

**Proposed Syllabus for Integrated UG/PG (Hons.) (Five  
years/Ten semesters)**

**(Biotechnology)**

(To be implemented from the academic session 2009-2010)

**Faculty of Life Sciences  
Department of Biotechnology  
Guru Ghasidas Vishwavidyalaya  
Bilaspur (C. G.)-495009**

## Integrated UG/PG Biotechnology (Five years/Ten semesters)

### Semester - I

Code	Subjects	End Semester Exam	Internal Assessment	Total
LBTC 101	Microbiology	30	20	50
LBTC 102	Cell Biology	30	20	50
LBZS 103	Zoology-I	30	20	50
LBZS 104	Zoology-II	30	20	50
LCS 105	Chemistry-I	30	20	50
LCS 106	Chemistry-II	30	20	50
	Hindi-I	30	20	50
	English-I	30	20	50
	<b>Laboratory</b>			
LBTL 107	Laboratory (Based on LBTC -101, LBTC -102)	30	20	50
LBZL 108	Laboratory (Based on LBZS -103, LBZS -104)	30	20	50
LCSL 109	Laboratory (Based on LCS -105, LCS -106)	30	20	50
			<b>Total</b>	<b>550</b>

### Semester- II

Code	Subjects	End Semester Exam	Internal Assessment	Total
LBTC 201	Biomolecules	30	20	50
LBTC 202	Genetics	30	20	50
LBBS 203	Botany-I	30	20	50
LBBS 204	Botany-II	30	20	50
LCS 205	Chemistry-III	30	20	50
LCS 206	Chemistry-IV	30	20	50
	Hindi-II	30	20	50
	English-II	30	20	50
	<b>Laboratory</b>			
LBTL 207	Laboratory (Based on LBTC -201, LBTC -202)	30	20	50
LBBL 208	Laboratory (Based on LBBS -203, LBBS -204)	30	20	50
LCSL 209	Laboratory (Based on LCS -205, LCS -206)	30	20	50
			<b>Total</b>	<b>550</b>

### Semester - III

Code	Subjects	End Semester Exam	Internal Assessment	Total
LBTC 301	Biophysics & Instrumentation	30	20	50
LBTC 302	Biochemistry	30	20	50
LBZS 303	Zoology-III	30	20	50
LBZS 304	Zoology-IV	30	20	50
LCS 305	Chemistry-V	30	20	50
LCS 306	Chemistry-VI	30	20	50
	Environmental Sciences	100	-	100
	<b>Laboratory</b>			
LBTL 307	Laboratory (Based on LBTC -301, LBTC -302)	30	20	50
LBZL 308	Laboratory (Based on LBZS -303, LBZS -304)	30	20	50
LCSL 309	Laboratory (Based on LCS -305, LCS -306)	30	20	50
			<b>Total</b>	<b>550</b>

### Semester - IV

Code	Subject	End Semester Exam	Internal Assessment	Total
LBTC 401	Molecular Biology	30	20	50
LBTC 402	Plant and Animal Tissue culture: Techniques and applications	30	20	50
LBBS 403	Botany- III	30	20	50
LBBS 404	Botany-IV	30	20	50
LCS 405	Chemistry-VII	30	20	50
LCS 406	Chemistry-VIII	30	20	50
	<b>Laboratory</b>			
LBTL 407	Laboratory (Based on LBTC -401, LBTC -402)	30	20	50
LBBL 408	Laboratory (Based on LBBS -403, LBBS -404)	30	20	50
LCSL 409	Laboratory (Based on LCS -405, LCS -406)	30	20	50
			<b>Total</b>	<b>450</b>

### Semester – V

Code	Subject	End Semester Exam	Internal Assessment	Total
LBTC 501	Recombinant DNA Technology & Genomics	30	20	50
LBTC 502	Biostatistics and Computer Application	30	20	50
LBTC 503	Basic Animal Biotechnology	30	20	50
LBTC 504	Bioinformatics <b>Laboratory</b>	30	20	50
LBTL 505	Laboratory Based on LBTC -502 & 504	30	20	50
LBTL 506	Laboratory Based on LBTC -501 & 503	30	20	50
LBTC 507	Seminar			50
			<b>Total</b>	<b>350</b>

### Semester- VI

Code	Subject	End Semester Exam	Internal Assessment	Total
LBTC 601	Immunology	30	20	50
LBTC 602	Industrial Biotechnology	30	20	50
LBTC 603	Biosafety, Bioethics and IPR Issues	30	20	50
LBTC 604	Major Elective <b>Laboratory</b>	30	20	50
LBTC 605	Laboratory XV (Based on LBTC - 601 & 602)	30	20	50
LBTC 606	Project Dissertation (Based on major elective LBTC - 604)	90	60	150
			<b>Total</b>	<b>400</b>

**Major Elective:** Environmental Biotechnology, Fermentation Technology, Plant Biotechnology

\*\* B.Sc. Biotechnology (Hons.) students shall opt one Major Elective papers from Major Electives offered by same Department.

@ Project work/ Field Study will be based on major elective paper (s) opted by the student.

## LBTC 101 : MICROBIOLOGY

### **Unit - 1**

History and scope of Microbiology, Development of microscopy and Pasteur's experiments, Microscopy-Light microscopy, Bright & Dark field microscopy and Phase contrast microscopy. Koch's postulates, Aseptic techniques, Methods of sterilization, Classification of microbes.

### **Unit - 2**

Classification and General account of virus and mycoplasma, Retrovirus, Rhinovirus,  $\phi$ X174

### **Unit - 3**

Classification, General account of bacteria, Cell structure and reproduction, Nutritional diversity and Economic importance of bacteria. General characteristics of Cyanobacteria and their economic importance.

### **Unit - 4**

General characters, Classification, evolutionary trends and comparative study of different classes of fungi with respect to sexual processes, economic importance of fungi. General account and economic importance of actinomycetes.

### **Unit - 5**

Microbes in extreme environment. Archea: General characters, Classification. Survival mechanism of thermophiles, halophiles, psychrophiles,. Use of extremophiles in biotechnology.

### **Suggested Readings**

1. Microbiology (2<sup>nd</sup> Ed) by Talaro
2. Biology of Microorganism (9<sup>th</sup> Ed) by Broak
3. Principal of Microbiology by Atlas (1995)
4. Molecular Biology of Gene by Watson (1987)
5. Microbiology (6<sup>th</sup> Ed) by Fred Alcamo (2002)
6. General Microbiology by Stanier (1986)
7. Microbiology by Pelczar & Krieg (1998)

## LBTC 102 : CELL BIOLOGY

### **Unit - 1**

Origin of life - Theory of Chemical Evolution, Formation of RNA and DNA, Formation of nucleoproteins, Natural Selection of Self replicating Polymers

### **Unit - 2**

Basics of Eukaryotic Cell Biology (structure & function) – Historical Background, Discovery of cell and Cell Theory; Comparison between plant and animal cells

### **Unit - 3**

Ultrastructure of Cell: Cell wall; Plasma membrane, Cytoskeleton; Protoplasm; Mitochondria; Chloroplast; Endoplasmic Reticulum, Golgi complex; Lysosome, endosome and microbodies; Ribosome; Centriole; Nucleus.

### **Unit - 4**

Chemical components of a cell; Catalysis and use of energy by cells. Methods in Cell Biology: Elementary idea of microscopy and cell fractionation.

### **Unit - 5**

An overview of cell cycle; mitosis, mitotic spindle and chromosome movement, Process and phases of mitosis & meiosis and its significance. Apoptosis.

### **Suggested Readings**

1. Cell ( A Molecular approach ) : Cooper , G. M.
2. Cell and Molecular Biology (1996) Karp, G.
3. Cell Biology (1993) Sadava D. E.
4. Cell and Molecular Biology (1995) Kish V. M. and Kleinsmith L. J.
5. Cell and Molecular Biology : deRobertis and deRobertis

## LBTC 201 : BIOMOLECULES

### Unit - 1

Biomolecules: configuration and conformation. Properties of water as biological solvent.

Carbohydrates: Chemical structures, nature, properties, Classification and Importance in Biological Systems.

### Unit - 2

Amino acids: Classification, properties, structure, nature. Proteins: Classification, Structure and Function. Primary, Secondary, Tertiary and Quaternary Structure and their functional significance.

### Unit - 3

Enzymes: Classification, Characteristics, Factors affecting enzyme activity. Enzyme Kinetics,  $K_m$  &  $V_{max}$ , Activation and Inhibition of Enzymes. Non-Protein Enzymes, Application of Enzymes *in vitro* and *in vivo*.

### Unit - 4

Lipids: Structure, Classification, Properties and Function. Vitamins: Fat-soluble and water-soluble, Classification and function of Vitamins and Hormones.

### Unit - 5

Nucleic acids: Bases, nucleosides and nucleotides, DNA & RNA structure, DNA forms, RNA types. Watson and crick model. Nucleosome model of chromosome. Genome organization and Packaging of DNA

### Suggested Readings

1. Principle of Biochemistry : Leinger , A. L.
2. Biochemistry (1995) Lubert Stryer
3. Text Book of Biochemistry (1997) Devlin , Thomas M.
4. Biochemistry (1993) Geoffery, Zubay
5. Basic Biological Chemistry : Mahler and Cordes
6. Harper's Review of Physiological Chemistry(1993) Murray, R. K., Mayes, P. A. Gramner, D. K. and Rowell V. W.
7. Lehninger's Principle of Biochemistry D L Nelson & M M Cox 5<sup>th</sup> Edition
8. Biochemistry – Keshav Trehan Wiley Eastern Publications
9. Fundamentals of Biochemistry-J.L.Jain S.Chand and Company
10. Biochemistry- Prasaranga, Bangalore University
11. Fundamental of Biochemistry – Dr.A.C.Deb
12. Textbook of Organic Chemistry ( A Modern Approach)
13. The Biochemistry of Nucleic acid – Tenth Edition-Roger L.P.Adams, John T. Knowler and David P.Leader, Chapman and Hall Publications

## LBTC 202 : GENETICS

### **Unit - 1**

Mendelism & Chromosome Theory – Mendel's principles, applications of Mendel's principles, chromosome Theory of Heredity (Sutton-Boveri), Inheritance patterns, phenomenon of Dominance, Inheritance patterns in Human (Sex-linked & Autosomal).

### **Unit - 2**

Linkage & Crossing over - Chromosome theory of Linkage, kinds of linkage, linkage groups, Genetic mapping, Relationship between Linkage & Crossing over, mechanism of Meiotic Crossing over, Types and mechanism of Crossing over, significance of Crossing over.

### **Unit - 3**

Non-Mendelian inheritance – Evidences for Cytoplasmic factors, cytoplasmic inheritance, extranuclear inheritance (mitochondrial, chloroplast), maternal inheritance.

### **Unit - 4**

Chromosomal variation in Number & Structure – Euploidy, Non-disjunction & Aneuploidy, Aneuploidy in Human, Induced Polyploidy, applications of Polyploidy.

### **Unit - 5**

Human Genetics: Karyotype, banding, nomenclature of chromosome subdivisions. Genetic disorders . Down, Turner and Klinefelter syndromes, chronic myeloid leukemia, cry of cat syndrome, cystic fibrosis.

### **Suggested Readings**

1. Genetics: Strickberger MW
2. Genetics Analysis by Griffiths and Suzuki
3. Genetics: Instant notes series
4. Genetics: Hartl and Jones
5. Genetics: Gupta PK
6. Genetics: Gardner
7. Microbial Genetics: David Friefielder
8. Gene IX: Lewin Benjamin

## LBTC 301 : BIOPHYSICS & INSTRUMENTATION

### Unit - 1

General Biophysical methods - Measurement of pH, Buffers, Henderson - Hasselbalch equation. Dielectric constant, Dipole moment, Osmosis, Diffusion, Isoelectric point.

### Unit - 2

Separation & Identification of Materials - concept of Chromatography (Partition Chromatography, Paper Chromatography, Adsorption Chromatography, TLC, GLC, Ion Exchange Chromatography, Gel Chromatography, HPLC, Affinity Chromatography) Electrophoresis (Gel Electrophoresis, Paper Electrophoresis).

### Unit - 3

Centrifugation - Basic Principle of Centrifugation, Instrumentation of Ultracentrifuge (Preparative, Analytical), Factors affecting Sedimentation velocity, Standard sedimentation Coefficient, Rate-Zonal centrifugation, Density Gradient Centrifugation.

### Unit - 4

Microscopy - Light microscopy, Bright & Dark Field microscopy, Fluorescence microscopy, Phase Contrast microscopy, TEM, SEM, X-Ray Crystallography, X-ray diffraction, Bragg equation.

### Unit - 5

Spectroscopy: Simple theory of the absorption of light by molecules, Beer-Lambert law, Instrumentation for measuring the absorbance of visible light, Factors affecting the absorption properties of a Chromophore. Radioactive labeling & counting, Autoradiography. Scintillation counters, Geiger-Muller counter.

### Suggested Readings

1. Biochemical Techniques theory and practice : White R
2. Analytical Chemistry: Christian G. D.
3. A Biologist Guide to Principle and Techniques: Willson K. and Gounding K. H.
4. An Introduction to Practical Biochemistry: Plummer D. T.
5. Undergraduate Instrumental Analysis (1995) 5th ed., Robinsan, J. W.
6. Narayanan, P (2000) Essentials of Biophysics, New Age Int. Pub. New Delhi.
7. Roy R.N. (1999) A Text Book of Biophysics New Central Book Agency.

## LBTC 302: BIOCHEMISTRY

### **Unit - 1**

Bioenergetics: Thermodynamic System, I and II law of Thermodynamics. Free energy, standard free-energy change. Redox potential. High energy Phosphate compounds, Free energy of Hydrolysis of ATP and sugar phosphates.

### **Unit - 2**

Carbohydrate Metabolism, glycolytic pathways, fate of the products of glycolysis. Citric acid cycle, glycogenesis, glycogenolysis, Pentose-phosphate pathway.

### **Unit - 3**

Lipids: Biological significance and classification, Fatty acids, Formation of lipid bi-layer. Process of Lipid Metabolism -beta oxidation of saturated, unsaturated fatty acids and odd chain fatty acids, energy yield, ketone bodies.

### **Unit - 4**

Enzymes: General properties. Major classes of enzymes. Mechanism of enzyme action (binding to substrate, lowering of energy of activation,  $K_m$  and  $V_{max}$ ). Michaelis-Menten equation, Lineweaver-Burk plot.

### **Unit - 5**

Amino acid Metabolism - Deamination & transamination. Urea cycle, Nucleic acids: Bases, nucleosides and nucleotides, DNA & RNA structure.

### **Suggested Readings**

1. Biochemical Techniques theory and practice : White R
2. Biochemistry: Plummer D. T.
3. Leninger's Principles of Biochemistry: by Nelson and Cox
4. Biochemistry: Voet & Voet
5. Biochemistry by Stryer

## LBTC 401 : MOLECULAR BIOLOGY

### Unit - 1

Prokaryotic and Eukaryotic genome organization, Central dogma. Modern concept of gene structure & function: Benzer's Experiment, Cistron, muton, recon, one gene-one enzyme and one cistron-one polypeptide concept.

### Unit - 2

Enzymes involved and Mechanisms of DNA Replication in Prokaryotes and Eukaryotes (Initiation, elongation and termination), Role of Telomerase. DNA damage and repair mechanism.

### Unit - 3

Mutation: Spontaneous and induced mutations, Chromosomal Mutation: Structural and numerical changes, Gene Mutation: Substitution and Frame-Shift mutations, DNA recombination in prokaryotes & eukaryotes, Insertion elements & transposon mutagenesis.

### Unit - 4

Prokaryotic and Eukaryotic Transcription: Initiation, Elongation, Termination, Structural analysis of Promoters, Post-transcriptional modification (Gene splicing), Role of Elements and factors in Regulation of Transcription.

### Unit - 5

Prokaryotic and Eukaryotic translation machinery, mechanism of initiation, elongation and termination. Regulation of gene expression, Induction and Repression and Autogenous Regulation, Upstream & Downstream Regulatory sequences, Operon concept, lac Operon, Positive & Negative controls, trp operon, Attenuation control.

### Suggested Readings

1. Molecular Biology of the Gene (1987) Watson J. D. , Hopkins N., Robast J. and Steiz, J.
2. Gene VIII : Lewine Benjamin.
3. The Biochemistry of the nucleic acid (1996) Adams et al
4. Microbial Genetics : David Fridflelder.
5. Molecular cell Biology (1999) Lodish, H., Baltimore, D., Berk, A, Zipursky SL, Paul M and Darnell J.
6. Cell and Molecular Biology (1996) Gerald Karp.

## LBTC 402 : PLANT AND ANIMAL TISSUE CULTURE: TECHNIQUES AND APPLICATIONS

### **Unit - 1**

Introduction to Techniques - Introductory history, Laboratory organization, Maintaining Aseptic environment, Basic concepts in cell culture - cell culture, Cellular Totipotency, Somatic Embryogenesis.

### **Unit - 2**

In vitro culture : approaches & methodologies - preparation steps for tissue culture, surface sterilization of plant tissue material, basic procedure for aseptic tissue transfer, incubation of culture.

### **Unit - 3**

Tissue nutrition : Growth Hormones - Plant cells (Composition of culture media, Growth hormones, Vitamins, Unidentified supplements, selection of media); Animal cells (substrate on which cells grow, Feeder layer on substrate, gas phase for tissue culture, media and supplements).

### **Unit - 4**

Tissue culture methodologies - Plant cells (Callus Culture, Cell Suspension Culture, Organ culture); Animal cells (Source of tissue, primary culture, differentiation of cells, growth kinetics, animal cell lines and their origin and characterization).

### **Unit - 5**

Cloning & Selection of specific cell types - cloning, somatic cell fusion and HAT election, Medium suspension fusion, selection of Hybrid clone, production of monoclonal antibodies, Organ Culture - Culture of embryonic organs, whole embryo culture, culture of adult organs.

### **Suggested Readings**

1. Plant tissue culture : Bajaj, Y.P.S. Series.
2. Plant tissue culture : Gamborg and Phillip.
3. Basic and Agricultural Biotechnology (1993) Purohit and Mathur
4. Plants, Genes, and Agriculture : Chrispeels, M. J. and Grierson, D.
5. Genetic Engineering of crop plants : Lycett, G. W. and Grierson, D.
6. Biotechnological innovation in Animal productivity: (Biotol Series)
7. Culture of Animal cell: A manual of Basic Techniques(4th ed.) (2000) Freshney

# LBTC 501 : RECOMBINANT DNA TECHNOLOGY & GENOMICS

## Unit - 1

History of Recombinant DNA Technology. Isolation and Quantification of DNA and RNA. Host controlled Restriction –Modification system, Restriction Endonucleases. Cutting and joining of DNA molecules *in vitro*. Phosphatases , Ligases and Polymerases. Vectors: Plasmid, Bacteriophage, Cosmids, Phagemid and other (SV 40) Virus vectors. Expression Vectors.

## Unit - 2

Gene transfer methods in animals: Microinjection, Electroporation, Microprojectile bombardment, Shot Gun method, Ultrasonication, Lipofection, Micro laser.

Selection and Screening of Recombinants by genetic, immunochemical and hybridization methods, Southern, Northern and Western blotting.

## Unit - 3

Expression of Foreign genes in *E.coli* and Yeast, Application of gene cloning for the analysis of gene structure and function, Expression of foreign genes using strong promoters, Production of protein and other therapeutics from cloned genes, Artificial insulin gene, Recombinant vaccine.

## Unit - 4

Genetic engineering in plants: Use of *Agrobacterium tumefaciens* and *Arhizogenes*, Ti plasmids, Strategies for gene transfer to plant cells, Direct DNA transfer to plants, Gene targeting in plants, Use of plant viruses as episomal expression vectors. Application of Recombinant DNA Technology Agriculture.

## Unit - 5

Genetic engineering in animals: Production of transgenic mice, ES cells can be used for gene targeting in mice, Applications of gene targeting, Introduction to Genomics: Proteomics, Transcriptomics.

## Suggested Readings

1. Glick, B.R & Pasternak J.J (1994) Molecular Biotechnology, Principles and Applications of Recombinant DNA, American Society for Microbiology, Washington D.C
2. Christopler H. (1995) Gene cloning and Manipulating, Cambridge University Press
3. Nicholl, D.S.T (1994) An Introduction of Genetic Engineering, Cambridge University Press.
4. Old. R.W. and Primrose, S.B. (1986) Principles of Gene manipulation, An introduction to genetic engineering (3rd Edition) Black well Scientific Publications
5. Watson J.D. Hopkins, N.H Roberts, J.W.Stectz J.A and Weiner A.M. (1988). Molecular biology of society for Microbiology
7. Lewin b. (1994) Genes VI, New York,Oxford University Press.

## BTC 502 : BASIC BIOSTATISTICS & COMPUTER SKILLS

### **Unit - 1**

Introduction and Definition of Biostatistics, Tabulation and classification of data, Frequency distribution and Graphical distribution of data, Measures of central tendencies Mean, Median, Mode and their properties. Computation of mean, variance and standard deviation, t-test, correlation coefficient.

### **Unit - 2**

Measures of dispersion: range, Mean deviation, Standard deviation and coefficient of Variation. Student T and Chi-square test, Concepts and problems on probability, Normal Distribution and their applications. Types of errors (Type I, II).

### **Unit - 3**

Introduction to computer fundamental, Organization. Evolution, Generation of computers (I, II, III, IV, V). Classification of computers (mainframes, minicomputers, microcomputers, special purpose).

### **Unit - 4**

Low- Level and high-level languages, Permanent storage of number system, flow charts and programming techniques (Logic and algorithm) Decimal to binary and vice-versa; binary coded decimal number.

### **Unit - 5**

Introduction to MS-Office software covering word-processing, spreadsheets and presentation software, Introduction to Hardware graphics.

### **Suggested Readings**

1. Bioinformatics(2002) Bishop Martin
2. Molecular databases for protein and sequence and structure studies: Sillince A. and Sillince M.
3. Sequence Analysis primers : Gribskov, M. and Devereux, J.
4. Bioinformatics: Sequence and Genome Analysis By David W. Mount, *University of Arizona, Tucson*
5. Discovering Genomics, Proteomics, & Bioinformatics, Second Edition By A. Malcolm Campbell, *Davidson College*; Laurie J. Heyer, *Davidson College*; With a Foreword by Francis S. Collins

## LBTC 503: BASIC ANIMAL BIOTECHNOLOGY

### **Unit - 1**

History of animal cell culture, Laboratory requirements for animal cell culture, Sterilization techniques.

### **Unit - 2**

Media used for animal cell culture, Types of cell culture (Primary and Secondary), Introduction to established cell lines, Stem cells.

### **Unit - 3**

Cryopreservation of cell cultures, application of animal cell cultures in production of therapeutics proteins. Hybridoma technology.

### **Unit - 4**

Gene transfer methods in Animals – Microinjection, Embryonic Stem cell gene transfer, Retrovirus & Gene transfer. Transgenic Animals, Animal propagation – Artificial insemination, Animal Clones, Conservation Biology – Embryo transfer techniques.

### **Unit - 5**

Ubiquity of biological rhythms: types of biological rhythms and their fundamental properties; selective advantages of biological rhythms in organisms. Models and mechanisms of time keeping systems: Organization of the biological clock: Molecular mechanisms underlying clock functioning in organisms: Circadian clock mutant types in *Drosophila* (*per*, *tim*, *dbt*, *dclock*, *cycle*, *vriille*, *pdf*, *lark*, *takeout*)

## ***LBTC 504: BIOINFORMATICS***

### **Unit - 1**

Introduction to Bioinformatics. Genomics - information flow in biology, DNA sequence data. Nature of Biological data. Major Bioinformatics Resources: NCBI, EBI & ExPASy.

### **Unit - 2**

Sequence alignment & data base search. Multiple sequence alignment, Data mining, BLAST and FASTA as sequence alignment tool.

### **Unit - 3**

Functional Proteomics - protein sequence and structural data. Computational, biological data analysis and application, sequence data bases, NCBI model, file format.

### **Unit - 4**

Genome Analysis: Introduction, Gene prediction methods, Gene mapping and applications- Genetic and Physical Mapping, Integrated map ; Sequence assembly and gene expression.

### **Unit - 5**

Genome Annotation- Introduction. DNA Microarray for analysis of single nucleotide polymorphism using DNA chips. Transcriptome and Proteome- General Account. Protein sequence analysis by mass spectroscopy.

### **Suggested Readings**

1. Bioinformatics (2002) Bishop Martin.
2. Molecular databases for protein and sequence and structure studies: Sillince A. and Sillince M.
3. Sequence Analysis primers: Gribskov, M. and Devereux, J.
4. Bioinformatics: Sequence and Genome Analysis By David W. Mount, *University of Arizona, Tucson*.
5. Discovering Genomics, Proteomics, & Bioinformatics, Second Edition By A. Malcolm Campbell, *Davidson College*; Laurie J. Heyer, *Davidson College*; With a Foreword by Francis S. Collins.

## LBTC 507: SEMINAR

Seminar will be of 45-minute duration during which the presentation will be followed by questions session by the audience comprising of faculty and students. Every student shall be required to submit the topic of his/her seminar in consultation with the Head of the Department/Faculty members well in advance so that the same may be displayed on the notice board. The speaker has to write an Abstract to be distributed during Seminar in addition to two copies of write-up giving relevant details of the background of the subject, methods used and references/List of sources from where the material for presentation has been collected.

## LBTC 601: IMMUNOLOGY

### **Unit - 1**

Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity. B and T cell epitopes.

### **Unit - 2**

Structure and function of antibody molecules, generation of antibody diversity, monoclonal antibodies, antibody engineering, antigen-antibody interactions.

### **Unit - 3**

MHC molecules, antigen processing and presentation, activation and differentiation of B and T cells, B and T cell receptors.

### **Unit - 4**

Humoral and cell-mediated immune responses, primary and secondary immune modulation, the complement system, Toll-like receptors, cell-mediated effector functions.

### **Unit - 5**

Inflammation, hypersensitivity and autoimmunity, immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections. SCID, AIDS, vaccines.

### **Suggested Readings**

1. Essentials of Immunology : Roitt. I. M.
2. Immunology (1997) Kuby J.
3. Advanced Immunology (1991) Male D.,Champion B. Cooke A. & Owen M.
4. Principle and practice of Immunoassay (IInd ed.) Christopher P. Price and David J. Newman.
5. Essential Immunology Review: Roitt, I. M. and Deloves P.J.
6. Culture of Animal cell- Ian Freshney (4th Edition)
7. Buttler. Elements of Biotechnology – P.K. Gupta (1st Edition -2000) Rastogi Publications.

## LBTC 602: INDUSTRIAL BIOTECHNOLOGY

### Unit - 1

Principles of Microbial growth – introduction, the ways of growing microorganisms, ways to increase yield of microbes, Batch, fed-batch and continuous cultures (definition and kinetics).

### Unit - 2

Bioreactor / Fermenter – types, working & operation of Bioreactors, Fermenters (Stirred tank, bubble columns, airlift. Bioreactors, Static, Submerged and agitated fermentation), advantages & disadvantages of solid substrate & liquid fermentations.

### Unit - 3

Upstream processing (Strain selection, Sterilization), Downstream processing – extraction, separation, concentration, recovery & purification, operations (Insulin, Vitamins, Metabolites).

### Unit - 4

Enzyme technology – nature of enzymes, application of enzymes, limitations of microbial cells used as catalysts in fermentation, multi-enzyme reactors, protein engineering of enzymes, cloning strategy for enzymes, technology of enzyme production, industrial applications of immobilized enzymes.

### Unit - 5

Biotechnology in specific medical & industrial applications - Retting of jute, microbial process for immunization (Production of monoclonal antibodies), Deterioration of paper, textiles, painted surfaces and their prevention, Biofilms, microbial biopolymers, biosurfactants, Microbial culture selection with high yield potential.

### Suggested Readings

1. Sullia S. B& Shantharam S: (1998) General Microbiology, Oxford & IBH Publishing Co. Pvt. Ltd.
2. Bisen P.S (1994) Frontiers in Microbial Technology, 1st Edition, CBS Publishers.
3. Glaser A.N & Nilaido.H (1995) Microbial Biotechnology, W.H Freeman & Co.
4. Prescott & Dunn (1987) Industrial Microbiology 4th Edition, CBS Publishers & Distributors.
5. Prescott & Dunn (2002) Industrial Microbiology, Agrobios (India) Publishers.
6. Crueger W. & Crueger A. (2000) A text of Industrial Microbiology, 2nd Edition, Panima Publishing Corp.
7. Stanbury P.F, Ehitaker H, Hall S.J (1997) Principles of Fermentation Technology., Aditya Books (P) Ltd.

## LBTC 603: BIOSAFETY, BIOETHICS AND IPR ISSUES

### **Unit - 1**

Introduction to Bioethics and Biosafety, Human Genome Project and its Ethical Issues, . Molecular Detection of Pre-Symptomatic Genetic Diseases and its Importance in Healthcare. . Prenatal Diagnosis, Genetic Manipulations and their Ethical Issues. Ethical, Legal and Social Implications of Human Genome Project. Genetics Studies on Ethnic Races.

### **Unit - 2**

Biosafety Guidelines and Regulations. Legal and Socio-economic Impacts of Biotechnology. Use of Genetically Modified Organisms and their Release in the Environment. Hazardous Materials used in Biotechnology their Handling and Disposal. Good Laboratory Practice (GLP) and Good Manufacturing Practice (GMP). Public Education of Producing Transgenic Organisms.

### **Unit - 3**

Intellectual Property Rights and Agricultural Technology, and their Implications for India and other Developing Countries. International Organizations and Intellectual Property Rights. Introduction to Patent and Process Involved in Patenting. Patenting Living Organisms. Traditional Knowledge, Commercial Exploitation, and Protection.

### **Unit - 4**

Bioethics in Biodiversity and Resource Management. Ethical Issues in Genetically Modified Organisms: Foods and Crops. Labeling of Genetically Modified Food and Crops. Stem Cell Research, Ethical Issues Involved in Stem Cell Research and Use. Use of Animals in Research and Testing, and Alternatives for Animals in Research. Animal Cloning, Human Cloning and their Ethical Aspects. Testing of Drugs on Human Volunteers. Organ Transplantation and Ethical Issues.

### **Unit - 5**

Public and Non-Governmental Organizations (NGOs). Participation in Biosafety and Protection of Biodiversity. Indian Biodiversity Act.

## (LBTC 604 - MAJOR ELECTIVES)

1. ENVIRONMENTAL BIOTECHNOLOGY
2. FERMENTATION TECHNOLOGY
3. PLANT BIOTECHNOLOGY

### LBTC 604: ENVIRONMENTAL BIOTECHNOLOGY

#### **Unit - 1**

Components of Environment – Hydrosphere, lithosphere, atmosphere and biosphere – definitions with examples; Interaction of man and environment; Environmental Studies as a multidisciplinary subject.

#### **Unit - 2**

Global Environmental Problems – Green House Effect, Acid rain, Ozone depletion, salination, biodiversity loss; chemical and radiation hazards.

#### **Unit - 3**

Environmental pollution and degradation – Pollution of air, water and land with reference to their causes, nature of pollutions, impact and control strategies; noise pollution; Habitat Pollution by Chlorinated Hydrocarbons (DDT, PCBs, Dioxin etc).

#### **Unit - 4**

Environmental Management – Concept of health and sanitation, environmental diseases – infectious (water and air borne) and pollution related, health hazards due to pesticide and metal pollution, waste treatment, solid waste management.

#### **Unit - 5**

Bioremediation – Oil spills, Wastewater treatment, chemical degradation, heavy Metals.

#### **Suggested Readings**

1. Microbial Biotechnology (1995) Alexander n. Glazer Hiroshi Nikaido W.H.Freeman and Company
2. Molecular biotechnology: Principles and Applications of Recombinant DNA –Bernaral R. Glick and Jack J. Pastemak ASM Press. Washington, D.C (1994).
3. Fungal Ecology and Biotechnogy (1993) Rastogi Publicaions, Meerut.

## LBTC 604: FERMENTATION TECHNOLOGY

### Unit - 1

Introduction to fermentation: aerobic and anaerobic fermentations; Kinetics of growth and product formation - chemically structured models; mass transfer diffusion, membrane transport.

### Unit - 2

Fermenter design - operation, measurement and control in fermentation; Aeration and agitation in fermentation: Oxygen requirement, measurement of adsorption coefficients, bubble aeration, mechanical agitation, correlation between mass-transfer coefficient and operating variables, hollow fibre reactors, immobilized cell reactors.

### Unit - 3

Molecular engineering: Important strains and pathways - types, development of cultivations systems for aerobes and anaerobes, mutation and genetic engineering for strain improvements, product formation and inhibition pathways and their regulations; applications in medicine, agriculture and industry.

### Unit - 4

Biotransformation: types, methods and processes, analysis and isolation of products, applications in waste management, medicine and agriculture; Biogas production - pathways, regulation/modulation, advanced biomethanation systems and their applications.

### Unit - 5

Bioprocess technology: Down stream processing-Methods for vitamins, amino acids, organic acids, enzymes, antibiotics, alcohols and vaccines; Applications of cells in bioprocesses (lactic acid bacteria, yeasts, mixed cultures, plant and animal cells); microbes as biocontrol agents and chemical factories.

### Suggested Readings

1. Principles of Fermentation Technology - Whittaker & Stan bury, Pergamon Press
2. Bioprocess Engineering Principles - Pauline Doran, Academic Press 1995
3. Operational Modes of Bioreactors, BIOTOL series - Butter worth, Heinemann 1992
4. Bioreactor Design & Product Yield, BIOTOL series - Butter worth Heinemann 1992
5. Bioprocess Engineering : Systems, Equipment & Facilities - Ed. B. Lydersen,
6. N.A. Delia & K.M. Nelson, John Wiley & Sons Inc,1993
7. Bioseparation & Bioprocessing - Ed. G. Subramaniam, Wiley - VCH,1998
8. Product Recovery in Bioprocess Technology, 'BIOTOL series, Butter Worth Heinemann

1992

10. Bioseparation : Downstream Processing for Biotechnology - Paul A. Belter, E.L
11. Cussler, Wei-Shou Hu, Academic Press
12. Solvent Extraction in Biotechnology - Larl Schuger, Spinger Verlag, 1994

## LBTC 604: PLANT BIOTECHNOLOGY

### Unit - 1

Plant Tissue Culture applications – micropropagation, from Callus to plant, somatic embryogenesis, somaclonal variation, valuable germplasm, chemicals from plants, genetically engineered plants.

### Unit - 2

Applications of Plant Genetic Engineering – crop improvement, herbicide resistance, insect resistance, virus resistance, plants as bioreactors.

### Unit - 3

Genetic modification in Agriculture – transgenic plants, genetically modified foods, application, future applications, ecological impact of transgenic plants.

### Unit - 4

Genetically modified foods – organic foods, types of organic foods, identifying organic foods, organic food & preservatives.

### Unit - 5

Genetic modification in Food industry – background, history, controversies over risks, application, future applications.

### Suggested Readings

1. Ravishankar G.A and Venkataraman L.V. (1997) Biotechnology applications of Plant Tissue & cell culture. Oxford & IBH Publishing co., Pvt Ltd.
2. Bhan (1998) tissue Culture, Mittal Publications, New Delhi.
3. Islan A.C (1996) Plant Tissue Culture, Oxford & IBH Publishing Co., Pvt. Ltd.
4. Lydiane Kyte & John Kleyn (1996) Plants from test tubes. An introduction to
5. Micropropagation (3rd Edition) timber Press, Partland.
6. Kumar H.D (1991) A test book book on Biotechnology (2nd Edition). Affiliated East West Press Private Ltd. New Delhi.
7. Chrispeel M.J. and Sdava D.E. (1994) Plants, Genes and agriculture, Jones and Barlett Publishers, Boston.
8. Reinert J. and Bajaj y.P.S (1997) Applied and fundamental Aspects of Plant Cell, Tissue, and Organ Culture, Narosa Publishing House.