DEPARMENT OF BIOTECHNOLOGY
KAKTIYA UNIVERSITY, WARANGAL

Courses offered by the Department:

- M.Sc.Biotechnology
- 5 Year Integrated M.Sc. Biotechnology
- Ph.D. Programme in Biotechnology

M.Sc.Biotechnology: Students are selected through entrance test (KUCET) conducted by Kakatiya University**.** Two categories of seats are available – Free and Self Finance.

NRI Students: NRI students can be admitted directly without any entrance test based on their basic qualification.

Year Integrated M.Sc. Biotechnology: This programme is sanctioned by Andhra Pradesh State Counsel of Higher Education (APSCHE), Government of Andhra Pradesh and it is introduced from the academic year(2008-2009) with an intake of 30 seats and the students are selected through entrance test (KUCET).

Ph.D. Programme in Biotechnology: Ph.D. Students are selected through eligibility test conducted by Kakatiya University

Course Objectives

- To Create Intelligent and Skilled Human Resource to Cope up with the Development of Science and Industry.
- To train students to understand about different biomolecules, their structure and function.
- To acquaint the students with the chemistry of biological systems and to unravel the chemistry of the living state.
- To Develop Student Force to enter into Modern Research and Technology.

The students are trained in the following areas:

- General Biology, Cell Biology and Microbiology
- Basic and Molecular Genetics
- Immunology
- Biochemistry
- Biophysical and Chemical Methods and Bioprocess Technology
- Cell and Tissue Culture Technology
- Molecular Biology and Recombinant-DNA Technology
- Microbial Biotechnology
- Environmental Biotechnology
- Basic and Advance- Plant, Agriculture, Animal and Medical Biotechnology
- Biostatistics and Computer Applications
- Bioinformatics

Outcomes:

M.Sc Biotechnology:

Programme outcome:

- ❖ M.Sc. Biotechnology course is to produce competent skilled man power who can implement their knowledge in the various fields science such as agriculture, industry, healthcare and environment to provide sustainable solution that will benefit human being. Students will exhibit contemporary knowledge in Biotechnology and will be eligible for doing jobs in various sectors of pharmaceutical and biotechnological industry
- ❖ Students will be provided hands on learning into the functioning of the biotechnology industry. Students will have to undertake an Industry Project in their second year of the programme.

Programme Specific Outcomes:

- ➢ The course curriculum is designed to strengthen the fundamentals in basic subjects and provide hands on practice in all the disciplines of biotechnology.
- ➢ Fundamental multidisciplinary knowledge will enable students to design, conduct experiment, analyze and interpret data for investigating problems in Biotechnology and allied fields.
- ➢ The Programme inculcates critical thinking and analytical skills, which increases their marketability. Industrial project/Internships give a strong exposure to real time research problems in life science and enable the graduates to launch them in their workplace environment
- ➢ Students can opt for higher studies for Ph.D. in India and Abroad. Students can appear for CSIR-NET, GATE, ICMR, DBT examination for getting fellowships for doing research. Students can become entrepreneur and can start consultancy in the field of life science. Several career opportunities are also available for biotechnology students in Abroad.
- ➢ Students will gain in-depth knowledge in the domains of Cell biology, Microbiology, Biochemistry, Genetics, Molecular biology, Genetic engineering and Bioinformatics. Students will also obtain hands on training in laboratory techniques related to biophysics, clinical biochemistry, microbiology, molecular biology, bioinformatics, immunology, plant and animal tissue culture.
- ➢ This course will develop effective communication, managerial and other skills in students to carry out advanced projects and collaborations even across the disciplines.

Course Outcomes

Paper Code	Course/Paper Title	Course outcome
101	**Biochemistry**	Students will be imparted knowledge about structure and function of different biomolecules (proteins, lipids, nucleic acids, and carbohydrates). Understanding of carbohydrate, protein, lipid, purine and pyrimidine biosynthesis and metabolism.

102	**Microbiology and Biodiversity**	This course will help students to acquire skills and competency in microbiological laboratory practices applicable to microbiological research or clinical methods, including accurately reporting observations and analysis, applications of Microorganisms in various fields. To study various aspects of biodiversity. To understand global biodiversity (plant and animal) and the concept of Bioprospecting, biosafety, biopiracy and biodiversity conservation.
103	**Cell Biology and Genetics**	To gain the knowledge of living cells such as prokaryotic and eukaryotic cells. To understand the molecular aspects of of Cell Signaling, Protein sorting Cell Cycle and Cell Division Cell Death Pathways. To understand the basics of cancer biology. To understand basic principles and exceptions of Mendelian inheritance. To learn the concepts of Linkage, crossing over and recombination. To gain knowledge about the organelle inheritance. To make students understand the role of the X and Y chromosomes in determining sex and how they are inherited. To impart knowledge about DNA damage and Repair mechanism.
104	**Biophysical and Biochemical Techniques**	To understand the safety measures in laboratory, handling and care of instruments and demonstrate a broad understanding of life science technologies. To demonstrate ability to plan and execute experiments, and analyze and interpret outcomes. Demonstrate understanding of selected Basic Principles & Concepts about biological techniques like microscopy, centrifugation, electrophoresis, chromatography and basics of radioactivity.
201	**Enzymology and Plant Biochemistry**	To understand the Mechanisms of enzyme action and Enzymes kinetics.. To study the Regulation of enzyme activity mechanism of some important enzymes. To know the Photosynthetic pigments and photosynthesis in bacteria and higher plants. To study the CO_2 fixation by C3, C4, and CAM pathways and photorespiration. Students will also be imparted knowledge about nitrogen fixation and *nif* and *nod* genes.
202	**Immunology and Immunotechnology**	To introduce the basic concepts of cells and organs of the immune system and immunity. To study the structure and function of antigen and antibodies. Study of rearrangement of Ig genes. To learn about Major Histocompatibility Complex, antigen processing and presentation, complement system and cytokines. To provide knowledge about Humoral and Cell Mediated Immune Response: B- cell and T – cell receptor complex. Cell mediated cytotoxicity: T cytotoxic cells, Natural Killer (NK) Cells, Antibody dependent cell cytotoxicity (ADCC). To give an overview of hypersensitivity and autoimmunity. Transplantation: Graft vs. host reaction and rejection; Immunization and

		Vaccines. To provide knowledge of antigen-anibody interaction and Immunodiagnostic techniques: RIA and ELISA.
203	**Molecular Biology**	To understand the concepts of Molecular Biology. To study the chemical & physical properties of nucleic acids. Learn experimental evidences for nucleic acid as carrier of genetic information. To understand DNA replication, transcription, translation in Prokaryotes and Eukaryotes. To study the basic features of genetic code. To understand the regulation of gene expression in Prokaryotes and Eukaryotes.
204	**Biostatistics and computer applications**	This course will help students' tools of biostatics in interpretation of biological data. Students will be able to characterize data and understand different sampling methods. To understand the concept of mean, mode, median, range, mean deviation, standard deviation, standard error, correlation & regression, chi square test, t-test. Students will learn about Fundamentals of Computers and Applications of Computers in Biology
301	**Plant Biotechnology**	Develop skills for application of plant tissue culture techniques. To get the knowledge about the genetic transformation and production of transgenic plants.
302	**r DNA Technology**	Learning outcomes of this course are technical know-how on versatile techniques in recombinant DNA technology, application of genetic engineering techniques in basic and applied experimental biology and proficiency in designing and conducting experiments involving genetic manipulation. Development of an ability to design and conduct genetic engineering experiments, as well as to analyze and interpret data and construction of DNA and cDNA libraries. Development of research aptitude and technical skills to secure a job in genetic engineering labs. Understand genome complexity, genome organization and genome analysis. Learn Whole genome Sequencing, accessing whole genome sequence databases. Learn the procedures involved in PCR and southern hybridization, etc.
303 Elective	**a). Microbial Biotechnology**	The course will provide technical knowledge applications of industrial microorganisms. The course will also provide the technical knowledge of several industrial products such as amino acids, organic acids, industrial enzymes and beverages. To gain the knowledge about the role of microbes in food industry.
	b). Advanced Biotechnology	Students will be able to understand the mechanism of Site specific recombination and Advances in transgenic strategies for gene inhibition. The course will provide technical knowledge and applications of ribozyme technology, gene silencing and RNAi technology, genome editing using CRISPR Cas

		Students will the knowledge about host parasite interaction and genome mapping such as Fluorescent in situ hybridization (FISH) and Sequence tagged site (STS) mapping,
304 Elective	**a). Medical Biotechnology**	Development of solid foundation and requisite research aptitude for further higher studies on regenerative medicines. Become competent to secure a job in biopharmaceutical and biomedical industry. Students will be able to understand the classification of genetic diseases, disease diagnosis and drug delivery & designs This course will help the students to acquire skills and competency in Prenatal diagnosis, gene therapy and Animal Cloning
	b). Nanotechnology	To know the preparation and characterization of appropriate nano materials with precision conceptualize the insertion of nano size in the relevant field of interest
401	**Agricultural Biotechnology**	Engineering plants for biotic stress like insect and fungal diseases. Engineering plants for abiotic stress like drought and herbicide tolerance. Engineering plants for shelf life and nutritional quality. Gaining knowledge on biosafety, risk assessment and regulation of transgenic plants in India Understand the historical background, importance and levels of Biosafety at laboratory and industrial scale. Understanding of the relationship between society and science and the justification for biotechnological manipulation of plants, animals, and microorganisms.
402	**Animal Biotechnology**	To know the basics of animal cell culture and apply the knowledge in the relevant field of interest. Pursuing research related to animal cell and tissue culture at national and international level. To contribute in industries related to animal cell culture as scientists
403 Elective	**a). Environmental Biotechnology**	Explain the importance of microbial diversity and of molecular approaches in environmental microbiology. Describe existing and emerging technologies that are important in the area of environmental biotechnology; Describe biotechnological solutions to address environmental issues including pollution, mineral resource winning, renewable energy and water recycling. Learning outcome of Environment Biotechnology is to gain the knowledge of biodiversity, bioremediation, pollution.
	b). Bioprocess Technology	Plan a research career or to work in the biotechnology industry with strong foundation about bioreactor design and scale-up. Students will be able to explain the steps involved in the production of bioproducts and methods to improve modern biotechnology and can apply basic biotechnological principles, methods and models to solve

		biotechnological tasks. Graduates gain ability to investigate, design and conduct experiments, analyze and interpret data, and apply the laboratory skills to solve complex bioprocess engineering problems. Able to separate the molecules through chromatography and understand the complexity in scale up of unit operations. Able to choose the downstream steps within the constraints of biosafety and process economics
404 Elective	**a). Bioinformatics**	Students will be able to analyze, interpret and study biological data (sequence, structure, etc) stored in various databases available on internet. Using existing software effectively to extract information from large databases and to use this information in computer modeling.
	b).Pharmaceutical biotechnology	The course will provide technical knowledge of characterization and screening of pharmaceutically important plant secondary metabolites. Students will be able to understand the working and applications of biosensors in Pharmaceutical industries and also drug discovery, design and development
	Industrial Project	In this course, the student will undergo training in any biotechnology industry/institute for 30-45 days during summer vacation after first year This will not only enhance knowledge base of students but also provide them exposure as to how to conduct and carry out a research based task. Students will also learn how to compile and interpret results.

Ph.D. Programme in Biotechnology

Programme outcome:

Students will be able to identify societal problems and recognize the importance of designing scientifically sound and ethical research to solve societal problems. Research scholar will become into a good academician and author of necessary papers. At end, research scholars will be awarded with Ph.D and they will be more suitable for higher education and industry needs.

Programme Specific Outcomes:

- Acquire in-depth knowledge in the basic concepts of biotechnology to strengthen background for academic, research, industrial and pharmaceutical applications.
- Recognise the need for the preparation and ability to carry out independent research in broadest context of biotechnological relevance.
- Analyse and interpret the data using modern tools in biotechnology and effectively communicate the results to the stakeholders

SYLLABUS for M. Sc. BIOTECHNOLOGY
Semester Pattern
Kakatiya University, Warangal

Effective from 2016-2017

GENERAL RULES & REGULATIONS

The syllabus is divided into four semesters. All the semesters carry four theory papers and two practical papers and a seminar. Each theory paper is divided into four units and all the units carry equal weightage. All theory and practical papers are compulsory. Each theory and practical papers carries 100 marks. 100 marks are allotted to the project work to be presented at the end of the fourth semester and the project is compulsory. 25 marks are allotted to the Seminar.

1) **Number of theory and practical periods:** The syllabus is based on 16 theory periods and 18 practicalperiods per week. Candidates are required to pass separately in theory and practical examination.

2) **Seminars:** In all the semesters every student has to give at least one seminar and submit a writtensummary of the same**.**

3) **Project work:** The student will undergo training in any Biotechnology Industry/Institute for 45 days after completion of II semester. Report will be submitted at the end of the IVth semester. Project report will be evaluated by the External and Internal (Chairperson, BOS, Biotechnology) examiners at end of the fourth semester, 100 marks (4 Credits) are allotted to the project work. The project iscompulsory.

4) **Study tour:** Students of M. Sc. Biotechnology are encouraged to visit some research institutes ofnational and international repute during the two-year course.

5) **Pattern of Question Paper:** There will be four units in each paper. Question paper will consist of five questions. First question will be compulsory with questions from each of the four units having equal weightage and there will be no internal choice. Four questions will be on four units with internal choice (One question on each unit). Maximum marks of each paper will be 80. Each paper will be of 3 hours duration. Practical/laboratory examination of 100 marks. Minimum passing marks in each head (theory& practical) will be 40%.

6) **Subject Elective:** Selection of subject elective in IIIrd and IVth semesters is based on marks scored in previous semesters (results declared) followed by rule of reservation

7) Distribution of theory/practical/seminar/project marks:

M. Sc. Biotechnology
Semester I

S. No	Paper Code	Title of the paper	No. of Credits	Marks		Total Marks
				External	Internal	
1	101	Biochemistry	04	80	20	100
2	102	Microbiology and Biodiversity	04	80	20	100
3	103	Cell Biology and Genetics	04	80	20	100
4	104	Biophysical and Biochemical Techniques	04	80	20	100
5	105	Practical I:Biochemistry, Microbiology and Biodiversity	04	100	--	100
6	106	Practical II: Cell Biology, Genetics, Biophysical and Biochemical Techniques	04	100	--	100
7	107	Seminar	01	--	25	25
		TOTAL	**25**	**480**	**145**	**625**

M. Sc. Biotechnology
Semester II

S. No	Paper Code	Title of the paper	No. of Credits	Marks		Total Marks
				External	Internal	
1	201	Enzymology and Plant Biochemistry	04	80	20	100
2	202	Immunology and Immunotechnology	04	80	20	100
3	203	Molecular Biology	04	80	20	100
4	204	Biostatistics and computer applications	04	80	20	100
5	205	Practical I: Enzymology and Plant Biochemistry and Immunology and Immunotechnology	04	100	--	100
6	206	Practical II: Molecular Biology, Biostatistics and computer applications	04	100	--	100

7	207	Seminar	01	--	25	25
		TOTAL	**25**	**480**	**145**	**625**

M. Sc. Biotechnology

Semester III

S. No	Paper Code	Title of the paper	No. of Credits	Marks		Total Marks
				External	Internal	
1	301	Plant Biotechnology	04	80	20	100
2	302	r DNA Technology	04	80	20	100
3	303 Subject Elective	a). Microbial Biotechnology b). Nanotechnology	04	80	20	100
4	304 Subject Elective	a). Medical Biotechnology b). Advanced Biotechnology	04	80	20	100
5	305	Practical I:Plant biotechnology and r DNA technology	04	100	--	100
6	306	Practical II: Elective Practical	04	100	--	100
7	307	Seminar	01	--	25	25
		TOTAL	**25**	**480**	**145**	**625**

M. Sc. Biotechnology

Semester IV

S. No	Paper Code	Title of the paper	No. of Credits	Marks		Total Marks
				External	Internal	
1	401	Agricultural Biotechnology	04	80	20	100
2	402	Animal Biotechnology	04	80	20	100
3	403 Subject Elective	a). Environmental Biotechnology b). Bioprocess Technology	04	80	20	100

4	404 Subject Elective	a). Bioinformatics b).Pharmaceutical biotechnology	04	80	20	100
5	405	Practical I: Agricultural Biotechnology and Animal Biotechnology	04	100	--	100
6	406	Practical II: Elective Practical	04	100	--	100
7	407	Seminar	01	--	25	25
8	408	**Project & Viva voce**	**04**	**100**	**--**	**100**
		TOTAL	**29**	**580**	**145**	**725**

Summary

Semester	No.of credits	Marks
I	25	625
II	25	625
III	25	625
IV	29	725
TOTAL	**104**	**2600**

Kakatiya University, Warangal

M. Sc. BIOTECHNOLOGY

(SEMESTER SYSTEM)

(Effective from 2014 -2015)

SYLLABUS

SEMESTER – I

BT-101: BIOCHEMISTRY

Unit I

1. Buffers and measurement of pH.
2. Hydrodynamic properties of biomolecules: viscosity, diffusion, osmosis, partial specific volume and Donnan's effect.
3. Carbohydrates – Classification and properties of carbohydrates, mono (glucose, galactose, fructose), di (lactose, maltose, sucrose) and poly (starch, glycogen, cellulose) sacharides. Chemical and enzymatic methods for structural elucidation of starch and mucopolysaccharides.
4. Amino acids – classification, Structure and physico-chemical properties, Peptides – Peptide bonds.

Unit II

1. Naturally occurring peptides (glutathione, bradykinin, kallikrien, tyrocidin). Peptide synthesis by solid-phase technique.

2. Proteins – Classification, Isolation and purification of proteins, criteria of homogeneity.
3. Primary structure of proteins and its sequence determination.
4. Lipids – Classification. Structure and biological functions of fatty acids, triacylglycerols, steroids. Physico-chemical properties and analysis of fats and oils. Structure and functions of prostaglandins, leukotrienes, thromoboxanes.

Unit III

1. Secondary (Ramachandran plot), tertiary and quaternary structural features of proteins, Protein folding (Alfensen's experiment on ribonuclease).
2. Forces responsible for protein stability. Structural organization: globular (myoglobin, Hemoglobin), fibrous proteins (collagen, Keratins, silk fibroin).
3. Denaturation and renaturation of proteins
4. Structure and functions of glycoproteins and lipoproteins.

Unit IV

1. Nucleic Acids – Structure of purines, pyrimidine, nucleosides, and nucleotides.

2. Structure, Properties and functions of nucleic acids (DNA, RNA). Different forms of DNA and RNA. Three dimensional structure of RNA.
3. Isolation of nucleic acids, Denaturation and renaturation of nucleic acids,
4. Chemical synthesis of DNA. DNA constancy & C-Value paradox

PRACTICALS:

1. General color reactions of sugars
2. General color reactions of amino acids
3. Estimation by glucose DNS method
4. Isolation and estimation glycogen from liver
5. Preparation of lecithin
6. Estimation of proteins by Biuret , modified Lowry and Bradford method
7. Estimation of glucose by glucose oxidase method
8. Titration curve of an amino acid and calculation of pK and pI values.

BOOKS RECOMMENDED

1. Textbook of Biochemistry. 1968 by West and Todd (MacMillan).
2. Principles of Biochemistry. 1993 by A. L. Lehninger, Nelson and Cox. (CBS, India).
3. Biochemistry (2nd edition) by Donald Voet and JudithVoet.
4. Biochemistry (4th edition) by L. Stryer (Freeman).
5. Biochemistry by Zubay
6. Nucleic acid Biochemistry and Molecular Biology by Main Waring et al., (Blackwell)

7. Biochemistry, 2nd Edn. by Albert L. Lehninger. 1978. Kalyani Publishers, New Delhi
8. Biochemical calculations, Irwin H. Segel, John Wiley and sons Inc.

BT-102: MICROBIOLOGY AND BIODIVERSITY

Unit-I

1. Systematic position of microorganisms in living world, classification of microorganisms: Hackle's three kingdom concept, Whittaker's five kingdom concept, three domain concept of CralWoese
2. Historical account of bacterial classification, detail account of bacterial classification according to the 1st edition of Bergy's manual of systematic bacteriology (up to sections). Detail account of bacterial classification according to the 2nd edition of Bergy's manual of systematic bacteriology (up to orders)
3. General characters, thallus organization, cell structure, reproduction and classification of fungi, nutrition, reproduction and parasexuality, structure, reproduction and molecular and biotechnological aspects of yeasts.
4. History, general properties and structure of viruses: Viruses related agents (viroids& prions), nomenclature and classification of viruses, auto virus infection, and persistent viruses. General features of virus reproduction, replication of ribonucleic acid (RNA) and deoxyribonucleic acid (DNA) viruses, bacteriophages, transmission of viruses, and management of viruses.

Unit-II

1. Microbial Evolution: Evolution of earth and earliest life-forms; primitive organisms and their metabolic strategies.
2. Microbial Diversity: Bacteria, Archea and their broad classification eukaryotic microbes, Yeast, Fungi, moulds and Protozoa; Viruses and their diversity.
3. Metabolic Diversity-I: Photosynthesis in microorganisms-Role of chlorophylls, carotenoids and phycobilins.
4. Metabolic Diversity-II: Calvin cycle, chemolitho-trophy; Hydrogen-iron, nitrateoxidizingbactetria. Nitrate and sulphate reduction; Methanogenesis and acetogenesis.

Unit-III

1. *Biodiversity*: Definition, levels, organization , uses, and valuing biodiversity
2. *Genetic Diversity*: Nature and origin of genetic variation, measuring genetic diversity variation. Wild relatives of cultivated/domesticated/cultured organisms (plants/animals/microbes). *Species Diversity:* Concept of species, measurement of species diversity, global distribution of species riches. *Ecosystem diversity:* Terrestrial and aquatic ecosystems. Centers of mega diversity and hotspots.
3. *Biodiversity vs. Biotechnology and* Bioprospecting, biosafety, biopiracy and Intellectual Property Rights (IPR).

4. *Biodiversity for Sustainable Development:* Sustainable management of biodiversity: International and regional policies. Biodiversity Act, National Biodiversity Board and AndhraPradeshState Biodiversity Board.

Unit-IV

1. Global Animal Diversity: A bird's view of animal kingdom. Domesticated animal diversity and wild animal resources of India. A brief account of diversity in aquatic life. A case study of over-fishing resulting in ecological disaster.
2. Concept and characteristics of plant community. Methods of studying vegetation. Raunkier's life forms. Biological spectrum. Plant succession. Concept of climax and climax communities.
3. IUCN categories. Rare and endangered categories and extinct animals of India. Trends of extinction rates. Wildlife Act of India and CITES.

4. *Biodiversity Conservation* : Principles and rationale. *Ex situ* and*In situ* conservation strategies (Incl. sperm/seed banks, cryopreservation, embryo collection and freezing creation of parks, wildlife sanctuaries, botanical gardens, etc.)

PRACTICALS

1. Preparation of liquid and solid media for growth of microorganisms.

2. Isolation and maintenance of microorganism by streaking and serial dilution plating method

3. Isolation of pure cultures of microorganisms from soil and water

4. Slants and stab culture. Storage of microorganisms.

5. Growth; Microbial growth curve; Measurement of bacterial population by turbidometry and serial dilution methods. Effect of temperature, pH and carbon and nitrogen sources on growth.

6. Microscopic examination of bacteria, yeast and molds and study of organisms by Gram stain, acid fast stain and staining for spores.

7. Assay of antibiotics and demonstration of antibiotic resistance

8. Analysis for water potability and determination of MPN

9. Bacterial transformation

10. Biochemical characterization of selected microbes

BOOKS RECOMMENDED

1. Pelczar. M.J., Chan, E.C.S. and Krieg, N.R. 1986, Microbiology 5/Edn. McGraw Hill Book Co.

2. Stainer. R.Y. Adelberg, F.A. and Ingraham, J.L. 1984. General Microbiology.4/Edn. McMillan Press.
3. Prescott, L.M. Harley, J.P and Klein, DA, 1990. Microbiology, WCB Publishers.
4. Rosenbeng, E. and Chohan, I.R. 1983. Microbial Biology, HS International Editions.
5. Powar, C.B. and Daginwala, H.F. 1989. General Microbiology. Vol. I & II Himalaya Publishing House.
6. Volk. W.A. and Wheeler, M.F. 1980. Basic Microbiology, J.B. Lippincott Company.
7. Freifelder, D. 1987. Microbial Genetics. Jones and Bartlett Publishers.
8. Hayes. W. 1988. The Genetics of bacteria and their viruses. John Wiley and Sons.
9. K.V. Krishnamurthy. 2003. An advanced text book on Biodiversity. Principles and Practice. Oxford & IBH Publishers, New Delhi.
10. Wilson, E.O and F.M Peters (Eds). Biodiversity. National Academy Press Washington.
11. Pushpangadan, P. K. Ravi and V. Santhosh (eds) Conservation and Economic evaluation of Biodiversity. Oxford & IBH Publishers, New Delhi.

BT-103: CELL BIOLOGY AND GENETICS

Unit I

1. Nucleus -Ultra structure of nucleus and nuclear envelope.
2. Organization of eukaryotic chromosome - structure of nucleosome and extent of chromatin condensation in metaphase chromosome. Euchromatin and heterochromatin (constitutive and facultative).Special Types of Chromosomes: Polytene and Lampbrush chromosomes, Nomenclature of chromosome, dosage compensation.
3. Cell cycle - Overview of eukaryotic cell cycle, regulation of cell cycle by cell growth and extra cellular signals, Cell cycle check points, Regulators of cell cycle progression -MPF, cyclins and cyclin-dependent kinases.
4. Cell differentiation. Cell death and proliferation-Apoptosis: definition, morphological and biochemical differences between apoptosis and necrosis, mechanism (internal and external signals) and significance. Brief account of biology of cancer.

Unit II

1. Cell Communication - General principles, Cell surface receptors (ion channel linked, G-protein linked and enzyme-linked receptors) and intracellular receptors,

2. Forms of intracellular signaling – Autocrine, paracrine, contact dependent, synaptic and endocrine signaling. Response of cell to signals. Intracellular signaling proteins: Different types and their role. Second messengers - cAMP pathway and role of calcium. Cellular interactions -Mocrovilli, tight junctions, belt and spot

3. Desmosomes, gap junctions-Electrical coupling, Theconnexon, factor mediating cell-self recognition (aggregation factor).
4. Cytoskeleton - Structure and functions of actin, microfilaments and intermediary filaments.

Unit III

1. Introduction to genetics: Mendel's principles, Gene interaction & Modified ratios,
2. Multiple alleles, multiple factor inheritance, Extra chromosomal inheritance
3. Linkage and crossing over and genetic mapping: sex-linked inheritance, cytological evidence of crossing over in maize, crossing over frequency and map distances, recombination models: maize, yeast and Neurospora.
4. Population genetics: Hardy –Weinberg's law, factors influencing the equilibrium

Unit IV

1. Bacterial Genetics: Conjugation, Transformation, Transduction, recombination and gene mapping.
2. Phage Genetics: Gene fine structure, concepts of cistron, muton& recon, r II locus
3. Molecular mechanisms of mutations, Ames test for mutagenesis, DNA damage and repair,
4. Mutations: Chromosome variations in number and structure, Role of mutations in crop improvement

PRACTICALS:

1. Preparation of cytological studies for identification of stages of mitosis using root tips
2. Preparation of cytological studies for identification of stages of meiosis–I using flower buds: chiasma frequency
3. Demonstration of chromosomal (structural and numerical) aberrations
4. Study of polytene chromosomes
5. Karyotypic study
6. Construction of genetic maps based on problems in two and three factor crosses.

BOOKS RECOMMENDED

1. Cooper Geoffrey, M. 2000. The Cell-a molecular approach. 2nd Edn. ASM Press. Washington.
2. Sharma AK & A Sharma. 1980. Chromosome techniques: Theory & Practice. Batterworth.
3. De Robertis EDP & EMF De Robertis. 2001. Cell and Molecular biology. Lippincott Williams & Wilkins. Bombay.
4. Freifelder D. 1990. Molecular biology. Narosa publication house, New Delhi
5. Gardner E J & D P Snustad 1996. Principles of Genetics. John Willey, New York.
6. Sambamurthy, AVSS. 1999. Genetics. Narosa publ. New Delhi.

7. Stansfield WD 1991. Theory & Problems in genetics. McGraw Hill, New York.
8. Strickberger MW 1996. Genetics III edn. McMillan, New York.
9. Winchester AM 1967. Genetics. Oxford & IBH. New Delhi.

BT-104: BIOPHYSICAL AND BIOCHEMICAL TECHNIQUES

Unit I

1. Microscopy: Principles and application of light, phase contrast, fluorescence, scanning and transmission electron microscopy.
2. Cytophotometry and flow cytometry, fixation and staining.
3. Centrifugation: Basic principles of sedimentation, types of centrifuges and rotors. Preparative ultracentrifugation-differential centrifugation, Density-gradient, analytical ultracentrifugation.
4. Applications in determination of molecular weight, purity and detection of conformational changes in macromolecules.

Unit II

1. Separation methods - General principles and definitions, Paper chromatography, adsorption chromatography (thin-layer chromatography), gas-liquid chromatography,
2. Methods based on size: Principle of Gel filtration, methodology and applications. Dialysis, ultra filtration
3. Methods based on affinity: Principle of Affinity chromatography; methodology and applications. Ion-exchange chromatography: Principle & methodology
4. High-performance liquid chromatography: Principle, instrumentation, practical procedure and applications.

Unit III

1. Electrophoresis: General principles and definitions. PAGE-Native-PAGE, SDS-PAGE,
2. Iso-electricfocussing, 2D electrophoresis, identification of novel proteins in 2D gels, capillary electrophoresis.
3. Agarose gel electrophoresis : Preparation, separation and determination of molecular size of DNA, denaturing agarose gel electrophoresis and their applications, recovery of DNA from agarose gels.
4. Pulse-field gel electrophoresis : principle, methodology and applications in separation of large DNA fragments.

Unit IV

1. Spectroscopy: Electromagnetic spectrum of light, simple theory of absorption of light molecules, Beer-Lambert law, absorbance, transmittance, extinction, coefficient, light sources, monochromatic, type of detection, UV, visible spectrophotometer, infra red spectroscopy.

2. Raman spectroscopy, flame photometer, atomic absorption, plasma emission, mass ESR and NMR spectrometry, MALDI – TOF, ESI MS.
3. Radioisotope Techniques : Types of isotopes, radioactive decay. Detection and measurement of radioactivity-GM counter, scintillation counter, autoradiography.
4. Preparation of label compounds: Pulse chase studies and tracer techniques, isotopes used in biology, safety methods in handling radioisotopes.

PRACTICALS:

1. Preparation of buffers and measurement of pH
2. Separation and identification of amino acids by paper chromatography
3. Separation and identification of sugars by TLC
4. Separation of proteins by Gel filtration
5. Absorption spectra of amino acids, proteins and nucleic acids
6. Verification of Beer's law
7. Dialysis
8. HPLC demonstration
9. Separation of proteins by PAGE
10. Separation of amino acids by paper electrophoresis

BOOKS RECOMMENDED

1. S.J. Morris and P. Morris. Separation methods in biochemistry. (Pitman)
2. Terrance G. Cooper.The tools of Biochemistry. Wiley Eastern.
3. John M. Wriggles. Biochemical research technique (A practical introduction).
4. David J. Holmes and Hazel peck. Analytical biochemistry
5. Williams and K. Wilson A Biologist's guide to principles and techniques of practical
6. Biochemistry, 2nd ed. Edward Arnold.
7. D. Freifelder. Biophysical chemistry. W.H. Freeman
8. K.E. Vanholdem W.C. Johnson, P.S. 1998. Principles of Physical Biochemistry
9. W.W Umbrit and R.H. Burris. Manometer and biochemical techniques. Burgens
10. The determination of Molecular Structure by (Oxford Clarenders press) 1968

Kakatiya University, Warangal

M. Sc. BIOTECHNOLOGY

(SEMESTER SYSTEM)

SYLLABUS

SEMESTER – II

BT-201: ENZYMOLOGY AND PLANT BIOCHEMISTRY

Unit I

1. Enzymes: Definitions and nomenclature (EC recommended).
2. Mechanisms of enzyme action, active site and its location, binding site, chymotrypsin, ribonuclease, carboxyl peptidase as models.
3. Enzymes kinetics, derivation of Michaelis-Menten constant, determination of V-max and Km, enzyme inhibition: competitive and non-competitive inhibition.
4. Regulation of enzyme activity: allosteric enzymes, models explaining allosteric behaviour-KMF, MWC models, feedback inhibition in metabolism.

Unit II

1. Concept of free energy: Energy metabolism, Thermodynamic principles in biology, Energy rich bonds, weak interactions,
2. Coupled reactions and oxidative phosphorylations, group transfer, biological energy transducers, bioenergetics. Glycolysis and TCA cycle, HMP shunt, Gluconeogenesis, Energy derivations in fermentation, aerobic and anaerobic respirations.
3. Glyoxylate cycle, Components and organization of mitochondrial electron transport system

Unit III

1. Chloroplast as an energy transducing organelle.
2. Photosynthetic pigments and photosynthesis in bacteria and higher plants. Organization of thaylakoid membrane protein complex involved in photosynthesis Cyclic and non-cyclic photophosphorylation, Mechanism of photophosphorylation.
3. Pathways of CO_2 fixation by C3, C4, and CAM pathways.
4. Photorespiration. Fatty acid oxidation (ß-oxidation). Biosynthesis of fatty acids, triglycerides and cholesterol, ketone bodies synthesis.

Unit IV

1. Nitrogen fixation: Diazotrophic microorganisms, nitrogen fixation genes. Transfer of *nif*genes to non-diazotrophic microorganisms.
2. Organization, regulation and expression of Nif genes,
3. *Nod* genes, structure function and role in nodulation,
4. Photoreceptor phytochrome- Phytochrome regulated gene expression

PRACTICALS:

1. Assay of L-amylase from saliva
2. Assay of LDH from serum
3. Assay of acid and alkaline phosphatase
4. A preparation of urease crystals from horsegram seeds and assay
5. Purification of an enzyme and effect of time pH, temperature, substrateconcentration, enzyme concentration, inhibition on enzyme activity.
6. Spectrophotometric assay of Hill reaction and estimation of chlorophyll

BOOKS RECOMMENDED

1. Principles of Biochemistry, While. A, Handler, P and Smith
2. Biochemistry, Lehninger .A.L
3. Biochemistry, DavidE. Metzler
4. Biochemistry, LuberStryer
5. Review of Physiological Chemistry, Harold A. Harper
6. Outlines of Biochemistry, Conn and Stummf
7. Text Book of Biochemistry, West and Todds
8. Metabolic Pathways , Greenberg
9. Mitochondria, Munn
10. Biochemistry 2nd/Edn

BT-202: IMMUNOLOGY AND IMMUNOTECHNOLOGY

Unit I

1. Phylogeny of immune system. Types of immunity – innate and acquired.
2. Cells of the immune system – B-cells, T-cells, phagocytes, inflammatory cells, antigen presenting cells.
3. Organs – primary, secondary and tertiary lymphoid organs. Antigens – nature, types, factors influencing antigenicity, haptens, adjuvants and super antigens.
4. Antibodies – structure, types, classes and functions. Antibody diversity – theories of antibody diversity, mechanism of diversification, allelic exclusion.

Unit II

1. T-cell receptor – structure and diversity.
2. MHC – Types, structure, distribution, self-restriction, T-and B-cell activation. Maturation of lymphocytes – positive and negative selection, process of maturation.
3. Antigen processing and presentation – cytosolic and endosomal pathways, T and NK cell – mediated lysis of cells, ADCC.
4. Complement system – components, cascades, MAC, outcomes. Cytokines – classification, properties and role as immunomodulators.

Unit III

1. Hypersensitivity – classification, mediators, mechanism, consequences of hypersensitive reaction.
2. Autoimmunity - concept of tolerance of autoimmune disorders, basis and therapy for autoimmune disorders.
3. Transplantation – transplantation antigens, mechanism of graft rejection, graft versus host reaction, immunosupressors. Tumor immunity – tumors of immune system, immune responses against tumors.
4. Immunodeficiency – primary and secondary immunodeficiency, combined immunodeficiency, complement deficiency, AIDS.

Unit IV

1. Antigen- antibody interactions – principle, lattice hypothesis.Precipitation reaction – radial immunodiffusion, Ouchyterlony technique, immunoelectrophoresis, counter current and rocket electrophoresis.
2. Agglutination reactions – bacterial and hemeagglutination, passive agglutination, agglutination inhibitions assay. RIA and ELISA – principle, methodology and application. Immunofluorescence, FAACS, immunoblotting.
3. Hybridoma technology – polyclonals, monoclonals, selection, HAT medium, production of monoclonal antibodies and applications.
4. Vaccines – concept of immunization, routes of vaccination. Types of vaccines – whole organism (attenuated and inactivated) and component vaccines (synthetic peptides, DNA vaccines, recombinant vaccines, subunit vaccines, idiotypic based vaccines, deletion vaccines, glycoconjugate vaccines), Vaccine delivery systems.

PRACTICALS:

1. Staining of blood smear and identification of different leukocytes.
2. Determination of A,B,O and Rh blood groups in human beings.
3. Identification of primary and secondary lymphoid organs.
4. Recognition of T-cell by rosette formation
5. Preparation of antigen
6. Electrophoretic study of normal and immune serum

7. Separation of immunoglobulins by gel electrophoresis
8. Different serological tests
    a. Agglutination – Brucella system
    b. Immunoelectrophoresis – Counter current and Rocket
    c. Hemagglutination and Hemagglutination inhibition tests
    d. Labeled antibody test – ELISA

BOOKS RECOMMENDED

1. Essentials of Immunology, Ian &Riott, Blackwell Scientific Publications
2. Fundamentals of Immunology, William C. Boyed (Wiley Toppan)
3. Introduction to Immunology, John W. Kinball
4. Fundamentals of Immunology, Otto S. View and others
5. Immunology, D.M. Wier
6. Immunology, Jains Kubary (2001) 2nd/Edn, W.K. Frecman& Com, Newyork
7. Cellular and Molecular Immunology 3rd/Edn. Abul K. Abbas Andrew, K. Lichtman Jordan S. Pober

BT-203: MOLECULAR BIOLOGY

Unit I

1. DNA Replication and repair: Modes of replication. Experimental evidences for semi-conservative mode of replication - Meselson–Stahl, and Cairns experiments.
2. Replication fork, continuous and discontinuous DNA synthesis.
3. Enzymes and proteins in replication - Single strand DNA binding proteins (SSB), Helicases, Topoisomerases, DNA ligases. Priming by RNA polymerase and primase. DNApolymerases - E.coli DNA polymerase I, II and III, and Eukaryotic DNA polymerases.
4. Replication of E. coli chromosome and M13 genome. Rolling circle replication in bacteriophage. Eukaryotic DNA replication. Autonomous replication sequences (ARS). Regulation of ColE1 plasmid DNA replication. Termination and fidelity of DNA replication. Nearest neighbour base pair analysis. Inhibitors of DNA replication.

Unit II

1. Promoters and their characterization. Enhancer sequences.
2. Transcription (RNA Biosynthesis): Initiation, elongation and termination of RNA synthesis. Monocistronic and polycistronic RNAs. Polynucleotide phosphorylase. RNA polymerases - structure of E. coli RNA polymerase, and nature of eukaryotic RNA polymerases.
3. RNA splicing and splicing mechanisms. Splicing of nuclear pre-tRNA, group I and group II introns, and pre-mRNA splicing. Excision of multiple introns. Role of catalytic RNA. Inhibitors of transcription.
4. Posttranscriptional modifications of eukaryotic hnRNA – capping, methylation and polyadenylation,

Unit III

1. Translation (Protein synthesis): Elucidation of the genetic code - experimental studies of Nirenburg and Khorona.
2. General features of genetic code, codon degeneracy and universality. Mitochondrial genetic code, tRNA role in protein synthesis. Amino acyl-tRNAsynthetases, wobble hypothesis.
3. Mechanism of initiation, elongation and termination of protein synthesis. Translational factors.
4. Inhibitors of protein synthesis – antibiotics and other inhibitors. Post-translational modifications.

Unit IV

1. Regulation of gene expression: House-keeping genes, constitutive genes, and regulatory genes. Induction and repression. Regulatory proteins- DNA-binding motif of regulatory proteins. Role of zinc fingers, leucine zippers, helix-turn-helix.

2. Regulation of gene expression in prokaryotic operons. Negative regulation and positive regulation. Fine structure of lac operon. Repressor and the catabolite activator proteins in gene regulation of lac operon. Dual functions of the repressor in ara operon.
3. Transcriptional control by attenuation in trp-operon. Regulation of gene expression in eukaryotes.
4. Hormones and environmental factors affecting gene expression. Homeotic genes and their regulation.

PRACTICALS:

1. Determination of log phase during culturing of E.coli
2. Demonstration of ß-galactosidase induction in E.coli lack+ strains
3. Isolation of plasmid DNA
4. Determination of purity and quantity of DNA by UV absorption method
5. Determination of melting temperature (Tm) of DNA
6. Isolation of RNA from yeast and plant tissue
7. Problems related to molecular genetics
8. Southern and Western blotting
9. Electro-elution of DNA.

BOOKS RECOMMENDED

1. Molecular Biology of the Cell, A. Alberts, D. Bray, J. Lewis, M. Raff, K. Robertsand J.D. Watson, (Garland Publishing, New York and London)
2. Molecular Biology, A Comprehensive Introduction to Prokaryotes and Eukaryotes, D. Freifelder (Jones and Bartlett, USA).
3. Recombinant DNA, A Short Course, J.D. Watson, J. Tooze and D.T. Kurtz.(Scientific American Book, W.A. Preemon)
4. Molecular Cloning, Laboratory Manual, Maniatis, E.F. Fritsch and J. Sambrook (Cold Spring Harber Laboratory, New York).

5. Modern Genetics (2nd /Edn, 1984), A.J. Ayala and W. Castra (GoomHelns, London)
6. Techniques in Molecular Biology (1992), J. Walker and W. Castra (GeomHelns, London)
7. Practical Methods in Molecular Biology (1991), R.F. Schecleif and PC. Wensik (SpringerVerlag).
8. Genes V (1994), Benjamin Lewin (Oxford University Press).

BT-204: BIOSTATISTICS AND COMPUTER APPLICATIONS

UNIT-I

1. Introduction to Biostatistics, Applications of Biostatistics.
2. Variables, Random Variables, discrete and Continuous variables. Population sample and random sample
3. Mean, Mode, Quartiles, Geometric and Harmonic means. Frequency, Frequency distribution.
4. Frequency curve, frequency polygon and histogram.

UNIT-II

1. Measures of dispersion: Range, Variance, coefficient of variance, SD,SE
2. Probability distribution: Normal, binomial and poison.
3. Tests of hypothesis: Students t –test,x2(chi-square)-distribution
4. Correlation coefficient and analysis of variance ANOVA.

UNIT –III

1. Fundamentals of Computers: Characteristics of Computer, Generations of Computers, Classification of Computers, Input Devices, Output Devices, Soft Copy Devices, Hard Copy Devices. Introduction to Memory, Memory Hierarchy, Registers, Cache Memory, Primary Memory and Secondary Memory.
2. Operating System and Computer Software :Introduction to Operating System, Types of Operating Systems, Classification of Computer Software, System Software, Application Software.
3. MS-Office: Introduction to MS-Office, Applications of MS-Office.
4. MS-Word: Introduction, Features of MS-Word, Editing Documents, Working with tables, Headers and Footers.

UNIT -IV

1. MS-Excel: Introduction, Features of MS-Excel, Editing and Formatting Worksheets, Mathematical Functions, Statistical Functions, Working with Charts, Data Validation.
2. MS-Power point: Introduction, Features of MS-Power Point, Creating Slides, Editing, Deleting.

3. Fundamentals of Networks: Introduction, Types of Networks. Internet: History, Internet Services- Electronic Mail, File Transfer Protocol, Chatting, Internet Conferencing, World Wide Web, Online Shopping.
4. Applications of Computers in Biology

PRACTICALS:

1. Problems on mean, median and mode
2. Problems on variance, coefficient of variance, standard deviation (SD) and standard error (SE)
3. Probability distribution: Normal, binomial and poison
4. Test of hypotheses: Students t-test, X2 distribution (Chi square), correlation coefficient and analysis of variance (ANOVA

BOOKS RECOMMENDED

1. Statistical Methods, S.P. Gupta
2. Fundamentals of mathematical statistics. S.C. Gupta &Kapoor
3. Statistical methods in biological and Health Science, J.S. Milton & J.O. Tsokan
4. Primrose SB. Principles of Genome Analysis, A guide mapping and sequencing DNA from different organisms. 2nd/Edn. 1998. Blackwell Science, Oxford ISBN 0-632-04983-9.
5. Genome mapping – A Practical approach. Dear P (Editor). 1st Edn. 2000. Oxford University Press, Oxford, New York.
6. ReemaTharaja, Fundamentals of Computers, Oxford 2015
7. A. Goel, Computer Fundamentals, Pearson Education 2010.
8. Williams, Sawyer, Information Technology, Tata McGraw-Hill Edition.
9. Sanjay Saxena, MS Office 2000, Vikas Publishing House Pvt. Ltd.

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SEMESTER – III

BT-301 PLANT BIOTECHNOLOGY

Unit-I:

1. Introduction to cell, tissue and organ culture and different types of Tissue culture media and composition.
2. Cytodifferentiation*in vitro*.
3. Role of nutrients and growth regulators in plant growth and differentiation
4. Cell suspension cultures, Production of Secondary metabolites and biotransformation.

Unit-II:

1. Micropropagation and clonal propagation.
2. Shoot tip and meristem culture and Production of virus-free plants
3. Somatic Embryogenesis and Synseed technology, Wide hybridization and embryo rescue
4. Androgenic haploidy (Pollen & Anther Culture) and its importance in crop improvement.

UNIT.III

1. Protoplast studies: Isolation, culture, fusion and selection of hybrid cells, somatic hybrids and cybrids and applications
2. Somaclonal variations and role in crop improvement
3. Cell line selection: Induction and selection of mutants- drought and disease resistant.
4. Cryopreservation and conservation of Germplasm.

UNIT.IV:

1. Genetic transformation Methods:Vector *(Agrobacterium)* mediated genetic transformation
2. Physical Methods: electroporation, microinjection and particle bombardment and selection of transformants and regeneration of transgenic plants.
3. Selectable markers and their role in genetic transformation
4. Reporter genes and their role in genetic transformation

PRACTICALS:

1. Preparation of tissue culture media
2. Surface sterilization of explants
3. Organ culture
4. Callus propagation, organogenesis, transfer of plants to soil
5. Encapsulation of somatic embryos and synseed production
6. Protoplast isolation and culture
7. Cytological examination of regenerated plants
8. Agrobacterium culture, selection of transformants

RECOMMENDED BOOKS:

1. Biotechnology in Crop Improvement, HSChawla. International Book Distributing Company 1998
2. Practical Application of Plant Molecular Biology. RJ Henry. Chapman and Hall 1997
3. Elements of Biotechnology, P.K. Gupta. Rastogi and Co., Meerut 1996
4. A Text Book of Biotechnology, HD Kumar (WE pub.)
5. Biotechnology in Agricture, MS Swaminathan, MCMillian India Ltd.
6. Gene transfer to Plants 1995, Polykus I and Spongernberg, G.Ed. Springer Scam.
7. Genetic Engineering with Plant Viruses, 1992 T. Michael, A Wilson and JW Davis, CRC Press,
8. Molecular Approaches to Crop Improvement1991. Dennis Liwelly Eds. PP 16

9. Plant Biotechnology 1994, Prakash and Perk , Oxford & IBH Publishers Co
10. Plant Cell and Tissue Culture. A Laboratory manual 1994. Reinert J and Yeoman MM Springer

BT – 302 rDNA TECHNOLOGY

Unit-I:

1. Restriction endonucleases and their importance in gene cloning.
2. Enzymes used in recombinant-DNA technology: DNA polymerases, ligases and DNA modifying enzymes (methylases, alkaline-phosphatases, topoisomerases).
3. Cloning vectors: Plasmids, Phagemids, Cosmids, Viral vectors, shuttle vectors and Binary Vectors.
4. Expression vectors: Bacterial, Yeast, Animal and Plant

Unit-II:

1. Gene cloning strategies, analysis and expression of cloned genes
2. Construction of Genomic libraries: genome mapping and chromosome walking and DNA foot printing, BAC and YAC.
3. C-DNA synthesis: Isolation of eukaryotic mRNA and mechanism of C-DNA synthesis, c-DNA libraries and *in vitro* packaging.
4. Genome sequencing: Different strategies.

Unit-III:

1. Blotting techniques: Southern, Western and Northern blotting techniques.
2. Molecular markers: RFLP, RAPD, AFLP, SSR and their applications.
3. DNA finger printing technology and its application in forensic medicine
4. PCR Technology-Designing and synthesis of oligonucleotide primers-PCR amplification of specific DNA sequences, current innovations, cloning PCR products, mutagenesis by PCR, thermostable DNA polymerases and applications of PCR technology in Biology and medicine.

Unit-IV:

1. Introduction of Recombinant DNA molecules into appropriate hosts-competent cells preparation.
2. Genetic selection – alpha complementation, insertional inactivation.
3. Screening of libraries using labeled probes.
4. Transposable elements, types and mechanism of transposition.

PRACTICALS:

1. Preparation of electro and chemically competent E.coli

2. Isolation of plant genomic DNA
3. Restriction digestion of lambda DNA
4. Construction of restriction map of lamba DNA
5. Cloning of foreign DNA in pUC 18 and screen for positive clones using blue white selection
6. Amplification of selected DNA fragment of PCR
7. Reporter gene assay (Gus/CAT/ß-GAL)

RECOMMENDED BOOKS:

1. J. Sambrook, E. Frisch and T. Maniatis 2000. Molecular Cloning: Laboratory manual , Cold Spring Harbor Laboratory Press New York.
2. D.M. Glover and BD Hames 2001. DNA Cloning: A Practical Approach, IRL Press, New York.
3. D.V. Goeddel 1990. Methods in Enzymology Vol.185, Gene Expression Technology, , Academic Press, Inc. San Diego,
4. D.A. Mickloss and GA Freyer 1990. DNA Science. A first Course in Recombinant Technology, Cold Spring Harbor Laboratory Press, New York.
5. S.B. Primrose. 1994. Molecular Biotechnology (2nd Edn), Blackwell Scietific Pub. Oxford.
6. M.R. Walker and R Rapley.1997.Route Maps in Gene Technology, Blackwell Science Ltd, Oxford
7. Glick and Pasternock 2002. Molecular Biotechnology, Paneema-2004.
8. D. Balasubramanian 2005. Concepts of Biotechnology new edition..
9. Old and S.B. Primrose. 2002. Principles of Gene Manipulation by Blackwell, Oxford.
10. T.A. Brown, 2002. Gene cloning – DNA Analysis – Blackwell, London.

BT – 303 Elective-A MICROBIAL BIOTECHNOLOGY

UNIT-I: Industrial Microorganisms

1. Isolation, and culture of microorganism primary and secondary screening of industrial strains improvement of industrial important microorganism
2. Characteristics of microorganisms
3. Maintenance and preservation of industrial microorganisms
4. Immobilization process immobilization of cells and enzymes and its applications

UNIT-II Industrial production of Microbial Products:

1. Amino acids – Glutamic acid and lysine, Vitamins- B12
2. Organic acid- Lactic acid, Citric acid, Antibiotics- Streptomycin and Penicillin

3. Organic solvents-Ethanol : Enzymes-Amlases, proteases and lipases and their applications
4. Bevarages- Alcoholic (Beer and Wine), Nonalcoholic (sauerkraut, Idly and fermented soya and peanut milk)

UNIT-III Microbes in Food industry

1. Industrial production and preservation of fermented foods: Dairy products – cheeses, yogurt and acidophilus milk
2. Yeast and yeast products: brewer's yeast, baker's yeast, bread making, enzymes in food industry
3. Edible mushrooms and their cultivation: Oyester, Button and Paddy straw mushrooms
4. Medical importance of mushroom products, nutraceuticals and functional foods

UNIT-IV Food technology

1. Starter culture technology- Importance of microorganisms in food production
2. Probiotics and prebiotics- Impact on Human health by using milk, milk products and other antiobesity molecules from microbes, plants and animals
3. Food additives, Food colors and sweeteners- Quality material used in food processing (example organic acid, cellulose and cellulose derivatives)

4. Food quality assurance and food laws- food spoiled by different microorganisms and their control measures, food quality maintained by EFSA (European food safety authority) and FDA (Food and Drug authority)

PRACTICALS:

1. Development of laboratory scale bioreactors: know how
2. Cell/tissue immobilization
3. Extraction of protein from a crude bioprocess homogenate using Aqueous Two Phase System (ATPS)
4. Purification and identification of unknown compounds from using column chromatography, TLC
5. Production of organic acids - Citric acid production & estimation
6. Production of alcohol (wine)- Alcohol production & estimation
7. Screening Production and assay for lipase producing organisms
8. Penicillin production and estimation
9.

RECOMMENDED BOOKS:

1. Crueger&Crueger Biotechnology: A Text Book of Industrial microbiology 2nd edition
2. Demain, A.L Biology of Industrial Microorganisms

3. Hobbs, B.C. and Rioberts,D 1993 Food Poisoning and Food Hygiene Edward Anold, London.

4. Hui Y H 2006 Food Biochemistry and Food Processing Blackwell
5. Joshi, V.K. Ashok Pondey 1999 Biotechnology and Food fermentation Vol. I & II.
6. Patel, A.H. Industrial microbiology
7. Prescott and Dunn's, Industrial Microbiology 4th edution.
8. Reed, G. Industrial Microbiology, CBS Publishers
9. Microbial Technology Vol. I & II. Pepplelr&Perllman (EDS)
10. Microbial Ecology – Fundamentals and applications. Atlas and Bartha

BT – 303 Elective-B: NANOTECHNOLOGY

Unit-I

Introduction to Nanotechnology: Size dependent properties. Size dependence of sedimentation rate, adsorption effects, scattering of light, absorption of electromagnetic radiation, electrical and magnetic properties.Effects of confinement on protein stability.

Unit-II

Carbon based Nanomaterials: CNTs-synthesis of carbon nanotubes. Growth mechanism, electronic structure of carbon nanotubes, preparation and characterization of fullerenes and graphene.Nanodiamond, BN nanotubes.

Unit-III:

Synthesis of Nanomaterials: Physical methods: Methods based on evaporation, sputter deposition, chemical vapor deposition (CVD), electric arc deposition.
Chemical Methods: Colloids and colloids in solution, synthesis of nanoparticles by colloidal routes, micro emulsions, Sol-Gel method.
Biological Methods: Introduction to biomaterials, Synthesis using microorganisms and plant extracts

Unit-IV

Diagnostics and prognostics: principles and applications of Nanoarrays and Nanofluidics.
BioNanomechanics: NanoBiomotors. Mechanics of cilia and flagella.Nanobioelectronics: Nanowires based on DNA. Molecular transistors, Voltage gated ion channels. Nanopore sequencing of DNA

PRACTICALS:

1. Nanostructed DNA Templates
2. Probing DNA structure with Nanoparticles
3. Fluoroimmoassays using Antibody- conjugated Quantum Dots
4. Surface- Functionalized Nanoparticles for controlled Drug Delivery
5. Quantum Dot- encoded Beads
6. Ultrasensitive DNA sequence detection using nanoscaleZnO sensor arrays
7. Electrochemical Biosensors for the Detection of Pesticides

8. Membrane-Based Electrochemical Nanobiosensor for Escherichia coli Detection and Analysis of Cells Viability

RECOMMENDED BOOKS:

1. C. M. Niemeyer, C. A. Mirkin, ―Nanobiotechnology: Concepts, Applications and Perspectives‖, Wiley – VCH, (2004).
2. 2 T. Pradeep, ―Nano: The Essentials‖, McGraw – Hill education, (2007).
3. Challa, S.S.R. Kumar, Josef Hormes, CarolaLeuschaer, ‖Nanofabrication Towards Biomedical Applications, Techniques,
4. Tools, Applications and Impact‖, Wiley – VCH, (2005).
5. Nicholas A. Kotov, ―Nanoparticle Assemblies and Superstructures‖, CRC, (2006).
6. David S Goodsell, "Bionanotechnology‖, John Wiley & Sons, (2004)

BT – 304 Elective -A: MEDICAL BIOTECHNOLOGY

Unit-I:

1. Scope and importance of Medical Biotechnology
2. Classification of genetic diseases: Chromosomal disorders- Numerical disorders e.g.-trisomics, monosomics, Structural disorders e.g.- deletions, duplications, translocations and inversions, Chromosomal instability syndromes, Gene controlled diseases-autosomal and X-linked disorders, Mitochondrial disorders.

3. In vitro fertilization in humans- types and causes of male and female infertility, sperm collection and cryopreservation, artificial insemination, super ovulation and Oocyte recovery, embryo culture and transfer.
4. Cancer genetics: Evolution of cancer, oncogenes, Tumor suppressor genes, Stability of genome, Control of cell cycle.

Unit-II:

1. Disease diagnosis: DNA Probes, Enzyme probes- glucose oxidase, lactate oxidase, monoamine oxidase; PCR amplification and diagnosis- Applications in forensic medicine, Haemoglobinopathies
2. Prenatal diagnosis- indications for prenatal diagnosis, pre-implantation genetic diagnosis, invasive techniques and non-invasive techniques
3. genetic counseling- calculating risk & discussing the options
4. Human genome sequences- mapping and cloning of human- disease genes.

UNIT III:

1. Human gene therapy (ex vivo, in vivo methods),Strategies of Gene Therapy& applications,
2. Vectors used in gene therapy: Biological vectors- Retrovirus, Adenoviruses, Herpes, Synthetic vectors- liposome
3. Methods of gene therapy: Vector engineering, gene correlation, gene editing, gene silencing, gene targeting, prospects of germ line therapy.
4. Mass production of bioactive substances: interferon, interleukins and lymphokines.

UNIT IV:

1. Transgenic animals (mice, cattle, sheep), animals as bioreactors in molecular farming and Gene knockout technology,Animal Cloning- ethical social implications.
2. Pharmacokinetics: and drug delivery & designs
3. Health care products, Products from recombinant DNA technology- Insulin, HGH, Factor VIII, Tissue plasminogen activator.
4. Cell and tissue engineering: Potential use of stem cells- Cell based therapies; Nanomedicine

PRACTCALS:

1. Genotyping of candidate genes for diseases by RFLP
2. Screening for known mutations by PCR
3. Screening for unknown mutations by SSCP and sequencing
4. Detection for dynamic mutations - Trinucleotide repeat polymorphism
5. Identification of disease gene expression by RT PCR
6. Sequencing of c DNA and cloning in expression vectors
7. Identification of fetal cells in maternal blood for detecting genetic defects

8. Detection of congenital abnormalities by triple test
9. Preparation of Ag nano particles and testing their anti microbial effect
10. Encapsulation of lymphocytes/ RBCs

RECOMMENDE BOOKS:

1. Introduction to Human Molecular Genetics – J.J Pasternak, John Wiley Publishers.
2. Human Molecular Genetics –Tom Strachen and A P Read, Bios Scxientific Publishers
3. Human Genetics Molecular Evolution, McConkey,
4. Recombinant DNA Technology , AEH Emery
5. Principles and Practice of Medical Genetics, I, II, III Volumes by AEH Edts. Emery

BT – 304. Elective-B: ADVANCED BIOTECHNOLOGY

Unit I

Advances in transgene technology: Inducible expression systems, Site specific recombinases and application of site specific recombination, Advances in transgenic strategies for gene inhibition

Unit II

Ribozyme Technology: molecular mechanism of antisense molecules and its applications, Biochemistry of ribozyme-hammer head, hair pin and other ribozymes and application of ribozyme technology, Gene silencing and RNAi technology, Genome editing using CRSPR Cas

Unit III

Host-parasite interaction : Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells, alteration of host cell behavior by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells.

Unit IV

Mapping Genomes : Constructing molecular maps- Physical Mapping, Restriction Mapping, Fluorescent in situ hybridization (FISH), Sequence tagged site (STS) mapping, Molecular tagging of genes/traits, Marker-assisted selection of qualitative and quantitative traits, Physical maps of chromosomes, The concept of gene synteny, The concept of map-based cloning and their use in transgenics

PRACTICALS:

1. FISH for chromosome study

2. Histological assay using FISH techniques
3. Restriction mapping of Tobacco DNA
4. Construction of 1x and 2X sgRNA-Cas9 expression vectors
5. Detection of targeted gene modification by RFLP and AFLP
6. Detection of targeted gene modification by derived cleaved amplified polymorphic sequences (dCAPs) assay
7. G-Banded karyotyping

RECOMMENDED BOOKS:

1. D.M. Glover and BD Hames 2001. DNA Cloning: A Practical Approach, IRL Press, New York.
2. 3. P.B. Kaufman, W. Wu, D. Kim and L.J. Cseke. 2000. Molecular and Cellular methods in Biology and Medicine. CRC.
3. D.A. Mickloss and GA Freyer 1990. DNA Science. A first Course in Recombinant Technology, Cold Spring Harbor Laboratory Press, New York.
4. S.B. Primrose. 1994. Molecular Biotechnology (2nd Edn), Blackwell Scietific Pub. Oxford.
5. J.A. Davies and WS Reznikoff. 1992. Milestones in Biotechnology. Classic papers on Genetic Engineering. Butterworth-Heinemann, Boston, 1992
6. M.R. Walker and R Rapley.1997.Route Maps in Gene Technology, Blackwell Science Ltd, Oxford
7. Glick and Pasternock 2002. Molecular Biotechnology, Paneema-2004.
8. D. Balasubramanian 2005. Concepts of Biotechnology new edition..
9. A. Old and S.B. Primrose. 2002. Principles of Gene Manipulation by Blackwell, Oxford.
10. T.A. Brown, 2002. Gene cloning – DNA Analysis – Blackwell, London.

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M. Sc. BIOTECHNOLOGY

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Semester IV

BT-401 AGRICULTURAL BIOTECHNOLOGY

UNIT-I

1. Application of plant transformation for productivity and performance: Herbicide resistance – phosphinothricin, glyphosate, atrazine.
2. Molecular aspects of abiotic stress responses and genetic engineering for drought, salinity and Temperature.
3. GM Crops: Improvement of nutritional quality and Golden Rice
4. Seed storage proteins and their genetic improvement- structure, classification, biochemistry and molecular approaches for improvement of seed storage proteins

UNIT II

1. Insect resistance – bt genes. Structure and function of cry proteins – mechanism of action, critical evaluation of its impact on insect control. Non-bt like protease inhibitors, alpha amylase inhibitors and lectins
2. Virus resistance – coat protein mediated, nucleocapsid gene and RNAi approach
3. Fungal resistance – PR proteins-1- chitinase, -3 beta glucanases.
4. Nematode resistance - Nematode infestation and engineering for nematode resistance.

UNIT III

1. Plastid transformation-Chloroplast genetic system, plastome engineering in higher plants & advantages.
2. long shelf-life of fruits and flowers: use of ACC synthase, polygalacturanase, ACC oxidase.
3. Male sterile lines: barstar and barnase systems.
4. Genetic improvement of nutritional quality of oils-Molecular approches

Unit IV

1. Molecular Pharming, Plantibodies and plants as bioreactors
2. Biotechnology and Society – Social, ethical and legal aspects of Biotechnology and national level policies on Biotechnology.
3. Implications of Biotechnology on health, environment, food and sustainable agriculture.
4. Regulatory mechanisms in releasing GMOs. IPRs. Plant breeders rights, WTO, GATT & TRIPS. Biosafety regulations

PRACTICALS:

1. Drought resistant plantlets through embryo rescue techniques

2. PEG resistant plantlets through embryo rescue techniques

3. Identification of Bt or Non Bt cotton using Cry primers
4. Application for IPR for a local plant product. Ex: Turmeric, Basmati rice and Teak
5. Amplification of homologous flanking sequences from plastid genome

6. Gene delivery into plastid genome by particle bombardment

7. Identification of transgenic integration in plastids by PCR

8. Identification of different stages of nematode infestation

9. Identification of different Isozyme patterns from nematode protein

RECOMMENDED BOOKS:

1. S.B. Primrose. 1994. Molecular Biotechnology (2nd Edn), Blackwell Scietific Pub. Oxford.
2. J.A. Davies and WS Reznikoff. 1992. Milestones in Biotechnology. Classic papers on Genetic Engineering. Butterworth-Heinemann, Boston, 1992
3. M.R. Walker and R Rapley.1997.Route Maps in Gene Technology, Blackwell Science Ltd, Oxford
4. Glick and Pasternock 2002. Molecular Biotechnology, Paneema-2004.
5. D. Balasubramanian 2005. Concepts of Biotechnology new edition..
6. A. Old and S.B. Primrose. 2002. Principles of Gene Manipulation by Blackwell, Oxford.
7. T.A. Brown, 2002. Gene cloning – DNA Analysis – Blackwell, London.

BT-402 ANIMAL BIOTECHNOLOGY

UNIT-I

1. Introduction to animal cell culture and Equipment, Culture vessels for animal cell culture
2. Cell culture media: basal salt solution, natural media, artificial media, Serum free media (advantages and disadvantages)
3. Physicochemical properties of culture media
4. Preparation and sterilization methods: reagents and media

UNIT-II

1. Types of animal cell cultures and their culture procedures in preparation: primary and secondary (Cell line)
2. Types of disaggregation: tissues, cells and cell counting

3. Subculture and Maintenance of animal cell cultures, properties of cell lines
4. Biology and characterization of cultured cells.

UNIT-III

1. Measurement of growth parameters of cultured cells (growth cycle of cultured cells, plating efficiency of cultured cells)
2. Measurement of cell death: cytotoxicity and cell viability assays
3. Cell synchronization, senescence and apoptosis
4. Cell transformation and cell cloning

UNIT-IV

1. Vaccine, hormone production, in vitro culture of tissues and organs
2. Stem cell technology: embryonic stem cells, maintenance of stem cells in culture, characterization of stem cells
3. Cryopreservation: principles of cryopreservation, cell bank
4. Applications of animal cell culture

PRACTICALS:

1. Preparation of animal cell culture medium and membrane filtration
2. Preparation of single cell suspension from spleen and thymus
3. Cell counting and cell viability
4. Macrophage monolayer from PEC and measurement of phagocytic activity
5. Trypsinization of monolayer and sub culturing
6. Cryopreservation and thawing
7. MTT assay for cell viability and growth

RECOMMENDED BOOKS:

1. Culture of Animal Cells. (3/Edn) R Ian Freshney. Wiley-Liss
2. Animal Cell Culture – Practical Approach. Ed. John RW. Masters, Oxford
3. Cell Growth and Division : A Practical Approach Ed. R. Basega, IRL Press
4. Cell Culture Lab Fax. Eds. M. Butler & M Dawson, Bios Scientific Publications Ltd. Oxford
5. Animal Cell culture Techniques Ed Martin Clynes, Spripnger
6. Methods in Cell Biology, Vol. 57, Animal Cell Culture Methods Ed. Jenni P Mather and David Bames. Academic Press
7. Fish and Fisheries India VG Jhingram
8. Animal Cell Technology, Principles and practices, 1987. Butter, M Oxford Press
9. Animal Cell Biotechnology, 1990. Spier, RE and Griffith. JB, Acadmic Press, London

BT – 403.Elective-A. ENVIRONMENTAL BIOTECHNOLOGY

Unit I:

1. Solid waste management – Waste generation, handling, storage, processing, transport, bailing,; composting- incineration, pyrolysis, land farming – waste disposal by sanitary land filling (aerobic and anaerobic degradation), waste minimization , recycling and product re-use.
2. Biodegradation of Pesticides - Microbes known for pesticide degradation, microbial metabolism of pesticides, molecular mechanism of pesticide degradation, molecular breeding, degradative plasmids, microbes and cloning strategies.
3. Microbial leaching and biomining– Types and methods of bioleaching, Chemistry and microbiology of bioleaching, *in situ* and *ex situ* leaching process of copper and uranium, plasmidas and genes in biomining.
4. Sewage treatment through microorganisms- Composition of sewage, aerobic treatment of sewage (biological filters, aeration tanks, biological ponds, irrigation fields), anaerobic treatment of sewage (septic tank, imhoff's tank, Upflow anaerobic sludge blanket-UASB, Anaerobic attachment film expanded bed - AAFEB).

Unit II:

1. Biodelignification- Major groups of lignin, pathways of lignin biosynthesis, lignin degrading enzymes, chemistry of lignin degradation, kappa number, biopulping and biobleaching in wood based industries, environmental advantages.
2. Bioetahnol- Fermentative bioconversion of lignocelluloses to ethanol. Biosynthesis of ethanol – milling, liquefaction, saccharification, fermentation, distillation, dehydration and blending, co-products, Social and scientific perspective of bioethanol, bioethanol vs.food crisis. biogas - hydrogen to reverse the global warming.
3. Biodesulphurization of coal/petrolem/diesel – Bioprocessing of coal, Mechanism of inorganic sulphur removal, Organic sulphur removal by Kodama pathway and 4 S pathways, Asian Brown Clouds – Acid Rains.
4. Biofertilizers and biopesticides and Integrated Pest Management – Bacterial, algal, fungal bioferilizers, earthworms as bioferilizers; Biopesticides – Bacterial, fungal, plant, biochemical pesticides, Integrated pest management and sustainable agriculture.

Unit III:

1. Biosorption of heavy metals – metal binding targets and organisms, metal-microbial interactions, biomethylation of elements, commercial biosorbents, metal precipitation,phytoremediation

2. Bio-medical waste management – waste category, waste class and description,treatment and disposal systems,cost of biomedical waste management,

3. GEMs and their products- construction and release of GEMs and their impact on the environment, concept of biosafety – biosafety levels, good microbiological practices, biosafety guidelines, biohazards, biological weapons, bioethical issues, general approval procedures.
4. Carbon sequestration– Vision and aim- methods and managemental strategies, microbial technology and economics.

Unit IV:

1. Pollution control biotechnology- Commercial blends of microorganisms and enzymes, immobilized cells and enzymes, biotechnological approaches for recovery of useful products.
2. Microbial techniques for treatment of industrial effluents in pulp and paper, tanning and leather, distillery and dye industries – primary treatment, secondary treatment, aerobic process, treatment by bacteria and fungi and enzymatic treatment.
3. Emission control biotechnology - air sampling techniques- Impactors and impingers, - cyclones, fabric filters, electrostatic precipitators, scrubbers; air sanitation – control of air borne pathogens, biotechnological methods for the abatement of environmental bio-pollution
4. Biomonitoring of the environment – Plants as pollution indicators, algal pollution indices (Odum, Nygaard, Palmer, Margalef, Kothe), biosensors and genosensors, biofilters, biofuel cells and biochips. Endorphins.

PRACTICALS:

1. Biomas estimation by different methods
2. Isolation of Biofertilizer microbes by biological enrichment method
3. Production of microbial biofertilizers and biopesticides
4. Efficacy testing for biofertilizers (nodulation test for rhizobia) and biopesticides
5. Estimation of BOD & COD
6. Testing for microbiological quality of potable water (Coli form test)
7. Microbial degradation of organic matter
8. Testing for effect of chemical pesticides on soil microbial respiration
9. Testing for microbial biodegradation of pesticides
10. Development of genetically engineered microorganisms for bioremediation

BT – 403.Elective-B. BIOPROCESS TECHNOLOGY

Unit I

1. Introduction to Bioprocess engineering and bioprocess technoques

2. Transport Phenomena: Transport Phenomena in Bioprocess, Nature and properties of fluid, Mechanism of movementum transport
3. Newtn's law of viscosity, Non- Newtonian fluids, Theory of viscosity of liquids, Rheological properties of fermentation process. Laws governing fluid flow
4. Basics of Mass Transfer and Heat Transfer

UNIT-II

1. Basic design and construction of fermenter and anallories: aseptic operation and containment, main parameters to be controlled and monitored in fermentation process
2. Formulation fermentation medium requirements for optimum operation of fermentation process, medium optimization.
3. Sterilization of media and fermenters ; scale -up of fermentation
4. Types of fermentations: batch, continuous, fed of batch, solid state, submerged fermentation process. Biochemistry of cell growth and product formation.

Unit III

1. An overview of arobic and anaerobic fermentation process and their application in biotechnology industry.
2. Growth Kinetics, Batch Culture and Continuous Culture Chemostat
3. Deviations from Ideal Chemostat, Auxostat, Fed -Batch Culture.
4. Behavior of microorganisms in different reactors (Airlift, Fluidized, Batch, continuous and fed batch continues

Unit IV:Product Isolation:

1. Downstream processing, disruption of microbial cells, Solid -Liquid Separation, Concentration of products.
2. Membrane processes, Microfiltration, Ultrafiltration, Reverse Osmosis
3. Evaporation, Extraction: Aqueous two phase extraction, Supercritical fluid extraction
4. Precipitation, Dialysis and Electrodialysis, Chromatographic separations, Crystallization and Drying. Economics of industrial fermentation.

PRACTICALS:

1. Quantitative description of bioprocess by estimating specific growth rate of target organism using kinetic models and determination of yield co-efficient
2. Cell/tissue immobilization, production of biomass and harvesting of biological organism for analysis
3. Development of laboratory scale bioreactors
4. Recovery of product from fermentation broth and optimization of parameters
5. Extraction of protein from a crude bioprocess homogenate using Aqueous Two Phase System (ATPS)

6. Purification and identification of unknown compounds from a mixture of compounds using column chromatography and TLC

RECOMMENDED BOOKS:

1. Crueger&Crueger Biotechnology: A Text Book of Industrial microbiology 2nd edition
2. Demain, A.L Biology of Industrial Microorganisms
3. Hobbs, B.C. and Rioberts,D 1993 Food Poisoning and Food Hygiene Edward Anold, London.
4. Hui Y H 2006 Food Biochemistry and Food Processing Blackwell
5. Joshi, V.K. Ashok Pondey 1999 Biotechnology and Food fermentation Vol. I & II.
6. Patel, A.H. Industrial microbiology
7. Prescott and Dunn's, Industrial Microbiology 4th edution.
8. Reed, G. Industrial Microbiology, CBS Publishers
9. Microbial Technology Vol. I & II. Pepplelr&Perllman (EDS)
10. Microbial Ecology – Fundamentals and applications. Atlas and Bartha

BT – 404.Elective-A: BIOINFORMATICS

Unit-I:

1) Biological databases: Basic concepts of databases, importance of databases, integration of databases and its need.
2) Nucleotide sequence databases, protein sequence databases, functional motif databases, Protein structure databases.
3) Sequence Analysis: Concept of DNA and protein sequence alignments and their importance. Sequence alignment programs.
4) Comparitive sequence analysis: Pair-wise sequence alignment and tools of Local and Global alignment, multiple sequence alignment and tools like Clustal W2 and T-Coffee.

Unit-II:

1) Primary, secondary, tertiary and quarternary structures of proteins.
2) Forces influencing protein structure; Molecular chaperones; Protein folding, domain, motifs.
3) Protein databases: GenPept, RefSeq, Swiss-Prot, PIR, PRF, PDB, SCOP, CATH.
4) Proteomic tools: proteomic chip arrays, high resolution mass spectroscopy.

Unit-III:

1) Introduction to gene, genome and genomic branches. Define homology, analogy, orthologs and paralogs.
2) Evolution of genome:lateral or horizontal transfer of genome; phylogenetic analysis

3) Structural genomics:Genetical and physical mapping of genomes and applications.
4) Microarray technology, transcriptome and applications.

Unit-IV

1) Protein profiling (2D gels, protein fingerprinting & identification), protein structure analysis

2) Protein classification: SCOP and CATH schemes of classification (motifs, domains, folds, class, architecture, family & super family)

3) Protein structure: structure visualization

4) Metabolic networks: metabolic pathways and metabolic reconstruction

PRACTICALS:

1. Introduction to Pubmed, NCBI & EMBL
2. Introduction to FASTA & BLAST
3. Dot-matrix comparison – understanding stringency
4. Searching DNA databases with FASTA and BLAST
5. Searching protein sequence databases with FASTA and BLAST
6. Pairwise alignment
7. Multiple sequence alignment
8. Compositional analysis of DNA – GC/AT content - codon usage - codon bias
9. Protein structure visualization
10. Understanding the bioinformatics behind human, rice, yeast and E.coli genome projects

RECOMMENDED BOOKS:

1. Bioinformatics: Sequence and Genome Analysis by David W. Mount, Cold Spring Harbor Laboratory Press
2. Biological Sequence Analysis : Probabilistic Models of Proteins and Nucleic Acids by Richard Durbin, Sean R. Eddy, Anders Krogh, Graeme Mitchison, Cambridge University Press.
3. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Second Edition by Andreas D. Baxevanis, B. F. Francis Ouellette, Wiley-Interscience
4. Foundations to bioinformatics – Evolution, similar macromolecular components, constancy of gene number and core proteome in closely related organisms
5. Bioinformatics data – nucleic acid sequence, protein sequence, protein structure, genomic, proteomic and metabolomics information
6. Bioinformatics databases – types, design, file formats, access tools with examples
7. Bioinformatics tools and Resources – free online tools, downloadable free tools, software packages, internet,

BT – 404.Elective-A: PAHARMACUITICAL BIOTECHNOLOGY

Unit-I

Plant secondary metabolites, control mechanisms and manipulation of phenylpropanoid pathway, shikimate pathway and alkaloids. Various methods for Isolation, characterization and screening of pharmaceutically important plant secondary metabolites.

Unit II:

Enhancement of secondary metabolites using precursor feeding, elicitors (biotic and abiotic) and hairy root induction. Metabolic engineering for enhancement of secondary metabolites

UNIT: III

Biosensors,Working and applications of biosensors in Pharmaceutical industries.GPCR – (G- Protein Coupled Receptors) to market a novel process for testing drugs.

UNIT:IV

Drug discovery, design and development: drug discovery without a lead (Penicillin). Lead discovery (Random screening, targeted screening). Lead modifications – identification of active part (Pharmacophore) and functional group modifications. Structural modifications to increase potency (Homologation, chain branching, ring-chain transformation, bioisosterism.

Practicals:

1. Enhancement of secondary metabolites using elicitor strategies
2. Enhancement of secondary metabolites using precursor feeding strategies
3. Preparation of hairy root cultures and enhancement of secondary metabolites.
4. Isolation of alkaloids using various solvents
5. Anti-microbial plate assay
6. Anti-fungal plate assay

RECOMMENDED BOOKS

1. The Pharmacological Basis of Therapeutics by Goodman and Gilman
2. Textbook of Pharmacology by Rang and Dale
3. Quientessence of Medical Pharmacology by C.Chowdary
4. Lippincott's illustrated reviews - Pharmacology by Richard D.Howland and Mery J.Mylek
5. Essentials of medical pharmacology by K.D.Tripathi
6. Pharmacology and Pharmacotherapeutics by R.S.Satoskar, S.D.Bhanderkar and S.S.Ainapure

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