratory, safety with chemical/reagents, first aid in laboratory accidents. SI units. Universal work precautions for lab personnels. Medical laboratories in the developing countries Fundamental chemistry - Indicators, solutes, solvents and solutions. Percentage, molar and normal solution with simple biochemical calculations.	**08**	**CO1**
Unit - II	**Clinical Haematology:** Ways of obtaining blood, Anticoagulants, Blood collection system, estimation of haemoglobin- Sahli's and Cyanmethaemoglobin method, packed cell volume and erythrocyte sedimentation rate, blood cell counts – WBC and RBC. Blood film examination, stain preparation and staining, rapid diagnostics – automation in haematology, bleeding time, clotting time.	**08**	**CO2**

Unit - III	**Urine analysis and Stool examination:** Physicochemical characteristics of urine, preservation of specimen, gross examination of urine and chemical examination of urine- mechanism of proteinuria, micro albuminuria, tests for glucose, ketone bodies, bile salts, bile pigments. Hereditary of carbohydrate metabolism. Stool examination – Specimen collection, test for occult blood, preparation and sample collection, microscopic examination of stool.	**08**	**CO3**
Unit - IV	**Clinical Chemistry and Enzymology:** Diabetes Mellitus - Introduction, screening tests, diagnostic tests, insulin tolerance test. Estimation of glucose in blood, GTT, glycosylated haemoglobin. Cardiovascular disease - Estimation of cholesterol, urea, creatinine and protein. Enzymology - Alkaline and acid phosphatase	**08**	**CO4**
Unit - V	**Organ function tests:** Liver function test: Tests based on abnormalities of bile pigments, classification of jaundice. Renal Function: function of the kidney, dilution test, phenol red test, clearance test, principles of precise tests of renal function – Glomerular filtration rate, renal plasma flow and maximal tubular capacity.	**08**	**CO5**

REFERENCE BOOKS:

TEXT BOOKS:

1. *Ramnik Sood.* 2006. **Medical Laboratory Technology.** [First Edition]. Jaypee Brother's Medical Publishers Ltd., New Delhi.
2. *Kanai L. Mukherjee.* 2005. **Medical Laboratory Technology, Volume I.** Tata McGraw- Hill Publishing Co. New Delhi.

COURSE OUTCOMES:

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

CO1	Practice the safe laboratory process and reagent preparation
CO2	Explain the general concepts of specimens handling methods and analysis of blood cells and clinical labs.
CO3	Recite the handling and analytical procedures of urines and stool samples.
CO4	Describe the general concepts and methods in diagnosis of clinical disorders
CO5	Perform various laboratory procedures to assess the functional status of the organs

MAPPING

PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	H	H	H	H	H	H	M	M
CO2	M	M	H	H	H	H	H	M	M	M
CO3	M	M	H	H	H	M	M	M	L	H
CO4	M	M	H	H	H	M	M	M	L	H
CO5	M	M	H	H	H	H	H	H	H	H

H-High; M-Medium; L-Low

21PBCBTIP201	GEC PRACTICAL I: DIAGNOSTIC BIOCHEMISTRY		SEMESTER – II
Course Objectives: **The Course aims** • To enable the students to develop practical knowledge in handling and testing the biological samples			
			Total Hours: 24
S.No.	**EXPERIMENT**	**Hrs**	**CO**
I. Clinical haematology			
1.	Enumeration of WBC and RBC	3	1
2.	Estimation of haemoglobin (Sahli's method)	3	1
3.	Erythrocyte sedimentation rate (Westergren's method)	3	1
II. Blood analysis			
4.	Estimation of glucose in blood (Nelson Somogyi's method).	3	2
5.	Estimation of urea in blood (DAM method).	3	2
6.	Estimation of creatinine in blood (Jaffe's method).	3	2
III. Urine analysis			
7.	Estimation of creatinine in urine (Jaffe's method).	3	2
8.	Qualitative analysis of normal and abnormal constituents in urine	3	3
Reference Books:			
1 .	*Harold Varley*. 1980. **Practical Biochemistry.Volume I & II.** [Fifth Edition]. CBS Publishers, New Delhi		

21PMBBTI201	GEC I : FUNDAMENTALS OF CLINICAL MICROBIOLOGY	SEMESTER – II

OBJECTIVES:

To familiarize the students with:

1. Basics in Microbiology
2. Basics in Microbial techniques.

UNIT	CONTENTS	Total Hours: 50	
		Hrs	CO
Unit - I	Definition and scope of Microbiology – Sterilization – Principles – dry heat and moist heat – radiation – filtration – chemical agents. Antibiotics – Mode of Action - Penicillin.	**10**	**CO1**
Unit - II	Media preparation – Liquid media, solid media, enriched media and differential medium. Pure culture techniques – Pour Plate, Streak Plate and Spread Plate techniques. Staining techniques – Gram's, Ziehl- Neelsen, Spore and Capsule staining.	**10**	**CO2**
Unit - III	Collection, transportation and processing of clinical specimens. Host parasite relationship – Normal flora. Morphology, culture, biochemical, pathogenicity, lab diagnosis and control of *Staphylococcus aureus* and *Escherichia coli*.	**10**	**CO3**
Unit - IV	General characteristic features of Fungi. Epidemiology, pathogenicity, lab diagnosis and treatment of Candidosis. General characteristic features of Protozoa. Pathogenicity, clinical manifestation and diagnosis of *Entamoeba histolytica*.	**10**	**CO4**

Unit - V	General characteristic features of viruses, cultivation of viruses. Properties, pathogenicity, diagnosis and treatment of Hepatitis virus A and B.	**10**	**CO5**

REFERENCE BOOKS:

TEXT BOOKS:

1. *Ananthanarayan, R. and Jayaram Paniker, C.K.* 2007. **Text Book of Microbiology**. [Seventh Edition]. Orient Longman Ltd., Chennai.
2. *Lansing M Prescott, John P Harley and Donald A Klein.* 2007. **Microbiology**. [Seventh Edition]. Mc Graw Hill, New York.

REFERENCE BOOKS:

1. *Madigan, M.T., Martinko, J.M. and Parker, J.* 2000. **Brock Biology of Microorganisms**. [Twelfth Edition]. Pearson Benjamin Cummings, San Francisco, USA.
2. *Mackie and McCarthy* 1994. **Medical Microbiology.** [Fortieth Edition]. Churchill Livingstone, New York.

Mapping

PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	H	M	M	M	H	M	M
CO2	M	H	H	H	M	M	M	H	M	M
CO3	M	M	H	H	H	H	H	H	M	H
CO4	M	M	H	H	H	M	M	M	M	H
CO5	H	H	H	H	H	H	H	H	H	H

H-High; M-Medium; L-Low

21PMBBTIP201	GEC PRACTICAL I: CLINICAL MICROBIOLOGY	SEMESTER – II

OBJECTIVE:

To know the molecular basis of cell and to obtain knowledge about various molecular mechanisms.

S No	CONTENTS	Total Hours: 50	
		Hrs	CO
1.	1. Staining techniques - Preparation of Stains.	**03**	**CO1**
2.	2. Smear preparation - Heat fixation - Simple staining procedure.	**03**	
3.	3. Differential staining procedure - Gram's staining.	**03**	**CO2**
4.	4. Determination of motility - Hanging drop method.	**03**	
5.	5. Preparation of Enriched media-Blood agar. Selective media –EMB agar.	**03**	**CO3**
6.	6. Differential media- Mac Conkey agar.	**03**	
7.	7. Pure culture technique: Pour plate method.	**03**	**CO4**
8.	8. Spread plate method.	**03**	
9.	9. Streak plate method – Single line, Quadrant, T-streak, Continuous.	**03**	**CO5**
10.	10. Identification of pathogenic organisms – *E. coli* and *S. aureus.*	**03**	

REFERENCE BOOKS:

James G. Cappucino and Sherman Natalie 2005. Microbiology – A Laboratory manual. [Seventh edition]. Pearson education India, New Delhi.

21PVE201	**VALUE EDUCATION: HUMAN RIGHTS**	**SEMESTER – II**	
OBJECTIVE: 1. To make the students to understand the concepts of human rights.			
UNIT	**CONTENTS**	**Total Hours: 50**	
		Hrs	**CO**
Unit - I	Human Rights: Definition - Historical Evolution - Classification of Rights - Universal Declaration of Human Rights - International Covenants on Economic and Social Rights - Constitutional Provision for Human Rights – Fundamental Rights - Directive Principles of the State Policy – Indian Constitutions	**10**	**CO1**
Unit - II	Civil and Political Rights: Right to Work – Right to Personal Freedom – Right to Freedom of Expression - Right to Property - Right to Education - Right to Equality - Right to Religion - Right to Form Associations and Unions - Right to Movement – Right to Family – Right to Contract – Right to Constitutional Remedies – Right to Vote and Contest in Elections – Right to Hold Public Offices – Right to Petition – Right to Information – Right to Criticise the Government – Right to Democratic Governance.	10	**CO2**
Unit - III	Women's Rights: Right to Inheritance – Right to Marriage – Divorce and Remarry – Right to Adoption – Right to Education – Right to Employment and Career Advancement – Rights Relating to Dowry – Right for Equality – Right for Safe Working Conditions – Children's Rights – Right to Protection and Care – Right to Education – Issues Related with Infanticide – Street Children – Child Labour – Bonded Labour – Refugees Rights – Minority Rights – Dalit Rights – Tribal Rights – Nomads Rights.	10	**CO3**

Unit - IV	Economic Rights: Right to Work – Right to Adequate Wages – Right to Reasonable Hours of Work – Right to Fair Working Conditions – Right to Self Government in Industry – Customer Rights – Social and Cultural Rights – Right to Life - Right to Clean Environments	10	CO4
Unit - V	Human Rights Violation: International, National, Regional Level Organizations to Protect Human Rights – UNO – National Commission for Human Rights – State Commissions – Non Governmental Organizations and Human Rights – Amnesty Terrorism and Human Rights – Emergency and Human Rights – Judiciary and Human Rights – Media and Human Rights - Police and Human Rights.	10	CO5

REFERENCE BOOKS:
Paul Singh. **Human Rights and Legal System.** Himalaya Publishing House, New Delhi..

21PLS201	**CAREER COMPETENCY SKILLS II**	**SEMESTER – II**	
OBJECTIVE: To enhance employability skills and to develop career competency			
UNIT	**CONTENTS**	**Total Hours: 50**	
		Hrs	**CO**
Unit - I	Assertiveness and Self Confidence-Career Opportunities-Industry expectations (Skill set)	**03**	**CO1**
Unit - II	Campus to Corporate-Effective Communication	**03**	**CO2**
Unit - III	Situational Dialogues / Role Play (Telephonic Skills) - Oral Presentations- Prepared -'Just A Minute' Sessions (JAM)	**03**	**CO3**
Unit IV	Body Language-Dress code-Telephone etiquettes-Email etiquettes-Group Discussion-Creativity-Presentation skills	**03**	**CO4**
Unit V	Interviewing Techniques- Do's and Don'ts of Interview- Mock Interview.	**03**	**CO5**

21PBTM301	DSC VIII: PLANT AND ANIMAL TISSUE CULTURE TECHNOLOGY	SEMESTER – III	
OBJECTIVE: To learn the technique in plant tissue culture and animal cell culture.			
UNIT	**CONTENTS**	**Total Hours: 50**	
		Hrs	**CO**
Unit - I	Architecture of Plants – tissues and organs, Plant response to abiotic stress (Flood, drought and high salinity) and biotic stress (insect), absorption and transportation of water and nutrients by the plants, Transpiration, Seed storage proteins.	**10**	**CO1**
Unit - II	Principles of plant tissue culture, PTC laboratory organization, Plant tissue culture media, sterilization of Explant Callus and suspension culture, Micropropagation, Somaclonal variation, Somatic embryogenesis, Haploid plant production, Isolation and culture of protoplast, Somatic hybridization and Cybridization, Viral free plant production – Meristem culture, Hardening.	**10**	**CO2**
Unit - III	Biosynthesis of Alkaloids, flavanoids, anthocyanins, phenols and their medical applications. Physiological effects and mechanism of action of the auxins, cytokinins, gibberllins and abscissic acid. Biosynthesis and function of ethylene.	**10**	**CO3**

Unit - IV	An Introduction about animal cell culture, Planning and Construction of Lab layout, Equipments - Laminar-flow hood, CO2 Incubators, Inverted microscope, Cryostorage containers, Aseptic concepts and Cell culture vessel. Preparation of Media- defined media and supplements, Types of cell culture media; Physical and chemical property of Medium, Balanced salts, Antibiotics, growth supplements; Fetal bovine serum; Serum free media. Biosafety Cabinet and Biosafety levels.	**12**	**CO4**
Unit - V	Primary culture – Isolation of tissues and disaggregation methods, Subculture and Cell lines. Types of primary culture; separation; Continuous cell lines; Suspension culture; Application of Animal cell culture.	**08**	**CO5**

REFERENCE BOOKS:

Bhojwani, S.S. and Razdan, M.K. 2008. **Plant Tissue Culture – Theory and Practice**. Elsevier Publishers, New Delhi.

2. *Chawla, H.S*. 1998. **Biotechnology in Crop Improvement**. International Book Distribution Co., New Delhi.
3. *Slater, A., Scott, N. and Fowler. M.* 2008. **Plant Biotechnology – The Genetic Manipulation of Plants.** [Second Edition]. Oxford Publications, Oxford, UK.
4. *Hopkins, W.G., and Hiiner, N.P.A*. 2004. **Introduction to Plant Physiology**. [Third Edition]. John Wiley and Sons, New Jersey, USA.
5. *Jain, V.K.* 2013. **Fundamentals of Plant Physiology**. [Fifth Edition]. S. Chand and Company, NewYork.

6 Trivedi, P.C. 2004. **Advances in Plant Physiology**. [Third Edition]. I.K. International

Publications Pvt Ltd, New Delhi.

7. *Freshney, R.I.,* 2005. **Culture of Animal Aells: A Manual of Basic Technique.** [Fifth Edition]. John Wiley and Sons , New Jersey.

COURSE OUTCOMES:	
At the end of the course, the students will be able to	
CO1	Know the details about the growth strategies in plants
CO2	Understand the concepts of developing artificial techniques to grow plants
CO3	Get knowledge about the biomedical applications of plant components
CO4	Know the details of the animal cell culturing
CO5	Understand the methods of developing artificial animal cell cultures in laboratory

Mapping

PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	M	H	H	H	H	H	M	H	H	H
CO2	M	H	H	H	H	H	H	H	M	H
CO3	M	H	H	H	H	H	H	M	H	H
CO4	M	H	H	H	H	H	H	M	M	H
CO5	M	H	H	H	M	H	H	M	M	H

H-High; M-Medium; L-Low

21PBTM302	CORE IX: RESEARCH METHODOLOGY, BIOETHICS & IPR	SEMESTER III

Course objectives

- To achieve competence and proficiency in the theory of and practice of research.
- To offer basic knowledge of ethical issues in medicine, health and the life sciences.
- To introduce fundamental aspects of Intellectual property rights.

Credit: 02 **Total Hours: 30**

UNIT	CONTENTS	Hrs	CO
I	**Research** – Meaning and objectives of research. Types of research – Basic and applied research. Essential steps in research. Experimental designs- Hypothesis and Null-hypothesis, Basic principle of experiment. Experimental unit and sampling unit, Experimental error, Replication, Generalization, Controls, Randomization, Measurements. Few common experimental designs.	06	CO1
II	**Research Problem Identification & Formulation:** Defining and formulating the research problem, Selecting the problem. Literature collection – Need of literature review, Review and bibliography.	06	CO2
III	**Literature citation** – Formulation of research objectives and their importance, Computer and its role in research. Report writing and scholarly publishing. Research report – components of research report, Research report – Tables and Figures. Research report – Formatting and typing. Format of thesis.	06	CO3
IV	**Bioethics in Research:** Ethics-ethical issues, ethical committees (Human & Animal). Ethical issues in clinical research. Ethical issues related to Publishing, Authorship, Plagiarism and Self-Plagiarism. Contemporary issues in	06	CO4

	research ethics.		
V	**Intellectual Property Rights (IPR):** Introduction to IPR, Patentable life science process and products, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design. Procedure for IPR registration, the effect of registration and term of protection. Govt of India's National IPR Policy and Career opportunities in IPR.	**06**	**CO5**

Reference/Text Books

1) Kumar, R. (2011). **Research Methodology: a step-by-step guide for beginners (3rd edition)**. London, UK: TJ International Ltd, Padstow, Corwall.
2) Gurumani, N. (2017). **Research methodology for biological sciences**. MJP Publishers, Chennai.
3) Kothari, C.R. (2019). **Research Methodology: Methods and Techniques**. 4th Edition, New Age International Publishers, New Delhi.
4) Fink, A., 2009. **Conducting Research Literature Reviews: From the Internet to Paper**. Sage Publications
5) Satheesh, M. K. 2011. **Bioethics and Biosafety**. I.K. International, New Delhi.
6) Nithyananda, K V. (2019). **Intellectual Property Rights: Protection and Management**. India, IN: Cengage Learning India Private Limited.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Can learn the fundamental details of research and will have knowledge on how to design a research work
CO2	Will understand what is a research problem, how to identify the research gap and how to formulate a hypothesis and objectives of the research
CO3	Could gain knowledge on how to interpret the research data, how to write a research report and how to publish a research paper
CO4	Might acquire fundamental knowledge of various bioethics in research
CO5	Can create awareness for students on intellectual property rights and their by-laws

Mapping

PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	H	H	H	M	H	H	H
CO2	H	H	H	H	H	H	M	M	H	H
CO3	H	H	H	H	H	H	H	H	H	H
CO4	M	H	H	H	M	H	H	M	H	H
CO5	M	H	H	H	M	H	H	M	M	H

H-High; M-Medium; L-Low

21PBTM303	DSC X: BIOSTATISTICS	SEMESTER – III	
OBJECTIVE: • To familiarize the application of biostatistics in biology. • To know about the research concepts. • To learn the strategies of research field and also to provide knowledge to understand the role of statistics in research			
UNIT	**CONTENTS**	**Total Hours: 50**	
		Hrs	**CO**
Unit - I	**Statistics:** Introduction – Definition of Statistics – Functions of Statistics – Applications and Limitations of Statistics. **Collection of data**: Primary and Secondary data – Methods of collecting primary data – Sources of secondary data. **Classification and Tabulation of data**: Types of classification – Tabulation of data – Parts of a table - Types of tables. **Diagrammatic and Graphical Representation:** Types of diagrams – Graphs – Graphs of frequency distributions.	**10**	**CO1**
Unit - II	**Measures of Central Tendency:** Arithmetic Mean (except weighted mean and corrected values) – Median – Mode – Merits and demerits – Geometric mean - Harmonic Mean.	**10**	**CO2**
Unit - III	**Measures of Dispersion:** Range – Quartile deviation – Standard deviation – Coefficient of variation.	**10**	**CO3**

Unit - IV	**Correlation Analysis:** Types of correlation – Methods of Correlation - Karl Pearson's Coefficient – Rank correlation coefficient. **Regression Analysis:** Regression lines (except graphing) – Regression equations.	**10**	**CO4**
Unit - V	**Test of Hypothesis:** Population – Sample – Procedure of testing hypothesis – Types of errors – Standard error - t test – Chi-square test of independence of attributes. **Analysis of Variance:** One way classification – Two way classification.	**10**	**CO5**

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-REFERENCE BOOKS:

TEXT BOOK:

1. **S.P.Gupta**, 2008. **STATISTICAL METHODS**,[Thirty Seventh Edition] S. Chand and Company Ltd., New Delhi.

REFERENCE BOOKS:

1. **Sancheti,D,C and Kapoor V.K** 2005. **STATISTICS**.[Seventh Editions]. S, Chand And Company limited, New Delhi.

Course Outcomes (CO)

After completion of the course, the students will be able to

CO 1	Learn the importance of statistics
CO 2	Understand the concepts of measures of central tendency
CO 3	Know the concepts of measures of dispersion
CO 4	Gain knowledge on correlation and regression analyses
CO 5	Test the samples using testing of hypothesis

MAPPING

PO/PSO / CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	L	L	M	M	M	L	M	L	H	H
CO 2	M	M	M	M	H	L	M	L	M	M
CO 3	M	M	M	M	H	L	M	M	H	H
CO 4	M	M	H	M	H	L	M	M	H	H
CO 5	M	M	H	M	H	L	M	L	H	H

H-High; M-Medium; L-Low

21PBTM304	**DSC XI: GENETIC ENGINEERING**	**SEMESTER – III**	
OBJECTIVE: To know about the advances in rDNA technology and its importance in various fields.			
UNIT	**CONTENTS**	**Total Hours: 50**	
		Hrs	**CO**
Unit - I	History and scope of genetic engineering. Enzymes in Genetic engineering – DNA modifying enzymes – i) Restriction enzymes, ii) DNA polymerase – Klenow, DNA polymerase I, T4 DNA Polymerase, iii) Reverse transcriptase, iv) Terminal transferase, v) T4 polynucleotide kinases, vi) Alkaline phosphatase, vii) DNA ligase, viii) Nucleases –Bal 31, S1 nucleases, DNase I, Mungbean nucleases, Ribonucleases, EXO III, RNA polymerase, Thermostable enzymes.	**10**	**CO1**
Unit - II	Bacterial vectors- pBR322 and pUC vectors. Phage vectors – Lambda, M13, Cosmid and Phagemid, Artificial chromosomes – YAC, BAC, PAC and HAC, Expression vectors and Shuttle vectors. Host cell types and transformation.	10	**CO2**
Unit - III	Cloning strategies – Gene library construction – Genomic and cDNA libraries. DNA cloning – Homopolymer tailing and use of adapters and linkers. Screening and analysis of recombinants – radiolabeled and non-radiolabeled probes. Blotting techniques-Southern/Northern/Western. Immunological screening of expressed genes.	10	**CO3**

Unit - IV	Expression strategies - Gene Expression in *E. coli, Saccharomyces cerevisiae, Schizosaccharomyces,* Expression in insect cells, higher eukaryotic system – Tet On/Off systems, Phage display and Meta Genomics.	**10**	**CO4**
Unit - V	DNA sequencing – Chemical, enzymatic and automated DNA sequencing. Microarrays – Principles and applications. PCR – Principle, types and applications, Site directed mutagenesis and Protein engineering. Gene therapy, Gene knockout technologies. Next Generation Sequencing.	**10**	**CO5**

REFERENCE BOOKS:

1. *Primrose S.B and Twyman, R.M.* 2006. **Principles of Gene Manipulation and Genomics**. [Seventh Edition]. Blackwell Publishing Co., USA.
2. *Ernst-L.Winnacker.* 2003. **From Genes to Clones**. Panima Publishing Co., Bangalore.
3. *Reece, R.J.* 2004. **Analysis of Genes and Genomes**. John Wiley and Sons Ltd., USA.
4. *Brown, T.A* .2007. **Genomes**. [Third Edition]. Garland Science, USA.
5. *Joseph Sambrook and David W. Russell*, 2001. **Molecular cloning – A laboratory manual Volume 1 to 3**. [Third Edition]. Cold Spring Harbor Laboratory Press, New York.
6. *James D. Watson, Richard M. Myers, Amy A. Caudy, Jan A. Witkowski*. 2006. **Recombinant DNA.** [Third Edition]. W.H Freeman & Company, New York.
7. *Micklos, D.A., Freyer, G.A. and Crotty, D.A*. 2003. **DNA science**. [Second Edition]. Cold Spring Harbor Laboratory Press, New York.
8. *Satheesh, M.K.* 2011. **Bioethics and Biosafety**. I.K. International, New Delhi.

COURSE OUTCOMES:	
At the end of the course, the students will be able to	
CO1	Know the types of enzymes used in genetic engineering.
CO2	Demonstrate the types of vectors used in genetic engineering and different strains used.
CO3	Explain about the construction of gene libraries and screen the recombinants
CO4	Apply the various strategies involved in gene cloning
CO5	Apply their knowledge in the genetic engineering application

Mapping

PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	H	M	H	H	M	H	M	H	H	H
CO2	H	M	H	H	H	M	M	H	H	H
CO3	H	H	H	H	H	H	H	H	H	H
CO4	H	H	M	M	H	H	H	H	H	H
CO5	H	H	M	H	M	M	M	H	M	H

H-High; M-Medium; L-Low

21PBTMP301	**DSC PRACTICAL – III**	**SEMESTER – III**

OBJECTIVE:

Lab in rDNA technology, Plant and Animal tissue culture

S.No	**LIST OF EXPREMENT**	**Total Hours: 50**	
		Hrs	**CO**
1)	Isolation of Genomic DNA from Bacteria	**05**	**CO1**
2)	Isolation of plasmid DNA	**05**	
3)	Restriction Digestion and Ligation	**05**	**CO2**
4)	Bacterial Transformation	**05**	
5)	Media preparation for Animal Cell Culture and Primary and secondary culture of animal cells	**05**	**CO3**
6)	Determination of viability of cells using Trypan blue stain	**05**	
7)	Preparation of media for Plant Tissue Culture	**05**	**CO4**
8)	Selection and sterilization of explants for callus induction	**05**	
9)	Micropropagation	**05**	
10)	Embryo culture, Root and Shoot induction	**05**	

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COURSE OUTCOMES:	
At the end of the course, the students will be able to	
CO1	Isolate the DNA, Restrict and amplify the DNA.
CO2	Produce DNA fragments, amplified the DNA and also can perform bacterial transformation.
CO3	Perform media for culturing Animal cell, culture the animal cell line and also can determine the viability of animal cell.
CO4	Prepare the media for Plant Tissue culture and also can perform callus induction and micropropagation

REFERENCE BOOKS:

1. *Bhojwani, S.S. and Razdan, M.K.* 2008. **Plant Tissue Culture – Theory and Practice**. Elsevier Publishers, New Delhi.
2. *Freshney, R.I.* 2005. **Culture of Animal Cells: A manual of basic technique.** [Fifth Edition]. John Wiley and Sons, New Jersey.
3. *Joseph Sambrook and David W. Russell*, 2001. **Molecular cloning – A laboratory manual Volume 1 to 3**. [Third Edition]. Cold Spring Harbor Laboratory Press, New York.
4. Aneja, K.R. 2003. **Experiments in Microbiology, Plant pathology and Biotechnology.** [Fourth Edition]. New age international.

21PBTMP302	**DSC PRACTICAL IV: STATISTICAL SOFTWARE**		**SEMESTER – III**
Course Objective: The Course aims To give a good grip on concepts in analyzing the data using statistical software			
Credit: 2			Total Hours: 24
PROGRAM	CONTENTS	Hrs.	CO
1	Diagrams and graphs	03	CO 1
2	Measures of Central Tendency	03	CO 2
3	Measures of Dispersion	03	CO 2
4	Correlation Coefficient (Karl Pearson and Spearman Rank Method)	03	CO 3
5	Regression lines	03	CO 3
6	Small Sample Test (t and F)	03	CO 4
7	Chi-square Test for Independence of Attributes.	03	CO 4
8	ANOVA (one way and two way classification)	03	CO 4
Reference Books			
	Shentan J. Coakes, Lyndall Steed and PetaDzidic.SPSS 13.0 version for Windows analysis without Anguish. John Wiley & Sons, Australia.		
	Andy Field. 2006. Discovering Statistics using SPSS. [Second Edition]. SAGE Publications.		

Course Outcomes (CO)

After completion of the course, the students will be able to

CO 1	Demonstrate the data in diagrammatic and graphical representation
CO 2	Find the averages and measures dispersion
CO 3	Calculate correlation and regression for huge amount data
CO 4	Gain knowledge about test of significance

21PBCBTI301	GEC II: PHARMACEUTICAL BIOCHEMISTRY	SEMESTER–III

Course Objectives:

The Course aims

- To enable the students to learn about Pharmacodynamics and pharmacokinetics of drugs.
- To make the students aware of Plant therapeutics

Credits: 2 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**Drugs**: History of Drugs, Definition-Nomenclature. Classification of drugs based on their source – Plant, animal, mineral and synthetic, based on action. Routes of drug administration, Drug absorption- mechanism. Factors influencing drug absorption	8	CO1
II	Distribution and elimination of drugs. Factors influencing drug distribution and elimination. Mechanism of drug action- Physical, Chemical, Enzymes, Receptors. Drug-Receptor interactions: Receptor – Definition. Agonists, partial aganoists, inverse agonists and antagonists. Forces involved in drug-receptor interaction. Drug action not mediated through receptor. Dose response relationship (LD50 and ED50)	8	CO2
III	Adverse drug reactions- Definition, Classification and drug induced side effects, biological effects of drug abuse and drug dependence, drug tolerance and intolerance. Drug discovery- Animal toxicity studies and clinical evaluation Phase I-IV (Elementary details)	8	CO3
IV	Phytomedicine: History, Definition and Scope of Phytomedicine. Indian Medicinal systems– Ayurveda, Siddha and Unani. Medicinal properties and active principles of plant parts (leaves, flowers, roots, seeds, rhizome, bark etc). Role of medicinal and aromatic plants in national economy.	8	CO4

V	Secondary metabolites of plants - Alkaloids, flavonoids and terpenoids, phenols – occurrence, distribution and functions. (Synthesis not required). Extraction of Phytopharmaceuticals or crude drugs – (Aqueous, Methonol and Chloroform extracts) maceration, percolation (soxhlet) extraction - Analysis of phytochemicals (carbohydrates, aminoacids, proteins, phenols, flavonoids, alkaloids tannins, glycosides, saponins and terpenoids).	**8**	**CO5**

Text Books

1. *Tripathi, K. D*. 1999. **Essentials of Medical Pharmacology.** [Fourth Edition]. Jaypee Brothers Medical Publishers, New Delhi **(UNIT - I, II & III).**

2. *Kokate, C. K., Purohit, A. P.* and *Gokhale, S.B.* 2007. **Pharmocognosy.** [Thirty Seventh Edition]. Nirali Prakasham, Pune. **(UNIT – IV & V)**

Reference Books

1. *Satoskar, R. S., Nirmala N. Rege* and *Bhandarkar S.D,* 2011. **Pharmacology and Pharmacotherapeutics** [Twenty-Second edition]. Popular Prakashan Pvt Ltd, Mumbai

2. *Roseline, A.* 2011**. Pharmacognosy.** M.J.P Publishers, Chennai

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Describe the drug sources, classification and its pharmacodynamics
CO2	Explain the mechanisms of action and fate of drugs inside living organisms
CO3	Analyze the effects of adverse drug reactions
CO4	Appreciate the various medical systems that utilize phytoconstituents as medicines
CO5	Explore the new strategies in the development of efficient drugs to combat diseases from plants

MAPPING

PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	H	M	H	M	M	M	M	M
CO2	H	M	H	M	H	M	M	M	M	M
CO3	H	M	H	M	H	M	M	M	M	M
CO4	H	M	H	M	H	H	H	H	H	H
CO5	H	M	H	M	H	H	H	H	H	H

H-High; M-Medium; L-Low

21PBCBTIP301	GEC II: PHARMACEUTICAL BIOCHEMISTRY	SEMESTER – III

Course Objectives:

The Course aims

- To enable the students to understand the basic concepts in extraction, screening, quantification process of secondary metabolites

Credits: 2 **Total Hours: 24**

S.No.	EXPERIMENT	Hrs	CO
1.	Extraction of phyto constituents of neem leaves using water and methanol as solvents- Maceration and Soxhlet extraction	3	1
2.	Preliminary phytochemical screening for the presence of following constituents (i) Carbohydrates (ii) Lipids (iii) Proteins and Amino acids (iv) Phenols (v) Flavonoids (vi) Anthraquinones (vii) Alkaloids (viii) Terpenoids (xi) Glycosides (x) Saponins	6	1
3.	Quantitative estimation of proteins (Lowry's method).	3	2
4.	Quantitative estimation of carbohydrates (Anthrone method).	3	2
5.	Quantitative estimation of phenols (Singleton and Rossi's method).	3	2
6.	Isolation and partial purification of phytoconstituents (Phenol and Flavonoids) using Chromatographic techniques (TLC)	6	2

Reference Books

1. *Kokate, C.K., Purohit, A.P.* and *Gokhsale, S.B.* 2008. **Phytochemical Methods.** Nirali Prakasham, Pune

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Extract and screen the presence of various plant metabolites
CO2	Quantify the presence of biomolecules and secondary metabolites in samples

18PMBBTI 301	**GEC II: INDUSTRIAL MICROBIOLOGY**	**SEMESTER – IV**	
OBJECTIVES: To learn the basics of bioprocess techniques. To know about fermenter design and production of various fermented products.			
UNIT	**CONTENTS**	**Total Hours: 50**	
		Hrs	**CO**
Unit - I	Introduction to bioprocess technology - Historical development of industrial microbiology – screening techniques – primary and secondary – preservation of industrial cultures – objective – Lyophilization and Cryogenic storage. Strain improvement – rDNA technology - strain development for various fermentation processes.	**10**	**CO1**
Unit - II	Media for industrial fermentation – formulation – sterilization – fermentation types – solid state and submerged fermentation – Downstream processing - Foam separation – Precipitation - Filteration – Cell disruption – physico – mechanical and chemical. Solvent recovery and drying.	**10**	**CO2**
Unit - III	Fermentor – component parts of fermentor – Body construction - stirring and mixing – scale up window – control of pH, temperature, foam and pressure – types of bioreactors – Air lift and cylindro conical bioreactors	**10**	**CO3**
Unit - IV	Microbial production of fermented products – Wine. Organic acid – Citric acid and Lactic acids. Vitamin – Vitamin B12. Enzyme – α-amylase.	**10**	**CO4**

Unit - V	Microbial production of antibiotic – Penicillin - Streptomycin; Vaccines – BCG; Toxoid – Tetanus Toxoid – Preparation of antisera	**10**	**CO5**

REFERENCE BOOKS:

Text Books

1. Stanbury, P.F., Whitaker, A., and Hall, S.J., 2005. Principles of Fermentation technology. Reed Elsevier India Ltd., New Delhi.
2. Patel, A.H., 2005. An Introduction to Industrial Microbiology. MacMillan India Ltd., Chennai.
3. Cruegar, W and Cruegar, A. 1989. Biotechnology: A Textbook of Industrial Microbiology. Panima Publishing Corporation, New Delhi.

Reference Books

1. Michael J Waites, John S Roackey, Neil L. Morgan and Garry Highton. 2006. Industrial Microbiology – An Introduction. Blackwell Science Ltd., USA.
2 Hugo, W.B. and Russell, A.D. 1998. Pharmaceutical Microbiology.[Sixth Edition]. Blackwell Scientific Company Ltd., USA.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Recall the basics and importance of industrially important microbes.
CO2	Apply the techniques for the formulation of media for microbial products.
CO3	Develop the suitable conditions for maximum product yield.
CO4	Apply fermentation technology for production of microbial products.
CO5	Demonstrate chemotherapeutic drugs production under in vitro conditions.

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21PBTM401	**DSC XII: FOOD AND PHARMACEUTICAL BIOTECHNOLOGY**	**SEMESTER – IV**	
OBJECTIVES: 1. To understand the basics about the food and food products. 2. To understand the basics about the pharmaceutical biotechnology			
UNIT	**CONTENTS**	**Total Hours: 50**	
		Hrs	**CO**
Unit - I	Constituents and dietary sources of food – Carbohydrates, Lipids, Proteins, Water, Vitamins and Minerals, Fermented Cereals food: Soy Sauce, Miso, Idli. Fermented fish products. Fermentation of vegetables: Sauerkraut Pickles, Cheese, Yoghurt.	**10**	**CO1**
Unit - II	Production of bread, distilled beverages- wine and beer. Production of food flavourant and colorants, Production of baker's yeast, Food spoilage – Factors responsible for spoilage. Poultry products and processing.	**10**	**CO2**
Unit - III	Principles and methods of food preservation: Asepsis removal, Anaerobic conditions, Preservation by use of high temperature, low temperature, drying, food additives, radiation, Pasteurization, Blanching, Canning, Drying and Dehydration. Application of Nanotechnology in food preservation. Various packaging methods.	**10**	**CO3**
Unit - IV	History and scope of Pharmaceutical biotechnology, Production of antibiotics from the microbes-penicillin, streptomycin, Manufacturing of drugs and principles. Packing techniques of Drugs and tablets.	**10**	**CO4**

Unit - V	Quality assurance and control – concept of good manufacturing practices, role of FDA, and their release into the market, Hormones. Drug metabolism – biotransformation of drugs, enzymes responsible for biotransformation, microsomal and non-microsomal mechanisms, Pharmacology - pharmacodynamics pharmacokinetics, FDA, FSSAI, ISO.	**10**	**CO5**

REFERENCE BOOKS:

1. *Daan, J., Crommelin, A., Robert D. Sindelar, Bernd Meibohm,* 2008. **Pharmaceutical Biotechnology – Fundamentals and Applications.** Informa Healthcare USA, Inc.
2. *Toledo, R.T*. 1980. **Fundamentals of Food Processing**. [Third Edition]. AVI Publishing Company, USA.
3. *Coultate, T.P.* 1992. **Food – The Chemistry of Its Components**. [Second Edition]. Royal Society, London.
4. *Jay, J.M.* 1987. **Modern Food Microbiology**. [Third Edition]. CBS Publications, New Delhi.
5. *Kayser. O. and Müller, R. H.* 2004. **Pharmaceutical Biotechnology: Drug Discovery and Clinical Applications.** Wiley Publications.

COURSE OUTCOMES:	
At the end of the course, the students will be able to	
CO1	Explain dietary sources and fermented food products.
CO2	Illustrate the production of beverages, food colorants as well as factors responsible for food spoilage.
CO3	Demonstrate the principles and methods of food preservation.
CO4	Know the production, manufacturing of antibiotics and drugs and tablet packaging..
CO5	Learn the role of FDA, drug metabolism and pharmacology.

Mapping

PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	M	H	H	M	M	H	H	H
CO2	H	H	H	H	H	H	H	M	H	M
CO3	H	H	H	H	H	H	H	H	H	M
CO4	H	H	H	M	H	H	H	H	H	M
CO5	H	H	H	H	H	H	H	H	M	M

H-High; M-Medium; L-Low

21PBTEL401	**DSE II: ELECTIVE II**: A) **ENVIRONMENTAL BIOTECHNOLOGY**	**SEMESTER – III**	
OBJECTIVE To know about environment and to get knowledge about applications of biotechnology to protect and to develop our environment.			
UNIT	**CONTENTS**	**Total Hours: 50**	
		Hrs	**CO**
Unit - I	Basic concepts and issues, Environmental pollution – air, water and soil, its control measures. Ozone depletion, UV-B, green-house effect and acid rain, their impact and biotechnological approaches for management, impact of chemicals and biological warfare agents on environment. Methodology of environmental management.	**10**	**CO1**
Unit - II	Aerobic System -Biological processes for domestic and industrial waste water treatments; Activated sludge process, Trickling filters, Biological filters, Rotating biological contractors, Fluidized bed reactor, Expanded bed reactor, Inverse fluidized bed biofilm reactor, Packed bed reactors, Air- sparged reactors, Anaerobic System- Anaerobic biological treatment - Contact digesters, Packed column reactors, UASB.	10	**CO2**
Unit - III	Introduction, constraints and priorities of Bioremediation, Bio stimulation of Naturally occurring microbial activities, Bio augmentation, *in situ*, *ex situ*, intrinsic & engineered bioremediation, Solid phase bioremediation - land farming, prepared beds, soil piles, Phytoremediation. Composting, Bioventing & Bio sparging; Liquid phase bioremediation - Suspended bioreactors, Fixed biofilm reactors. Bioremediation of oil contaminated soil and water	10	**CO3**

Unit - IV	Microbial transformation, accumulation and concentration of metals, metal leaching, extraction and future prospects. Microorganisms and energy requirements of mankind; Production of nonconventional fuels - Methane (Biogas), Hydrogen, Alcohols and algal hydrocarbons,Use of microorganisms in augmentation of petroleum recovery. CO2 sequestration through plant.	**10**	**CO4**
Unit - V	Introduction - Xenobiotic compounds, recalcitrance. Biodegradation of Xenobiotics. Biological detoxification - market for hazardous waste management, biotechnology application to hazardous waste management - examples of biotechnological applications to hazardous waste management – cyanide detoxification - detoxification of oxalate, urea and toxic organics like phenols	**10**	**CO5**

REFERENCE BOOKS:

1. *Wesley, W. and Eckenfelder, J.R.* 2000. **Industrial Water Pollution Control**. [Third Edition]. Mc Graw – Hill Higher Education.
2. *Martin Alexander*, 1999. **Biodegradation & Bioremediation**. Academic Press.
3. *Ronald. L. Crawford and Don L. Crawford*, 1998. **Bioremediation Principles and Application.** [First Edition]. Cambridge University Press.
4. *Rao, C.S.* 1999. **Environmental Pollution Control Engineering.** [First Edition]. New Age International (P) Limited, New Delhi.
5. *Atlas and Bartha.* 1998. **Microbiol ecology.** [Fourth Edition]. Benjamin Science Publishing (P) Ltd.

6. *Indu Shekhar Thakur.* 2011. **Environmental Biotechnology- Basic concepts and applications** [Second Edition]. I.K. International Publishing House Pvt Ltd.
7. *Pradipa Kumar Mahapatra.* 2006. **Textbook of Environmental Biotechnology.** [First Edition]. I.K. International Publishing House Pvt Ltd.

COURSE OUTCOMES:	
At the end of the course, the students will be able to	
CO1	Solve the environmental issue through biotechnological approaches.
CO2	Treat the industrial waste water by biological treatment.
CO3	Apply bioremediation to the contaminated soil and water.
CO4	To use microbes to leach metals and to produce biogas.
CO5	Manage the hazardous waste and to detoxify them.

Mapping

PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	H	H	H	H	M	H	M	H	M	H
CO2	M	H	H	M	H	H	H	H	H	H
CO3	H	H	H	H	H	H	M	H	M	H
CO4	H	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	H	H	H	H	H	H

H-High; M-Medium; L-Low

21PBTEL402	**GEC II: B) EVOLUTION AND BIODIVERSITY**	**SEMESTER – III**	
OBJECTIVE: 1. To understand the evolutionary concept and biodiversity			
UNIT	**CONTENTS**	**Total Hours: 50**	
		Hrs	**CO**
Unit - I	Emergence of evolutionary thoughts Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis.	**08**	**CO1**
Unit - II	Origin of cells and unicellular evolution: Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiement of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.	**12**	**CO2**
Unit - III	Paleontology and Evolutionary History: The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multi cellular organisms; Major groups of plants and animals; Stages in primate evolution including Homo.	**10**	**CO3**

Unit - IV	**Principles & methods of taxonomy:** Concepts of species and hierarchical taxa, biological nomenclature, classical & quantititative methods of taxonomy of plants, animals and microorganisms. **Levels of structural organization:** Unicellular, colonial and multicellular forms. Levels of organization of tissues, organs & systems. Comparative anatomy, adaptive radiation, adaptive modifications.	**08**	**CO4**
Unit - V	**Outline classification of plants, animals & microorganisms:** Important criteria used for classification in each taxon. Classification of plants, animals and microorganisms. Evolutionary relationships among taxa. **Natural history of Indian subcontinent:** Major habitat types of the subcontinent, geographic origins and migrations of species. Comman Indian mammals, birds. Seasonality and phenology of the subcontinent. **Organisms of conservation concern:** Rare, endangered species. Conservation strategies.	**12**	**CO5**

REFERENCE BOOKS:

1. Veer Bala Rastogi. 12th Edition. Organic evolution. Kedarnat Ramnath, Meerut, Delhi.
2. Jha AP, 1997. Genes and Evolution. Mac Millan India Limited.
3. Douglas J Futuyma and Mark Kirkpatric, 2017. Evolution. Oxford University press.

COURSE OUTCOMES:	
At the end of the course, the students will be able to	
CO1	Evolutionary concepts of organisms.
CO2	Orgin of prokaryotes and unicellular and multi cellular organism.
CO3	Evolutionary history of various organisms.
CO4	Principles and methods of taxonomy.
CO5	The classification of plant, animal and microorganism.

Mapping

PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	H	M	H	M	H	H	H	M	H	H
CO2	H	H	H	H	H	H	M	M	H	M
CO3	H	H	M	H	H	H	H	H	H	M
CO4	H	M	H	M	H	H	H	H	M	M
CO5	H	H	H	M	H	H	H	M	M	M

H-High; M-Medium; L-Low

GUIDELINES

MARK DISTRIBUTION

1. SUBMISSION OF RECORD NOTE BOOKS AND PROJECT DISSERTATION:

Candidates appearing for Practical Examinations and Project Viva-Voce shall submit Bonafide Record Note Books/ Dissertation prescribed for Practical/ Project Viva-Voce Examinations, otherwise the candidates will not be permitted to appear for the Practical/ Project Viva-Voce Examinations.

2. PASSING MINIMUM AND INTERNAL MARK DISTRIBUTION (Theory, Practical and Project)

(i) A. THEORY

The candidate shall be declared to have passed the Examination, if the candidate secure not less than 50 marks put together out of 100 in the Comprehensive Examination in each Theory paper with a passing minimum of 38 marks in External out of 75.

***Internal Marks Distribution** [CA- Total Marks: 25]*

Attendance	: 5 Marks
Assignment	: 5 Marks
Seminar	: 5 Marks
Internal Examinations	: 10 Marks
Total	**: 25 Marks**

Question paper pattern for theory examinations
(Maximums marks: 75)

PART A
Answer all questions (5 x 5 = 25)
(Internal Choice questions)

PART B
Answer all questions (5 x 10= 50)
(Internal Choice questions)

B. (i) THEORY (If Internal Evaluation is for 100 Marks)

The candidate shall be declared to have passed the Examination, if the candidate secures not less than 50 marks out of 100.

Internal Marks Distribution ***[CA- Total Marks: 100]***

Attendance	: 10 Marks
Assignment	: 20 Marks (2 Assignments Compulsory)
Seminar	: 10 Marks
Internal Examinations	: 60 Marks
Total	**: 100 Marks**

B. (ii) THEORY (If External Evaluation is for 100 Marks)

The candidate shall be declared to have passed the Examination, if the candidate secures not less than 50 marks out of 100 in the Comprehensive Examination (External Evaluation only).

Question paper pattern for theory examinations ***and Mark Distribution*** **(For 100 marks)**

PART – A

Answer all questions (5 x 5 = 25 Marks)

One question from each UNIT with Internal Choice

PART – B

Answer ALL questions (5x 15 = 75 Marks)

One question from each UNIT with Internal Choice

(ii) PRACTICAL

The candidate shall be declared to have passed the Examination, if the candidate secure not less than 50 marks put together out of 100 in the Comprehensive Examination in each Practical paper with a passing minimum of 30 marks in External out of 60.

Marks Distribution

Continuous Assessment (CA) - 40 marks
Comprehensive Examination (CE) - 60 marks

***Internal Marks Distribution* [CA- Total Marks: 40]**

Experiment	: 10 Marks
Attendance	: 5 Marks
Record	: 5 Marks
Internal Examinations	: 20 Marks
Total	**: 40 Marks**

***Comprehensive Exam Marks Distribution* [CE- Total Marks: 60]**

Major experiment	: 25 Marks
Minor experiment	: 15 Marks
Spotters	: 5X2=10 Marks
Viva voce	: 10 Marks
Total	**: 60 Marks**

Submission of Record Note Books

Candidates appearing for Practical Examinations shall submit Bonafide Record Note Books for Practical Examinations; otherwise the candidates will not be permitted to appear for the Practical Examinations.

QUESTION PAPER PATTERN FOR PRACTICAL EXAMINATIONS

Max marks	: 60
Time	: 6Hrs/9Hrs (6+3)
Major experiment	: 25 Marks
Minor experiment	: 15 Marks
Spotters	: 5X2=10 Marks
Viva voce	: 10 Marks

Key for evaluation of Practical Examination

1. **Major (25 Marks)**

Procedure	: 15 Marks
Performance	: 05 Marks
Result	: 05Marks

2. **Minor (15 Marks)**

Procedure	: 10 Marks
Performance	: 03 Marks
Result	: 02 Marks

3. **Spotters** : 5x3=15 Marks

4. **Viva – Voce** **:** 05 Marks

iii) CERTIFICATE COURSE

Classification of Marks

Examinations	: 50 Marks (5X10=50)
Practical/Performance	: 15 Marks
Assignment	: 30 Marks (3 Assignment)
Attendance	: 05 Marks
Total	**: 100 Marks**

III) PROJECT WORK /DISSERTATION

The project work shall be carried out by each student in the IV semester and has to complete the work at the end Semester.

- Upon completion of the project work/dissertation the candidate will be required to appear for a viva-voce conducted by an external examiner.
- The Student has to attend three reviews before completing his/her Project.
- All three reviews will be reviewed by Subject expert.
- A candidate failing to secure the prescribed passing minimum in the dissertation shall be required to re-submit the dissertation with the necessary modifications.

Mark Distribution Pattern

Comprehensive Examination (CE)	**:150 Marks**
Continuous Assessment (CA)	**: 50 Marks**

The candidate shall be declared to have passed the Examination, if the candidate secures not less than 100 marks put together out of 200. In the Comprehensive Examination in Project with a passing minimum of 75 marks in External out of 150.

Internal Mark Distribution **[CA - Total Marks: 50 Marks]**

1. Research work done	:	20 Marks
2. Attendance	:	5 Marks
3. Observation Note	:	10 Marks
4. Review	:	15 Marks
Total	**:**	**50 Marks**

External Mark Distribution [CE - Total Marks: 150 Marks]

1. Project report : 100 Marks
2. Presentation : 25 Marks
3. Viva Voce : 25 Marks

Total : 150 Marks

IV) CAREER COMPETENCY SKILLS- METHODOLOGY OF ASSESSMENT

On Line Objective Examination (Multiple Choice questions)

- 100 questions-100 minutes
- Twenty questions from each UNIT.
- On line examination will be conducted at the end of the III Semester.

Viva Voce

- A Student has to come in proper dress code and he/she should bring 2 copies of Resume for the Viva Voce.
- A student may be asked to
  - Give Self Introduction
  - Submit the resume to the examiner(s) and answer the questions based on it.
  - Speak on any given topic for at least two minutes.
  - Give a presentation for 10 minutes on a topic of their choice.
  - Sit with other students in a Group for a Discussion.

GENERIC ELECTIVE COURSES (GEC)

S.NO	SUBJECT CODE	SUBJECT	SEMESTER	OFFERED TO THE STUDENTS OF
1	21PBTMBI201/ 21PBTBCI201	**GEC** I: Plant Tissue culture technology	II	Microbiology/Biochemistry
2	21PBTMBIP20/ 21PBTBCIP201	**GEC** Practical I: Plant Tissue culture technology	II	Microbiology/Biochemistry
3	21PBTMBI301/ 21PBTBCI301	**GEC** II: Animal Tissue culture	III	Microbiology/Biochemistry
4	21PBTMBIP30/ 21PBTBCIP301	**GEC** Practical II: Animal Tissue culture technology	III	Microbiology/Biochemistry

<table>
<tr><td>21PBTMBI201/
21PBTBCI201</td><td colspan="2">GEC I: PLANT
TISSUE CULTURE TECHNOLOGY</td><td>SEMESTER- II</td></tr>
<tr><td colspan="4">Course Objectives:
The Course aims
• To understand the basic techniques in plant tissue culture.</td></tr>
<tr><td colspan="2">Credits:2</td><td colspan="2">Total Hours: 40</td></tr>
<tr><td>UNIT</td><td>CONTENTS</td><td>Hrs</td><td>CO</td></tr>
<tr><td>I</td><td>Introduction to Plant cells, Types of plant cells, Principles of plant tissue culture, Tissue culture media, Growth regulators and Sterilization techniques.</td><td>07</td><td>CO1</td></tr>
<tr><td>II</td><td>Callus and suspension culture, Micropropagation, Meristem culture, Somatic embryogenesis, Protoplast isolation, Fusion of protoplast, Somaclonal variations.</td><td>08</td><td>CO2</td></tr>
<tr><td>III</td><td>Agrobacterium mediated gene transfer, Agrobacterium based vectors, direct gene transfer methods - electroporation, microinjection, particle bombardment.</td><td>09</td><td>CO3</td></tr>
<tr><td>IV</td><td>Genetic engineering for quality improvement- Protein, lipids, carbohydrates, and vitamins, Production of resistant plants - Herbicide resistance, Insect resistance (Bt approach), Abiotic stress tolerance plant production - Drought, temperature and salt.</td><td>10</td><td>CO4</td></tr>
<tr><td>V</td><td>Secondary metabolites from plants – Alkaloids, flavonoids and phenolic compounds, Germplasm conservation.</td><td>06</td><td>CO5</td></tr>
<tr><td colspan="4">Text Book</td></tr>
</table>

1	*Bhojwani, S.S., and Razdan, M.K.* 2008. **Plant Tissue C ultur e – Theory and Practice.** Elsevier Publishers, New Delhi.
Reference Books	
1	*Chawla, H.S.* 1998. **Biotechnology in Crop Improvement.** International Book Distribution Co., New Delhi.
2	*Hopkins, W.G. and Hiiner, N.P.A.* 2004. **Introduction to Plant Physiology.** [Third Edition]. John W i l e y and Sons, New Jersey, USA.
3	*Jain, V.K.* 2013. **Fundamentals of Plant Physiology**. [Fifth Edition]. S. Chand and Company, New York.
4	*Trivedi, P.C.* 2004. **Advances in Plant Physiology**. [Third Edition]. I.K. International Publications Pvt Ltd., New Delhi.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Simplify the types of plant cells and will able to utilize various sterilization techniques
CO2	Utilize the micro propagation and isolation of plant tissue
CO3	Analyze the techniques for Transfer gene by biological and physical method
CO4	Contrast the benefits and develop the genetically modified crops
CO5	Demonstrate the Extraction and identification of secondary metabolites

MAPPING

PSO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	M	H	M	M	M	M	H	H
CO2	H	M	M	H	H	M	M	M	H	H
CO3	H	M	M	H	M	M	H	H	M	M
CO4	H	M	M	H	L	M	M	M	H	H
CO5	H	M	M	H	M	M	H	H	M	M

H-High; M-Medium; L-Low

21PBTMBIP201/ 21PBTBCIP201	**GEC PRACTICAL I:PLANT TISSUE CULTURE TECHNOLOGY**	**SEMESTER -II**

Course Objectives:

The Course aims

- To get hands on experience on Plant tissue culture.

Credits: 2 **Total Hours: 24**

S.No	EXPERIMENT	Hrs	CO
1.	Media preparation	**06**	**CO1**
2.	Hormone stock solution preparation	**06**	
3.	Callus induction	**03**	
4.	Micropropagation	**03**	
5.	Protoplast isolation	**03**	
6.	Synthetic seed preparation	**03**	

Reference Book

1 *Aneja, K.R.* 2003. **Experiments in Microbiology, Plant pathology and Biotechnology.** [Fourth Edition]. New age international.

2 *Bhojwani, S.S. and Razdan, M.K.* 2008. **Plant Tissue Culture– Theory and Practice**. Elsevier Publishers, New Delhi.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Prepare media for plant tissue culture and cultivate the plant tissues / cells.

21PBTMBI301/ 21PBTBCI301	**GEC II: ANIMAL CELL CULTURE TECHNOLOGY**	**SEMESTER - III**

Course Objectives:

The Course aims

- To understand the basic techniques in Animal cell culture.

Credits: 2 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	Introduction to Animal cell c ulture, Applications of cell culture, Designing the cell culture laboratory – washing and sterilization area, Storage area and cell culture room, Equipments in tissue culture laboratory – Inverted Microscope, Centrifuge, Laminar flow benches, CO2 incubator.	**08**	**CO1**
II	Glass ware and other plastic ware in tissue culture Substrate materials for growing cells, cell culture vessels, culture media – Properties and special requirements, Complete media, Conditioned media.	**08**	**CO2**
III	Type of cell culture - Isolation of primary explants culture, Isolation of cells and disaggregation method cell culture, organ culture.	**08**	**CO3**
IV	Cell culture-Transformation, Differentiation and Dedifferentiation, Growth curve of cells, Types of microbial contamination, Stem cell culture.	**08**	**CO4**
V	Applications of Animal cell culture technology–Somatic cell fusion, Transgenic fish and sheep.	**08**	**CO5**

Reference Books	
1	*Sudha Gangal*, 2010. **Principles and Practice of Animal Tissue Culture**. [Second Edition]. University Press (India)Pvt. Ltd.
2	*Freshney, R.I.*2005.**Culture of Animal Cells: A manual of basic technique.** [Fifth Edition]. John Wiley and Sons, New Jersey.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Handle animal cells and familiar with instruments
CO2	Prepare animal tissue culture media for culturing animal cells
CO3	Disaggregate the animal tissues
CO4	Differentiate cells and stem cells
CO5	Apply the animal cell culture technology in day to day life

MAPPING

PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	H	M	M	H	M	M	M	M	H	H
CO2	H	M	M	M	H	M	M	M	H	H
CO3	H	H	M	H	M	M	H	H	M	M
CO4	H	M	M	M	L	M	M	M	H	H
CO5	H	M	M	H	M	M	H	H	M	M

H-High; M-Medium; L-Low

21PBTMBIP301/ 21PBTBCIP301	GEC II: ANIMAL CELL CULTURE TECHNOLOGY	SEMESTER -III

Course objectives:

The Course aims

- To get hands on experience on Animal cell culture.

Credits:2 **Total Hours: 24**

S.No	EXPERIMENT	Hrs	CO
1.	Sterilization techniques in Animal cell culture	06	CO1
2.	Media preparation for Animal cell culture	06	
3.	Primary culture of Chick embryo fibroblast	03	CO2
4.	Trypsinization and subculturing	06	
5.	Determination of viability of cells using Trypan blue stain.	03	CO3

Reference Book

1 *Freshney, R.I.*2005. **Culture of Animal cells: A manual of basic technique**. [Fifth edition]. John Wiley and Sons, New Jersey.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Sterilize the media and utensils for Animal cell culture
CO2	Cultivate the animal cells and maintain it for further studies.
CO3	Analyse viable cells.