ST. PHILOMENA'S COLLEGE (Autonomous), MYSURU-570 015

Subject: BIOTECHNOLOGY

REVISED SYLLABUS FOR B.Sc., UNDER SEMESTER SCHEME

From The Academic Year2016-17 Onwards

The Scheme of Teaching & Examination

Semester	Title of the Paper	Code No	Teaching Hours / Week			Examination			
			Theory	Practical	Credits	Duration	Theory/ Practical Max. Marks	I A Max Marks	Total
I	Paper-I Biomolecules and Microbiology	16MA 240	3	-	3	3	60	10	100
	Practical Paper-I Biomolecules And Microbiology	16MA242	-	3	1.5	3	20	10	
II	Paper-II Cell Biology and Genetics	16MB240	3	-	3	3	60	10	100
	Practical Paper-II Cell Biology and Genetics	16MB242	-	3	1.5	3	20	10	
III	Paper-III Enzymology and Cellular metabolism	16MC240	3	-	3	3	60	10	100
	Practical Paper-III Enzymology and Metabolism	16MC242	-	3	1.5	3	20	10	
IV	Paper-IV Plant tissue culture and Animal cell culture	16MD240	3	-	3	3	60	10	100
	Practical Paper-IV Plant tissue culture and Animal cell culture	16MD242	-	3	1.5	3	20	10	
V	Paper-V Molecular Biology and Genetic Engineering	16ME240	3	-	3	3	80	20	300
	Practical Paper-V Molecular Biology and Genetic Engineering	16ME244	-	2	1	3	40	10	
	Paper-VI Immunology and Medical biotechnology	16ME242	3	-	3	3	80	20	
	Practical Paper-VI Immunology and Medical biotechnology	16ME246	-	2	1	3	40	10	
VI	Paper-VII Microbial Technology and Agricultural Biotechnology	16MF240	3	-	3	3	80	20	300
	Practical Paper-VII Microbial Technology and Agricultural Biotechnology	16MF 244	-	2	1	3	40	10	
	Paper-VIII Environmental Biotechnology and Biophysics , Biostatistics	16MF242	3	-	3	3	80	20	
	Practical Paper-VIII Environmental Biotechnology and Biophysics , Biostatistics	16MF 246	-	2	1	3	40	10	
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ST. PHILOMENA'S COLLEGE (AUTONOMOUS), MYSORE-570 015

A COLLEGE WITH POTENTIAL FOR EXCELLENCE (UGC)

SUBJECT- BIOTECHNOLOGY

SYLLABUS FOR B. Sc., COURSE UNDER SEMESTER SCHEME

DURATION OF THE COURSE - THREE YEARS-SIX SEMESTERS

FROM THE ACADEMIC YEAR- 2016-17 Onwards

FIRST SEMESTER

BIOTECHNOLOGY PAPER-I

Title:BIOMOLECULES AND MICROBIOLOGY

CLASS DURATION – 03 HOURS PER WEEK **40Hours**

Marks-Theory - 60 + Internal Assessment -10= 70

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

Microorganisms are an heterogeneous group of organisms normally detectable for the human eye only by means of magnifying instruments (microscops). 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.

GOALS: 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.**

Study of microbiology enables students to understand the techniques involved in microbial culture, different microbial disorder.

OBJECTIVES: 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 –I	**Carbohydrates:** monosaccharides- ribose, glucose, galactose and fructose, reducing and non reducing sugars. Stereochemistry – epimers, enantiomers, anomers, isomers concept, Fischer and Haworth structure of disaccharides- sucrose, maltose and **lactose. Structure of polysaccharides – starch and glycogen. Racemization.**	**5Hrs**
Unit –II	**Proteins:** amino acids- generalized zwitterionic structure, essential and non essential amino acids , classification based on polarity, pKa value , D and L amino acids, optical activity, peptide bond, structure of oxytocin and insulin. Primary, secondary, tertiary and quaternary structural organization of proteins. Globular and fibrous proteins with special reference to structure of hemoglobin , collagen & Myoglobin**.**	**5 Hrs**
Unit III	**Lipids:** classification of lipids with examples. Simple and compound lipids, unsaturated and saturated fatty acids. Nomenclature of fatty acids. Physical and chemical properties of oils and fats. Structure and role of different types of lipids – glycolipids, phospholipids, sphingolipids & cholesterol.	**5 Hrs**
Unit– IV	**Nucleilc acids:** Nomenclature of bases, nucleosides nucleotides. Structure of DNA **,**types of DNA (A, B & Z forms), structure and types of RNA	**5 Hrs**

PART-B

MICROBIOLOGY

Unit – I	**General introduction**, scope and history, important discoveries by Robert Koch, Leeuwenhoek, Jenner, Pasteur, Fleming and iwanosky. **Basic microbiological techniques**: sterilization, disinfection, microscopy: electron microscopy Concept of prokaryotes and eukaryotes. General account on structure, classification and reproduction of bacteria, virus and fungi.	**1Hrs** **2Hrs** **4Hrs**

Unit II	**Microbiological nutrition and growth**: nutritional classes of micro organisms, culture media, pure culture, microbial growth pattern and methods of growth measurements, methods of maintenance and preservation of culture. **Fermentative types of microorganisms** – Aerobes, anaerobes and facultative anaerobes Physical and chemical control of microorganisms; antimicrobial agents- penicillin and tetracycline	**4hrs** **1hr** **2hrs**
Unit III	Role of microbes in bio geo cycles (nitrogen, carbon, sulphur and phosphorous cycle), biological nitrogen fixation. **Microbial diseases** : important plant diseases – downy mildew , bacterial leaf blight, TMV and animal diseases- Tuberculosis ,rabies and Candidiosis. Causative agents and control. Normal flora of the human body. Food spoilage, Microbial examination of food, food preservation, food poisoning.	**2Hrs** **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, NewDelhi, 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, Harely, 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.

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 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 AND GENETICS
CLASS DURATION – 03 HOURS PER WEEK 40 Hours
MARKS-Theory - 60 + Internal Assessment -10= 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.

GOALS: 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 Microbiology, students should be able to demonstrate an understanding of core concepts of microbiology whereas major goals of genetics have been to understand the relative contribution of heritable and environmental factors to trait variation.

OBJECTIVES: 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 I	**General Introduction**: Historical perspective, the cell theory, Ultra structure of plant and animal cell, different types of cells. **Cytological techniques** – teasing, smear preparation, squash preparation, whole mount , microtomy. **Cell organelles:** Structural and function of: cell wall, plasma membrane, membrane proteins, cytoplasm, nucleus, mitochondria, chloroplast, Golgi bodies, endoplasmic reticulum, ribosomes, lysosome, peroxisome.	**3 hrs**
Unit II	**Cell Division :** Cell cycle, phases and regulation of cell cycle, cell division, Mitosis and meiosis, comparison between mitosis and meiosis, fertilization, parthenogenesis , interphase nucleus , Achromatic apparatus, Synaptonemal complex.	**5hrs**
Unit -III	**Cell interaction and motility**:, Cell junctions- septate, tight and gap junctions, cell motility, flagellar and ciliary motion. Structure and function of muscle cells, muscle contraction, nerve cell structure and functions. **Special cells:** Stem cells, differentiation of stem cells and their application, blood cells, identification, structure and different types of blood cells. Cancer cells.	**5 hrs** **2 hrs**

PART-B
GENETICS

Unit-I	**History of genetics:** Introduction and historical overview of genetics **Mendelian Principles:** Laws of inheritance- dominance, segregation and independent assortment, test cross, back cross. Deviations to Mendelian inheritance- interaction of genes (13:3 ratio), incomplete dominance, co-dominance, epistasis, Sex-linked inheritance, chromosome theory of inheritance. Linkage and crossing-over.	**5 Hrs**

Unit-II	**Mutation**: Natural and induced mutations, mutagenesis- physical, Chemical, and biological mutagens, molecular mechanisms, thymine dimers. **Eukaryotic Chromosomes:** Types, chromatin structure, nucleosomes , higher order chromatin organization. Karyotype , Special chromosomes- lampbrush, polytene and B- chromosome.	**5 Hrs**
Unit-III	**Chromosomal aberrations**: Deletion, duplication, inversion, translocation and ploidy. Chromosomal disorders in humans.(Down's, Turner's, Klinefiltees, cri-du-chat, Triplo x)	**5 Hrs**
Unit- IV	**Genetic recombination in bacteria**- Transformation, transduction and conjugation. **Extra chromosomal inheritance in plants and animals –** Mitochondria and chloroplast	**5 Hrs**

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, Harely, 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. U.K. 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.

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 light microscope**
   a. Calibration of ocular micrometer
   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 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 colored beads
   a. Law of segregation
   b. Law of independent assortment.

THIRD SEMESTER
BIOTECHNOLOGY PAPER-III
Title: ENZYMOLOGY AND CELLULAR METABOLISM
CLASS DURATION – 03 HOURS PER WEEK 40 Hours
MARKS-Theory - 60 + Internal Assessment -10= 70

SUBJECT DESCRIPTION: This course emphasizes about 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.

GOALS: To enable the students to learn about the different types of enzymes and its isolation and purification which will pave the ways in which the students can enter in research field and also to learn about the basic functions, principles and concepts of metabolism.

OBJECTIVES: 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-I	**Role of proteins as biological catalysts,** isolation and purification of enzymes, Nomenclature, classification of enzymes **Enzyme kinetics**- Michaelis and Menten equation with derivation, significance of Km and Vmax,	**5 Hrs**
Unit-II	**Enzyme inhibition**- competitive , uncompetitive and noncompetitive, LB plots **Factors affecting enzyme activity**-substrate concentration, pH, temperature, metal ions, inhibitors, allosteric inhibitors, activators. Energy of activation. **Mechanism of enzyme action:** active and binding sites, enzyme-substrate complex formation, lock and key and induced fit theory.	**6 Hrs**
Unit- III	**Allosteric enzymes –** simple sequential model, concerted or symmetry model Co enzymes and co factors.	**4 Hrs**
Unit IV	**Isozymes-** Definition and explanation with examples **Multienzyme complex**- Definition and explanation with examples **Multifunctional enzymes** Definition and explanation with an examples **Applications of enzymes:** clinical, analytical and biotechnological.	**5 Hrs**

PART-B
CELLULAR METABOLISM

Unit-I	**Metabolism –** Definition, catabolism and anabolism , overview of metabolic pathways. **Carbohydrate Metabolism:** Glycolysis-Reactions of schematic pathway, Energetics and Stoichiometry. Fates of Pyruvate under aerobic and anaerobic conditions. Diabetes	**5 Hrs**
Unit - II	**TCA Cycle:** Reactions & Energetics. **Gluconeogenesis:** Reactions and its significance. **Photosynthesis:** Introduction, C3, C4 and CAM plants, Light and dark reactions, efficiency of utilization of sunlight. Photorespiration	**5 Hrs**

Unit-III	**Amino acid metabolism:** Glucogenic and ketogenic aminoacids, general reactions of aminoacid metabolism- Transamination, Deamination(oxidative & nonoxidative) & Decarboxylation with suitable examples, urea cycle-Reactions and significance **Bioenergetics:** Concept of free energy and high energy compounds (ATP), Electron transport chain (representation only), and oxidative phosphorylation (Mechanism).	**5 Hrs**
Unit-IV	**Lipid Metabolism:** α, β and ω oxidation of fatty acids(Definition only) , β oxidation of fatty acids containing even number of carbon atoms, Energetics and Biosynthesis of fatty acids containing even number of carbon atoms. Cholesterol – Outline of biosynthesis. **Metabolism of Nucleotides:** Degradation of Purines and Pyrimidines.	**5 Hrs**

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
Enzymology and Cellular Metabolism

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
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- albumine, glucose and ketone bodies.
3. Estimation of creatinine by Jaff'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 40 Hours
MARKS-Theory - 60 + Internal Assessment -10= 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.

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

OBJECTIVES: This enabled the students to know the different types of medias that are used in culturing techniques.

PART-A

PLANT CELL AND TISSUE CULTURE

Unit I	**Plant tissue culture introduction**: Importance, history and developments of plant tissue culture. Laboratory organization and culture techniques: general requirements, aseptic conditions. Media preparation, culture media, sterilization, pretreatment to explants, problems and solutions associated with tissue culture.	**5 Hrs**
Unit-II	Principles of tissue culture: callus culture-defination of callus , initiation, maintenance, sub culture and organogenesis . Organ culture – culture protocols and importance of root, meristem, ovary and ovule culture. Factors affecting organogenesis.	**5 Hrs**
Unit –III	**Micro propagation in plants:** Advantages, methods, stages of micropropogation, applications. **Somaclonal variation** for disease resistance and desired agronomic traits. **Somatic embryogenesis:** embryoid and embryogenesis, synthetic seeds and its applications. **Suspension culture:** batch and continuous cell suspension culture. Importance of suspension culture in production of secondary metabolites**.**	**2 Hrs** **2 Hrs**
Unit –IV	**Protoplast culture and fusion**: Definition of protoplast, isolation of protoplasts, culture protocol, regeneration of plants, protoplast fusion, somatic cell hybridization and its application. Anther culture and pollen culture.	**2 Hrs**

PART-B

ANIMAL CELL CULTURE TECHNOLOGY

Unit-I	**Introduction:** Importance, history and developments of animal cell culture. Advantages and disadvantages of tissue culture methods, laboratory facilities. **Culture procedures**: Preparation and sterilization of glasswares and apparatus, preparation and sterilization of regents .	**2 Hrs** **4 Hrs**
Unit-II	preparation and sterilization of media, preparation and sterilization of animal material.	**4 Hrs**
Unit-III	**Animal tissue culture media**:Culture media containing naturally occurring ingredients, blood plasma, blood serum, serum free media, tissue extracts, complex natural media,chemically defined media.	**5 Hrs**
Unit-IV	**Primary culture, cell lines and cloning**: Primary and established cell lines, somatic cell fusion, tissue cultures,(single coverslip cultures,double coverslip cultures, flask method) whole embryo culture. Eg. Chick embryo. **Application of animal cell culture.**	**5 Hrs**

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 tryphan 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 42 Hours
MARKS-Theory – 80 + Internal Assessment -20= 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.

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

OBJECTIVES: 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

	DNA as genetic material: experiments of Griffith, Avery and Hershey and chase. Semi conservative replication of DNA**.** Prokaryotic DNA synthesis: DNA polymerases, replication forks, coding and non coding strand, replicosome. **Mechanism of DNA replication.**	**6 Hrs**
Unit II	Concept of gene: functional units, promoter, introns and exons, lac operon. Transcription of prokaryotic genes: RNA polymerase, initiation of transcriptin at promoter sites elongation and termination, inhibitors of transcription.	**7 Hrs**
Unit III	Genetic code: deciphering genetic code , major features of genetic code, wobble hypothesis, universality of genetic code.	**2 Hrs**
Unit-IV	Translation: activation of amino acids, ribosome, formation of initiation complex, initiation, elongation and termination, fidelity of protein synthesis, inhibitors of protein synthesis, post translational modifications. Regulation of gene expression in prokaryotes and eukaryotes.	**5 Hrs**

PART-B

GENETIC ENGENEERING

Unit-I	**Importance**, history, concepts and developments of genetic engineering **Enzymes**- Restriction endonucleases, types of restriction enzymes, Ligases, alkaline phosphatases, polynucleotide kinase, terminal deoxynucleotidyl transferase, S1 nuclease, DNA polymerase, Klenow fragment, Taq DNApolymerase, ribonuclease, reverse transcriptase.	**5 Hrs**
Unit-II	**Gene cloning, vectors and host**: Types of vectors, importance of plasmids as cloning vectors, examples of plasmid types. Different forms of plasmids , plasmids coding for phenotypic traits. **Cloning hosts**: E.coli, yeast, plant cells and mammalian cells.	**5 Hrs**
Unit-III	Gene mapping, chromosome walking and jumping. **Recombinant DNA technology**: Isolation of gene and mRNA , preparation of complementary DNA, genomic and cDNA libraries, probes and hybridization**.**	**5 Hrs**
Unit-IV	**Genetic engineering techniques**: Agarose electrophoresis, Southern and Northern blotting, PCR, Sanger's method of DNA sequencing, outline of gene transfer methods.	**5 Hrs**

Reference Books:

1. Advanced Molecular Biology. Twymann, 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 40Hours
MARKS-Theory – 80 + Internal Assessment -20= 100

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

GOALS: 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 diagnosis and treatment of disorders.

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

PART-A
IMMUNOLOGY

Unit - I	**Historical account** – Contributions of Edward Jenner and Louis Pasteur. **Types of immunity**: Innate- mechanisms of innate immunity. Adaptive – active, passive and adoptive.	**5 Hrs**
Unit -II	**Antigens**: Definition, haptens, epitopes, antigenicity, blood group antigens. **Antibodies:** Definition, types, structure of IgG**.** **Immunization**: passive and active, adjuvants, vaccines, primary and secondary response	**4 Hrs**

Unit-III	**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**.** Immunological aspects of viral (HIV), bacterial and parasitic infection	**5 Hrs**
Unit -IV	**Immune disorders**: Autoimmune disorders- Grave's disease, Hashimoto's disease, Systemic Lupus erythromatosus. Hypersensitivity types. **Transplantation immunology**. **Immunotechniques:** Affinity and avidity, precipitation reaction, immunodiffusion, ELISA, Western blotting**.**	**6 Hrs**

PART-B

MEDICAL BIOTECHNOLOGY

Unit - I	Vaccine production- new developments: introduction, advantages of subunit vaccines over existing vaccines, production of vaccines of genetically engineered organisms (E.g. HBV), edible vaccine.	**4 Hrs**
Unit -II	**Nucleic acid analysis**: features of DNA probe and its applications in diagnosis, diagnosis of infectious diseases, and identification of mycobacterium tuberculosis in clinical samples using PCR. **Antibiotics:** introduction, strain development and improvements of strain by genetic engineering.	**6 Hrs**
Unit-III	**Enzymes in diagnosis**: enzymes used for diagnosis,, immobilized enzymes as diagnostic tools, diagnostic proteins e.g. AIDS diagnosis **Enzymes in therapy**: list of enzymes and their therapeutic applications	**4 Hrs**
Unit -IV	**Hormone Therapy:** list of hormones produced by recombinant DNA technology and their therapeutic applications, production of interferon by recombinant DNA technology. **Human Gene Therapy:** Definition, differences between somatic versus germline gene therapy. One example each for ex-vivo and in vivo gene therapy Antisense technology: principle and applications Transgenic animals and plants for production of biopharmaceuticals.	**6 Hrs**

Reference Books:

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

PRACTICAL-V AND VI
Molecular Biology, Genetic Engineering and Immunology & Medical Biotechnology

Practical Duration -04 Hours per week Examination -04 Hours
MARKS=100.
Practical Proper- 80 marks Internal Assessment – Record-10+ Class Test-10=20 marks

PRACTICAL-V

Part-A MOLECULAR BIOLOGY

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

Part-B GENETIC ENGENEERING

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

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 40 Hours
MARKS-Theory - 80 + Internal Assessment -20= 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

GOALS: it enables the students to learn the tools and techniques involved in microbial and agricultural biotechnology.

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

PART-A

MICROBIAL TECHNOLOGY

Unit - I	Introduction to biotechnological importance of microorganisms**.** **Metabolic pathways** involved in microbial products, primary and secondary metabolites, enzymes and microbial biomass**.**	**4 Hrs**
Unit -II	**Microbial production:** use of microbes in production of vitamins, enzymes, organic acids, amino acids, polysaccharides, growth regulators, colorants, flavors, sweetners,emulsifiers, proteins, lipids and antibiotics.	**6 Hrs**
Unit-III	Process for production of vit –c and penicillin, fermentors – types, Batch & continuous cultures with examples	**5 Hrs**
Unit -IV	**Microbial pesticides: fungicides and herbicides.** Bacterial, fungal and viral bioagents-bacillus thuringensis (Bt). Beauveria bassiana, baculoviruses, mechanism of biological control of plant diseases- induced resistance, hypo virulence, competition, antibiotics, mycoparasitism	**5 Hrs**

PART-B

AGRICULTURAL BIOTECHNOLOGY

Unit - I	**Introduction :** conventional crop improvement techniques and their limitations, biotechnology for crop improvement, future prospects of biotechnology for agriculture. **3Hrs** Biological nitrogen fixation: nitrogen fixing microorganisms, role of nitrogen , genetics of nitrogen fixation, regulation of nif gene expression.	**6 Hrs**
Unit -II	**Biofertilizers and phyto – stimulants:** mechanism of growth promotion by microbial inoculants, mass production of bradyrhyzobium and rhizobium, Azospirullum,Azatobacter, Mycorhizae.	**5 Hrs**

Unit-III	**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, few examples of transgenic plants obtained through gene transfer techniques- Bt cotton, herbicide tolerant soybean , virs resistant (papaa ring spot)	**5 Hrs**
Unit -IV	**Food biotechnology: food processing –** biotechnological approaches, fruit ripening and its manipulation , role off ACC synthase, genetically modified foods, transgenic fish, biotechnology in dairy industry.	**4 Hrs**

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 40Hours

MARKS-Theory - 80 + Internal Assessment -20= 100

SUBJECT DESCRIPTION: Environmental Biotechnology is the multidisciplinary integration of sciences and engineering in order to utilize the huge biochemical potential of microorganisms, plants

and parts thereof for the restoration and preservation of the environment and for the sustainable use of resources. Biophysics is an interdisciplinary science that uses the methods of physical science to study biological systems

GOALS: Environmental Biotechnology enables the students to learn 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.

OBJECTIVES: The major objective of Environmental Biotechnology is to impart knowledge on application of biotechnological processes for betterment of 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 - I	Introduction : major issues in environmental pollution- role of biotechnology to solve the problem **Biotechnological methods of pollution detections**: General bioassay, cell biological methods, immunoassays, DNA based methods, use of biosensors.	**5 Hrs**
Unit -II	**Biotechnological methods in pollution abatement:** reduction of CO_2 emission. Waste water treatment- conventional wastewater treatment, use of algae, eutrophication, use of cell immobilization	**5 Hrs**
Unit-III	**Biotechnological and biodegradation**: degradation of xenobiotic compounds- simple , aromaticc, chlorinated poly aromatic, petroleum products, pesticides and surfactants. **Bio-hydrometallurgy and biomining**: bioleaching, bio sorption, oil degradation, superbug. **Bioremediation** – insitu- exsitu bioremediation	**5Hrs**
Unit -IV	**Treatment of industrial waste**: dairy, pulp, dye, leather and pharmaceutical industries. Solid waste management .genetically engineered microbes for waste treatment **Ecofriendly bioproducts**: biomass resources, biogas, alcohol as fuel, biological hydrogen	**5 Hrs**

PART-B

BIOPHYSICS & BIOSTATISTICS

BIOPHYSICS

Unit –I	Scope and development of Biophysics Analytical techniques Principles and applications of a) Chromatography (Paper, thin-layer, column and GLC) b) Centrifugation (RPM and G, Ultracentrifugation)	**1 hr** **3 hrs**
Unit-II	Spectroscopic techniques UV, visible spectroscopy, X-ray crystallography, NMR, IR, fluorescence Isotopes Types, measure of radioactivity, GM counters &Scintillation counting.	**3 hrs** **3 hrs**

BIOSTATISTICS

Unit –III	**Statistical concepts:** Data structure, collection of data, classification of data and tabulation of data, diagrammatic presentation of data graphical representation **,** **Measure of Central Frequency:** Mean, median and mode, Problems on Mean, Median and Mode	**4 hr**
Unit-IV	**Measure of dispersion of data:** Range, semi-interquartile range, mean deviation, standard deviation, coefficient of variation. Sampling and Test of significance Chi square test and Goodness of fit	**3 hrs** **3 hrs**

Reference Books:

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

PRACTICAL- VII AND VIII
Microbial Technology & Agricultural Biotechnology and Environmental Biotechnology & Biophysics , Biostatistics

Practical Duration -04 Hours per week Examination - 04Hours
MARKS=100.
Practical Proper- 80 marks Internal Assessment - Record-10+ Class Test-10=20 marks

PRACTICAL-VII

MICROBIAL TECHNOLOGY & AGRICULTURAL BIOTECHNOLOGY

1. Identification of important micro organisms relevant to biotechnology: E.coli, sacaromyces cerevisiae, spirulina.
2. Demonstration of commercial microbial products- single cell proteins, microbial flavors
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 bio control formulation
9. Biofertilizer formulation

ENVIRONMENTAL BIOTECHNOLOGY & BIOPHYSICS, BIOSTATISTICS

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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