ST.PHILOMENA'S COLLEGE (AUTONOMOUS), MYSURU

(AFFILIATED TO UNIVERSITY OF MYSORE)

REACCREDITED BY NAAC WITH A GRADE

Three-year six semesters Choice Based Credit System (CBCS) and Continuous Assessment & Grading Pattern (CAGP) Under Graduate Programme under Autonomous Structure

The academic year 2018-19 onwards

B.Sc

DEPARTMENT OF BIOTECHNOLOGY

PREAMBLE

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

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

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

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

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

DEPARTMENT OF BIOTECHNOLOGY
CBCS SYLLABUS FOR BSc IN BIOTECHNOLOGY
FOR THE ACADEMIC YEAR 2018-19 ONWARDS
GENERAL SCHEME for TEACHING & EVALUATION

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

Semester	Title of the Paper	TYPE	Teaching Hours per Week	Credits	Exam Duration in Hours	Max. Marks Theory/ Practical		
			Theory/ Practical	Theory/ Practical	Theory/ Practical	Theory/Practical	I A Theory/Practical	Total Marks
I	Paper I: Biomolecules and Microbiology	DSC	03	03	03	50	20	100
	Practical I	DSC	03	1.5	03	20	10	
II	Paper-II: Cell Biology and Genetics	DSC	03	03	03	50	20	100
	Practical II	DSC	03	1.5	03	20	10	
III	Paper III: Enzymology and Metabolism	DSC	03	03	03	50	20	100
	Practical III	DSC	03	1.5	03	20	10	
IV	Paper IV: Plant tissue culture and Animal Cell culture	DSC	03	03	03	50	20	100
	Practical IV	DSC	03	1.5	03	20	10	
V	Paper V: Molecular Biology and Genetic Engineering	DSC	03	03	03	70	30	300
	Practical V	DSC	02	01	03	35	15	
	Paper VI: Immunology and Medical Biotechnology	DSC	03	03	03	70	30	
	Practical VI	DSC	02	01	03	35	15	
VI	Paper VII: Microbial Technology and Agricultural Biotechnology	DSC	03	03	03	70	30	300
	Practical VII	DSC	02	01	03	70	30	
	Paper VIII: Environmental Biotechnology, Biophysics and Biostatistics	DSC	03	03	03	70	30	
	Practical VIII	DSC	02	01	03	35	15	
		DSE 1	02	02	02	30	20	100
		DSE 2	02	02	02	30	20	
				38	-	760	340	1100

Discipline Specific Elective (DSE or Soft Core (SC)

SL. No	Title of the Paper	TYPE			Theory/ Examination Scheme			
			Semester	Theory Credits	Exam Duration in Hours	Theory Max. Marks	I A Max Marks	Total Marks
1.	Medical & Nano Biotechnology	DSE	II To IV	2 2	02	30	20	50
2.	Pharmaceutical Biotechnology	DSE		2 2	02	30	20	50
3.	Genomics & Proteomics	DSE		2 2	02	30	20	50
4.	Molecular Plant Physiology	DSE		2 2	02	30	20	50
5.	Project Work	DSE	V to VI	2 2	02	30	20	50
6.	Research Methodology	DSE		2 2	02	30	20	50
7.	Epigenetic and Cancer Biology	DSE		2 2	02	30	20	50
8.	PR, Patenting and Bioethics	DSE		2 2	02	30	20	50
9.	Molecular Virology and Infections	DSE		2 2	02	30	20	50

Note:

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

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SYLLABUS
ST. PHILOMENA'S COLLEGE (AUTONOMOUS), MYSORE-570 015
SUBJECT- BIOTECHNOLOGY
SYLLABUS FOR B. Sc., COURSE UNDER CBCS SCHEME
FROM THE ACADEMIC YEAR- 2018-19 Onwards

FIRST SEMESTER

BIOTECHNOLOGY PAPER-I

Title: BIOMOLECULES AND MICROBIOLOGY

CLASS DURATION – 03 HOURS PER WEEK **48 Hours**

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

SUBJECT DESCRIPTION: This course emphasizes various bio-molecules and its significance and principles, instrumentation, working and application of the instruments commonly used in the laboratories.

Microorganisms are a heterogeneous group of organisms normally detectable for the human eye only through magnifying instruments (microscopes). Phylogenetically, prokaryotes, being the oldest known form of life and comprising the domains eubacteria and archaea, are separated from eukaryotes, including fungi, algae and protists.

OBJECTIVES: To enable the students to learn the basic functions, structures and biological importance of lifeless chemical compounds along with functioning components of the various **instruments.**

LEARNING OUTCOME: Study of microbiology enables students to understand the techniques involved in microbial culture, different microbial disorders.

On successful completion of the course, the students should have understood the significance of the complex bio-molecules, polysaccharides, lipids, proteins, nucleic acids, vitamins and minerals and also would have learnt the principles and applications of the instruments.

After completing the Program of Study in Microbiology, students should be able to demonstrate an understanding of core concepts of microbiology, including the evolution and diversity of microbes; cell structure and function; metabolism; information flow and the role of microbes in ecosystems

PART-A

BIOMOLECULES

Unit 1

1.1 **Carbohydrates:** **2 hrs**

Monosaccharides- ribose, glucose, galactose and fructose, reducing and non-reducing sugars.

1.2 Stereochemistry – epimers, enantiomers, anomers, isomers concept, Fischer and Haworth structure of disaccharides- sucrose, maltose and **lactose.** **5hrs**

1.3 **Structure of polysaccharides – starch and glycogen. Racemization.**

Unit 2

2.1 **Proteins**

Amino acids- generalized zwitterionic structure, essential and non-essential amino acids

2.2 classification based on polarity, pKa value, D and L amino acids, optical activity, peptide bond, the structure of oxytocin and insulin. **5hrs**

2.3 Primary, secondary, tertiary and quaternary structural organization of proteins. Globular and fibrous proteins with special reference to the structure of haemoglobin, collagen & Myoglobin**.**

Unit 3

3.1 **Lipids:**
Classification of lipids with examples. Simple and compound lipids, unsaturated and saturated fatty acids.

3.2 Nomenclature of fatty acids. **5hrs**

3.3 Physical and chemical properties of oils and fats. **2hrs**
Structure and role of different types of lipids – glycolipids, phospholipids, sphingolipids & cholesterol.

Unit 4

4.1 **Nucleic acids:** **5hrs**
Nomenclature of bases, nucleosides nucleotides.

4.2 Structure of DNA**,** types of DNA (A, B & Z forms), structure and types of RNA

PART-B

MICROBIOLOGY

Unit 1

1.1 **General introduction:** **2Hrs**
Scope and history, important discoveries by Robert Koch, Leeuwenhoek, Jenner, Pasteur, Fleming and Iwanowski.

1.2 **Basic microbiological techniques**: sterilization, disinfection. **2Hrs**

1.3 **Basic microbiological techniques**: sterilization, disinfection.

1.4 Concept of prokaryotes and eukaryotes. A general account on structure, classification and reproduction of bacteria, viruses and fungi. **4Hrs**

Unit 2

2.1 **Microbiological nutrition and growth**: nutritional classes of microorganisms, culture media, pure culture, microbial growth pattern and methods of growth measurements, methods of maintenance and preservation of culture. **4Hrs**

2.2 **Fermentative types of microorganisms** – Aerobes, anaerobes and facultative anaerobes **1Hr**

2.3 Physical and chemical control of microorganisms; antimicrobial agents- penicillin and tetracycline **2Hrs**

Unit-3

3.1 **Role of microbes in bio geo cycles** (nitrogen, carbon, sulphur and phosphorous cycle). **2Hrs**

3.2 Biological nitrogen fixation

3.3 **Microbial diseases**: important plant diseases – downy mildew, bacterial leaf blight, TMV and animal diseases- Tuberculosis, rabies and Candidiosis. Causative agents and control. **5Hrs**

3.4 Normal flora of the human body.

3.5 Food spoilage, Microbial examination of food, food preservation, food poisoning **2Hrs**

Reference books:

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

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PRACTICAL-I

Biomolecules and Microbiology

Practical Duration -03 Hours per week Examination-03 Hours

MARKS=30.

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

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Part A

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

Part B

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

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

CLASS DURATION – 03 HOURS PER WEEK 48 Hours
MARKS-Theory - 50 + Internal Assessment -20= 70

SUBJECT DESCRIPTION: Cell biology is the sub-discipline of biology that studies the basic unit of life, the cell. Genetics is the branch of biology that deals with heredity.

OBJECTIVES: The basic goal of this class is for the student to gain an understanding of how cells operate, communicate, and control their activities. After completing the Program of Study in cell biology, students should be able to demonstrate an understanding of core concepts of cell biology whereas major goals of genetics have been to understand the relative contribution of heritable and environmental factors to trait variation.

LEARNING OUTCOME: Demonstrate a working conceptual knowledge of relevant sub-disciplines of biology and chemistry, including molecular and cell biology, genetics, and organism biology. Demonstrate laboratory skills in biology.

PART-A
CELL BIOLOGY

Unit 1

1.1 **General Introduction**: **2 hrs**
A historical perspective, the cell theory, the Ultrastructure of plant and animal cell, different types of cells.

1.2 **Cytological techniques** – teasing, smear preparation, squash preparation, whole-mount, microtomy **3 hrs**

1.3 **Cell organelles:** Structure and function of the cell wall, plasma membrane, membrane proteins, cytoplasm, nucleus, mitochondria, chloroplast, Golgi bodies, endoplasmic

Unit 2

2.1 **Cell Division :** **5hrs**
Cell cycle, phases and regulation of cell cycle, cell division, interphase nucleus

2.2 Mitosis and meiosis, comparison between mitosis and meiosis, Achromatic apparatus, Synaptonemal complex. **3hrs**

2.3 fertilization, parthenogenesis

Unit -3

3.1 **Cell interaction and motility**:

3.1.1 Cell junctions- septate, tight and gap junctions, cell motility, flagellar and ciliary motion. **5 hrs**

3.1.2 Structure and function of muscle cells, muscle contraction, nerve cell structure and functions. **2 hrs**

3.2 **Special cells**

3.2.1 Stem cells, differentiation of stem cells and their application,

3.2.2 Blood cells, identification, structure and different types of blood cells

3.2.3 Cancer cells. Structure and different types of blood cells. Cancer cells. **4hrs**

PART-B
GENETICS

Unit 1

1.1 **History of genetics:** Introduction and historical overview of genetics.

1.2 **Mendelian Principles:**

Laws of inheritance- dominance, segregation and independent assortment, test cross, back cross. **5 hrs**

1.3 Deviations to Mendelian inheritance- the interaction of genes (13:3 ratio), incomplete dominance, co-dominance, epistasis, Sex-linked inheritance. **2hrs**

1.4 Chromosome theory of inheritance.

1.5 Linkage and crossing-over

Unit 2

2.1 **Mutation**: Natural and induced mutations, mutagenesis- physical, Chemical, and biological mutagens, molecular mechanisms, thymine dimers. **2hrs**

2.2 **Eukaryotic Chromosomes:** Types, chromatin structure, nucleosomes, higher-order chromatin organization. **3hrs**

2.3 Karyotype, Special chromosomes- lampbrush, polytene and B- chromosome. **2hrs**

Unit -3

3.1 **Chromosomal aberrations**: Deletion, duplication, inversion, translocation and ploidy. **5 hrs**

3.2 Chromosomal disorders in humans. (Down's, Turner's, Klinefiltees, cri-du-chat, Triplo x)

Unit-4

4.1 **Genetic recombination in bacteria**- Transformation, transduction and conjugation. **5 hrs**

4.2 **Extra-chromosomal inheritance in plants and animals –** Mitochondria and chloroplast

Reference books:

1. Microbiology: Dynamics and Diversity. M. J. Pelczar, R. D. Reid, Chan, E.C.S. New York, Harcout Brace College Publishers, 1997.
2. Microbiology. Prescott, Lansing M, Harley, John P, Klein, Donald A.Oxford, W M.C. Brown publishers, 1993.
3. Microbiology. Sharma, P.D. Meerut, Rastogi Publications, 1991.
4. Microbiology: An Introduction. Tortora, Gerard, J, Funke, Berdell, R, Case, Christine L. California, Cumming Publishing Company Inc, 1992.
5. Biological Science. 3 Edition. Taylor, D.J., Green, N.P.O. and Stout, G.W. Cambridge editions. Cambridge University Press. The U.K. in 1998.
6. Principles of Biochemistry. Lehninger, A. L., Nelson, D. V. and Cox, M. M. CBS publishers, Delhi. 1993.
7. Cell Biology, C. B. Power, III edition, Himalaya Publishing House, Mumbai.
8. Cell Biology- Fundamentals and applications. M.L. Gupta and M.L. Jangir. Agrobios (India), Jodhpur, 2002.

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PRACTICAL-II
Cell Biology and Genetics

Practical Duration -03 Hours per week Examination-03 Hours
MARKS=30.
Practical Proper-20 marks Internal Assessment - Record-05+ Class Test-05=10 marks

Part-A
CELL BIOLOGY

1. **Cell counting methods**: Haemocytometer
2. **Measurements with the help of the light microscope**
    a. Calibration of ocular micrometre
    b. Finding out average cell size

3. **Temporary preparation of stained samples for**
    a. mitosis (onion root tips),
    b. meiosis (grasshopper testis)

Part-B

GENETICS

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

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THIRD SEMESTER
BIOTECHNOLOGY PAPER-III
Title: ENZYMOLOGY AND CELLULAR METABOLISM
CLASS DURATION – 03 HOURS PER WEEK 48 Hours
MARKS-Theory - 50 + Internal Assessment -20= 70

SUBJECT DESCRIPTION: This course emphasizes Enzymes which are protein catalyst that regulates the rates at which physiological process takes place. Mammals such as humans need to process the absorbed products of digestion of dietary carbohydrates, lipids and protein. These are mainly glucose, fatty acids, glycerol and amino acids respectively.

OBJECTIVES: To enable the students to learn about the different types of enzymes and their isolation and purification which will pave the way how the students can enter the research field and also learn about the basic functions, principles and concepts of metabolism.

LEARNING OUTCOME: On successful completion of the course the students will acquire knowledge about Techniques of isolation & purification of the enzyme and Provides much information related to carbohydrate, fat and protein metabolism that takes place in our body.

PART-A

ENZYMOLOGY

Unit 1

1.1 **Role of proteins as biological catalysts,** isolation and purification of enzymes, Nomenclature, classification of enzymes

1.2 **Enzyme kinetics**- Michaelis and Menten equation with derivation, the significance of Km and Vmax, **5hrs**

Unit 2

2.1 **Enzyme inhibition**- competitive, uncompetitive and non-competitive, LB plots

Factors affecting enzyme activity-substrate concentration, pH, temperature, metal ions, inhibitors, allosteric inhibitors, activators. the energy of activation. **6hrs**

2.3 **Mechanism of enzyme action:** active and binding sites, enzyme-substrate complex formation, lock and key and induced fit theory.

Unit -3

3.1 **Allosteric enzymes –** simple sequential model, concerted or symmetry model **4hrs**

3.2 Co enzymes and co-factors.

Unit-4

4.1 **Isozymes**- Definition and explanation with examples **2hrs**

4.2 **Multienzyme complex**- Definition and explanation with examples **2hrs**

4.3 **Applications of enzymes:** clinical, analytical and biotechnological. **5hrs**

PART-B
CELLULAR METABOLISM

Unit 1

1.1 **Metabolism –** Definition, catabolism and anabolism, an overview of metabolic pathways. **2 hrs**

1.2 **Carbohydrate Metabolism:** Glycolysis-Reactions of the schematic pathway, Energetics and Stoichiometry. Fates of Pyruvate under aerobic and anaerobic conditions. **5hrs**

1.3 Diabetes melitus , Diabetes incipidus.

Unit 2

2.1 **TCA Cycle:** Reactions & Energetics **5 hrs**

2.2 **Gluconeogenesis:** Reactions and their significance.

2.3 **Photosynthesis:** Introduction, C3, C4 and CAM plants, Light and dark reactions, the efficiency of utilization of sunlight. Photorespiration

Unit -3

3.1 **Amino acid metabolism:**
Glucogenic and ketogenic amino acids, general reactions of amino acid metabolism- Transamination, Deamination(oxidative & nonoxidative) & Decarboxylation with suitable examples, **5hrs**

3.2 Urea cycle-Reactions and significance. **2hrs**

3.3 **Bioenergetics:**
Concept of free energy and high energy compounds (ATP),

3.4 Electron transport chain (representation only), and oxidative phosphorylation (Mechanism).

Unit-4

Lipid Metabolism:

4.1 α, β and ω oxidation of fatty acids(Definition only), β oxidation of fatty acids containing even number of carbon atoms. **5hrs**

4.2 Energetics and Biosynthesis of fatty acids containing even number of carbon atoms.

4.3 Cholesterol – Outline of biosynthesis.

4.4 **Metabolism of Nucleotides:** Degradation of Purines and Pyrimidines.

Reference books:

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

PRACTICAL-III

Practical Duration -03 Hours per week Examination-03 Hours

MARKS=30.

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

Enzymology and Cellular Metabolism

Part-A

Enzymology

Assay of Salivary amylase-

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

Part-B

Cellular Metabolism

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

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FOURTH SEMESTER

BIOTECHNOLOGY PAPER-IV

Title: PLANT CELL AND TISSUE CULTURE AND ANIMAL CELL CULTURE

CLASS DURATION – 03 HOURS PER WEEK 48 Hours

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

SUBJECT DESCRIPTION: Plant and animal tissue culture is a collection of techniques used to maintain or grow plant cells and animal cells, tissues, or organs under sterile conditions.

OBJECTIVES: GOALS: It enables students to know the basic importance and applications of plant and animal tissue culture in the field of research

LEARNING OUTCOME: This enabled the students to know the different types of media that are used in culturing techniques.

PART-A

PLANT CELL AND TISSUE CULTURE

Unit 1

1.1 Plant tissue culture introduction: 1.1 Importance, history and developments of plant tissue culture.

1.2 Laboratory organization and culture techniques: general requirements, aseptic conditions. Media preparation, culture media, sterilization, pretreatment to explants, **5hrs**

1.3 Problems and solutions associated with tissue culture.

Unit 2

2.1 Principles of tissue culture: callus culture-definition of callus, initiation, maintenance, subculture and organogenesis.

2.2 Organ culture – culture protocols and importance of root, meristem, ovary and ovule culture. Factors affecting organogenesis. **5 hrs**

Unit -3

3.1	Micropropagation in plants: 3.1 Advantages, methods, stages of micropropagations, applications.	**2 hrs**
3.2	Somaclonal variation for disease resistance and desired agronomic traits.	**2hrs**
3.3	Somatic embryogenesis: embryoid and embryogenesis, synthetic seeds and its applications.	**2hrs**
3.4	Suspension culture: batch and continuous cell suspension culture. Importance of suspension culture in the production of secondary metabolites.	**2 hs**

Unit-4

4.1	Protoplast culture and fusion: Definition of protoplast, isolation of protoplasts, culture protocol, regeneration of plants, protoplast fusion, somatic cell hybridization and its application.	**4hrs**
4.2	Anther culture and pollen culture.	**2hrs**

PART-B
ANIMAL CELL CULTURE TECHNOLOGY

Unit 1

1.1	**Introduction:** Importance, history and developments of animal cell culture.	**2 hrs**
1.2	Advantages and disadvantages of tissue culture methods, laboratory facilities.	
1.3	**Culture procedures**: Preparation and sterilization of glassware and apparatus, preparation and sterilization of regents.	**4hrs**

Unit 2

2.1	Preparation and sterilization of media	**5hrs**
2.2	Preparation and sterilization of animal material.	

Unit -3

3.1	**Animal tissue culture media**: Culture media containing naturally occurring ingredients, blood plasma, blood serum, serum-free media, tissue extracts,	**5 hrs**
3.2	Complex natural media, chemically defined media.	

Unit-4

4.1	**Primary culture, cell lines and cloning**: Primary and established cell lines, somatic cell fusion,	**4hrs**
4.2	Tissue cultures,(single coverslip cultures, double coverslip cultures, flask method)	
4.3	Whole embryo culture. Eg. Chick embryo.	
4.4	Application of animal cell culture.	**4hrs**

Reference books:

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

PRACTICAL-IV.
Plant Cell and Tissue Culture and Animal Cell Culture
Practical Duration -03 Hours per week Examination-03 Hours
MARKS=30.
Practical Proper- 20 marks Internal Assessment - Record-05+ Class Test-05=10 marks

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

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

SUBJECT DESCRIPTION: Molecular biology presents the mechanism of synthesis of DNA, RNA and proteins, gene regulation and gene mutation. Genetic engineering presents the basis of gene cloning, vectors, genetic engineering techniques.

OBJECTIVES: Molecular biology enables the students to learn about the synthesis and functions of molecules that make up living organisms, their mutation and the identification of mutants. Whereas Genetic engineering enables the students to have sound knowledge on cloning methods, techniques and applications of genetic engineering.

LEARNING OUTCOME: On successful completion of the course the student should have understood the synthesis of genetic material, RNA and proteins along with gene repair mechanism &gene mutation in Organism. On successful completion of genetic engineering, the student should have understood the basics, vectors, methods of gene cloning. And also the Techniques and application of gene technology.

PART-A

MOLECULAR BIOLOGY

Unit 1

1.1 **DNA as genetic material: 1.1** Experiments of Griffith, Avery and Hershey and chase. Semi conservative replication of DNA**.** **5 hrs**

1.2 Prokaryotic DNA synthesis: DNA polymerases, replication forks, coding and non-coding strand, replisome. Mechanism of DNA replication.

Unit 2

2.1 Concept of gene: functional units, promoter, introns and exons, lac operon.

2.2 Transcription of prokaryotic genes: RNA polymerase, initiation of transcription at promoter sites elongation and termination, inhibitors of transcription. **7hrs**

Unit -3

3.1 Genetic code: deciphering genetic code, major features of genetic code, wobble hypothesis, the universality of genetic code. **5hrs**

Unit-4

4.1 Translation: activation of amino acids, ribosome, the formation of initiation complex, initiation, elongation and termination, the fidelity of protein synthesis, inhibitors of protein synthesis, post-translational modifications. **5hrs**

4.2 Regulation of gene expression in prokaryotes and eukaryotes. **2hrs**

PART-B
GENETIC ENGENEERING

Unit 1

1.1 **Importance**, history, concepts and developments of genetic engineering

1.2 **Enzymes**- Restriction endonucleases, types of restriction enzymes, Ligases, alkaline phosphatases, polynucleotide kinase, terminal deoxynucleotidyl transferase, S1 nuclease, DNA polymerase, Klenow fragment, Taq DNA polymerase, ribonuclease, reverse transcriptase. **5hrs**

Unit 2

2.1 **Gene cloning, vectors and host**: Types of vectors, the importance of plasmids as cloning vectors, examples of plasmid types. Different forms of plasmids, plasmids coding for phenotypic traits. **5hrs** **2hrs**

2.2 **Cloning hosts**: E.coli, yeast, plant cells and mammalian cells.

Unit -3

3.1 Gene mapping, chromosome walking and jumping.

3.2 Recombinant DNA technology: Isolation of gene and mRNA, preparation of complementary DNA, genomic and cDNA libraries, probes and hybridization. **5hrs**

Unit-4

4.1 **Genetic engineering techniques**: Agarose electrophoresis, Southern and Northern blotting, PCR, Sanger's method of DNA sequencing **7hrs**

4.2 Outline of gene transfer methods.

Reference Books:

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

FIFTH SEMESTER

BIOTECHNOLOGY PAPER-VI

Title: IMMUNOLOGY AND MEDICAL BIOTECHNOLOGY

CLASS DURATION – 03 HOURS PER WEEK 48 Hours

MARKS-Theory – 70 + Internal Assessment -30= 100

SUBJECT DESCRIPTION: Immunology presents a wide knowledge of all the aspects of the immune system for biomedical applications.
Medical biotechnology is the use of living cells and cell materials to research and produces pharmaceutical and diagnostic products that help treat and prevent human diseases.

OBJECTIVES: Immunology enables the students to learn about principles based on antigen and antibody interactions which help in the field of medicine and detection of diseases. Medical biotechnology enables the students to know the techniques involved in the diagnosis and treatment of disorders.

LEARNING OUTCOME: On successful completion immunology the student should have understood the detailed aspects of immune cells, organs and their role in hypersensitivity reactions.

PART-A
IMMUNOLOGY

Unit 1

1.1 **Historical account** – Contributions of Edward Jenner and Louis Pasteur. **2hrs**

1.2 **Types of immunity**: Innate- mechanisms of innate immunity. Adaptive – active, passive and adoptive. **5hrs**

Unit 2

2.1 **Antigens**: Definition, haptens, epitopes, antigenicity, blood group antigens.
Immunization: passive and active, adjuvants, vaccines, primary and secondary response

2.2 **Antibodies:** Definition, Types, the structure of IgG **5hrs**

2.3 **Immunization**: passive and active, adjuvants, vaccines, primary and secondary immune response.

Unit -3

3.1 **Cellular basis of immunity**: T-cells, cell-mediated immunity and types B-cells humoral immunity and macrophages, their role in antigen recognition, clonal selection, immunological memory**.**

3.2 Immunological aspects of viral (HIV), bacterial and parasitic infection **5hrs**

Unit-4

4.1 **Immune disorders**: Autoimmune disorders- Grave's disease, Hashimoto's disease, Systemic Lupus erythromatosus. Hypersensitivity types. **5 hrs**

4.2 **Transplantation immunology**.

4.3 **Immunotechniques:** Affinity and avidity, precipitation reaction, immunodiffusion, ELISA, Western blotting**.** **2hrs**

PART-B
MEDICAL BIOTECHNOLOGY

Unit 1

1.1 Vaccine production- new developments: introduction, advantages of subunit vaccines over existing vaccines. **4 hrs**

1.2 Production of vaccines by genetically engineered organisms.

1.3 Edible vaccine. **2 hrs**

Unit 2

2.1 **Nucleic acid analysis**: features of DNA probe and its applications in diagnosis, **6 hrs**

2.2 Diagnosis of infectious diseases, and identification of mycobacterium tuberculosis in clinical samples using PCR.

2.3 **Antibiotics:** introduction, strain development and improvements of strain by genetic engineering

Unit 3

3.1 **Enzymes in diagnosis**: enzymes used for diagnosis, immobilized enzymes as diagnostic tools, diagnostic proteins e.g. AIDS diagnosis **4hrs**

3.2 **Enzymes in therapy**: list of enzymes and their therapeutic applications

3.3 **Hormone Therapy:** list of hormones produced by recombinant DNA technology and their therapeutic applications, production of interferon by recombinant DNA technology. **2hrs**

Unit 4

4.1 **Human Gene Therapy:** Definition, differences between somatic versus germline gene therapy. One example each for ex-vivo and in vivo gene therapy **6 hrs**

4.2 Antisense technology: principle and applications

4.3 Transgenic animals and plants for the production of biopharmaceuticals.

Reference Books:

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

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PRACTICAL V
Molecular Biology, Genetic Engineering

Practical Duration -02 Hours per week Examination -03 Hours
MARKS=50.
Practical Proper -35 marks Internal Assessment – Record-05+ Class Test-10=15 marks

PRACTICAL V
Part-A MOLECULAR BIOLOGY

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

Part-B GENETIC ENGINEERING

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

PRACTICAL VI

IMMUNOLOGY & MEDICAL BIOTECHNOLOGY

Practical Duration -02 Hours per week Examination -03 Hours
MARKS=50
Practical Proper -35 marks Internal Assessment – Record-05+ Class Test-10=15 marks

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

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SIXTH SEMESTER
BIOTECHNOLOGYPAPER-VII
Title: MICROBIAL TECHNOLOGY AND AGRICULTURAL BIOTECHNOLOGY
CLASS DURATION – 03 HOURS PER WEEK 48 Hours
MARKS-Theory - 70 + Internal Assessment -30= 100

SUBJECT DESCRIPTION: Microbial biotechnology encompasses the use of microorganisms in the manufacture of food or industrial products. Agricultural biotechnology includes a range of tools that scientists employ to understand and manipulate the genetic make-up of organisms for use in the production or processing of agricultural products

OBJECTIVES: It enables the students to learn the tools and techniques involved in microbial and agricultural biotechnology.

LEARNING OUTCOME: On successful completion of microbial and agricultural biotechnology the student should have understood the detailed aspects of the application of microorganisms for industrial product formation and improvement of the crop.

PART-A

MICROBIAL TECHNOLOGY

Unit 1

1.1 Introduction to biotechnological importance of microorganisms**.**

1.2 **Metabolic pathways** involved in microbial products, primary and secondary metabolites, enzymes and microbial biomass**.** **6 hrs**

Unit 2

2.1 **Microbial production:** use of microbes in the production of vitamins, enzymes, organic acids, amino acids, polysaccharides, growth regulators, colourants, flavours, sweeteners, emulsifiers, proteins, lipids and antibiotics. **6hrs**

Unit 3

3.1 Process for the production of vitamin - C and Penicillin, **5hrs**

3.2 Fermenters – types, Batch & continuous cultures with examples

Unit 4

Microbial pesticides: fungicides and herbicides. **5hrs**

4.1 Bacterial, fungal and viral bioagents- *Bacillus thuringiensis* (Bt). *Beauveria bassiana*, baculoviruses.

4.2 Mechanism of biological control of plant diseases- induced resistance, hypovirulence, competition, antibiotics, Mycoparasitism **2hrs**

PART-B

AGRICULTURAL BIOTECHNOLOGY

1.1 **Introduction :** **6hrs**

Conventional crop improvement techniques and their limitations, biotechnology for crop improvement, prospects of biotechnology for agriculture.

1.2 Biological nitrogen fixation: nitrogen-fixing microorganisms, the role of nitrogen, genetics of nitrogen fixation, regulation of nif gene expression.

Unit 2

2.1 **Biofertilizers and Phyto – stimulants:** Mechanism of growth promotion by microbial inoculants. **5hrs**

2.2 Mass production of Brady rhizobium and rhizobium, Azospirullum,Azatobacter, Mycorhizae.

Unit 3

3.1 **Genetic engineering of crop plants:** Gene transfer techniques for desirable traits in crop plants – agrobacterium mediated gene transfer, direct gene transfer to protoplast, biolistic gene transfer. **5hrs**

3.2 Few examples of transgenic plants obtained through gene transfer techniques- Bt cotton, herbicide-tolerant soybean, virus-resistant (papaya ringspot). **2hrs**

Unit-4

4.1 **Food biotechnology: food processing**

Biotechnological approaches, fruit ripening and its manipulation, roll-off ACC synthase, genetically modified foods, transgenic fish **6hrs**

4.2 Biotechnology in the dairy industry.

Reference Books:

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

SIXTH SEMESTER
BIOTECHNOLOGYPAPER-VIII

Title: ENVIRONMENTAL BIOTECHNOLOGY AND BIOPHYSICS, BIOSTATISTICS

CLASS DURATION – 03 HOURS PER WEEK 48 Hours
MARKS-Theory - 70 + Internal Assessment -30= 100

SUBJECT DESCRIPTION: Environmental Biotechnology is the multidisciplinary integration of sciences and engineering to utilize the huge biochemical potential of microorganisms, plants and parts thereof for the restoration and preservation of the environment and the sustainable use of resources. Biophysics is an interdisciplinary science that uses the methods of physical science to study biological systems

OBJECTIVES: Environmental Biotechnology enables students to learn the biotechnological aspects of pollution control. Biophysics enable a wide scope of problems related to the main physical mechanisms of processes taking place on different organization levels in biosystems.

LEARNING OUTCOME: The major objective of Environmental Biotechnology is to impart knowledge on the application of biotechnological processes for the betterment of the environment. Biophysics: On completion of the program, students will be skilled in both the fields of physics and biology and in the use of their respective tools.

PART-A

ENVIRONMENTAL BIOTECHNOLOGY

Unit 1

1.1 **Introduction:** major issues in environmental pollution- the role of biotechnology to solve the problem.

1.2 **Biotechnological methods of pollution detections**: General bioassay, cell biological methods, immunoassays, DNA based methods, use of biosensors. **5hrs**

Unit 2

2.1 **Biotechnological methods in pollution abatement:** reduction of CO_2 emission. **5hrs**

2.2 Wastewater treatment- conventional wastewater treatment.

2.3 Use of algae, eutrophication, use of cell immobilization.

Unit 3

3.1 **Biotechnological and biodegradation**: degradation of xenobiotic compounds- simple, aromatic, chlorinated polyaromatic, petroleum products, pesticides and surfactant. **5hrs**

3.2 **Bio-hydrometallurgy and biomining**: bioleaching, biosorption, oil degradation, the superbug. **2hrs**

3.3 **Bioremediation** – in-situ and ex-situ bioremediation

Unit 4

4.1 **Treatment of industrial waste**: dairy, pulp, dye, leather and pharmaceutical industries.

4.2 Solid Waste Management **5hrs**

4.3 Genetically engineered microbes for waste treatment.

4.4 **Ecofriendly bioproducts**: biomass resources, biogas, alcohol as fuel, biological hydrogen **2hrs**

PART-B

BIOPHYSICS & BIOSTATISTICS

Unit 1

1.1 Scope and development of Biophysics

1.2 Analytical techniques **2hrs**

Principles and applications of

a) Chromatography (Paper, thin-layer, column and GLC) **5hrs**

b) Centrifugation (RPM and G, Ultracentrifugation)

Unit 2

2.1 Spectroscopic techniques, UV, visible spectroscopy, X-ray crystallography, NMR, IR,

2.2 Isotopes - Types, the measure of radioactivity, GM counters &Scintillation counting. **5hrs**

Unit 3

3.1 **Statistical concepts:** Data structure, collection of data, classification of data and tabulation of data, diagrammatic presentation of data, graphical representation**,** **5hrs**

3.2 **A measure of Central Frequency:** Mean, median and mode, Problems on Mean, Median and Mode

Unit 4

4.1 **A measure of the dispersion of data:** Range, semi-interquartile range, mean deviation, standard deviation, coefficient of variation. **5hrs**

4.2 Sampling and Test of significance

4.3 Chi-square test and Goodness of fit **2hrs**

Reference Books:

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

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PRACTICAL- VII AND VIII

Microbial Technology & Agricultural Biotechnology and Environmental Biotechnology Biophysics & Biostatistics

Practical Duration -02 Hours per week Examination -03 Hours

MARKS=50

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

PRACTICAL-VII

MICROBIAL TECHNOLOGY & AGRICULTURAL BIOTECHNOLOGY

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

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PRACTICAL- VIII

Environmental Biotechnology Biophysics & Biostatistics

Practical Duration -02 Hours per week Examination -03 Hours
MARKS=50
Practical Proper -35 marks Internal Assessment – Record-05+ Class Test-10=15 marks

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

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DISCIPLINE SPECIFIC ELECTIVES (DSE)

BIOTECHNOLOGY

SEMESTER- V & VI

Title: DISSERTATION

CLASS DURATION – 02 HOURS PER WEEK 2 CREDITS

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

DISSERTATION

1. Project on review article.

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

3. The Dissertation work will be in the final semester

4. The Dissertation report (also work book shall be presented at the time of presentation and viva voce) will be submitted at the end of the Semester and evaluated.

5. Three copies of the project report shall be submitted to the HOD.

6. The evaluation will be done by ppt presentation.

DISCIPLINE SPECIFIC ELECTIVES (DSE)

BIOTECHNOLOGY

SEMESTER- V & VI

Title: RESEARCH METHODOLOGY IN BIOTECHNOLOGY

CLASS DURATION – 02 HOURS PER WEEK 2 CREDITS

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

32HRS

OBJECTIVES: To enable students to:

Become knowledgeable of the research process and its different approaches. Develop critical thinking to find business opportunities and to solve questions related to service industries.

LEARNING OUTCOME: the student will be able to:

1. Apply a range of quantitative and/or qualitative research techniques to business and management problems/issues
2. Understand and apply research approaches, techniques and strategies in the appropriate manner for managerial decision making
3. Demonstrate knowledge and understanding of data analysis and interpretation with the research process
4. Conceptualise the research process
5. Develop necessary critical thinking skills to evaluate different research approaches utilised in the service industries

UNIT 1

1.1 Introduction to Research Methodology: Meaning of Research, Objectives of Research, Motivations in Research, Types of Research, Research Approaches, Significance of Research, Research Methods v/s Methodology, Research and Scientific Methods, Research Process, Criteria of Good Research

1.2 Defining the Research Problem: What is Research Problem?, Selecting the Problem, Necessity of and Techniques in defining the problem,

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

1.4 Basic Principles of Experimental Design, Developing a Research Plan

12 hrs

UNIT 2

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

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

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

2.3 GC-MS, LCMS, NMR. **14hrs**

UNIT-3

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

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

3.3 Hypothesis as a framework for scientific projects. Alternatives to hypothesis-driven research:

hypothesis-generating research, Writing research hypothesis (grant). Presenting research: oral and poster. **6hrs**

Reference:

1. Research Methods for the Biosciences. Holmes, Moody & Dine.Oxford University Press.
2. Experimental Design for the Life Sciences. Ruxton&Colegrave.Oxford University Press.
3. Experimental Design for Biologists. David J. Glass. Cold Spring Harbor Laboratory.
4. Kothari, C.R., Research Methodology (Methods and Techniques), New Age Publisher

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DISCIPLINE SPECIFIC ELECTIVES (DSE)

BIOTECHNOLOGY
SEMESTER- V & VI
Title: EPIGENETICS AND CANCER BIOLOGY

CLASS DURATION – 02 HOURS PER WEEK 2 CREDITS

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

32 Hours

OBJECTIVES: The primary objectives are : (1) understanding the epigenetic regulation in normal & cancer cells; (2) deciphering epigenetic pathways and molecular targets in malignant transformation; (3) learning the impact of epigenetic alterations associated with cancers; 4) reviewing recent advances in epigenetic issues/phenomena by highlighting the growing importance of epigenetic therapeutics in cancers; (5) learning the scientific approaches/methods employed to define epigenetic-mediated cancer drivers and their therapeutic potential. Moreover, a broad range of topics will be covered by discussing landmark papers and emerging concepts in the field of epigenetic research. In the class, students will discuss background materials, including papers related to individual topics.

UNIT – 1

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

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

8Hrs

UNIT –2

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

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

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

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

UNIT – 3

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

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

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

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

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

Reference :

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

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

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

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

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

DISCIPLINE SPECIFIC ELECTIVES (DSE)

BIOTECHNOLOGY

SEMESTER- V & VI

Title: INTELLECTUAL PROPERTY RIGHTS, PATENTING AND BIOETHICS

CLASS DURATION – 02 HOURS PER WEEK 2 CREDITS

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

32HRS

Unit 1

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

1.2 Introduction to Intellectual Property: Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of GMOs IP as a factor in R&D; IPs of relevance to Biotechnology and few.

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

12Hrs

Unit 2

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

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

8hrs

Unit 3

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

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

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

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

3.5 Patent infringement- meaning, scope, litigation, case studies **12hrs**

Reference:

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

2. Kankanala C., Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd., 2007

Important Links:

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

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

http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html

http://www.patentoffice.nic.in

DISCIPLINE SPECIFIC ELECTIVES (DSE)

BIOTECHNOLOGY

SEMESTER- V & VI

Title:- MEDICAL & NANOBIOTECHNOLOGY

CLASS DURATION – 02 HOURS PER WEEK 2 CREDITS

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

32 Hours

Objectives and Expected Learning Outcomes:

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

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

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

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4. To understand viral evolution mechanisms and how they contribute to the emergence and re-emergence of viral disease

5.To become familiar with biological, environmental and human behaviour (including social and political behaviour) contributes to the transmission of viruses, particularly emerging and re-emerging
disease

6.To comprehend and appreciate the major and varied laboratory techniques and research approaches employed in the field of virology

UNIT –1

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

1.2 Structures of animal and plant viruses and their morphology.

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

UNIT – 2

2.1 Virus Replication: Structure and replication strategies of bacteriophages - T7, λ, ΦX174, and plant viruses - ss RNA virus (TMV) and ds DNA virus (CaMV).

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

UNIT – 3

3.1 Interferon and Antiviral Agents: Viral Interference and Interferons.

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

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

3.4 Modern vaccines - Recombinant proteins, subunits, DNA vaccines, peptides, immunomodulators (cytokines). Vaccine delivery and adjuvants, large-scale manufacturing.

12Hrs

Reference:

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

DISCIPLINE SPECIFIC ELECTIVES (DSE)

BIOTECHNOLOGY

SEMESTER-II, III & IV

Title:- MEDICAL & NANOBIOTECHNOLOGY

CLASS DURATION – 02 HOURS PER WEEK 2 CREDITS

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

32 Hours

Objectives: The science of Pharmaceutical biotechnology is a dynamic science aims at focusing the the attention of students at some basic knowledge about biological techniques used in producing some of the biological drugs as Penicillin and monoclonal antibodies and some basic principles and definitions related to Pharmaceutical biotechnology as tissue culture and genetic engineering.

Learning outcome:

1. Recognise information about molecular biology and genetics.
2. Improve the pharmaceutical theoretical skills to be able to formulate dosage forms and evaluate preparations for drug contents and purity assessment.
3. Investigate biotechnology applications in the pharmaceutical field

UNIT 1

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

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

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

UNIT 2

2.1 Metabolism of Drugs and Xenobiotics

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

UNIT 3

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

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

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

DISCIPLINE SPECIFIC ELECTIVES (DSE)

BIOTECHNOLOGY

SEMESTER-II, III & IV

Title:- MEDICAL & NANOBIOTECHNOLOGY

CLASS DURATION – 02 HOURS PER WEEK 2 CREDITS

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

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32 Hours

Objective: Learn the wide range of applications of nanotechnology and its interdisciplinary aspect.

* Learn the principles governing the effect of size on material properties at the nanoscale, and perform quantitative analysis.

* Familiarize the students with native bio-nanomachinery in living cells, how cells use these "soft machines" for generating energy, motion, synthesizing biomolecules, and how these principles can be applied to design new biomolecules and bio-nano devices.

Learning outcome: Learn the wide range of applications of nanotechnology and its interdisciplinary aspect. students Learn the principles governing the effect of size on material properties at the nanoscale and perform quantitative analysis.

UNIT 1

1.1 Introduction to Nanoworld: The nanoscale dimension and paradigm, Definitions and historical evolution (colloids, etc.) and current practice.

1.2 Nanoscience and Nanotechnology - Types of nanomaterials and their classifications (1D, 2D and 3D, etc.) Nanoparticles, Nanowires, thin films and multilayer.

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

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

UNIT – 2

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

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

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

Protozoa: Malaria

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

UNIT 3

Nanobiotechnology in Plant Management:

3.1 Nanotechnology: a new opportunity in plant sciences, Role of nanoparticles in plants

3.2 Nanotechnology in fertilizers, Nanotechnology in agricultural diseases and food safety.

3.3 Nanoparticles in sustainable agricultural crop production: applications and perspectives,

3.4 Nanotechnology: scope and application in plant disease management **8hrs**

REFERENCES:

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

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

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

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

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DISCIPLINE SPECIFIC ELECTIVES (DSE)

BIOTECHNOLOGY

SEMESTER-II,III & IV

Title:- GENOMICS& PROTEIOMICS

CLASS DURATION – 02 HOURS PER WEEK 2 CREDITS

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

32 Hours

Objective:

1. The objective of the course is to organise a large amount of information about genomics, proteomics and bioinformatics and offer basic knowledge of genome sequencing, major differences

between prokaryotic and eukaryotic genomes, basic proteomics and its applications, basics in bioinformatics, comparative and evolutionary genomics and applications.

Learning outcomes:

1. Students learn the uses of functional genomics and proteomics in agriculture, ecotoxicology and human health.
2. One can identify and discuss the techniques used in functional genomics such as microarrays, next-generation sequencing technology, mRNA expression and miRNA expression; and Interpret data obtained through high throughput expression studies.

UNIT 1

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

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

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

UNIT 2

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

2.2 Approaches to analysing global gene expression: transcriptome, Serial Analysis of Gene Expression (SAGE), Expressed Sequence Tags (ESTs), SNPs and their relevance, Massively Parallel Signature

2.3 Sequencing (MPSS), microarray and its applications, gene tagging.

2.4 Metagenomics: Prospecting for novel genes from metagenomes and their biotechnological applications. **12 Hrs**.

UNIT 3

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

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

REFERENCES:

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

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

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

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

DISCIPLINE SPECIFIC ELECTIVES (DSE)

BIOTECHNOLOGY

SEMESTER-II, III & IV

Title: - MOLECULAR PLANT PHYSIOLOGY

CLASS DURATION – 02 HOURS PER WEEK 2 CREDITS

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

32 Hours

Course objectives:

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

* To deliver a molecular understanding of the primary and secondary metabolic process.

* To present perspectives of the current tools for application in biological systems for biotechnological research.

Learning outcomes

* This module will provide an understanding of the unique features of plant cells and a general grounding on plant physiology and growth.

* Also it will provide a brief introduction to the various physiological, molecular, and biochemical mechanisms plants use to respond to environmental stresses like extreme temperature, drought, salt, and pathogens.

UNIT – 1

1.1 Photosynthesis alternative respiration and Hexose monophosphate.

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

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

UNIT – 2

Mineral Nutrition in Plants :

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

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

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

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

8hrs

UNIT – 3

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

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

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

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

deterioration of fruits, vegetables and cut flowers. **12hrs**

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

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

BIOTECHNOLOGY
BluePrint of question paper Biotechnology forI, II, III& IV sem
Time-03Hrs Max Marks-60

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

BIOTECHNOLOGY

Blue Print of question paper Biotechnology for V& VI sem

Time-03Hrs Max Marks-70

Part-A			
1.	**Define /Explain any five of the following:**		**5x2=10M**
	a		
	b		
	c		
	d		
	e		
	f		
Part-B			
	Write a note on any Six of the following:		**6x5=30M**
2			
3			
4			
5			
6			
7			
8			
Part-C			
Answer any Three of the following Questions:			**3x10=30M**
9			
10			
11			
12			

BIOTECHNOLOGY

Blue Print of question paper Biotechnology DSE

Time-02Hrs Max Marks-30

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

Internal assessment =20Marks

1. Seminar-10M

2. Test/Quiz-10M