



**PSG College of Arts & Science**  
*An Epitome of Quality Learning*

# **B.Sc. BIOTECHNOLOGY**

**2016 - 2019**

**BSc Biotechnology**  
**Scheme of Examinations**  
*(For students admitted from 2014-15 & onwards)*

CODE NO.	SUBJECT	EXAM DURATION (Hrs)	Max. Marks			Credit points
			CA	CE	Total	
<b>First Semester</b>						
<b>Part –I</b>						
14LAU01 12LAU01 14LAU01	Tamil – I OR Hindi – I OR French-I	3	25	75	100	3
<b>Part –II</b>						
14EU01	Communicative English - I- Interpersonal Communication	3	25	75	100	3
<b>Part –III</b>						
14BTU01	Cell Biology	3	25	75	100	4
14BTU02	Fundamentals of Microbiology	3	25	75	100	4
14BTU03	Chemistry for Biotechnology (Allied-CH)	3	25	75	100	5
14BTU04	Biotechniques Practical	3	40	60	100	2
<b>Second Semester</b>						
<b>Part –I</b>						
14LAU02 12LAU02 14LAU02	Tamil – II OR Hindi – II OR French-II	3	25	75	100	3
<b>Part –II</b>						
14EU02	Communicative English II– Academic Communication	3	25	75	100	3
<b>Part –III</b>						
14BTU05	Enzymology	3	25	75	100	4
14BTU06	Clinical Genetics	3	25	75	100	4
14BTU07	Biochemistry (Allied-BC)	3	25	75	100	4
14BTU08	Enzymes & Genetics Practical	3	40	60	100	2
14BTU09	Biochemistry Practical(Allied-BC)-	3	40	60	100	1
<b>Part –IV</b>						
14VEU01	Value Education	--	100	--	100	2

CODE NO.	SUBJECT	EXAM DURATION (Hrs)	Max. Marks			Credit points
			CA	CE	Total	
<b>Third Semester</b>						
<b>Part –I</b>						
14LAU03 12LAU03 14LAU03	Tamil – III OR Hindi – III OR French-III	3	25	75	100	3
<b>Part –II</b>						
14EU03	Communicative English III- English for Career	3	25	75	100	3
<b>Part –III</b>						
14BTU10	Molecular Biology	3	25	75	100	4
14BTU11	Immunobiology	3	25	75	100	4
14BTU12	Computers for Biotechnology(Allied-CM)	--	100	--	100	5
14BTU13	Molecular Biology Practical	6	40	60	100	2
<b>Part –IV</b>						
14ESU01	Environmental Studies	--	100	--	100	2
<b>Fourth Semester</b>						
<b>Part –I</b>						
14LAU04 12LAU04 14LAU04	Tamil – IV OR Hindi – IV OR French-IV	3	25	75	100	3
<b>Part –II</b>						
14EU04	Communicative English- IV English Through Literature and Newspapers	3	25	75	100	3
<b>Part –III</b>						
14BTU14	rDNA Technology	3	25	75	100	4
14BTU15	Analytical Techniques	3	25	75	100	4
14BTU16	Biophysics( Allied –BT)	--	100	--	100	5
14BTU17	rDNA Practical	6	40	60	100	2
<b>Part –IV</b>						
14SBU01	<b>Skill Based Subject :</b> Internet Security	--	100	--	100	2

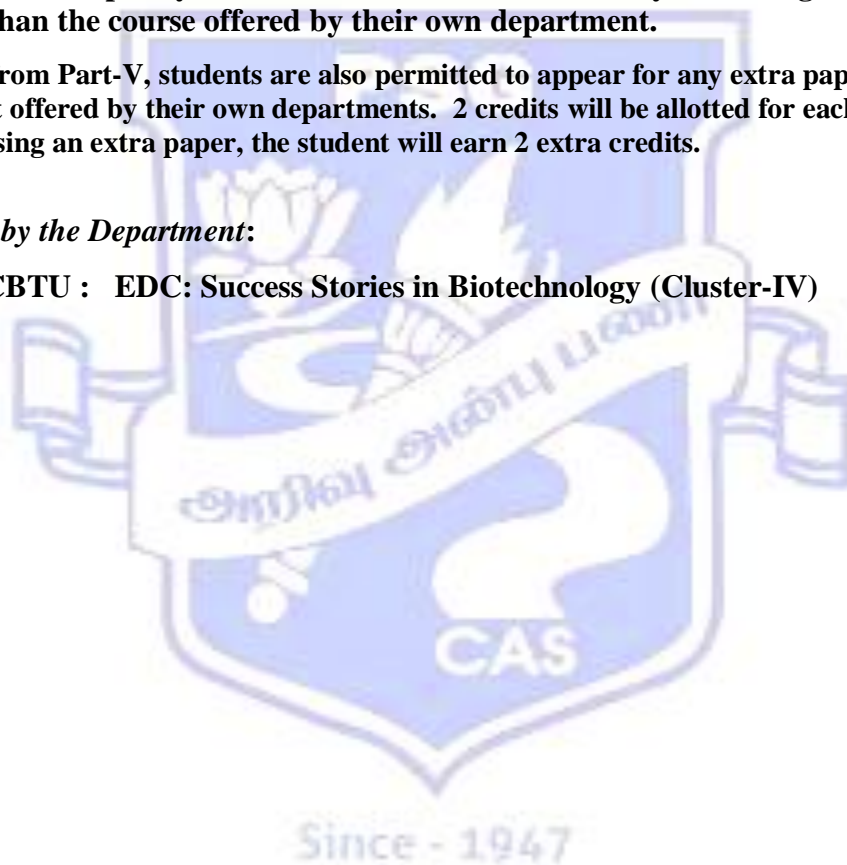
CODE NO.	SUBJECT	EXAM DURATION (Hrs)	Max. Marks			Credit points
			CA	CE	Total	
<b>Fifth Semester</b>						
<b>Part –III</b>						
14BTU18	Metabolism	3	25	75	100	4
14BTU19	Genomics and Proteomics	3	25	75	100	4
14BTU20	Computer applications in Biotechnology: Introduction to Bioinformatics Practical	--	100	--	100	4
14BTU21	IPR, Biosafety and Bioethics	3	25	75	100	4
14BTU22	Plant Biotechnology Practical	6	40	60	100	2
14BTU23A (or) 14BTU23B	<b>Core Elective:</b> Plant Tissue Culture and Transgenics Technology * <b>(OR)</b> Agri biotechnology	3	25	75	100	4
<b>Part –IV</b>						
14NME01	<b>Non-Major Elective (1) :</b> EDC	--	100	--	100	2
14NME02	<b>Non-Major Elective (2) :</b> General Awareness (On-line Test)	1½	--	100	100	2
<b>Sixth Semester</b>						
<b>Part –III</b>						
14BTU24	Animal Biotechnology	3	25	75	100	4
14BTU25	Biopharmaceuticals	3	25	75	100	4
14BTU26	Applied Aspects of Biotechnology	3	25	75	100	3
14BTU27	Business Biotechnology	3	25	75	100	3
14BTU28	Applied Biotech Practical	6	60	40	100	2
14BTU29A (or) 14BTU29B	<b>Core Elective:</b> Industrial and Microbial Biotechnology * <b>(OR)</b> Biofuel and Bioremediation	3	25	75	100	4
<b>Total Credits</b>						<b>136</b>

<b>PART-V</b>		<b>Credits</b>
<b><u>Extension Activity</u> :</b> NSS / NCC / Sports / Department Extension Activity	I – VI semesters	2
<b><u>Competence Enhancement</u> :</b> Add-on Course / Women’s Studies / Extra paper	I – VI semesters	2
<b>Grand Total</b>		<b>140</b>

- **Students can opt any one EDC of Cluster -IV offered by the College at UG level, other than the course offered by their own department.**
- **Apart from Part-V, students are also permitted to appear for any extra paper (s) which is /are not offered by their own departments. 2 credits will be allotted for each extra paper. On passing an extra paper, the student will earn 2 extra credits.**

***EDC Offered by the Department:***

**14EDCBTU : EDC: Success Stories in Biotechnology (Cluster-IV)**



**CELL BIOLOGY****Objectives:**

- to understand the internal architecture of cell
- to study about cell cycle, cell- cell interaction
- to understand the basics of cellular signaling and cell death

**Unit I****(10Hours)**

**Cell organization:** Origin and organization of pro and eukaryotic cell; internal architecture of cells; Ultra structure of cell organelles and functions; cell wall; cell membrane systems and transport. Ribosomes, polysomes, lysosomes, peroxisomes, Golgi apparatus, mitochondria, Nucleus . Chromosome banding and karyotyping\*. Cytoskeleton: Microtubules, microfilaments and intermediate filaments.

**Unit II****(10Hours)**

**Tools in Biology:** Specimen preparation, Shadow casting for Electron microscope, phase contrast microscope, high voltage Electron microscope, SEM, STEM, Fluorescence microscopy. Autoradiography- general principle\*, Flow cytometry and cell sorting

**Unit III****(10Hours)**

**Cell Growth and Division:** The cell Cycle (Eukaryotic)- G1, S, G2 and M phase molecular events, Events in mitosis and role of mitotic apparatus, polypeptide and growth factors and control of cell proliferation. Cell cycle control: role of MPF, cd2 proteins and G1 cyclin. Mitosis and cell division (its molecular mechanisms), molecular mechanism of meiosis

**Unit IV****(10 Hours)**

**Cell –Cell Interaction:** structure and function of cell- cell interaction. Glycocalyx, ECM, Collagen, fibronectin, lamin, proteoglycan, integrins, cell junctions, desmosomes, gap junctions, tight junctions, plasmodesmata, selectins, cadherins and other molecules.

**Unit V****(10Hours)**

**Apoptosis, Cell signaling and cancer:** Cell signaling ; general principles , receptor ligand interactions, Heat shock protein, G proteins : Structure and role in signaling, intracellular cAMP, Role of Calcium in signaling, calmodulin , Ras Raf pathway, Cell transformation and malignancy, cancer genes and anti-onco genes, cell ageing and death by apoptosis.

\*Self study topic

**References:**

1. Gerald Karp, Cell Biology, 6<sup>th</sup> Edition, 2010, John Wiley & Sons
2. G M Cooper, The cell- A Molecular Approach, ASM Press
3. Garret and Griesham- Molecular aspects of cell biology, Saunders Publication

**FUNDAMENTALS OF MICROBIOLOGY****Objectives**

- to understand the basic concepts of microbiology and characteristics of microorganisms
- to study the importance of various cellular organization and taxonomic groups

**Unit I****(10 Hours)**

Historical developments and Scope of Microbiology; Modern developments in microbiology, Microscopy: Construction and working principles of Light, compound, Dark field, Phase contrast and fluorescent and Electron Microscopes. Preparation and staining of specimens. Domain and Kingdom concepts in classification of microorganisms. Microbial taxonomy, taxonomic ranks & phylogeny, Bergey's Manual of Systematic Bacteriology\*.

**Unit II****(10 Hours)**

Microbial Anatomy – Prokaryotic Cell structure & Organization, Cell membrane, Cytoplasmic and Inclusion bodies, Cell wall, Capsule, spores, Slime layers, S layers, Fili & Fimbriae, Flagella & Motility. General properties, Structure, Multiplication and Classification of viruses based on genetic material and host, viral infections. Bacteriophage – Structure, genetic map, life cycle and assembly of T<sub>4</sub> and λ phage.

**Unit III****(10Hours)**

Principles of microbial nutrition; Preparation of culture media; Enrichment culture techniques for isolation of nutritional categories. Microbial Growth: growth curve, Synchronous growth; Continuous culture; Influence of environmental factors on Growth; Measurement of Microbial population. Culture collection, Preservation and maintenance of cultures. Sterilization techniques: Physical- Dry Heat, Wet Heat, Radiation, Filtration and Chemical methods\*. Antibiotics-Types, source and mechanism of Action.

**Unit IV****(10 Hours)**

Microbial Pathogenicity: Host - Pathogen relationships, Distribution and occurrence of normal micro flora in human. Pathogenicity, Infections, types of infection. Exposure and mode of transmission, Toxins, diagnosis and treatment. Epidemiology and public health\*. Prevention and control of epidemics-Vaccination. Air borne diseases- Tuberculosis, Polio; Food and water borne diseases- Typhoid, Hepatitis. Arthropod-Borne Diseases-Malaria & Plague, Zoonotic Diseases-Rabies & Anthrax. Direct Contact Diseases-Common cold & STDs, Opportunistic fungal infections – Candidiasis, Aspergillosis. Antifungal agents.

**Unit V****(10Hours)**

Microbiology of food: Microbial growth food spoilage, controlling of spoilage, fermented foods & Probiotics. Microbial Ecology: Biogeochemical cycles (Carbon, Nitrogen, Sulfur cycle, phosphorous and Iron cycle)\*. Microbial associations: Positive- Neutralism, Commensalism, Synergism, Mutualism. Negative interactions – Ammensalism, Predation, Parasitism. Biodegradation and Bioremediation. Solid and liquid waste treatment- Domestic and Industrial wastes.

\*Self study topic

**Reference:**

1. Prescott, L.M., Harley, J.P. and Klein, D.A. (2010) Microbiology. McGraw Hill, New Delhi
2. Pelczar, M.J., Jr., Chan, E.C.S and Kreig, N.R., 5<sup>th</sup> ed (2009) Microbiology. McGraw Hill, New York.

**14BTU03      Chemistry for Biotechnology (50 Hrs)      Semester I**  
**(Allied subject for Biotechnology)**

**Objectives**

- To learn the basic applications of chemistry in Industries.

**Unit I Purification and separation techniques      (10 Hrs)**

Concentration Terms -Mass percentage, volume percentage, normality, molarity, molality, mole fraction, and ppm.

Extraction of organic compounds- methods of purification of solids- crystallization, fractional crystallization, sublimation methods of purification of liquids- Distillation, fractional distillation, steam distillation, distillation under reduced pressure, counter current distribution.

Green chemistry – an elementary idea, green synthesis (any two example). Nano chemistry – an elementary idea.

**Unit II Organic Chemistry      (10 Hrs)**

Chemotherapy-introduction- -analgesics-antibiotics-tranquillizers- sulpha drugs anaesthetics-antiseptics definition, types and examples.

Vitamins-occurrence of fat and water soluble vitamins, functions and deficiency diseases, structural representations of vitamins A, D, E, K, B complex and ascorbic acid ( synthesis and structural elucidation are not expected)

3D structure of molecules – conformational analysis of ethane, n-butane and cyclohexane.

**Unit III Fertilizers & Insecticides      (10Hrs)**

Plant nutrients, need for fertilizers, classification of fertilizers, natural & artificial fertilizers, natural organic, natural inorganic fertilizers. Manufacture of ammonium nitrate, urea.

Phosphate fertilizers-manufacture of triple super phosphate.

Potassium fertilizers.

Insecticides- classification according to mode of action. Inorganic insecticides- Lead arsenate, calcium arsenate. Natural plant insecticides- nicotine, rotenone, allethrin.

**Unit – IV Perfumes, polymers & detergents      (10 Hrs)**

Perfumes and flavoring industry – composition and manufacturing process of essential oils. Isolation and production of semi synthetic chemicals. Perfume formulation(example). Natural fruit concentrate – preparation of vanilla, Cocoa and monosodium glutamate.

Polymers – nomenclature and types of polymerization. Plastics- thermoplastics and thermosetting plastics. Preparation, properties and biological applications of nitrocellulose, Teflon and poly urethane, polyethylene.

Detergents: Classification: ionic and non ionic amphoteric detergents. Manufacture of detergents. Enzymes in detergent industry.

**Unit V Leather and adhesives      (10 Hrs)**

Leather industry – leather forms and types. Leather manufacturing process – preservation and disinfection of skins. Preparation of hides, lining, bating, tanning and finishing. Enzymes involved in leather industry. Preparation and conditioning.

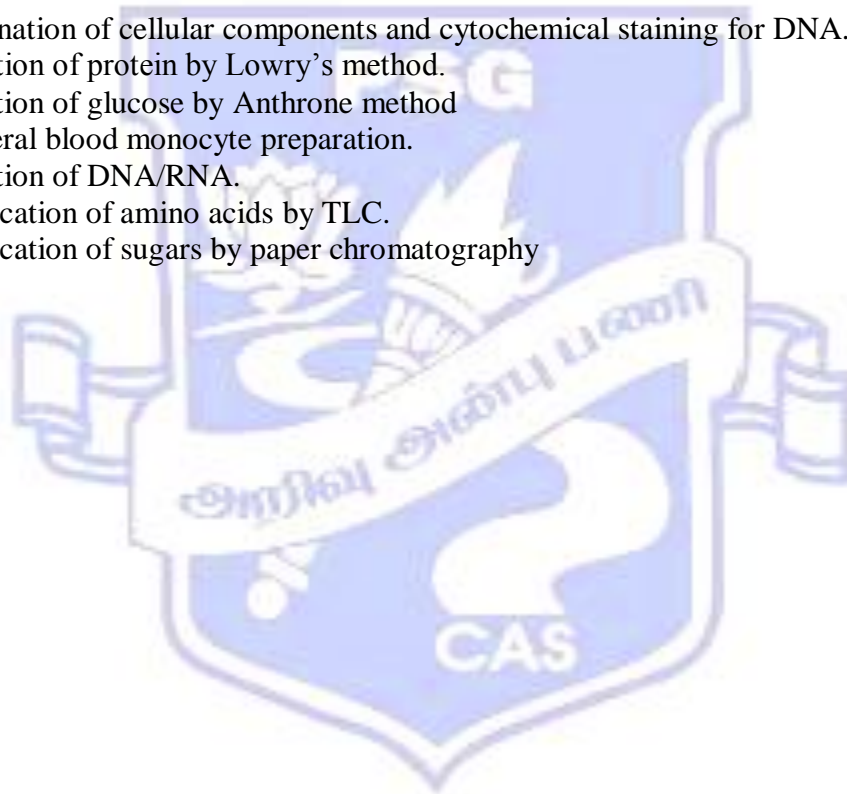
Adhesives- animal glue, other protein adhesives starch adhesives, synthetic resin adhesive. Rubber based adhesives, silicate adhesives.

**References**

1. Text book of organic chemistry P. L. Soni, Sultan & Chand sons Ltd.,2000.
2. Industrial Chemistry B. K. Sharma, Goel Publications House, Meerut, 2000.
3. P.C. Jain and Monika Jain, Engineering Chemistry, Dhanpat Raj and Sons, New Delhi, 2007.

**BIOTECHNIQUES PRACTICAL**

1. Enumeration of bacterial population from soil by serial dilution technique.
2. Isolation of microorganisms by streak plate technique.
3. Identification of microorganism by staining.
4. Effect of temperature on the growth of *E.coli*.
5. Antibiotic sensitivity tests for bacteria ( Kirby-Bauer method)
  
6. Fractionation of cellular components and cytochemical staining for DNA.
7. Estimation of protein by Lowry's method.
8. Estimation of glucose by Anthrone method
9. Peripheral blood monocyte preparation.
10. Estimation of DNA/RNA.
11. Identification of amino acids by TLC.
12. Identification of sugars by paper chromatography



Since - 1947

**ENZYMOLOGY****Objectives:**

- to understand the fundamentals of enzyme kinetics and enzyme action
- to study the application of enzymes

**Unit I****(9 hours)**

Basic principles of chemical kinetics, velocity, order and molecularity of chemical reaction, kinetic equation for zero, first, second and third order reactions. Determination of order of the reaction, Arrhenius equation, activation energy and its estimation, collision and transition state theories of reaction rates, catalysts- mode of catalysis, nucleophilic, electrophilic and acid base catalysis. Structure and function of coenzymes\_ NAD, PLP, TPP, co factors and metal ions and metalloenzymes

**Unit II****(9 hours)**

Enzymes as biocatalysts, properties of enzymes as catalysts, active site, lock and key hypothesis, induced fit theory, strategies of purification and characterization of enzymes, criteria for purity, Nomenclature and classification of enzymes, units of enzyme activity, turnover number of enzymes

**Unit III****(9 hours)**

Enzyme kinetics : Methods of investigating the kinetics of enzyme catalyzed reactions- induced velocity studies; effect of pH and temperature on enzyme activity, Kinetics of single substrate reactions, Michaelis Menten equation-derivation , transformation of M M equation to L B plot, Hanes plot, different types of enzyme inhibition, kinetics of enzyme inhibition.

**Unit IV****(9 hours)**

Enzyme regulation , feedback inhibition , kinetic behavior of allosteric (ATCaes) enzymes, mechanism of allosteric interactions, Hill equation , sequential and concerted models, properties of multi enzyme complexes, pyruvate dehydrogenase complex and FAS complex. Mechanism of action of lysozyme, Carboxypeptodase, chymotrypsin and Ribonuclease A

**Unit V****(9 hours)**

Enzyme Technology: Enzyme immobilization techniques, uses of isolated enzymes in industrial process (amylases, proteases and lipases), enzymes in clinical diagnosis enzyme therapy: LDH and CK isoenzymes, abzymes, ribozymes, artificial enzymes, AC esterase, angiotensin converting enzyme, extremozyme.

**References:**

1. Palmer T, Enzymes: Biochemistry, Biotechnology, Clinical Chemistry, 5<sup>th</sup> Edition, 2000, East-West Press
2. Price N C and Stevens L, Fundamentals of Enzymology, 3<sup>rd</sup> Edition, Oxford University Press

**CLINICAL GENETICS****Objectives:**

- to get a case study and pedigree oriented analysis of human genetics in each unit
- to understand basics of the use of biostatistics in genetic clinics
- to gain knowledge on genetic counseling

**Unit I****(9 hours)**

Gene interactions and exceptions to Mendel ratios, maternal inheritance and mitochondrial genes- heteroplasmy, Genetic linkage and gene mapping, Garrod's in born errors in metabolism

**Unit II****(10hours)**

Mutation: Types of mutation, Spontaneous, induced- causes of mutation , Sickle Cell disease. Alzheimer's, DMD, HD, DNA repair disorders, Normal Karyotype and chromosome structure, banding, Karyotyping, FISHing, chromosomal painting, visualizing chromosomes, prenatal diagnosis of genetic diseases, Amniocentesis, Chorionic Villus sampling, Fetal cell sorting. Abnormal Chromosome Number- polyploidy, aneuploidy, Down's, Edwards, Patau, Turners Syndromes, Klinefelter Syndrome. Abnormal chromosome structure- Deletions, duplications, Inversions and translocations. Allele frequencies . genetic screening and counseling to prevent disorders.

**Unit III****(8 hours)**

Sex determination in humans, X linked recessive inheritance- Haemophilia A and Thalassemia, Colour blindness, X linked dominant inheritance and X inactivation, Genomic imprinting and examples of syndromes

**Unit IV****(9 hours)**

Human genome complexity, Unusual traits in OMIM, Single gene inheritance in humans, pedigree analysis, Examples to display Mendel's laws, making predictions, polygene disorders and multifactor disease, CF, Diabetes mellitus; twins for multifactor disease, modes of inheritance- examples of autosomal recessive, autosomal dominant, X linked diseases and pedigrees, diagnosis and management of genetic disorders affecting humans.

**Unit V****(9 hours)**

Basic statistical measures: Measures of Central tendency, measures of dispersion, Correlation and Regression (only genetic problem solving). Skewness, kurtosis, chi square test, Allele frequency and Hardy Weinberg Principle.

**References:**

1. Ricki Lewis, Human Genetics- Concepts and applications, 5<sup>th</sup> Edition, 2003, Mc Graw Hill
2. Andrew Read and Dian Donnai, New Clinical Genetics, 2<sup>nd</sup> Edition, 2011, Scion publishing Ltd

14BTU07

48 Hrs

**BIOCHEMISTRY – Allied**  
**[ FOR BIOTECHNOLOGY]**

- To understand basic concepts in biochemistry
- To understand the interactions of various biomolecules

**UNIT – I**

**10 hrs**

Early history of biochemistry: chemical elements in biomolecules, biological macromolecules. Biochemistry of water: water as biological solvent, properties, hydrogen bonding, solubility and cellular reactions of water. pH and buffer system of biological fluid. Laws of thermodynamics (outline without derivation).

**UNIT-II**

**10 hrs**

Carbohydrates: monosaccharide – classification, structures and chemical reactions. Disaccharides- structure and properties of maltose, lactose and sucrose. Polysaccharides-chemistry and properties of homopolysaccharides and heteropolysaccharides. Glycoproteins.

**UNIT-III**

**10 hrs**

Amino acids and proteins: classifications and structure of amino acids, reactions of side chains. Biologically active amino acids- GABA and histamines. Peptides-structure of peptide bond-examples and their biological importance. Separation of amino acid by chromatography. Proteins:-classification, structure-primary, secondary, tertiary and quaternary structures(hemoglobin and myoglobin as examples). Protein denaturation.

**UNIT-IV**

**9 hrs**

Lipids- classification, structure, properties and chemical reactions of fatty acids. Sterols-cholesterol-structure and functions. Phospholipids and Glycolipids -structure and functions. Nucleic acids:-constituents of nucleic acids-DNA-double helix; forms of DNA, denaturation and renaturation of DNA; RNA-types and functions.

**UNIT-V**

**9 hrs**

Water soluble and fat soluble vitamins- sources, biological functions and deficiency manifestation.

Glycolysis, TCA cycle,  $\beta$ - oxidation of saturated fatty acid and urea cycle.

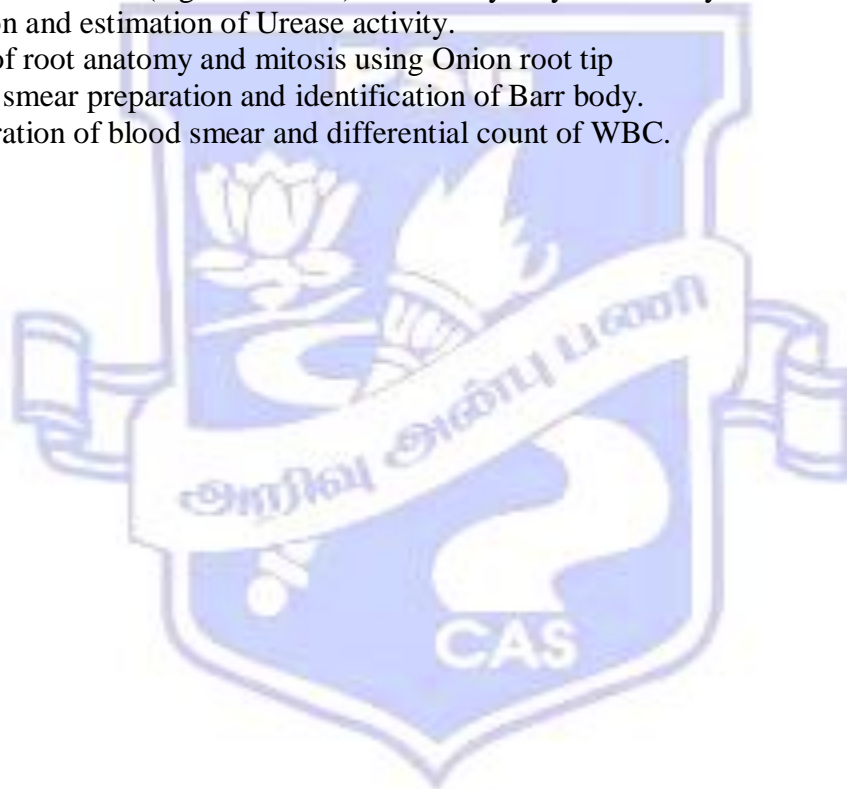
Hormones:-steroid and peptide hormones-structure, functions and disorders of insulin and estrogens.

**REFERENCES**

1. Boyer, R 2002. Concepts in Biochemistry, 2<sup>nd</sup> edition, Brooks/Cole.
2. Berg.J.M., Tymoczko.J.L., and Stryer L., 2002, Biochemistry, 5<sup>th</sup> edition, W H Freeman & Co.
3. Voet & Voet, 1995, Biochemistry, 2<sup>nd</sup> edition, John Wiley & Sons Inc.,
4. Jain JL, 2005, Fundamentals of Biochemistry, 1<sup>st</sup> multicolor edition, S Chand & company Ltd.,
5. Nelson, D.L& Cox,M.M (2005) “ Lehninger Principles of Biochemistry”, W.H. Freeman and Company, New York.

**ENZYMES AND GENETICS PRACTICAL**

1. Determination of pH from unknown biological samples using pH paper and pH meter.
2. Determination of salivary amylase activity.
3. Effect of temperature on salivary amylase activity
4. Effect of pH on salivary amylase activity.
5. Effect of Substrate on salivary amylase activity.
6. Effect of inhibitor ( $\text{HgCl}_2$  &  $\text{NaCl}$ ) on salivary amylase activity
7. Isolation and estimation of Urease activity.
8. Study of root anatomy and mitosis using Onion root tip
9. Buccal smear preparation and identification of Barr body.
10. Preparation of blood smear and differential count of WBC.



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**14BTU09**

**BIOCHEMISTRY Allied PRACTICALS  
[FOR BIOTECHNOLOGY]**

**2 hrs/week**

1. Analysis of carbohydrates
  - i) Glucose
  - ii) Fructose
  - iii) Xylose
  - iv) Lactose
  - v) Sucrose
2. Identification of given sugar.
3. Analysis of amino acids
  - i) Tyrosine
  - ii) Methionine
  - iii) Arginine
  - iv) Tryptophan
  - v) Cysteine
4. Identification of given amino acid.
5. Estimation of glucose by ortho touidine method
6. Estimation of ascorbic acid by titrimetry

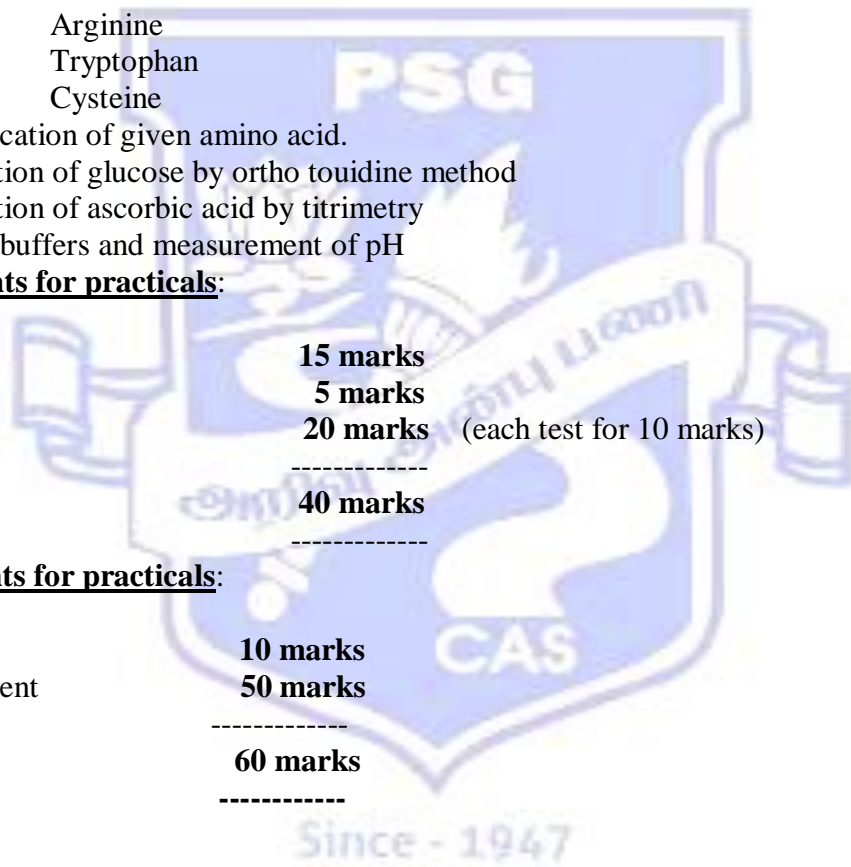
Preparation of buffers and measurement of pH

**CA components for practicals:**

Experiment	<b>15 marks</b>	
Record	<b>5 marks</b>	
Test (2)	<b>20 marks</b>	(each test for 10 marks)
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	<b>40 marks</b>	
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**CE components for practicals:**

1. Record	<b>10 marks</b>
2. Experiment	<b>50 marks</b>
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	<b>60 marks</b>
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**MOLECULAR BIOLOGY****Objectives:**

- to study gene function namely replication, gene expression, regulation and mutation in prokaryotes
- to learn the basis of lambda lysogeny, transposition and recombination

**Unit I****(9 hours)**

The genetics of Viruses- phage T4, lambda- genetic switch, genetic exchange in bacteria- experiments and mapping genes by transformation , transduction , conjugation. DNA, RNA structures- forms and super coiling.

**Unit II****(9 hours)**

Chromosome structure in prokaryotes and viruses in contrast with eukaryotic nucleosome packaging. Semiconservative replication and experiment, replication *in vivo*, replication *in vitro*, Bidirectional and rolling circle, events at replication fork, DNA polymerases and eukaryotic telomerase

**Unit III****(8 hours)**

Central Dogma: Transcription in prokaryotes, RNA polymerases and the process, interrupted genes in eukaryotes, a brief comparison to transcription and RNA processing in eukaryotes, lac and trp operons, DNA methylation

**Unit IV****(10 hours)**

Genetic code and experiments to decipher the code, Ribosomes , tRNA structure, protein synthesis, suppressor mutations, post translational modifications in eukaryotes, inhibitors of translation . Mutation: spontaneous and induced, molecular basis of mutation, mutation in globin genes of humans, complementation test and Ames test

**Unit V****(9 hours)**

DNA repair mechanisms- base excision, mismatch, error prone and SOS repair, UV repair, mechanisms; Model and mechanism of recombination, recombinases, transposons in bacteria and transposition

**References:**

1. D Peter Snustad, Michael J Simmons- Genetics, 6<sup>th</sup> Edition, 2012, John Wiley & Sons
2. Russell P J- iGenetics- A molecular approach, 2<sup>nd</sup> Edition, 2006, Pearson Benjamins Cummins Press
3. Griffiths et al- Introduction to Genetic Analysis, 8<sup>th</sup> Edition, W H Freeman & Company

**IMMUNOBIOLOGY****Objectives:**

- to familiarize the students to mechanisms associated with immune system
- to learn about the abnormalities that could lead to disease development

**Unit I****(9hours)**

Overview and Elements Of The Immune System: Medical Importance of the Immune System / How the Immune System Works, Cells and Organs of the Immune System, Innate Immunity, Inflammation, Bridge between innate and adaptive immunity, Role of Dendritic cells in immune response, Antigens, haptens and adjuvants.

**Unit II****(9hours)**

*Immunochemistry:* Immunoglobulin structure and function. Isotypes, idiotypes and allotypes , Biological functions of immunoglobulin isotypes, MHC proteins: Gene organization, Structure and function and their role in immune response, Antigen processing and presentation pathways. The complement system and regulation of complement proteins

**Unit III****(9 hours)**

Cellular immunology: Ontogeny, development, differentiation and activation of T and B cells, TCR, BCR, Signal pathways in antigen activation of naïve B and T cells, Effector cells and their role. Humoral and Cell mediated immune response, Cytokines Immune regulation, tolerance

**Unit IV****(9hours)**

Hypersensitivity reactions, Immunoprophylaxis (Vaccines), Immunology of HIV Infection, Infection and Immunity, Autoimmunity, Disorders of the Immune Response Immunology of Cancer, Monoclonal antibody and abzymes Modern Antibody Therapy

**Unit V****(9 hours)**

*Immunological methods:* Immunoprecipitation, qualitative and quantitative methods, agglutination, immunoblotting, radio/enzymoimmunoassay and immunohistology.

Immunisation, isolation and characterisation of antibodies. Immune cell activation and detection.

**Reference:**

1. Thomas J Kindt, Barbara A Osborne, Richard A Goldsby Kuby's Immunology (Kindt, Kuby Immunology) W H Freeman & Company
2. Roitt I, Essential Immunology, 10<sup>th</sup> Edition , Blackwell Science

**COMPUTERS FOR BIOTECHNOLOGY****UNIT – I****(5 Hours)****MICROSOFT EXCEL:** - concept of spread sheets, creating worksheet.**MICROSOFT WORD:** - concept of toolbar, character, paragraph & document formatting, drawing tool bar**MICROSOFT POWER POINT:** - slide presentation, slide layout & design, custom animation, image importing, slide transition.**UNIT – II:****(5 Hours)****C++ PROGRAMMING:** Introduction – OOP – Arrays – Functions – pointers - control structures -

Loops

**NETWORKS:** Introduction– OSI Layers – Function of OSI Layers**UNIT – III:****(5 Hours)****BIOPERL:** Scalar variables, lists, arrays, strings. Flow control structures. Subroutines, Associative arrays (hashes) - Input/output - Pattern matching with regular expressions - Perl applications in Bioinformatics - the BIOPERL project.**UNIT – IV:****(5 Hours)****PYTHON:** Unpacking a Sequence into Separate Variables - Strings and Text - Iterators and Generators – Functions**UNIT – V:****(5 Hours)****BIOJAVA:** Applications of Java in Bioinformatics: BioJAVA-Java based software used for Bioinformatics analysis (Pattern Hunter)-Java code examples.**TEXT BOOK:**

1. Introduction to Computers (2005) by Peter Norton, Sixth Edition, Tata McGraw Hill.
2. E.Balagurusamy, “Object oriented Programming in C++”, TMH.
3. Behrouz Forouzan, “Data Communication and Networking” Second Edition, Tata McGraw Hill.
4. Herbert Schildt, “The Complete Reference JAVA 2” Fifth Edition, Tata McGraw Hill, 2005.
5. David Beazley, Brian K. Jones, “Python Cookbook”, Third Edition, O’Reilly, 2013. (Chapters 1, 2 ,4 ,7)
6. James Tisdall, “Mastering Perl for Bioinformatics”, O’Reilly, 2010.

**MOLECULAR BIOLOGY PRACTICAL**

01. Agarose gel electrophoresis
02. Extraction and Purification of genomic DNA from bacteria
03. Extraction and Purification of Human DNA from blood
04. Quantitation of DNA by Spot test assay and UV Spectroscopy
05. Preparation of T4 phage and titration
06. Extraction of bacterial proteins and quantitation by UV spectroscopy
07. Separation of proteins on Poly acrylamide electrophoresis and Determination of molecular weight.
08. Isolation of RNA (DEMO)\*
09. Screening for auxotrophic and prototrophic markers
10. *In Vitro* mutagenesis of Bacteria
11. Preparation of Yeast DNA in agarose plug



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**RECOMBINANT DNA TECHNOLOGY****Objectives:**

- to provide students with an understanding of principles of genetic engineering including, cloning, expression of cloned genes and applications of PCR

**Unit I****(8 hours)**

Gene cloning-steps, vectors-plasmids and phages, preparation of bacterial DNA, plasmid DNA and phage DNA

**Unit II****(9 hours)**

DNA Manipulative enzymes- restriction endonucleases, restriction enzyme cleavage and restriction mapping, separation of DNA by gel electrophoresis (AGE and PFGE)\*, DNA ligases-properties and ligation technology, other enzymes as tools in rDNA technology

**Unit III****(10hours)**

Introduction of DNA into bacterial cells: Transformation and electroporation- identification of recombinants, phage DNA into bacteria and identification of recombinant phages  
Cloning vectors for *E.coli*- pBR322, pUC18, vectors based on lambda phage and M13 phage, cosmids and phagemids, Cloning vectors for yeasts

**Unit IV****(9 hours)**

Gene library and cDNA library: methods in clone identification by hybridization and protein products, blotting methods, PCR methods- RT PCR and Real time PCR, DNA sequencing by Maxam Gilbert and Sangers method, Next Generation Sequencing, Oligo nucleotide directed mutagenesis and protein engineering

**Unit V****(9 hours)**

Expression vectors for *E.coli*: Reporter genes, problems using *E.coli*, recombinant insulin, vaccines and other proteins. DNA analysis in forensic science, genetic fingerprinting, use in crime and paternity, cases in DNA analysis\*.

\* Self Study

**References:**

1. T A Brown- Gene Cloning and DNA analysis, 2011, 6<sup>th</sup> Edition, Wiley - Blackwell Publication
2. Desmond S T Nicholl- An Introduction to Genetic Engineering, 2002, 2<sup>nd</sup> Edition, Cambridge
3. Glick B R and Pasternack J J- Molecular Biotechnology, 2001, 3<sup>rd</sup> Edition, ASM Press

**ANALYTICAL TECHNIQUES****Objectives:**

- to get a working knowledge of biochemical techniques
- to understand the basis of separation and preparation of biomolecules

**Unit I ( 9 hours)**

Molarity, Molality and Normality Buffers- types of buffers used in Biological science and their principle. Preparation and use of buffers. Theory, principle and applications of pH Meter and Conductivity meter. CO<sub>2</sub>-responsive systems. Other ion-sensitive electrodes, for example, Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>++</sup>Redox, including O<sub>2</sub>-responsive systems. Titrations, potentiometric, amperometric, and conductimetric. The use of such methods in dynamic situations such as enzyme rate determination and for semi-automatic analysis. Biosensors

**Unit II ( 9 hours)**

**Chromatographic and Electrophoretic Techniques-** Various supporting media, for example, paper, membranes, gels, thin layer, ion exchange resins molecular sieves, disc, column, continuous flow, and others.

Immuno-electrophoresis, conventional, medium and high voltage electrophoresis.

Isoelectric focusing. Gas and high-pressure liquid chromatography. Sample preparation, dialysis, desalting, concentration, preparation of derivatives. Capillary electrophoresis.

**Unit III ( 9 hours)**

**General Physical Techniques- Fractional** distillation, for example, preparation of solvents. Solvent extraction, partition coefficients. Density gradient and analytical centrifuges, .Ultra-centrifugation. Freeze-drying . Preparation of high quality water- RO and De mineraliser and Softner.

**Unit IV ( 9 hours)**

**Photometric methods-** Absorptiometry. Spectrophotometry Turbidimetry. Flame photometry. Atomic absorption spectrophotometry, Flame emission spectroscopy Mass spectrometry (including tandem) Spectroscopy- Raman and IR spectroscopy, Fluorescence Spectroscopy

**Unit V ( 9 hours)**

**Radioactivity-** Discovery of radioactive elements, Units of radioactivity, Concepts of Physical and biological half-life. Laboratory hazards and Safety standards\*. Principles of radioactive detection and counting (GM and Scintillation counter) .Uses of radioisotopes in biological research, Autoradiography\*

**References:**

1. Wilson K and Walker J. 2000. Practical Biochemistry, 5th edition. Cambridge University Press, Cambridge.
2. Sharma B.K. 1991. Instrumental Methods of Chemical analysis, Goel Publishing House, New Delhi.
3. Holme and Peck. 1998. Analytical Biochemistry, 3rd Edition, Longman Scientific.

\* Self Study

**BIOPHYSICS – (Allied)****Objectives:**

- to integrate knowledge of physics with biology
- to understand the application of physical techniques to biological systems.

**Unit I****( 9 hours)**

Elemental Crystallography: Introduction to crystals, Bravais lattice- Simple cubic, FCC, BCC, ICC, Weiss indices, Miller indices, asymmetric unit, unit cell, 7 crystal systems, reciprocal lattice, symmetry in crystals –translation- rotation mirror planes and center of inversion- Space group and Point groups, X ray diffraction – Diffractometer- Bragg law.

**Unit II****( 9 hours)**

Diffusion, osmosis, osmotic pressure, osmoregulation, surface tension, dialysis, adsorption, viscosity, thermal conduction, Collides- sedimentation. Kinetics of molecules and reactions: zero, first, second and third order reactions,

**Unit III****( 9 hours)**

Principles of Light absorption and scattering: absorption of light- UV and visible, radiation sources, rotational and vibrational spectra, Raman effect, Rayleigh Light scattering, Fluorescence and phosphorescence principles, Quenching and energy transfers

**Unit IV****(9hours)**

Quantum Biology and its uses: Chemical mechanics, Newton, Lagrange and Hamilton equations, Schrodinger's equation, central force and angular momentum, atomic orbitals models, the wave equation, molecular orbitals

**Unit V****( 9 hours)**

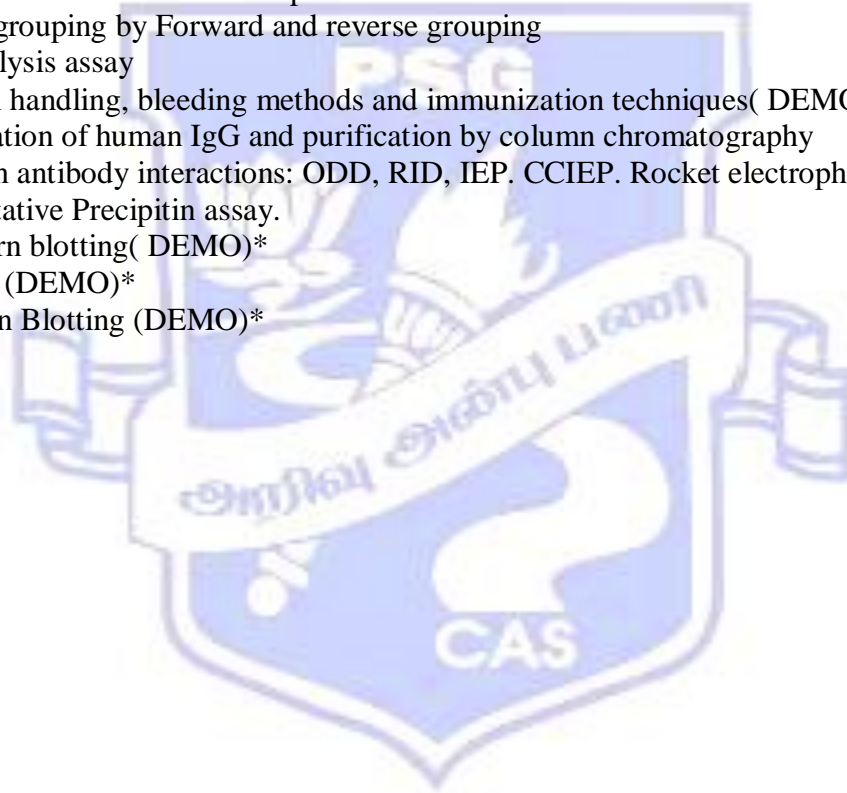
Theoretical modeling of bimolecular systems: Basic principles of modeling, modeling by energy minimization techniques, concepts of rotation about bonds, Ramachandran plot, energy minimization by basic techniques for small molecules

**Reference:**

1. Text Book of Biophysics, R N Roy, New Central Agency (P) Ltd, Calcutta
2. Aspects of Biophysics, Hugh S W, John Wiley and Sons.
3. R. S. Khandpur "Handbook of Bio-Medical Instrumentation", Tata McGraw Hill.

**rDNA PRACTICAL**

01. Preparation of restriction enzymes from bacteria
02. Restriction digestion of DNA
03. RAPD PCR
04. Preparation of competent cells and bacterial transformation
05. Preparation of particulate and soluble antigen
06. Preparation of serum and complement
07. Blood grouping by Forward and reverse grouping
08. Haemolysis assay
09. Animal handling, bleeding methods and immunization techniques( DEMO)
10. Preparation of human IgG and purification by column chromatography
11. Antigen antibody interactions: ODD, RID, IEP. CCIEP. Rocket electrophoresis, Quantitative Precipitin assay.
12. Southern blotting( DEMO)\*
13. ELISA (DEMO)\*
14. Western Blotting (DEMO)\*



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**METABOLISM****Objectives:**

- to acquire knowledge about the various metabolic pathways and energetics
- to know about integration of metabolism and relation to common diseases

**Unit I****(10hours)**

Introduction to metabolism-Carbohydrate metabolism- Glycolysis- pathways and energetics involved- biomedical importance, TCA Cycle, energetics, symmetrical reactions and regulation, gluconeogenesis, glycogen metabolism, overview and pathways. Homeostasis of blood glucose.

**Unit II****(10hours)**

Lipid metabolism- oxidation and activation of omega 3 fatty acids, biosynthesis of saturated and unsaturated fatty acids, Beta oxidation of fatty acids, phospholipid synthesis of phosphatidyl choline, glycolipids- metabolism of cholesterol. Alpha and Omega Oxidation.

**Unit III****(10hours)**

Nucleic acids- purine and pyrimidine bases, biosynthesis of purines – de novo and salvage pathways, catabolism of purines, biosynthesis of pyrimidines, catabolism of pyrimidines, disorders of purine and pyrimidine metabolism- gout and Lesh Nyhan syndrome.

**Unit IV****(10hours)**

Protein and nucleic acid metabolism- amino acid metabolism- biosynthesis of tyrosine, tryptophan and phenyl alanine, deamination and transamination. Urea cycle- pathways and energetics. Hormones. Integration of metabolism- starvation and induction of metabolic changes.

**Unit V****(10hours)**

Mineral metabolism- Calcium, Iron, Copper and Zinc.

BMR, role of exercise, alcoholism, control of body weight- caloric homeostasis, obesity\*. Diseases due to metabolic errors- Phenylketonuria, Jaundice, Albinism, Pompe and Diabetes- changes in metabolism.

**Reference:**

1. David L. Nelson and Michael M Cox, 1998, Principles of Biochemistry by, Macmillan Worth Publisher.
2. Stryer L, 2000, Biochemistry, 4<sup>th</sup> Edition, WH Freeman & Co.,
3. Voet and Voet, 1995, Biochemistry, 2<sup>nd</sup> Edition, John Wiley & Sons Inc.

\* Self study topics

**GENOMICS AND PROTEOMICS****Objectives:**

- Illustrate how modern techniques and procedures have evolved
- Moves from gene manipulation to genomic to proteomics to metabolomics synonymous with the new millennium

**Unit I****(10hours)**

Structural organization of genome, Satellites, SINES, LINES in pro and eukaryotes, Pseudogenes, gene duplication and gene annotation, Pedigree analysis, Physical and genetic mapping techniques, RH mapping and cytogenetic mapping, DNA Polymorphisms and markers as tools- RFLP, SNP, AFLP, identification using 16srRNA typing Transcriptomics- mRNA's in a cell, expression profiling

**Unit II****(10hours)**

HGP-Goals, procedures, short comings and uses, Shot gun sequencing, hierarchical sequencing , Craig Venter, YAC and BAC libraries, comparative genomics, orthologs and paralogs, exon shuffling, model organisms- *Drosophila*, *E.coli*, *S.cerevisiae*, *C.elegans*, *Mus musculus*, *A.thaliana* and their genomes.

**Unit III****(10hours)**

Proteomics: 2D electrophoresis of proteins, Isoelectric focusing, peptide sequencing, Mass spectrophotometry and its uses, LC/MS-MS to identify proteins, MALDI-TOF, SAGE, differential display proteomics, protein-protein interactions, Yeast two hybrid systems, Phage display screening

**Unit IV****(10hours)**

Pharmacogenomics: Concept of genomic medicine, High Throughput screening in genome for drug discovery, identification of gene targets, pharmacogenetics and drug development

**Unit V****(10hours)**

Applications of Proteomics: Analysis of microarray data- protein peptide microarray based technology, PCR directed protein arrays , structural proteomics, Metabolomics

**References:**

1. S B Primrose and R M Twyman- Principles of Gene Manipulation and Genomics, 7<sup>th</sup> Edition , 2006, Blackwell Publishing
2. Ronald J Trent- Molecular Medicine- An introductory Text, 3<sup>rd</sup> Edition, 2005, Elsevier

**Computer Applications In Biotechnology:  
INTRODUCTION TO BIOINFORMATICS PRACTICAL****Objectives:**

- to understand levels of structural organization of macromolecules and experimental methods of structure determination
- to know the approaches for structure analysis

**Unit I**

Data storage and retrieval: FLAT files, relational object oriented data base, file formats. Bioinformatics resources on web, NCBI, EBI, Pubmed.

Biological Databases: Sequence database- primary, secondary, Nucleic acid database- GenBank, DDBJ, EMBL.

**Lab:** Information retrieval from databases: SRS, ENTREZ.  
Genbank and EMBL entry format,  
Gene annotation with Artemis

**Unit II- Similarity Searching and Alignment**

Sequence alignment. Dot Plot, Distances. Similarity and homology, substitution scores and matrices, database search. Local and global alignment, Pairwise alignment. Multiple sequence alignments. Phylogenetics.

**Lab:** Use of BLAST and FASTA as gene analysis  
Use of CLUSTALW,  
Tree building and Phylip,

**Unit III**

Finding genes in DNA sequences, promoters, regulatory elements. RNA structure prediction methods.

**Lab:** PCR primer design,  
Finding ORF's and Restriction Sites

**Unit IV**

Protein databases Primary, Secondary and Composite- UniPROT and SWISS PROT, Specialized database: TIGR and SGD. Protein Structure prediction: prediction of secondary structure- GOR and Chou Fossman, Protein tertiary structure modeling- threading, Ab initio modeling, homology modeling. fold recognition. Protein motif and domain databases.

**Lab:** Working with PDB  
Molecular docking of proteins and visualization using RasMol,  
EXPasy to study the properties of proteins and predict the secondary structure

**Unit V:**

Genome mapping, annotation and genome sequence assembly, comparative genomics and analysis. Drug modeling.

**Lab:**

Comparison using VISTA.  
Docking Of Drugs.

**References:**

1. Brown S.M., Bioinformatics: A biologist's guide to Biocomputing and the internet, Eaton Publishing.
2. Baxevanis and Ouellette, 2005, Bioinformatics A practical guide to the analysis of genes and proteins, WILEY.

**Work Instructions:**

01. 100% Internal Assessment (Practical) and no Comprehensive Examination
02. The Passing minimum is 40%
03. The paper has in built practical components with theory
04. Totally 2 tests will be conducted giving equal weightage to theory and practical
05. Each test will be for 2 hours duration

1. Theory Component:

2. Objective questions and Short answers : 15 Marks

3. Practical Component:

2 experiments x 7.5= : 15 Marks

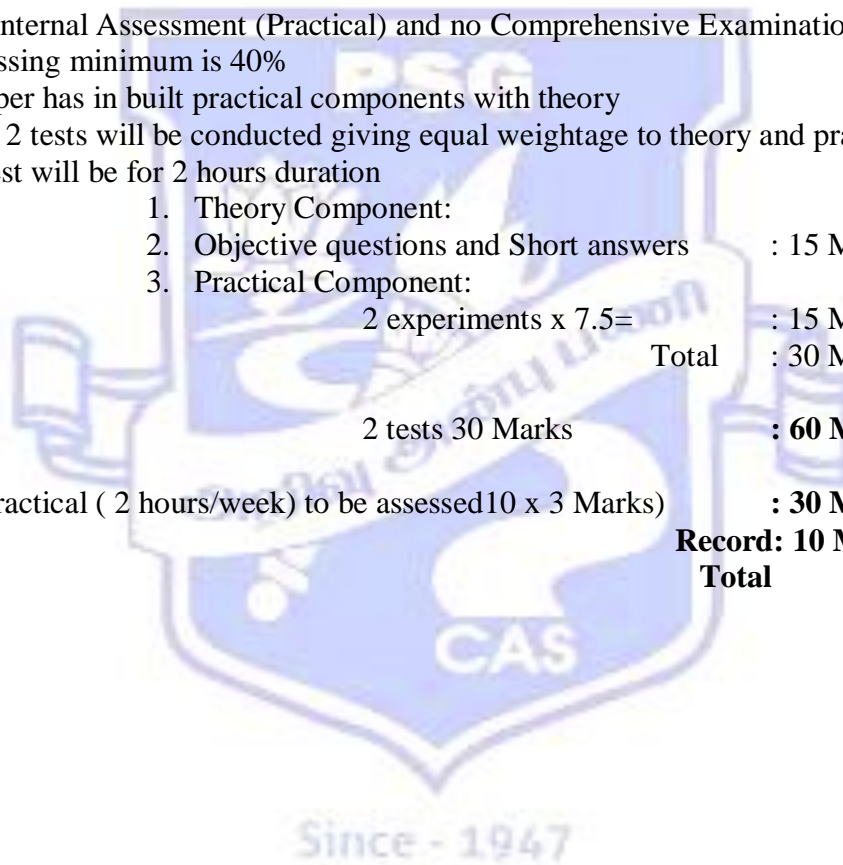
Total : 30 Marks

2 tests 30 Marks : 60 Marks

06. Each practical ( 2 hours/week) to be assessed 10 x 3 Marks) : 30 Marks

**Record: 10 Marks**

**Total : 100 Marks**



## IPR, BIOSAFETY AND BIOETHICS

### Objectives:

- to learn the principles behind IPR, Biosafety and Bioethics regulations in India

### Unit I

(9hrs)

IPR:Biotechnology and international trade, WTO and TRIPS, IPR copy rights, patents IPP  
Patent Biotechnology- criteria, products and process, Patent, Patent laws, Patenting of biological system, Benefits of patenting, requirements for biotechnological inventions.

### Unit II

(9hrs)

Protection of traditional knowledge, geographical indicators, treatise plant varieties- protection, Biodiversity and benefit sharing.  
Herbal wealth of India. Case studies Basmati, Turmeric and Neem.

### Unit III

(9hrs)

Bioethics:

Ethical issues in Agriculture, Controversy in crops- Bt cotton, rice, brinjal, Transgenics.  
Recombinant microorganisms, Business ethics.

### Unit IV

(9 hrs)

Biosafety

Ethics in biomedical practice, IVF, Cloning, GMO and Stem cell ethics, Safety in pharmaceuticals ,drugs and vaccines, drug controversies, Safety in laboratories, lab associated infections.

### Unit V

(9 hrs)

Biohazards in Biotechnology, Risks and benefits of Biotechnology, Bioterrorism and biological weapons, social and genetic discrimination laws, right to information.

### Reference:

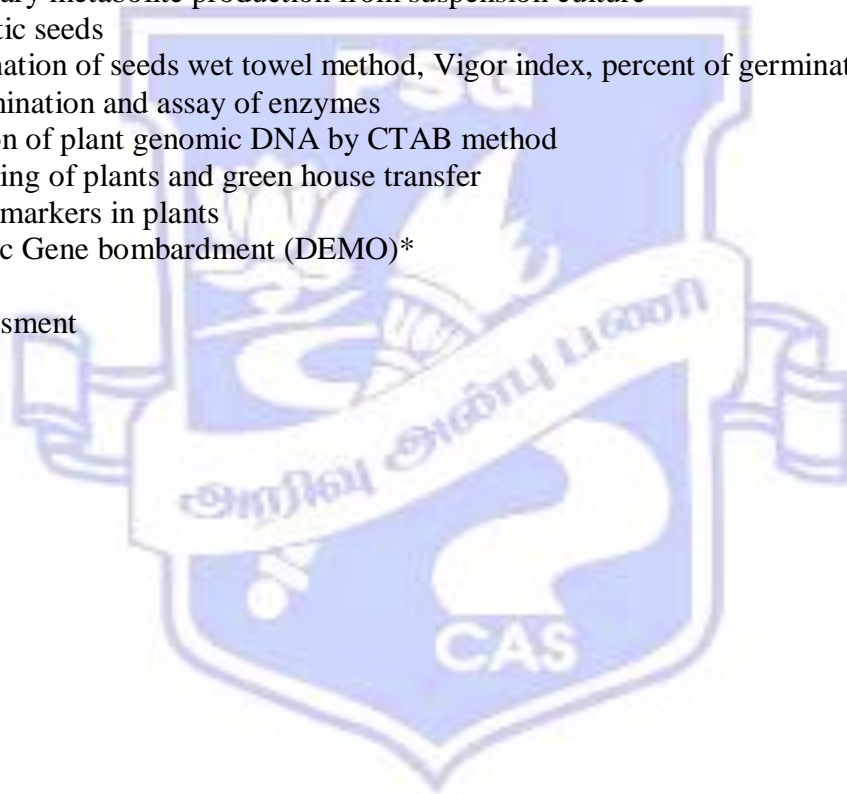
1. Subbaram N.R. " Handbook of Indian Patent Law and Practice ", S. Viswanathan (Printers and Publishers) Pvt. Ltd., 1998.

## PLANT BIOTECHNOLOGY PRACTICAL

Prelude: Lab design for plant and animal cell culture, media preparation and sterilization.

01. Callus induction
02. Micropropagation
03. Isolation of Protoplast and checking for viability
04. Suspension culture
05. Secondary metabolite production from suspension culture
06. Synthetic seeds
07. Germination of seeds wet towel method, Vigor index, percent of germination and speed of germination and assay of enzymes
08. Isolation of plant genomic DNA by CTAB method
09. Hardening of plants and green house transfer
10. RAPD markers in plants
11. Biolistic Gene bombardment (DEMO)\*

\* Not for assessment



Since - 1947

**CORE ELECTIVE - I**  
**PLANT TISSUE CULTURE AND TRANSGENIC TECHNOLOGY \***

**Objectives:**

- to study the value of tissue culture and its applications in phytochemical production.
- to give information on GM crops and stress resistant plants.
- to study about molecular markers for crop improvement

**Unit I (9hrs)**

History and development of plant tissue culture, laboratory organization, aseptic techniques, media constituents and preparation, cellular totipotency- cyto differentiation , cell cultures, establishment and maintenance of callus and suspension cultures, Organogenesis and embryogenesis, artificial seeds.

**Unit II (9hrs)**

Haploid production, anther and microspore culture, embryo culture and rescue in agricultural crops, in vitro pollination, germplasm conservation, protoplast technology-isolation, culture and regeneration, somatic hybridization, selection of hybrids, cybrids- applications

**Unit III (9hrs)**

Micropropagation, Meristem culture and virus elimination, micro grafting, virus indexing, somoclonal variation, selection, sources and causes for variation, application in crop improvement. Production of secondary metabolites through cell cultures, Bioreactor designing..

**Unit IV (9hrs)**

Transgenic plants:- Vectors for plant genetic engineering, Agrobacterium mediated transformation, Particle Bombardment methods for creating transgenics and its applications  
Plants as Biofactories- Production of useful proteins in plants, edible vaccines, Plantibodies.

**Unit V (9hrs)**

Stress resistance plants: herbicide resistance- strategies for engineering herbicide resistance. Environmental impact. Pest resistance- Bt approach, copy nature strategy. Disease resistance and abiotic stress resistance. Gm crops- current status and regulations.

**References:**

01. Bhojwani S.S , Razdan M.K, 1996, Plant Tissue Culture: Theory and practice. Elsevier, Amsterdam.
- 02.Chawala.H.S. 2009, Plant Biotechnology, Oxford and IBH Publications.
03. A. Slatter et al , 2008, Plant Biotechnology: the Genetic manipulation of plants, Oxford University Press.

**14BTU23B**

**CORE ELECTIVE-I**

**V Semester  
4hrs/week**

**AGRI BIOTECHNOLOGY**

**Objectives:**

- to expose students to indigenous resources
- to learn about local bioproducts

**Unit-I**

**(9 hours)**

Cultivation of button mushroom. Oyster and paddy straw mushroom- economics of mushroom cultivation, products from mushroom .Bioproducts from algae:- Growing spirulina and chlorella, Extraction and formulation of SCP products.

**Unit-II**

**(9 hours)**

Vermi composting : Soil biota- role of earthworm in soil- Vermicompost as small scale industry and its economics. Organic farming:- Tradition technology in farming. Integrated farming system with milch animals. Development of organic grains, vegetables and eggs.

**Unit-III**

**(9 hours)**

Herbal resources in South India-Active Principles isolation, Bio Prospecting , Silviculture and forest products. Phytochemical products-potential for export, uses in diseases, anti diabetic, hypo lipidemic, anti cancer . Medicinal plants as source for phytochemicals. Secondary metabolites, tribal medicinal plants.

**Unit-IV**

**(9 hours)**

Tissue culture and micro propagation as commercial venture. Floriculture- ornamental and cut flower technology- Micro propagation of roses, anthurium, gerbera, carnation and gladiolus.

**Unit – V**

**(9 hours)**

GIS and Remote sensing: Application in agriculture, identification of areas for cultivation, pesticide usage, Application in forestry and Mining.

**Reference:**

01. Dixon R A, Plant cell culture- A practical approach
02. Dubey R C, A Text book of biotechnology, Chand & Co

**ANIMAL BIOTECHNOLOGY****Objectives:**

- to learn the basis of mammalian cell culture and cell cloning
- to learn productive techniques in mammals and embryo transfer in IVF
- to understand cloning techniques by nuclear transfer and ES cells

**Unit I****(10hours)**

Basic Embryology- Gametogenesis and Fertilization in animals. Cleavage patterns, Role of maternal contributions in early embryonic development, Genetic regulation of development in oocyte of *Xenopus* and *Drosophila* homeotic genes. Collection and preservation of embryos, Semen banking, IVF and ICSI.

**Unit II****(10hours)**

Animal cell culture – History and development, Pluripotency, Media, balanced salt solutions, Physical, chemical and metabolic functions of constituents of culture media, Role of carbon dioxide, Serum, growth factors and amino acids in media. Serum containing and serum free media. Constitution of a media for cell line. Essential equipments required for animal cell culture.

**Unit III****(10hours)**

Types of cell culture- Primary, Secondary and Organ culture, Tissue engineering. Role of feeder layers in cell culture, Cell separation techniques, Cell cloning, cell synchronization, Cell counting methods, cryopreservation, Cell banking procedures. Biology of cultured cells- Apoptosis and cell death- pathways leading to apoptosis, cytotoxicity assays.

**Unit IV****(10hours)**

Transfection of cells in culture- Animal viral vectors for transfection, Physical methods of transfection, HAT selection, selectable markers. Micro manipulation of cells, Gene targeting, gene silencing and Gene knockout and their applications.

**Unit V****(10hours)**

Stem cell culture, embryonic stem cells and adult stem cells and their applications. Cell culture based vaccines. Somatic cell genetics. Animal Cloning- Dolly, Transgenics- Transgenic animals- production and applications (Molly, Polly and ANDi). Pharming, Expression of bovine growth hormone. Ethical issues in animal biotechnology.

**Reference:**

1. Ian Freshney ,Culture of Animal Cells, IRL Press.
2. Butterworth et al In vitro cultivation of animal cells, Biotol series.
3. Old and Primrose, Principles of Gene Manipulation, Blackwell,Scientific Publications.

**BIOPHARMACEUTICALS****Objectives:**

- to decipher farm to pharma methodology
- to understand dynamics and kinetics of drugs

**Unit I****(9 hours)**

Introduction to farm products from local resources- plant and herbs animals, microbes and minerals, raw materials and separation -extraction ( Solvent extraction , Steam distillation) process, identification of bioactive constituents, sources of essential oils and its chemistry

**Unit II****(9 hours)**

Pharmacodynamics: physico chemical principle Mechanism of drug action, drug receptors and physiological receptors, structural and functional families, ADMET, , Drug delivery systems: sustained delivery of drugs- liposomes, Nanoparticle based delivery systems- nanocapsules, nanoshells, intra nasal sprays

**Unit III****(9 hours)**

Pharmacokinetics: pharmacokinetics, biotransformation of drugs, bioavailability of drugs, drug absorption and drug distribution, effect of food on drug absorption

**Unit IV****(9 hours)**

Drug Manufacturing Processes: Good Manufacturing practice: Industrial plant design, quality control, maintenance of manufacturing standards, validation. Clinical trials; rDNA technology in manufacturing processes, Cell line and bioreactor improvements. Transgenic expression system , Case study.

**Unit V****(9 hours)**

Production of biopharmaceuticals: drug formulation, Production of therapeutic proteins, hormones, cytokines, interferons, interleukins, Tumor necrosis factor, blood clotting factors, asparaginase, vaccines. Oils used in aroma therapy. Role of biopharmaceuticals in treatment of diseases, manufacturing and regulatory issues, Compliance/Adherence and acceptability of Product

**References:**

1. Gary Walsh, Biopharmaceuticals: Biochemistry and Biotechnology, John Wiley & Sons Ltd
2. Tripathi KD- Essentials of medical pharmacology, 6<sup>th</sup> Edition , Jaypee Publication
3. Guyton A C- Text book of medical physiology, 9<sup>th</sup> Edition, Hancourt Brace & Co

**APPLIED ASPECTS OF BIOTECHNOLOGY****Objectives:**

- to learn the latest technologies like nanotechnology and application of stem cells
- to understand the principles behind tissue engineering, artificial organs and new therapeutic for diseases

**Unit I****(10hours)**

Basic concepts of Nanoscience and Technology- Atom structure, Top down and Bottom up approach. Nanoparticles; micelles, quantum dots and dendrimers. Application of nanoparticle in cancer detection, imaging and therapeutics. Carbon nanotubes and applications. AFM.

**Unit II****(10hours)**

Stem cells: origin and types of stem cells. Induced pluripotent stem cells. Application of stem cells in treating neuronal, liver and cardiac diseases. Isolation and proliferation of stem cells. Bone marrow transplantation. Therapeutic and reproductive cloning. Cloning and ethical issues.

**Unit III****(10hours)**

New therapeutics: DNA nanobots, nucleic acid aptamers and clinical applications. RNA based – interference RNA and therapy for cancer and infection. Protein based therapy- therapeutic targets for Alzheimer's and HIV.

**Unit IV****(10hours)**

Tissue engineering: classification of Biomaterials- Metallic, ceramic and polymeric implant materials. Skin replacement: anatomy of skin, skin grafting, and cell based therapy. Artificial skin products. Bone tissue engineering: bone grafts, Biomaterials in Bone tissue engineering and cell therapy, limits and challenges. Artificial organs- extracorporeal devices, types of bioreactors used to culture hepatocytes.

**Unit V****(10hours)**

Bio energy: Biohydrogen production from waste materials, Bio-processes for hydrogen gas production: Bio-photolysis of water by algae, dark fermentation, two stage dark/photo-fermentation. Biomass conversion: source and types of biomass and conversion, Bio refinery-categories and concepts. Polymer electrolyte and fuel cells.

**Reference:**

1. Claudio nicolini, 2008, Nanobiotechnology and nanosciences, Vol 1, pan stanford publishing.
2. Elisabeth s papazoglou , *et al.*, 2007, Bionanotechnology, Morgan and clay pool publishers.
3. John p fisher, *et al.*, 2012, Tissue engineering:principles and practices, CRC press
4. Jesop panno, 2009, Stem cell research, New York- NY facts on file publishers.

**BUSINESS BIOTECHNOLOGY****Objectives:**

- to describe the important factors for harnessing scientific creativity into a commercial enterprise
- to measure the importance of patents in securing intellectual property and corporate income

**Unit I****(10hours)**

Biotechnology strategies in India: Agencies- National Biotechnology Development Strategy (DBT), NBA, BCIL, ABBI- role in promoting development of Biotechnology in India. Technology parks and incubators- NCL, TERI, Women's Entrepreneurship development, Commercial biotechnology in India- Drug companies and products, enzymes, extraction and food industry.

**Unit II****(10hours)**

Establishment of Enterprise:

- a. Project Planning-Commercially successful biotech products and potential products
- b. Project proposal- preparation of proposal, financial assistance, venture capital, subsidy and grants- state and central Government
- c. Project implementation- statutory approval and clearance, pollution board, inspector of factories, fire, health, Local Panchayat board, Work schedules, project progress monitoring, budgeting and fund flow.

Case study: Venture capital and preparation of a proposal for funding

**Unit III****(10hours)**

Establishment of Enterprise ( cont...)

- d. Project Management- technology source, gestation period of projects, cash flow, labor management, product quality control, product planning and monitoring.
- e. Marketing- Product advertisement, product demonstration, product positioning, product placing, pricing, product viability and pay back period-IRR( Internal Rate of Return) benefit cost ratio, tax and tax structure- sales tax and income tax. VAT.
- f. Business Bioethics

**Unit IV****(10hours)**

Value addition to Biotechnology products, quality control and strategies for future development of products, IT for business administration, use of IT in improving business performance, E business set up, Industries in the production of GM plants and plant products in India.

**Unit V****(10hours)**

Therapeutic agents by rDNA technology in India and Biotech companies in drug and vaccine production in India, Clinical trials in pharma research. Microbial Consortia in Environmental biotechnology industry.

**Reference:**

Pisano G P., 2007, Science Business: The promise, the reality and the future of Biotech, Amazon Publishers

Malinowski M J, 2007, Biotechnology: Law, Business and Regulation, Aspen Publishers



Since - 1947

14BTU28

VI Semester

**APPLIED BIOTECHNOLOGY PRACTICALS**

1. Isolation and screening of Microorganisms for enzyme production
2. Production of Amylase enzyme
3. Immobilization of Amylase Enzyme and Assay
4. Precipitation of Enzyme by salts and organic solvents
5. Characterization of Enzyme
6. Immobilization of yeast and production of Ethanol
7. Production of Ethanol using various substrates
8. BOD
9. COD
10. Isolation of lymphocytes and viability test



Since - 1947

**CORE ELECTIVE- II****INDUSTRIAL AND MICROBIAL BIOTECHNOLOGY\*****Objectives:**

- to study the design of fermentor and downstream processing.
- to understand the production techniques in industrial, medical and food industries

**UNIT I****(10hours)**

Isolation, preservation and maintenance of microorganisms in industry. Media formulation and anti foam agents. Strain improvement..

Introduction to Bioprocess technology; Scale up Fermentor-types and design for microbial and animal cells– air lift and tower Fermentor.

**UNIT II****(10hours)**

Simple Bioproduction Kinetic –cellular growth Kinetics, substrate utilization and product formation. Kinetics of batch, fed batch and continuous culture. Types of Substrate, wastes and byproducts for use. Fermentation process – solid, semisolid and liquid states.

**UNIT III****(10hours)**

Downstream processing: removal microbial cells and solid matter. Foam separation, precipitation, Filtration, centrifugation, cell disruption, chromatography, membrane process, drying and crystallisation. Product recovery and yield.

**UNIT IV****(10hours)**

Production of acetic acid, citric acid, lactic acid and glutamic acid.

Production of amylases, proteases, riboflavin and penicillin.

Beverages- beer and wine production\*\*.

**UNIT V****(10hours)**

Production of Dairy products- Cheese and Yoghurt

Mushroom and SCP production\*\*. Baking industry – bread. Production of growth factors – gibberellins and interferon

**References:**

01. Brock. T.D ,1990, Biotechnology: A Text Book of Industrial Microbiology:, Smaeur Associates,

02. Casida L.E, 1989, Industrial Microbiology: Willey Eastern Ltd.,

03.Stanbury et al , 1998, Principles of Fermentation technology , Pergmann Publishers

\* Self Study

**14BTU29B**

**CORE ELECTIVE-II**

**VI Semester  
5hrs/week**

**BIOFUEL AND BIOREMEDIATION**

**Objective:**

- to learn about waste disposal in local area
- to harness natural bioresource for fuel production

**Unit-I**

**(10hours)**

Fundamental concepts in understanding biofuel/bioenergy production. Bioenergy – Sustainable Future and Current Status, First Generation Bioenergy – Crops and Products: Jatropa & Vegetable oils, Second Generation Bioenergy – Lignocellulosic Ethanol. Third Generation Bioenergy – Hydrogen and Biological Processes for Hydrogen Production, Algae-based Hydrogen Production and Water Splitting, Microbe Fuel Cells and Other Aspects of Bioenergy.

**Unit-II**

**(10hours)**

Feedstocks availability, characterization and attributes for biofuel/bioenergy production Biomass preprocessing: drying, size reduction, and densification, Various biofuels/bioenergy from biomass, Biomass conversion to heat and power: thermal gasification of biomass, anaerobic Digestion, Biomass conversion to biofuel: Thermal conversion, Chemical Pretreatment and Hydrolysis for Chemical and Enzymatic Conversion. Biodiesel production from oil seeds, waste oils and algae. Environmental impacts of biofuel production

**Unit-III**

**(10hours)**

Bioremediation: Introduction, Current remediation practices. Advantages vs disadvantages of bioremediation, Levels of bioremediation: biostimulation, bioaugmentation, Molecular techniques in bioremediation, limitations of bioremediation, Microbes in degrade or transformation of pollutants, Phytoremediation. Genetic release of engineered bacteria and its regulations.

**Unit-IV**

**(10hours)**

Solid waste management by municipalities, generation and characteristics of waste-Compositing, Vermicomposting, landfilling, Solar disinfection, incineration and energy recovery, Reuse and recycling of solid wastes, biological conversion-Biogas. Municipal Solid Waste Management Act 2003- Rules. Liquid waste management-Industrial & Domestic effluents-Primary, secondary and tertiary treatments. Plastics wastes-Recovery, recycling & resource conversion.

**Unit-V**

**(9hours)**

Hospital and lab waste: Risk of Biomedical Waste to Human Health, Classification of Bio-medical waste – Generation, handling, transport, storage-Treatment- Onsite/ off site and disposal – Colour Coding and type of Container for Disposal of Bio-medical wastes – Waste management strategies. Biomedical waste Management Rules and Regulations.

**Reference:**

01. Balasubramaniam D *et al*, 2004, Concepts in Biotechnology, Orient Longman
02. Indhu S T, 2006, Environmental Biotechnology, IK international
03. Swaminathan M S, 1991, Biotechnology reaching the un reached, CSR SARD Publishers



Since - 1947

**Non Major Elective (1): EDC**  
**SUCCESS STORIES IN BIOTECHNOLOGY**  
**(Cluster – IV)**

**Objectives:**

- To enable someone with zero biological knowledge to understand DNA- the Secret of Life

**Unit I**

DNA the double helix story  
Jacob's sheep and genetics  
Dolly, Polly and human Cloning  
Why no effective vaccines for AIDS and TB  
Anthrax bacterium and biological warfare  
Orange T and Vietnam War.

**Unit II**

Flavr Savr tomato  
Kary Mullis and PCR  
PCR in Sex determination  
Mad cow disease and prions

**Unit III**

DNA fingerprinting – crime stories- O.J.Simpson, Rajiv Gandhi, Paternity testing, identifying culprits in sexual molestation cases. Mitochondrial DNA and Czar  
Drug abuse in athletics  
Entrepreneur- Growth of biotech industries, Kiran Majumdar Shaw, Dr Reddy's lab, Shantha Biotech. Myths and facts about GMOs.

**Reference:**

1. E O Wilson, 2003, Watson DNA double helix, Arrow Books
2. Klug, Concepts of Genetics, Pearson education

