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

(Biotechnology)

(To be implemented from the academic session 2012-2013)

Department of Biotechnology
School of Life Sciences
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	Biomolecules – I	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
	Laboratory			
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
			Total	**550**

Semester- II				
Code	**Subjects**	**End Semester Exam**	**Internal Assessment**	**Total**
LBTC 201	Biomolecules – II	30	20	50
LBTC 202	Genetics	30	20	50
LBZS 203	Zoology-III	30	20	50
LBZS 204	Zoology-IV	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
	Laboratory			
LBTL 207	Laboratory (Based on LBTC -201, LBTC -202)	30	20	50
LBBL 208	Laboratory (Based on LBZS -203,LBZS -204)	30	20	50
LCSL 209	Laboratory (Based on LCS -205, LCS -206)	30	20	50
			Total	**550**

Semester - III				
Code	**Subjects**	**End Semester Exam**	**Internal Assessment**	**Total**
LBTC 301	Microbiology – I	30	20	50
LBTC 302	Molecular Biology – I	30	20	50
LBBS 303	Botany-I	30	20	50
LBBS 304	Botany-II	30	20	50
LCS 305	Chemistry-V	30	20	50
LCS 306	Chemistry-VI	30	20	50
	Environmental Sciences	60	40	100
	Laboratory			
LBTL 307	Laboratory (Based on LBTC -301, LBTC -302)	30	20	50
LBZL 308	Laboratory (Based on LBBS -303,LBBS -304)	30	20	50
LCSL 309	Laboratory (Based on LCS -305, LCS -306)	30	20	50
			Total	**550**

Semester – IV				
Code	**Subject**	**End Semester Exam**	**Internal Assessment**	**Total**
LBTC 401	Microbiology – II	30	20	50
LBTC 402	Molecular Biology - II	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
	Environmental Sciences	60	40	100
	Laboratory			
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
			Total	**550**

Semester – V				
Code	**Subject**	**End Semester Exam**	**Internal Assessment**	**Total**
LBTC 501	Biophysical chemistry and Instrumentation	30	20	50
LBTC 502	Plant and Animal Tissue culture	30	20	50
LBTC 503	Genetic Engineering	30	20	50
LBTC 504	Biostatistics and Computer application	30	20	50
	Laboratory			
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
			Total	**350**

Semester- VI				
Code	**Subject**	**End Semester Exam**	**Internal Assessment**	**Total**
LBTC 601	Immunology	30	20	50
LBTC 602	Industrial Biotechnology IPR and Bioethics	30	20	50
LBTC 603	Bioinformatics	30	20	50
LBTC 604	Major Elective	30	20	50
	Laboratory			
LBTC 605	Laboratory Based on LBTC – 601, 602 & 603)	30	20	50
LBTC 606	Project Dissertation (Based on major elective LBTC – 604)	90	60	150
			Total	**400**
Major Elective: Environmental Biotechnology, Microbial & Fermentation Technology, Plant Biotechnology				

** B.Sc. Biotechnology (Hons.) students shall opt one Major Elective papers from Major Elective basket offered by the Department.

@ Project work/ Field Study will be based on major elective paper (s) opted by the student, in consultation with the faculty concerned and on recommendation of the Head of the Department..

INTIGRATED M. Sc. BIOTECHNOLOGY (FOUR SEMESTERS)

Semester –VII/I						
Code	**Subject**	**End Semester exam**	**Internal Assessment**	**Attendance/ Seminar/ Interaction**	**Total**	**Passing Marks (%)**
LBTM- 101	Molecular Cell Biology	60	30	5 + 5 =10	100	40
LBTM- 102	Microbial Genetics and Physiology	60	30	5 + 5 =10	100	40
LBTM- 103	Bioinstrumentation	60	30	5 + 5 =10	100	40
LBTC- 104	Biochemistry (Metabolism and regulation)	60	30	5 + 5 =10	100	40
LBTL-105	Laboratory-I Based on LBTM -101 & 104	60	30	5 + 5 =10	100	40
LBTL-106	Laboratory-II Based on LBTM -102 & 103	60	30	5 + 5 =10	100	40
				Total	**600**	

Semester – VIII/II						
Code	**Subject**	**End Semester exam**	**Internal Assessment**	**Attendance/ Seminar/ Interaction**	**Total**	**Passing Marks (%)**
LBTM- 201	Molecular Genetics and Recombinant DNA Technology	60	30	5 + 5 =10	100	40
LBTM- 202	Molecular Genomics and Epigenetics	60	30	5 + 5 =10	100	40
LBTM- 203	Basic Enzymology and Enzyme Technology	60	30	5 + 5 =10	100	40
LBTM- 204	Computational Biology and Biostatistics	60	30	5 + 5 =10	100	40
LBTM- 205	Seminar	50			50	20
LBTL- 206	Laboratory III (Based on LBTM -201 & 203)	60	30	5 + 5 =10	100	40
LBTL- 207	Laboratory IV (Based on LBTM -202 & 204)	60	30	5 + 5 =10	100	40
				Total	**650**	

Semester – IX/III						
Code	**Subject**	**End Semester exam**	**Internal Assessment**	**Attendance/ Seminar/ Interaction**	**Total**	**Passing Marks (%)**
LBTM- 301	Bioprocess Engineering and Technology	60	30	5 + 5 =10	100	40
LBTM- 302	Advanced Immunology	60	30	5 + 5 =10	100	40
LBTM- 303	Plant Biotechnology	60	30	5 + 5 =10	100	40
LBTM- 304	Animal Biotechnology	60	30	5 + 5 =10	100	40
LBTM- 305	Review writing and Seminar				50	20
LBTL- 306	Laboratory V Based on LBTM - 301& 303)	60	30	5 + 5 =10	100	40
LBTL-307	Laboratory VI Based on LBTM -302 & 304)	60	30	5 + 5 =10	100	40
				Total	**650**	

Semester – X / IV						
Code	**Subject**	**End Semester exam**	**Internal Assessment**	**Attendance/ Seminar/ Interaction**	**Total**	**Passing Marks (%)**
LBTM- 401	Enterpreneurship & Management in Biotechnology	60	30	5 + 5 =10	100	40
	Major Elective Paper I	60	30	5 + 5 =10	100	40
	Major Elective Paper II	60	30	5 + 5 =10	100	40
LBTM- 410	Practical Based on Elective Paper				100	40
LBTM- 411	Project Dissertation & Viva				200	80
				Total	**600**	

Major Elective (Optional) Papers: Two papers of one elective to be selected						
Code	**Subject**	**End Semester exam**	**Internal Assessment**	**Attendance/ Seminar/ Interaction**	**Total**	**Passing Marks (%)**
Elective Paper for Microbial Biotechnology group						
LBTM- 402	Microbial Technology	60	30	5 + 5 =10	100	40
LBTM- 403	Bioprocess Technology	60	30	5 + 5 =10	100	40
Elective Paper for Plant Biotechnology group						
LBTM- 404	Advanced Plant Biotechnology	60	30	5 + 5 =10	100	40
LBTM- 405	Agriculture Biotechnology	60	30	5 + 5 =10	100	40
Elective Paper for Medical Biotechnology group						
LBTM- 406	Animal Biotechnology	60	30	5 + 5 =10	100	40

LBTM- 407	Advanced Therapy and Nano technology	60	30	5 + 5 =10	100	40
Elective Paper for Enviornmental Biotechnology group						
LBTM - 408	Advanced Environmental Biotechnology	60	30	5 + 5 =10	100	40
LBTM - 409	Environmental Mangement Technology	60	30	5 + 5 =10	100	40

LBTC 101: Biomolecules – I **(Maximum marks= 50)**

Average Teaching 9 hours /Unit

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 and examples. Cholesterol structure 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.

Suggested Readings

1. Lehninger's Principle of Biochemistry D L Nelson & M M Cox 5th Edition (2007)
2. Biochemistry (2005) Lubert Stryer
3. Text Book of Biochemistry (2007) Devlin , Thomas M.
4. Biochemistry (2007) Geoffery, Zubay
5. Basic Biological Chemistry : Mahler and Cordes
6. Harper's Review of Physiological Chemistry(2009) Murray, R. K., Mayes, P. A. Gramner, D. K. and Rowell V. W.
7. Biochemistry – Keshav Trehan Wiley Eastern Publications (2004)
8. Fundamentals of Bochemistry-J.L.Jain S.Chand and Company (2010)
9. Biochemistry- Prasaranga, Bangalore University
10. Fundamental of Biochemistry – Dr.A.C.Deb (2004)
11. Textbook of Organic Chemistry (A Modern Approach)
12. The Biochemistry of Nucleic acid – Tenth Edition-Roger L.P.Adams, John T. Knowler and David P.Leader, Chapman and Hall Publications (2002)

LBTC 102: Cell Biology **(Maximum marks= 50)**

Average Teaching 9 hours /Unit

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 , Cell wall; Plasma membrane: models, Membrane Transport-a brief account.

Unit - 3

Ultrastructure of Cell: Cytoskeleton; Protoplasm; Mitochondria; Chloroplast: Biogenesis of Chloroplast and Mitochondria, 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, Synaptonemal complex, Apoptosis.

Suggested Readings

1. Cell (A Molecular approach) : Cooper , G. M. (2007)
2. Cell and Molecular Biology (2006) Karp, G.
3. Cell Biology (2003) Sadava D. E.
4. Cell and Molecular Biology (2009) Kish V. M. and Kleinsmith L. J.
5. Cell and Molecular Biology : deRobertis and deRobertis (2010)
6. The Cell: Albert jhonson, 5th Ed. Gerland science press
7. Cell Biology: Gerald Karp, 6th Ed. Willey pub.
8. The world of Cell: Becker 6th Ed. Benjamin cuminns (2006)
9. Cell biology : Singh & Tomar 9th Ed. Rastogi pub.
10. Cell Biology : Sadava (2009)
11. Cell and Molecular Biology: Gerald Karp (2010)

LBTL 107: Laboratory (Based on LBTC-101, LBTC-102) **(Maximum marks= 50)**

LBTC 201: Biomolecules – II **(Maximum marks= 50)**

Average Teaching 9 hours /Unit

Unit -1

Carbohydrate metabolism: Glycolysis, Krebs' cycle. Gluconeogenesis, Pentose phosphate pathway, Glycogenolysis.

Unit -2

Overview of nitrogen metabolism. Biosynthesis of amino acids. Molecules derived from amino acids

Unit – 3

Biosynthesis and function/role: Fatty acids, Tryacylglycerol, Membrane phospholipids, Cholesterol and Steroids, Isoprenoids.

Unit – 4

Bioenergetics and Thermodynamics, Oxidative phosphorylation (Substrate level phosphorylation) Phosphoryl group transfer, Biological oxidation- reduction reactions (with suitable examples).

Unit – 5

Biosyntheis and degradation of nucleotides: Purine and Pyrimidine biosynthesis,degradation and their regulation, Novel separation products.

Suggested Readings

1. Principle of Biochemistry (2007): Lehninger , A. L.
2. Biochemistry (2005) Lubert Stryer
3. Text Book of Biochemistry (2007) Devlin , Thomas M.
4. Biochemistry (1993) Geoffery, Zubay
5. Basic Biological Chemistry : (2000) Mahler and Cordes
6. Harper's Review of Physiological Chemistry(2003) 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 5th Edition 2005
8. Biochemistry – Keshav Trehan Wiley Eastern Publications 2010
9. Fundamentals of Bochemistry-J.L.Jain S.Chand and Company 2010
10. Biochemistry- Prasaranga, Bangalore University 2009
11. Fundamental of Biochemistry – Dr.A.C.Deb 2009
12. Textbook of Organic Chemistry (A Modern Approach) 2009

LBTC 202: Genetics **(Maximum marks= 50)**

Average Teaching 9 hours /Unit

Unit - 1

Mendelism–Mendel's laws of inheritance, applications of Mendel's laws (Mono & dihybrid crosses) . Pos-Mendelian Inheritance, phenomenon of Co-dominance & Incomplete dominance. Multiple allelism, polygenic inheritance, pleiotropism. Sex linkage in Drosophila

Unit - 2

Chromosome Theory of Heredity (Sutton-Boveri), Linkage & Crossing over. Kinds of linkage, linkage groups, Genetic mapping, Relationship between Linkage & Crossing over, significance of Crossing over.

Unit - 3

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

Unit - 4

Chromosomal variation in Number & Structure – Euploidy (Auto and Allopolyploidy), Induced Polyploidy, applications of Polyploidy, Non-disjunction & Aneuploidy, Aneuploidy in Human,.

Unit - 5

Human Genetics: Karyotype, nomenclature of chromosome subdivisions. Inheritance patterns in Human (Sex-linked & Autosomal). Genetic disorders (Down, Turner and Klinefelter syndromes) Autosomal and Sex linked disorders due to recessive and dominant mutations. Chronic myeloid leukemia, Cry du cat syndrome, cystic fibrosis, Hemophilia, Colour blindness.

Suggested Readings

1. Genetics: Strickberger MW (2006)
2. Genetics Analysis by Griffiths and Suzuki (2007)
3. Genetics: Instant notes series (2009)
4. Genetics: Hartl and Jones (2009)
5. Genetics: Gupta PK (2010)
6. Genetics: Gardner (2009)
7. Microbial Genetics: David Friefielder (2009)
8. Gene IX: Lewin Benjamin (2009)
9. Principle of Genetics: 6th Ed., Gardner (2012)
10. Genome-3,: T.A. Brown 2dn ed., Pearson pub (2011)

LBTL 207: Laboratory (Based on LBTC-201, LBTC-202) **(Maximum marks= 50)**

LBTC 301: Microbiology –I **(Maximum marks= 50)**

Average Teaching 9 hours /Unit

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. Microbiological Practices: Aseptic techniques, Bacterial and fungal staining, Microbial Growth and Nutrition: Different types of culture media, obtaining pure culture, measurement of bacterial growth.

Unit - 2

Classification and General account of virus, mycoplasma and bacteriophage (lamda phage, T2, T4), general life cycle and Lysogeny, Abortive Lysogeny, Retrovirus, ΦX174.

Unit - 3

Classification, General account of bacteria, Cell structure and reproduction, Nutritional diversity, Genetic recombination, Economic importance of bacteria. Mycoplasma

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 asexual and 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 extermophiles in biotechnology.

Suggested Readings

1. Microbiology (2nd Ed) by Talaro (2007)
2. Biology of Microorganism (9th Ed) by Broak (2009)
3. Principal of Microbiology by Atlas (2005)
4. Molecular Biology of Gene by Watson (2007)
5. Microbiology (6th Ed) by Fred Alcamo (2005)
6. General Microbiology by Stanier (2006)
7. Microbiology by Pelczar & Krieg (2009)
8. Bergey's manual (2005)
9. TOB of Microbiology: Anantnarayan 8th ed., University press, 2010.
10. Microbiology 10th Ed. Tortora, (2009)

LBTC 302: Molecular Biology – I **(Maximum marks= 50)**

Average Teaching 9 hours /Unit

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 (Initiation, elongation and termination), Role of Telomerase.

Unit - 3

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

Unit - 4

Prokaryotic translation machinery, mechanism of initiation, elongation and termination. Antibiotics as Inhibitors of prokaryotic translation.

Unit - 5

Discovery of transposable elements; characteristics, of transposable elements; types of transposable elements: insertion sequences (IS) or simple transposons, transposons (Tn) or complex transposons; examples of transposons: Tn 3 transposon of *E.coli*, bacteriophage *Mu*

Suggested Readings

1. Molecular Biology of the Gene (1987) Watson J. D. , Hopking N., Robast J. and Steiz, J. (2006)
2. Gene X : Lewin Benjamin. (2007)
3. The Biochemistry of the nucleic acid (1996) Adams et al (2007)
4. Microbial Genetics : David Fridflelder. (2007)
5. Molecular cell Biology Lodish, H., Baltimore, D., Berk, A, Zipursky SL, Paul M and Darnell J. (2009)
6. Cell and Molecular Biology. Gerald Karp. (2009)
7. Molecular biology: Upadhyaye 1st Ed., Himayalaya, Pub (2005)
8. Molecular biotechnology, Piramal. V. 1st ed. Dominat pub (2006)
9. Molecular biology of the Gene, Watson 5th ed. (2000) Himalaya pub.
10. The world of Cell, Ronald atlas, Mosby pub (1994)

LBTL 307: Laboratory (Based on LBTC-301, LBTC-302) **(Maximum marks= 50)**

LBTC 401: Microbiology –II **(Maximum marks= 50)**

Average Teaching 9 hours /Unit

Unit - 1

Basic concepts, action of pathogens, human pathogenic viruses and bacteria, Gram-positive and Gram- negative Bacilli of medical importance. Miscellaneous bacterial agents of disease; DNA and RNA viruses and their diseases.

Unit -2

A basic concept of host parasite interaction, A brief account of Fungal diseases,: Mycoses-Types: Superficial, Cutaneous, Subcutaneous, Systemic, Opportunistic Mycoses, Candidiasis

Unit -3

Microbial genetics: Conjugation, Transformation, Transduction, Plasmids and sex factors, Transposons. Retrotansposons.

Unit-4

Microbial Nutrition: Metabolic diversity, photoautotroph's, photoheterotrophs, chemoautotrophs, chemohetrotrophs and their significance in biotechnology

Unit-5

Life cycle of some important pathogens, Latent period of pathogen, Brief account of selected diseases like Amoebiosis, Malaria, Hepatitis, Filaria, Kala-a-zar and AIDS.

Suggested Readings

1. Microbiology (2nd Ed) by Talaro (2007(
2. Biology of Microorganism (9th Ed) by Broak (2005)
3. Principal of Microbiology by Atlas (2009)
4. Molecular Biology of Gene by Watson (12007)
5. Microbiology (6th Ed) by Fred Alcamo (2006)
6. General Microbiology by Stanier (2006)
7. Microbiology by Pelczar & Krieg (2009)
8. Bergey's manual (*2005)
9. The world of Cell, Ronald atlas, Mosby pub (1994)
10. Microbial Genetics : David Fridflelder. (2007)
11. Molecular cell Biology Lodish, H., Baltimore, D., Berk, A, Zipursky SL, Paul M and Darnell J. (2009)

LBTC 402: Molecular Biology – II **(Maximum marks= 50)**

Average Teaching 9 hours /Unit

Unit – 1

DNA replication in Eukaryotes: Enzymes involved and Mechanisms of DNA Replication, (Initiation, elongation and termination), Role of Telomerase.

Unit – 2

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 - 3

Eukaryotic Transcription: Initiation, Elongation, Termination, Structural analysis of Promoters, Post-transcriptional modification (Gene splicing), Role of Elements and factors in Regulation of Transcription. Eukaryotic translation machinery, mechanism of initiation, elongation and termination.

Unit 4

Regulation of gene expression, Induction and Repression, Autogenous Regulation, Upstream & Downstream regulatory sequences, Operon concept, ***lac*** Operon, Positive & Negative controls, ***trp*** operon, Attenuation control.

Unit 5

Recombination: homologous and heterologous genetic recombination, meiotic and site specific recombination, models of recombination.

Suggested Readings

1. Molecular Biology of the Gene (2007) Watson J. D. , Hopking N., Robast J. and Steiz, J.
2. Gene X : Lewin Benjamin. (2010)
3. The Biochemistry of the nucleic acid (2006) Adams et al
4. Microbial Genetics : David Fridflelder. (2006)
5. Molecular cell Biology Lodish, H., Baltimore, D., Berk, A, Zipursky SL, Paul M and Darnell J. (2009)
6. Cell and Molecular Biology. Gerald Karp (2009)
7. Genomes. TA Brown (2011)
8. Microbial Genetics : David Fridflelder. (2007)
9. Molecular cell Biology Lodish, H., Baltimore, D., Berk, A, Zipursky SL, Paul M and Darnell J. (2009)

10 Genetic, P.K. Gupta (2009) Rastogi pub

LBTL 407: Laboratory (Based on LBTC-401, LBTC-402) **(Maximum marks= 50)**

LBTC 501: Biophysical chemistry and Instrumentation (Maximum marks= 50)

Average Teaching 9 hours /Unit

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.

Unit - 5

Spectroscopy: Simple theory of the absorption of light by molecules, Beer-Lambert's 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, ELISA and RIA.

Suggested Readings

1. Biochemical Techniques theory and practice : White R (2006)
2. Analytical Chemistry: Christion G. D. (2009)
3. A Biologist Guide to Principle and Techniques: Willson K. and Gounding K. H. (2011)
4. An Introduction to Practical Biochemistry: Plummer D. T. (2010)
5. Undergraduate Instrumental Analysis 5th ed., Robinsan, J. W. 2010
6. Narayanan, P (2000) Essentials of Biophysics, New Age Int. Pub. New Delhi. (2011)
7. Roy R.N. (1999) A Text Book of Biophysics New Central Book Agency. (2011)
8. Biophysical chemistry, Upadhya & Nath (2010)
9. Lehninger's Principle of Biochemistry D L Nelson & M M Cox 5th Edition 2005
10. Biochemistry – Keshav Trehan Wiley Eastern Publications 2010

LBTC 502: Plant and Animal Tissue culture (Maximum marks= 50)

Average Teaching 9 hours /Unit

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 cell culture: Callus Culture, Cell Suspension Culture, Organ culture; Somaclonal variations, Animal cell culture: source of tissues, primary & secondary culture, differentiation of cells, growth kinetics, animal cell lines- their origin and chracterization.

Unit - 5

Cloning & Selection of specific cell types – cloning, somatic cell fusion and HAT selection, 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. (2007)
2. Plant tissue culture : Gamborg and Phillip. (2008)
3. Basic and Agricultural Biotechnology (2003) Purohit and Mathur
4. Plants, Genes, and Agriculture : Chrispeels, M. J. and Grierson, D. (2009)
5. Genetic Engineering of crop plants : Lycett, G. W. and Grierson, D. (2005)
6. Biotechnological innovation in Animal productivity: (Biotol Series) (2006)
7. Culture of Animal cell: A mannual of Basic Techniques(4th ed.) (2004) Freshney
8. Plant tissue culture: Bhojwani and razdan (2011)
9. Plant biotechnology, Biswan P.K. (2008) dominat pub
10. Plant biotechnology, Trivedi P.C (2008) dominat pub

LBTC 503: Genetic Engineering **(Maximum marks= 50)**

Average Teaching 9 hours /Unit

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.

Unit - 2

Vectors: Plasmid, Bacteriophage, Cosmids, Phagemid and other (SV 40) Virus vectors. Expression Vectors. Gene transfer methods: 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 *Agrobacterium rhizogenes*, Ti plasmids, Use of plant viruses as episomal expression vectors. Application of Recombinant DNA Technology in Agriculture.

Unit - 5

Genetic engineering in animals: Production of transgenic mice, ES cells for gene targeting in mice, Applications of gene targeting,

Suggested Readings

1. Glick, B.R & Pasternak J.J (2004) Molecular Biotechnology, Princi[ples and Applicatiopns of Recombinant DNA, American Society for Microbiology, Washington D.C (2002)
2. Christopler H. (2005) Gene cloning and Manipulating, Cambridge Universoty Press
3. Nicholl, D.S.T (2004) An Introduction of Genetic Engineering, Cambridge University Press.
4. Old. R.W. and Primrose, S.B. Principles of Gene manipulation (2006)
5. An introduction to genetic engineering Black well Scientific Publications (2007)
6. Watson J.D. Hopins, N.H Roberts, J.W.Stectz J.A and Weiner A.M. (2008). Molecular biology of society for Microbiology
7. Lewin b. Genes (2011) New York,Oxford University Press.
8. Genetic engineering in plant, Narnin R 1st ed, dominat press (2006)
9. Applied biotech and plant Genetics, Sudhir M. (2005) 1st ed.
10. Principle of Genetics, Gardner 8th ed. (2007)

LBTC 504: Biostatistics and Computer applications (Maximum marks= 50)

Average Teaching 9 hours /Unit

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, correlation coefficient.

Unit - 2

Measures of dispersion: range, Mean deviation, Standard deviation and coefficient of Variation. Student t test 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 2007
2. Molecular databases for protein and sequence and structure studies: Sillince A. and Sillince M. 2010
3. Sequence Analysis primers : Gribskov, M. and Devereux, J. 2006
4. Bioinformatics: Sequence and Genome Analysis By David W. Mount, *University of Arizona, Tucson* 2007
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 2010
6. Bioinformatics : Sharma & Munjal (2008)
7. Principle of Biostatic, Marcello pagano 2nd ed. (2011)
8. Bioinformatics, Lesh M Arthur, 3rd ed. Oxford pub (2008
9. Introduction to Bioinformatics 6th ed. T.K. AtwoodPearson pub.
10. Principle of Biostatics, Marcello pagano 2nd ed. Cegage (2011)

LBTL 505: Laboratory (Based on LBTC-501, LBTC-503) (Maximum marks= 50)

LBTL 506: Laboratory (Based on LBTC-502, LBTC-504) (Maximum marks= 50)

LBTC 507: Seminar (Maximum marks= 50)

Each student shall be given a topic from the syllabus or research articles by the faculty members for presentation during seminar. The evaluation will be based on the review submitted as hard copy in duplicate and presentation using power point followed by discussion and questions.

LBTC 601: Immunology **(Maximum marks= 50)**

Average Teaching 9 hours /Unit

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 and their roles.

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(2010) Roitt. I. M.
2. Immunology (2007) Kuby J.
3. Advanced Immunology (2001) Male D.,Champion B. Cooke A. & Owen M.
4. Principle and practice of Immunoassay (2009) Christopher P. Price and David J. Newman.
5. Culture of Animal cell- Ian Freshney (2007)
6. Buttler. Elements of Biotechnology – P.K. Gupta (1st Edition -2000) Ras. Publications.
7. Immunolgy : C.V. Rao (2008)
8. Immunology 6th ed, Kubey (2010) Pearson pub
9. Immunology, Joshi, Osama 5th ed, agrobiotech pub (2007)
10. Immunology, M.M. Ranga, 1st ed.(2003) agro bio.

LBTC 602: Industrial Biotechnology, IPR and Bioethics (Maximum marks= 50)

Average Teaching 9 hours /Unit

Unit - 1

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 - 2

Enzyme technology – nature of enzymes, limitations of microbial cells used as catalysts in fermentation, multi-enzyme reactors, Recombinent DNA technology and protein engineering of enzymes. Industrial applications of free and immobilized enzymes.

Unit - 3

Upstream processing (Strain selection, Sterilization), Downstream processing – extraction, separation, concentration, recovery & purification, operations of fermentation products. Deterioration of paper, textiles, painted surfaces and their prevention, Biofilms, microbial biopolymers, biosurfactants,

Unit - 4

Intellectual Property Rights, International Organizations and Intellectual Property Rights Introduction to Patent and Process Involved in Patenting, Patenting Living Organisms. Traditional Knowledge, Commercial Exploitation, and Protection, Use of Genetically Modified Organisms and their Release in the Environment. Hazardous Materials used in Biotechnologytheir Handling and Disposal

Unit - 5

Introduction to Bioethics and Biosafety, Biosafety Guidelines and Regulations. Legal and Socio-economic Impacts of Biotechnology, Ethical, Legal and Social Implications of Human Genome Project, , Bioethics in Biodiversity and Resource Management. Ethical Issues in Genetically Modified Organisms

Suggested Readings

1. Sullia S. B& Shantharam S: (2008) General Microbiology, Oxford & IBH Publishing Co. Pvt. Ltd.
2. Bisen P.S (2005) Frontiers in Microbial Technology, 1st Edition, CBS Publishers.
3. Glaser A.N & Nilaido.H (2000) Microbial Biotechnology,W.H Freeman & Co. 4. Prescott & Dunn (2007) Industrial Microbiology 4th Edition, CBS Publishers & Distributors.
4. Prescott & Dunn (2002) Industrial Microbiology, Agrobios (India) Publishers.
5. Crueger W. & Crueger A. (2000) A text of Industrial Microbiology, 2nd Edition, Panima Publishing Corp.
6. Stanbury P.F, Ehitaker H, Hall S.J (2007) Priciples of Fermentation Technology. Aditya Books (P) Ltd.
7. Biochemistry & Molecular biology of plant, Buchman & James 4th ed. Garland press 2010
8. Environemntal Biotechnology, B.D. Singh (2008)
9. Fermentation biotechnology, Mansi (2006) Humna pub.
10. Principle of fermentation technology, Stanbury P.F. 2nd pub, Essiver pub (1995)

LBTC 603: Bioinformatics **(Maximum marks= 50)**

Average Teaching 9 hours /Unit

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

Introduction to Genomics; Proteomics, Transcriptomics. Genome Annotation- Introduction to DNA Microarray. Analysis of single nucleotide polymorphism using DNA chips. 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. 2010
6. Bioinformatics : Sharma & Munjal (2008)
7. Principle of Biostatic, Marcello pagano 2nd ed. (2011)
8. Bioinformatics, Lesh M Arthur, 3rd ed. Oxford pub (2008
9. Introduction to Bioinformatics 6th ed. T.K. AtwoodPearson pub.
10. Principle of Biostatics, Marcello pagano 2nd ed. Cegage (2011)

LBTC 604: MAJOR ELECTIVES **(Maximum marks= 50)**

Average Teaching 9 hours /Unit

1. Microbial & Fermentation technology

2. ENVIRONMENTAL BIOTECHNOLOGY

3. MICROBIAL AND FERMENTATION TECHNOLOGY

3. PLANT BIOTECHNOLOGY

LBTC 604: Environmental Biotechnology **(Maximum marks= 50)**

Average Teaching 9 hours /Unit

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. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology (2010): P.S. Verma and V.K. Agrwal
2. Elements of Biotechnology: (2011) P.K.Gupta
3. Environmental Biotechnology (2009) Chhatargy
4. Environmental Polutions (2011) Peavy & Rowe

5. Environemental biology, P.S. Verma (2012) S. chand.
6. Cell and mol Bio. (2012) P.S. Verma, Himalaya pub
7. Fermentation microbiology & BT (2005) I.K. Pub
8. Molecular biology, 1st, Sharma R.K., (2009)
9. Environmental Biotecyhnology, Indu Shekhar, 2nd ed. I.K. pub (2011)
10. Practical Biotechnology, R.S. George 2nd ed. I.K. pub (2008)

LBTC 604: Microbial and Fermentation Technology

(Maximum marks= 50)

Average Teaching 9 hours /Unit

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

Strain development: General aspects mutation selection of mutatants, recombination, regulation gene technology and use of genetic methods, In brief genetic engineering for strain improvements and applications in medicine, agriculture and industry.

Unit - 4

Micriobial 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

Microbial & Bioprocess technology: Down stream processing in brief -Methods for vitamins (B_{12} & Riboflavin), amino acids (L-glutamic acid & L Lysine), organic acids (Citric acid & Gluconic acid), enzymes (Amylases & pectinases), antibiotics (Beta Lactam antibiotics & amino acid and peptide antibiotics), microbes as biocontrol agents

Suggested Readings

1. Principles of Fermentation Technology – (2005) Whittaker & Stan bury, Pergamon Press
2. Bioprocess Engineering Principles - Pauline Doran, Academic Press (2007)
   Operational Modes of Bioreactors, BIOTOL series - Butter worth, Heinemann (2000)
3. Bioreactor Design & Product Yield, BIOTOL series - Butter worth Heinemann (2010)
4. Bioprocess Engineering : Systems, Equipment & Facilities - Ed. B. Lydersen, N.A. Delia & K.M. Nelson, John Wiley & Sons Inc,(2002)
5. Bioseparation & Bioprocessing - Ed. G. Subramaniam, Wiley –VCH,(2010)
6. Product Recovery in Bioprocess Technology, 'BIOTOL series, Butter Worth Heinemann (2002)

7. Bioseparation : Downstraem Processing for Biotechnology - Paul A. Belter, E.L. Cussler, Wei-Shou Hu, (2000) Academic Press
8. Solvent Extraction in Biotechnology - Larl Schuger, Spinger Verlag, (2004)
9. Biotechnology A Text of Industrial Microbiology Wulf Crueger and Anneliese Crueger (2005)
10. Biotechnology application of Microorganisms. D.K. Maheshwari, I.K. Internation (2006)

LBTC 604: Plant Biotechnology **(Maximum marks= 50)**

Average Teaching 9 hours /Unit

Unit - 1

Plant Tissue Culture applications – Micropropagation, somaclonal variation, somatic embryogenesis, Haploid plant: production and significance, Synthetic seeds, Cryopreservation, Protoplast isolation and culture,

Unit - 2

Applications of Plant Genetic Engineering - crop improvement by manipulating photosynthesis and nitrogen fixation, Quality improvement: Protein, lipids, carbohydrates, vitamins & mineral nutrients

Unit - 3

Genetic modification in Agriculture – Transgenic plants, Biotic stress tolerance: Herbicide resistance, Insect resistance, Virus resistance), A biotic stress tolerance: Drought and Salt, 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, Genetic modification in Food industry – background, history, controversies over risks, application, future applications, Edible vaccine

Unit - 5

Plant metabolic engineering - The concept of secondary metabolites Secondary metabolites in plants, Importance of secondary metabolites in medicine and agriculture, A brief account on various pathways for secondary metabolite production: Sikimate pathway, Flavinoid pathway and Terpinoid pathway, Biotransformation, plants as bioreactors

Suggested Readings

1. Ravishankar G.A and Venkataraman L.V. (2007) Biotechnology applications of Plant Tissue & cell culture. Oxford & IBH Publishing co., Pvt Ltd.
   Bhan (2008) tissue Culture, Mittal Publications, New Delhi.
2. Islan A.C (1996) Plant Tissue Culture, Oxford & IBH Publishing Co., Pvt. Ltd.
3. Lydiane Kyte & John Kleyn (2006) Plants from test tubes. An introduction t Micropropogation (2000) timber Press, Partland.
4. Kumar H.D (2010) A test book book on Biotechnology (2nd Edition). Affiliated East West Press Private Ltd. New Delhi.
5. Chrispeel M.J. and Sdava D.E. (2001) Plants, Genes and agriculture, Jones and Barlett Publishers, Boston.
6. Reinert J. and Bajaj y.P.S (2007) Applied and fundamental Aspects of Plant Cell, Tissue, and Organ Culture, Narosa Publishning House.
7. Elements of Biotechnology: (2011) P.K.Gupta
8. Environmental Biotechnology (2009) Chhatargy
9. Environmental Polutions (2011) Peavy & Rowe
10. Environemental biology, P.S. Verma (2012) S. chand

LBTL 605: Laboratory (Based on LBTC-601, 602 & 603) (Maximum marks= 50)

LBTL 606: Project Dissertation (Based on LBTC-604) (Maximum marks=150)

The student shall be required to complete the project work of not more than 45 day duration. Every student will be required to execute the proposed project either in the Department or at any Nationalized Institute/University inside India, where the practice of Biotechnology or any of relevant disciplines are covered, subject to approval of the Head of the Department. Students will have to submit a project report in the prescribed format of the Department. A student will evaluate on the basis of quality of the work, PowerPoint presentation and discussion.

As per UGC directives one paper on "Disaster management" will be offered as an optional paper in the undergraduate courses as decided by the statuary bodies of the University.

Practical schme for UG examination .

Major Practical	**Marks : 12**
Minor Practical	**Marks : 06**
Spotting /Quiz (05)	**Marks : 05**
Viva-Voce	**Marks : 05**
Practical Record	**Marks : 02**
	Total : 30

LBTM 101: Molecular Cell Biology **(Maximum marks= 100)**

Average Teaching 12 hours /Unit

Unit 1

Steps in cell cycle, yeast as model system, cell division control and regulation yeast *cdc* gene. Genes for social control of cell, Proto-oncogenes.

Unit 2

Cell signalling: Exocrine, Endocrine, Paracrine and Synaptic strategies of Chemical signalling, surface receptor mediated transduction (DAG, Ca^{+2}, c-AMP, G-Proteins) , MAKK, Notch, Jak-STAT signaling pathway

Unit 3

Overview of Membrane Transport,Active and passive transport. Intracellular protein transport. Translocation of Secretory Proteins across the ER Membrane, Insertion of Proteins into the ER Membrane, Protein Modifications, Folding. Molecular Mechanisms of Vesicle mediated protein transport.

Unit 4

Tumor Cells and the Onset of Cancer, The Genetic Basis of Cancer, Oncogenic Mutations in Growth-Promoting Proteins, Mutations Causing Loss of Growth-Inhibiting and Cell-Cycle Controls, The Role of Carcinogens and DNA Repair in Cancer, function of Ras, p53, Raf

Unit 5

Techniques in cell Biology: Section cutting, Cell smear preparation, Cell enumeration using haemocytometer, Flow cytometer and cell sorting, FISH.

Suggested Readings

1. Cell (A Molecular approach) (2000) Cooper , G. M.
2. Cell and Molecular Biology (2009) Karp, G.
3. Cell Biology (2010) Sadava D. E.
4. Cell and Molecular Biology (2005) Kish V. M. and Kleinsmith L. J.
5. Cell and Molecular Biology (2009) deRobertis and deRobertis
6.. Molecular cell Biology (2010) Lodish, H., Berk, A, Zipursky SL, Paul M and Darnell J.

LBTM 102: Microbial genetics and physiology (Maximum marks= 100)

Average Teaching 12 hours /Unit

Unit-I

History and Scope of Microbiology, Major characteristics used in microbial taxonomy (numerical and molecular), Current methods of microbial identification (Molecular 16s rRNA, House keeping genes), Bergeys manual of Systematic Bacteriology.

Unit-II

Cultivation and enumeration of microbes from environment, Ecology of micro-organisms, Ultrastructure of bacteria, algae, protozoa and viruses.

Unit-III

Nutritional requirements of micro-organisms, mode of nutrition, phototrophy, mixotrophy, saparophytic, symbiotic and parasitic organisms,

Unit-IV

Microbial growth and population kinetics, methodology for measuring growth and growth regulation. Physical and chemical control of microbes.

Unit-V

Mechanism of gene transfer and genetic recombination in bacteria: transformation, transduction, conjugation, sexduction .

Suggested Readings

1. Microbiology (1996) Prescott, Harlay and Klein
2. Biology of Micro-organism: (2009)Madigan, Martinko and Parker
3. Fundamentals of Microbiology (2004) Alcano
4. Foundations in Microbiology (1996) Talaro K. and Talaro A.
5. Microbiology: Concept and Applications (2003) Pleczar M. J., Chan E. C. S. and Krieg N. R.
6. Principles of Microbiology (2000) Atlas , R. M.
7. Bergey's Manual of Systematic Bacteriology (2001) (2nd ed.) Gornity, G. M.

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LBTM 103: Bioinstrumentation **(Maximum marks= 100)**

Average Teaching 12 hours /Unit

Unit-I

Principles and applications, simple, compound, phase-contrast and fluorescent microscopes. Electron microscopy: SEM and TEM. X-Ray Crystallography, X-ray diffraction, Bragg equation. Application in structural analysis of biomolecules, Centrifugation Techniques: Principles, types of centrifuges, density gradient centrifugation in isolation of cells, cell organelles and biomolecules.

Unit-II

Electromagnetic spectrum, Beer Lambert's Law. Photometry, UV/VIS Spectrophotometry, Infrared spectroscopy, Atomic absorption spectroscopy, ESR and NMR spectroscopy. Mass spectroscopy (LC-MS, GC-MS, MALDI - TOF). Fluorescent spectroscopy. Applications of different Spectroscopic techniques in Biology.

Unit-III

Introduction and types of chromatography, paper, thin layer, gas, Gel permeation, ion-exchange, HPLC, FPLC and affinity chromatography and instrumental details of each. Applications of Chromatographic techniques in Biology.

Unit-IV

Paper and gel electrophoresis, Polyacrylamide gel electrophoresis (native and SDS). Agarose gel electrophoresis. Immunoelectrophoresis. Intoduction to blotting (Southern, Western and Northern blotting). ELISA.

Unit-V

Nature and types of radiations, preparation of labeled biological samples. Detection and measurement of radioactivity, GM counter, Scintillation counter, Autoradiography, Safety measures in handling radioisotopes. RIA, Non radiolabelling.

Suggested Readings

1. Nuclear Magnetic Resonance:(2007) Williams
2. Biochemical Techniques theory and practice: (2009) White R
3. Analytical Chemistry: (2000) Christion G. D.
4. A Biologist Guide to Principle and Techniques: (2009) Willson K. and Gounding K.H.
5. An Introduction to Practical Biochemistry:(2008) Plummer D. T.

LBTM 104: Biochemistry (Metabolism and Regulation) (Maximum marks= 100)

Average Teaching 12 hours /Unit

Unit-1

Metabolism: basic concepts and design. Coupled reactions, Interconnecting reactions. Electron transport, Oxidative phosphorylation, energetics of chemolithotrops and autotrophs and transport, ATP.

Unit 2

Glycolytic pathways, Citric acid cycle, energy production, Glyoxylate cycle. Gluconeogenesis, Glycogenolysis.

Unit-3

Nitrogen acquisition and assimilation**.** Biosynthesis of Aromatic and Aliphatic amino acids in brief, Assimilation of amino acids, Mechanism of transamination reaction. Amino acid oxidation and production of urea. Urea cycle. Pathways of amino acid degradation.

Unit- 4

Lipid biosynthesis, d*e Novo biosynthesi*s, biosynthesis of unsaturated fattyacids. Biosynthesis of membrane lipids and steroids. Essential fatty acids and biosynthesis of eicosanoids. Degradation of fatty acids, β oxidation, ω oxidation.

Unit- 5

de Novo synthesis of pyrimidine. De Novo and salvage pathways for synthesis of purine bases. Feed back regulation of nucleotide biosynthesis. Catabolism of purine and pyrimidine.

Suggested Readings

1. Lehninger Principle of Biochemistry (2012): Nelson & Cox
2. Biochemistry (2012) Lubert Stryer
3. Text Book of Biochemistry (2007) Devlin , Thomas M.
4. Biochemistry (2000) Geoffery, Zubay
5. Basic Biological Chemistry :(2000) Mahler and Cordes
6. Harper's Review of Physiological Chemistry(2003) Murray, R. K., Mayes, P. A. Gramner, D. K. and Rowell V. W.
8. Biochemistry – (2000) Keshav Trehan Wiley Eastern Publications
9. Fundamentals of Bochemistry-(2009) J.L.Jain S.Chand and Company
10. Biochemistry- Prasaranga, Bangalore University
11. Fundamental of Biochemistry – (2000)Dr.A.C.Deb
12. Textbook of Organic Chemistry (2009) (A Modern Approach)
13. The Biochemistry of Nucleic acid – (2010) -Roger L.P.Adams, John T. Knowler and David P.Leader, Chapman and Hall Publications

LBTL 105: Laboratory (Based on LBTM-101, LBTM-102) (Maximum marks= 100)

LBTL 106: Laboratory (Based on LBTM-103, LBTM-104) (Maximum marks= 100)

LBTM 201- Molecular Genetics and Recombinant DNA Technology (Max. marks= 100)

Average Teaching 12 hours /Unit

Unit-I

Isolation of DNA and RNA. Quantification of nucleic acids. Radiolabelling of nucleic acids: End labelling, nick translation, labelling by primer extension, DNA sequencing: Maxam-Gilbert (Chemical) and Sanger- Nicolson (dideoxy/ enzymatic) sequencing method, Pyrosequencing.

Unit-II

Restriction endonucleases: Types of restriction endonucleases, classification and uses. Analysis of restriction fragments. Restriction mapping. DNA modifying enzymes, Nucleases, Polymerases, Phosphatases and Polynucleotide kinase.

Unit-III

Cloning vectors; Plasmid, Bacteriophage, and other vectors. Cosmid expression vectors. DNA ligases; Joining of DNA Fragments in vitro, cohesive and blunt end ligation, linkers, adaptors, Homo polymer tailing. Preparation of the Gene construct, Construction of genomic and c-DNA libraries. Selection, screening and analysis of recombinants.

Unit-IV

Principle of hybridization. Northern blotting, Southern blotting, Western blotting, South-Western blotting, Polymerase chain reaction, Restriction fragments length polymorphism, RAPD, AFLP.

Unit-V

Strategies of gene delivery, *in vitro* translation, expression in bacteria and yeast, expression in insects and insect cells, expression in mammalian cells, expression in plants. Chromosome engineering, Targeted gene replacement, gene editing, gene regulation and silencing.

Suggested Readings

1. Principles of Gene manipulation(2004) Old R.N. and Primrose S.B.
2. From Genes to Clones (2007) Winnaeker E.L.
3. Recombinant DNA (2002) Watson J.D., Witreowski J., Gilman M. and Zooller M.
4. An Introduction to Genetic Engineering: (2009) Nicholl, D.S.T.
5. Molecular Biotechnology (2006) Pasternak
6. The Biochemistry of Nucleic acid(2006)Adam et al
7. Genetic Engineering (2008)Janke k. swtlow

LBTM 202: Molecular Genomics and Epigenetics (Maximum marks= 100)

Average Teaching 12 hours /Unit

Unit -1

Genome and Genome organization. Genomics, Genome sequencing. Whole Genome analysis. Shotgun cloning method. Human Genome.

Unit -2

Gene mapping and applications- Transcriptome. DNA Microarray for analysis of gene expression patterns. cDNA based and oligonucleotide based DNA microarray. Application in system biology and diagnosis. Single nucleotide polymorphisms. Predictive genomic medicine.

Unit-3

Proteome- General Account. Isoelectric focusing. Protein profiling by one Dimensional and 2 Dimensional gel electrophoresis. Protein sequence analysis by mass spectroscopy. Protein microarrays. Advantages and disadvantages of DNA and protein microarrays. Protein homology search

Unit 4

Metabolomics: Definition, History, Tools, Databases and the Applications.

Unit 5

Epigenetics: Definition, Mechanisms of Epigenetic control of gene expression. DNA methylation, histone methylation and histone acetylation, Genomic imprinting.

Suggested Readings

1. Principles of Gene manipulation (7^{th} edition) Old R.N. and Primrose S.B and Twyman.
2. From Genes to Clones (2007) Winnaeker E.L.
3. Recombinant DNA (2002) Watson J.D., Witreowski J., Gilman M. and Zooller M.
4. Molecular databases for protein and sequence and structure studies: (2010) Sillince A. and Sillince M.
5. Sequence Analysis primers :(2010) Gribskov, M. and Devereux, J.
6. Bioinformatics: Sequence and Genome Analysis By David W. Mount, *University of Arizona, Tucson*
7. Discovering Genomics, Proteomics, & Bioinformatics, Second Edition
   By A. Malcolm Campbell, *Davidson College;* Laurie J. Heyer, *Davidson College;* With a Foreword by Francis S. Collins

LBTM 203 - Basic Enzymology and Enzyme Technology (Maximum marks= 100)

Average Teaching 12 hours /Unit

Unit-I

Introduction to Enzymes, enzyme nomenclature, enzyme commission numbers, and classification of enzymes. Isolation and purification of enzymes, preparation of purification chart, Enzyme activity, Specific activity and turn over number, Marker enzymes.

Unit-II

Enzyme Kinetics: Steady state, pre-steady state, equilibrium kinetics, Michaelis and Menten Equation and its derivation, Different methods to calculate the K_m and V_{max} and their significance.

Unit-III

Factor affecting enzyme activity and catalysis: pH, subsrate and enzyme concentration, temperature, coenzyme and cofactors, Mechanism of action of enzymes involving two/more substrates. Role of metal ions in enzyme catalysis. Enzyme inhibition, different types of inhibitors and activators.

Unit-IV

Structure and function of enzymes in brif: Lysozyme, chymotrypsin, proteases. Enzyme regulation and control of their activity. Introduction to allosteric enzymes and isozymes.

Unit-V

Enzyme Technology: Immobilization of enzymes, whole cell immobilization and their application, commercial production of enzymes, RNA-catalysis, abzymes, Protein and Enzyme enginering: Design and construction of novel enzymes.

Suggested reading:

1. Enzyme Kinetics (2009) Palmer
2. IUPAC Enzyme nomenclature series.
3. Enzyme kinetics: Dixon W. B.
4. General Enzymology :Kulkarni & Deshpande
5. Enzyme Assays:J. Raymond
6. Biochemistry: Voet and Voet
8. Lehninger Principles of Biochemistry by Nelson, Cox
9. Fundamentals of Enzymology Third edition, Nicholas C. Price and Lewis Stevens

LBTM 204: Computational Biology and Biostatistics (Maximum marks= 100)

Average Teaching 12 hours /Unit

Unit-I

Introduction and definition of biostatistics, concept of variables in biological systems. Measure of central tendency: Mean median and mode, and their relationship standard deviation, coefficient of variations. Correlation and regression, linear and quadratic regressions,

Unit-II

Probability, concept of random experiment, various definition of probability. Concept of Standard errors Student 't-', 'F' and 'Chi' square distribution their properties and use. ANOVA.

Unit-III

Basic knowledge of computers, hardware and software, Generation of Computers and information, storages devices. MS-OFFICE, MS-WORD and MS-EXCEL Application of Different computer software in handling the biostatistical problems and Data-management.

Unit-IV

Introduction to Bio-informatics: Definition, History and Aims, Introduction to data mining, Computational gene finding – multiple allignment and sequence search (BLAST, FASTA, CLUSTALW). Applications of Bioinformatics.

Unit-V

Predicting structure and function, Molecular Evolution and phylogenetic trees, Methods for Phylogenetic analysis: Sequence Alignment, Construction of Phylogenetic Tree. Pathway analysis

Suggested reading:

1. Bioinformatics(2002) Bishop Martin
2. Molecular databases for protein and sequence and structure studies: (2000) Sillince A. and Sillince M.
3. Sequence Analysis primers : (2009) Gribskov, M. and Devereux, J.
4. Bioinformatics: Sequence and Genome Analysis By David W. Mount(2010) *University of Arizona, Tucson*
5. Discovering Genomics, Proteomics, & Bioinformatics, (2009) By A. Malcolm Campbell, *Davidson College;* Laurie J. Heyer, *Davidson College;* With a Foreword by Francis S. Collins
6. Biostatistics (2010) P.N.Arora ,P.K.Malha
7. Introductory statistics for Biology (2000) *Mahajan , S. K.*
8. Statistical Methods :(2009) *Mishra and Mishra.*

LBTM 205: Seminar **(Maximum marks-50)**

Every student shall be given a topic from the syllabus or research articles by the faculty members for presentation during seminar on a date as notified by the Head of the Department. The evaluation will be based on the review submitted as hard copy in duplicate and presentation using power point followed by discussion and questions

LBTL 206: Laboratory (Based on LBTM-201, LBTM-203) **(Maximum marks= 100)**

LBTL 207: Laboratory (Based on LBTM-202, LBTM-204) **(Maximum marks= 100)**

LBTM 301: Bioprocess Engineering and Technology (Maximum marks= 100)

Average Teaching 12 hours /Unit

Unit-I

Introduction to bioprocess engineering, bioreactors, isolation, preservation and maintenance of industrial microorganisms, kinetics of microbial growth and death, media formulation for industrial fermentation, Air and media sterilization. Designing of a fermenter/Bioreactor.

Unit-II

Types of fermentation process, analysis of batch fed batch and continuous bioreactions, biotransformation, stability of microbial reactors, specialized bioreactors (pulsed, fluidized, photo bioreactors etc.) Measurement and control of bioprocess parameters

Unit-III

Downstream processing: introduction, removal of microbial cells and solid matters, foam separation, precipitation, filtration, centrifugation, cell disruption, liquid-liquid extraction, chromatography, membrane process, drying and crystallization.

Unit-IV

Industrial production of chemicals: alcohols, acids (citric, acetic), solvents (glycerols, acetone, butanol), antibiotics (penicillin, streptomycin, tetracycline) amino acids (lysine, glutamic acid), single cell proteins.

Unit-V

Food Biotechnology: Food spoilage and preservation process, dairy products, wine, beer and other alcoholic Beverages , petro crops, . Mushroom -types, isolation and culture.

Suggested reading

1. Sullia S. B& Shantharam S: (2008) General Microbiology, Oxford & IBH Publishing Co. Pvt.Ltd.
2. Glaser A.N & Nilaido.H (2005) Microbial Biotechnology,W.H Freeman & Co.
3. Prescott & Dunn (2007) Industrial Microbiology 4th Edition, CBS Publishers & Distributors.
4. Prescott & Dunn (2002) Industrial Microbiology, Agrobios (India) Publishers.
5. Crueger W. & Crueger A. (2000) A text of Industrial Microbiology, 2nd Edition, PanimaPublishing Corp.
6. Stanbury P.F, Ehitaker H, Hall S.J (2007) Priciples of Fermentation Technology., Aditya Books (P) Ltd.
7. S.N.Jogdan (2006) Industrial Biotechnology, Himalaya Publishing House Prescott & Dunn (2002) Industrial Microbiology, Agrobios (India) Publishers.
8. Crueger W. & Crueger A. (2000) A text of Industrial Microbiology, 2nd Edition, Panima Publishing Corp.
9. Stanbury P.F, Ehitaker H, Hall S.J (2007) Priciples of Fermentation Technology. Aditya Books (P) Ltd.
10. Biochemistry & Molecular biology of plant, Buchman & James 4th ed. Garland press 2010

LBTM 302: **Advanced Immunology** **(Maximum marks= 100)**

Average Teaching 12 hours /Unit

Unit-I

Introduction: Phylogeny of Immune system, innate and acquired immunity, Clonal nature of immune response. Organisation and structure of lymphoid organs.

Unit-II

Cells of immune system: Hematopoiesis and differentiation, lymphocyte trafficking, B-lymphocyte, T-lymphocytes, macrophages, Dentritic cells, natural killer and lymphokine activated killer cells. Eosinophils, neutrophils and mast cells.

Unit-III

Nature and Biology of antigens and super antigens. Antibody structure and function, antigen and antibody interactions, Major histocompatibility complex, HLA. Generation of antibody diversity and complement system. Activation of B and T- lymphocytes. Cell mediated cytotoxicity: mechanism of T cell and NK cell mediated lysis, antibody dependent cell mediated cytotoxicity and macrophage mediated cytotoxicity.

Unit-IV

Antigen processing and presentation, generation of humoral and cell mediated immune responses, cytokines and their role in immune regulation, T- cell regulation, MHC- regulation, Immunological tolerance, Hypersensitivity, Autoimmunity,Immonosenesence.

Unit-V

Transplantation, Immunity to infectious agents (intracellular parasites, helimenths & viruses,) Tumor Immunology, AIDS and other immunodeficiences. Hybridoma Technology and Monoclonal Antibodies.

Suggested reading

1. Essensials of Immunology: (2011) Roitt. I. M
2. Kuby's Immunology (2012) Goldsby et al.
3. Advanced Immunology (1991) Male D., Champion B. Cooke A. and Owen M.
4. Principle and practice of Immunoassay (2009) Christopher P. Price and David J.
5. Kuby Immunology Richard A. Goldsby, Thomas J. Kindt and Barbara A. Osborne 6 Ed. 2007 Edition
6. Principle and practice of Immunoassay (2009) Christopher P. Price and David J. Newman.
7. Culture of Animal cell- Ian Freshney (2007)
8. Buttler. Elements of Biotechnology – P.K. Gupta (1st Edition -2000) Ras. Publications.
9. Immunolgy : C.V. Rao (2008)
10. Immunology 6th ed, Kubey (2010) Pearson pu
11. Immunology, Joshi, Osama 5th ed, agrobiotech pub (2007)

LBTM 303: Plant Biotechnology **(Maximum marks= 100)**

Average Teaching 12 hours /Unit

Unit-I

Introduction to the techniques of plant tissue culture. Concept of cellular totipotency, Nutritional requirements, single cell culture, micro-propagation, somaclonal variation, somatic embryogenesis and production of embryoids.

Unit-II

Haploid and double haploid production, Protoplast isolation and culture. Somatic hybridization and cybrid production and their applications in crop improvement. Productions of virus free plants using meristem culture.

Unit-III

Basis of tumor formation, hairy roots, features of Ti and Ri plasmids, mechanisms of DNA transfer, role of virulence genes, use of Ti and Ri as vectors, binary vectors, use of 35S and other promoters, genetic markers, use of reporter genes, transformation of monocots. Transgene stability and gene silencing. Herbicide and insect resistance.

Plant Genetic Engineering: Transgenic plants, Genetically modified (GM) plants (Bt cotton, Bt Brinjal)

Unit-IV

Photoregulation and phytochrome regulation of nuclear and chloroplast genes expression, Molecular biology of light and dark reactions of photosynthesis, Genetics of *nif* genes, Molecular mechanism of nitrogen fixation.

Unit-V

Plant secondary metabolites: Control mechanisms and manipulation of alkaloids and industrial enzymes (Shikimate and PHA pathway), biodegradable plastics, therapeutic proteins, Edible vaccines, purification strategies. Green house Technology. Biotic and Abiotic stress.

Suggested reading

1. Plant Tissue Culture by MK Razdan & SS Bhojwani (2006) Elsevier
2. Experiment in Microbiology, Plant pathology and Tissue culture by K.R. Aneja (2010) Wishwa Prakashan
3. Genetic Transformation of Plants, Edited by Jackson, J.F.; Linskens, H.F. (2009), Springer
4. Plant Tissue Culture Concepts and Laboratory Exercises, (2010) Robert N Trigiano, Dennis J Gray, CRC Press
5. Chrispeel M.J. and Sdava D.E. (2001) Plants, Genes and agriculture, Jones and Barlett Publishers, Boston.

6. Reinert J. and Bajaj y.P.S (2007) Applied and fundamental Aspects of Plant Cell, Tissue, and Organ Culture, Narosa Publishning House.
7. Elements of Biotechnology: (2011) P.K.Gupta
8. Environmental Biotechnology (2009) Chhatargy
9. Environmental Polutions (2011) Peavy & Rowe
10. Environemental biology, P.S. Verma (2012) S. chand

LBTM 304: Animal Biotechnology **(Maximum marks= 100)**

Average Teaching 12 hours /Unit

Unit-I

Laboratory requirements for animal cell culture: Sterile handling area. Sterilization of different materials used in animal cell culture, Aseptic concepts. Instumentation and equipments for animal cell culture. History of cell culture. Primary and secondary cell culture.

Unit-II

Media and reagents: Types of cell culture media, Ingredients of media, Physiochemical properties, Antibiotics, growth supplements, Foetal bovine serum; Serum free media, Trypsin solution, Selection of medium and serum, Conditioned media, Other cell culture reagents, Preparation and sterilization of cell culture media, serum and other reagents.

Unit-III

Different types of cell cultures**,** Trypsinization, Cell separation, Continuous cell lines, Suspension culture, Organ culture. Development of cell lines, Characterization and maintenance of cell lines, stem cells, Cryopreservation, Common cell culture contaminants.

Unit-IV

Stem cell research: Current status and application in medicine. Application of animal cell culture for *in vitro* testing of drugs; Application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins. Production of recombinant hemoglobin, blood substituents, Artificial blood, General account of *in vitro* regulation of blood cells production.

Unit-V

Gene transfer technology in animals: Viral and non-viral methods, Production of transgenic animals and molecular pharming, current status of production of transgenic animals. Animal cloning: Techniques, relevance and ethical issues.

Suggested reading

1. Freshney, Culture of Animal Cells, 5th Edition, Wiley-Liss, 2005
2. Ed. John R.W. Masters, Animal Cell Culture - Practical Approach, 3rd Edition, Oxford University Press, 2000.
3. Ed. Martin Clynes, Animal Cell Culture Techniques., Springer, (2008).
4. B.Hafez, E.S.E Hafez, Reproduction in Farm Animals, 7th Edition, Wiley- Blackwell, (2010).
5. Louis-Marie Houdebine, Transgenic Animals: Generation and Use, 1st Edition, CRC Press, (2011).
6. Crueger W. & Crueger A. (2000) A text of Industrial Microbiology, 2nd Edition, PanimaPublishing Corp.

7. Molecular genetics, friedfilder (2009) 4th ed.
8. Text bool of Microbiology, Prescott (2009) 5th ed.
9. Text bool of Microbiology, Black(2009) 5th ed.
10. Gene-X, Lewin (2011)

LBTM 305 - **Review writing and Seminar** **(Maximum marks= 50)**

Each student will select a topic after consulting with faculty members for the proposed area of the dissertation work. The students shall be required to submit a synopsis of the proposed project work giving rationale of the work, methodology to be used, methods of data analysis as hard copy before seminar presentation.

LBTL 306: Laboratory (Based on LBTM-301, LBTM-303) **(Maximum marks= 100)**

LBTL 307: Laboratory (Based on LBTM-302, LBTM-304) **(Maximum marks= 100)**

Major Elective **(Maximum marks= 100)**

Each student has to select both elective papers from his group offered by the Department on the basis of availability of the resources.

LBTM 401 - Entrepreneurship & Management in Biotechnology (Max. marks= 100)

Average Teaching 12 hours /Unit

Unit-I

Introduction Meaning – nature and characteristics of Management, Scope and Functional areas of management. Management V/s Administration – Roles of Management, Levels of Management, Basic managerial functions.

Unit-II

Concept of entrepreneur, nature of entrepreneur, entrepreneurial characteristics, function of an entrepreneur, role of entrepreneurship in developing economy

Unit-III

Identification of Business opportunity: Business opportunity identification process, project identification, project appraisal.

Unit-IV

Institutional support system for small scale sector, SIDO, NSIC, SIDBI, SIBRI, BCIL

Unit-V

Structure of a Biotechnology Company. Start-up of Biotechnology Company, New Product Development. Market Research. Sales & Marketing Principles. Intellectual Property Principles in Biotechnology. Health Care Overview and Role of Government in Biotechnology. Ethical and Other Legal Issues in Biotechnology

Suggested reading

1. Principles of Management – P.C.Tripathi, P.N.Reddy (2005)– Tata McGraw Hill,
2. Dynamics of Entrepreneurial Development & Management – Vasant Desai (2010) – Himalaya Publishing House
3. Entrepreneurship Development – Poornima.M.Charantimath – Small Business Enterprises – Pearson Education – 2006 (2 & 4).
4. Management Fundamentals – Concepts, Application, Skill Development – Robers Lusier – Thomson (2006)
5. Entrepreneurship Development – S.S.Khanka – S.Chand & Co, (2009)
6. Management – Stephen Robbins – Pearson Education/PHI – 17th Edition, 2003.
7. Principles of Fermentation Technology – (2005) Whittaker & Stan bury, Pergamon Press

8. Bioprocess Engineering Principles - Pauline Doran, Academic Press (2007)
   Operational Modes of Bioreactors, BIOTOL series - Butter worth, Heinemann (2000)
9. Bioreactor Design & Product Yield, BIOTOL series - Butter worth Heinemann (2010)
10. Bioprocess Engineering : Systems, Equipment & Facilities - Ed. B. Lydersen, N.A. Delia & K.M. Nelson, John Wiley & Sons Inc,(2002)

LBTM 411: Project Dissertation & Viva **(Maximum marks= 200)**

Every student will be required to execute the proposed project either in the Department or at any National Institute/University in India, where the practices of Biotechnology or any of the relevant disciplines are covered. Students will have to submit a project report in the prescribed format as approved by the Head of the Department. The student shall be required to complete the proposed work within a period of six months. The dissertation will be evaluated on the basis of quality of the work, powerpoint presentation and interactive discussions/questions during the seminar followed by viva

MAJOR ELECTIVE PAPERS

LBTM-402: Microbial Technology **(Maximum marks= 100)**

Average Teaching 12 hours /Unit

Unit-I

Microbial biotechnology, scope and techniques, Bioprospecting of microbial diversity, Isolation and preservation of industrially important microorganisms.

Unit II

Genomics, Transcriptomics, Proteomics, Metabolomics, metagenomics and Systems Biology

Unit-III

Production of proteins and enzymes in bacteria, yeast and fungus, recombinant and synthetic vaccines. Microbial polysaccharides and polyesters.

Unit IV

Microbes as biocontrol agents microbial insecticides (Baculoviruses,entomopathogenic fungi, Bacillus thurinigiensis Bacillus sphaericus Bacillus popilae, Microbe derived inhibitors.

Unit-V

Microbial biomass production, utilization of plant biomass by microorganisms (lignocellulose biodegradation).

Suggested reading

1. Microbial Biotechnology (2006) Alexander n. Glazer Hiroshi Nikaido W.H.Freeman and Company
2. Molecular Biotechnogy: Principles a nd Applications of Recombinant DNA –(2011) Bernaral R.
3. Glick and Jack J. Pastemak ASM Press. Washington, D.C (2004).
4. Fungal Ecology and Biotechnogy (2003) Rastogi Publicaions, Meerut.
5. Principles of Fermentation Technology – (2005) Whittaker & Stan bury, Pergamon Press
6. Bioprocess Engineering Principles - Pauline Doran, Academic Press (2007)
   Operational Modes of Bioreactors, BIOTOL series - Butter worth, Heinemann (2000)
7. Bioreactor Design & Product Yield, BIOTOL series - Butter worth Heinemann (2010)
8. Bioprocess Engineering : Systems, Equipment & Facilities - Ed. B. Lydersen, N.A. Delia & K.M. Nelson, John Wiley & Sons Inc,(2002)
9. Bioseparation & Bioprocessing - Ed. G. Subramaniam, Wiley –VCH,(2010)
10. Product Recovery in Bioprocess Technology, 'BIOTOL series, Butter Worth Heinemann (2002)

MAJOR ELECTIVE PAPERS

LBTM-403: Bioprocess Technology **(Maximum marks= 100)**

Average Teaching 12 hours /Unit

Unit - I

Microbial production of amino acids and antibiotics. Biotransformation of steroid and non steroid compounds, metabolic engineering.

Unit-II

Biology of nitrogen fixation, preparation of different types of inoculants (nitrogen fixers, phosphate solubilizers, plant growth promoting rhizobacteria, PGPR, composting.

Unit-III

Introduction to the use of microbes in environmental applications, Bioremediation, bioaugemntation, Bioemulsifiers, biosurfactants, MEOR, Leaching of ores.

Unit- IV

Production of natural gas, Production of methane. Biological Hydrogen production. Microbial Fuel Cells. Production of fuel grade butanol and ethanol.

Unit V

Designing of aerobic and anerobic bioreactor for large production of primary and secondary metabolites from microorganism.

Suggested reading

1. Microbial Biotechnology (2009) Alexander n. Glazer Hiroshi Nikaido W.H.Freeman and Company
2. Molecular Biotechnogy: Principles and Applications of Recombinant DNA –Bernaral R.
3. Glick and Jack J. Pastemak ASM Press. Washington, D.C (2008).
4. Fungal Ecology and Biotechnogy (2009) Rastogi Publicaions, Meerut.
5. Kumar H.D (2010) A test book book on Biotechnology (2nd Edition). Affiliated East West Press Private Ltd. New Delhi.
6. Chrispeel M.J. and Sdava D.E. (2001) Plants, Genes and agriculture, Jones and Barlett Publishers, Boston.
7. Reinert J. and Bajaj y.P.S (2007) Applied and fundamental Aspects of Plant Cell, Tissue, and Organ Culture, Narosa Publishning House.
8. Elements of Biotechnology: (2011) P.K.Gupta
9. Environmental Biotechnology (2009) Chhatargy
10. Environmental Polutions (2011) Peavy & Rowe

LBTM-404: Advanced Plant Biotechnology **(Max. marks= 100)**

Average Teaching 12 hours /Unit

Unit-I

Basic techniques and tools in Plant Tissue Culture. Establishment of plant tissue culture lab: equipment, culture vessels. Green house and polyhouse establishment.

Unit-II

Physical and chemical sterilization methods. Surface sterilization of various explants, pretreatment of explant, subculture and repeated transfer of explants and cultures.

Unit-III

Genetic engineering for quality improvement of Protein, lipids, carbohydrates, vitamins & mineral nutrients, Plants as bioreactor.

Unit-IV

The concept of gene synteny. The concept of map-based cloning and their use in transgenics Plant Metabolic Engineering. The concept of secondary metabolites.

Unit V

Historical and current views, Importance of secondary metabolites in medicine and agriculture, Introduction to various pathways, Flavanoid pathway, Terpenoid pathway, Polyketoid pathway.

Suggested reading

1. Plant Tissue Culture by MK Razdan & SS Bhojwani (2006) Elsevier
2. Experiment in Microbiology, Plant pathology and Tissue culture by K.R. Aneja (2010) Wishwa Prakashan
3. Genetic Transformation of Plants, Edited by Jackson, J.F.; Linskens, H.F. (2009), Springer
4. Plant Tissue Culture Concepts and Laboratory Exercises, (2010) Robert N Trigiano, Dennis J Gray, CRC Press

5. Kumar H.D (2010) A test book book on Biotechnology (2nd Edition). Affiliated East West Press Private Ltd. New Delhi.
6. Chrispeel M.J. and Sdava D.E. (2001) Plants, Genes and agriculture, Jones and Barlett Publishers, Boston.
7. Reinert J. and Bajaj y.P.S (2007) Applied and fundamental Aspects of Plant Cell, Tissue, and Organ Culture, Narosa Publishning House.
8. Elements of Biotechnology: (2011) P.K.Gupta
9. Environmental Biotechnology (2009) Chhatargy
10. Environmental Polutions (2011) Peavy & Rowe
11. Environemental biology, P.S. Verma (2012) S. chand

LBTM-405: Agriculture Biotechnology **(Max. marks= 100)**

Average Teaching 12 hours /Unit

Unit I

Genetic engineering for biotic stress tolerance (Insects, fungi, bacteria, viruses, weeds). Genetic engineering for abiotic stress (drought, flooding, salt and temperature)

Unit-II

Molecular breeding, constructing molecular maps, Molecular tagging of genes/traits. Marker-assisted selection of qualitative and quantitative traits. Physical maps of chromosomes.

Unit-III

Biotechnology for Crop Improvement. Conventional methods for crop improvement, Pedigree breeding, Heterosis breeding, Mutation breeding.

Unit IV

Tissue culture in crop improvement, Micropropagation for virus-free plants, Somaclonal variation, Somatic hybridization, Haploids in plant breeding,

Unit-V

Genetic engineering for increasing crop productivity by manipulation of Photosynthesis, Nitrogen fixation, Nutrient uptake efficiency.

Suggested reading

1. Plant Tissue Culture by MK Razdan & SS Bhojwani (2006) Elsevier
2. Experiment in Microbiology, Plant pathology and Tissue culture by K.R. Aneja (2010) Wishwa Prakashan
3. Genetic Transformation of Plants, Edited by Jackson, J.F.; Linskens, H.F. (2009), Springer
4. Plant Tissue Culture Concepts and Laboratory Exercises, (2010) Robert N Trigiano, Dennis J Gray, CRC Press
5.

LBTM-406: Animal Biotechnology **(Maximum marks= 100)**

Average Teaching 12 hours /Unit

Unit-I

Classification of genetic diseases. Chromosomal disorders – Numerical disorders e.g. trisomies & monosomies, Structural disorders e.g. deletions, duplications, translocations & inversions.

Unit-II

Chromosomal instability syndromes. Gene controlled diseases – Autosomal and X-linked disorders, Mitochondrial disorders.

Unit-III

Molecular basis of human diseases - Pathogenic mutations. Gain of function mutations: Oncogenes, Huntingtons Disease. Dynamic Mutations- Fragile- X syndrome, Myotonic dystrophy. Mitochondrial diseases.

Unit-IV

Prenatal diagnosis - Invasive techniques - Amniocentesis, Fetoscopy, Chorionic Villi Sampling (CVS), Non-invasive techniques - Ultrasonography, X-ray, TIFA, maternal serum and fetal cells in maternal blood.

Unit V

Diagnosis using protein and enzyme markers, monoclonal antibodies. Molecular marker based diagnosis Hepatitis, Microarray technology- genomic and cDNA arrays, application to diseases.

Suggested reading

1. Diagnostic and Therapeutic Antibodies (Methods in Molecular Medicine by Andrew J.T. George (Editor), Catherine E. Urch (Editor) Publisher: Humana Press; edition (2000)
2. Molecular Diagnosis of Infectious Diseases (Methods in Molecular Medicine) by Jochen Decker, U. Reischl Amazon
3. Human Molecular Genetics by T. Strachan, Andrew Read Amazon Sales Rank: (2011)
4. Principles of Biostatistics by Marcello Pagano , Kimberlee Gauvreau (2009)
5. Essentials of Epidemiology in Public Health, Second Edition by Ann Aschengrau , George R., III Seage **(2009)**
6. Essentials of Epidemiology in Public Health, **2009** Second Edition by Ann Aschengrau , George R., III Seage
7. Animal form and Function, Breneman, 6th ed. Sidhwick & Jacson (1996)
8. Animal physiology: Goger Eckert , CBS pub (1974)
9. Microbial Biotechnology, Nandan Hazare 1st ed, Moninant pub (2005)

LBTM-407: Advance Therapy and Nano Biotechnology (Maximum marks= 100)

Average Teaching 12 hours /Unit

Unit-I

Clinical management and Metabolic manipulation – Phenylketouria, Familial Hypercholesterolemia, Rickets, ADA, Congenital hypothyroidism.

Unit- II

Gene therapy - Ex-vivo, Invivo, Insitu gene therapy, Stratagies of gene therapy: gene augmentation.

Unit-III

Vectors used in gene therapy – retrovirus, adenoviruses, Herpes Synthetic vectors– liposomes, receptor mediated gene transfer. Gene therapy trials.

Unit IV

Stem cell and tissue engineering, Embroynic and adult stem cell, Potential use of stem cells – Cell based therapies

Unit V

Nanotechnology and Nanomedicine, use and application of nanomaterials in medical biotechnololgy

Suggested reading

1. Diagnostic and Therapeutic Antibodies (Methods in Molecular Medicine by Andrew J.T. George (Editor), Catherine E. Urch (Editor) Publisher: Humana Press; edition (2007)
2. Molecular Diagnosis of Infectious Diseases (Methods in Molecular Medicine) by Jochen Decker, U. Reischl Amazon 3. Human Molecular Genetics by T. Strachan, Andrew Read Amazon Sales Rank 2008
3. Essentials of Epidemiology in Public Health, 2009 Second Edition by Ann Aschengrau , George R., III Seage
4. Animal form and Function, Breneman, 6th ed. Sidhwick & Jacson (1996)
5. Animal physiology: Goger Eckert , CBS pub (1974)
6. Microbial Biotechnology, Nandan Hazare 1st ed, Moninant pub (2005)
7. Mamal Ecology, Blakie, Champ man pub (2008)

LBTM – 408: ADVANCED ENVIRONMENTAL BIOTECHNOLOGY

Unit-I

Status and Scope of Biotechnology in Environmental protection. Non-conventional energy sources. Environment protection Act: Environmental laws, Environmental policies, Environmental ethics. UN declaration.

Unit II

Environmental protection and conservation. Environmental Impact Assessment, Ecoplanning and Sustainable Development

Unit-III

Physicochemical and bacteriological analysis of soil and water, Problems associated with soil alkali soils, sodic soils, and solid waste, Fate of insecticides fungicides, pesticides in soil,

Unit IV

use of genetically modified (insect-, pest- and pathogen resistant) plants. Ecotoxicology of soil pollutants, Municipal solid waste treatment strategies.

Unit-V

Waste water constituents, Analysis and selection of flow rates and loadings, Process Selection, Physical unit operations, Chemical unit operations, Fundamentals of biological treatment.

Books

1. Amann, R.I. Stromley, J. Stahl :(2010) Applied & Environmental Microbiology
2. Dash (2011) Concepts of Ecology
3. Chattergy (2009) Environmental Biotechnology
4. Varma & Agarwal (2012) Environmental Biology
5. B.K. Sharma (2010) Environmental Chemistry
6. Peavy & Rowe (2010) Environmental Pollution
7. Asthana & Asthana (2009) Environment Problems & Solutions
8. Environmental biotechnology (2008) B.D. Singh
9. Environemntal and Ecology, PK. Gupta (2008) Rastogi pub.
10. Introduction to Environmental Biotechnolgy, Chatterjee A.K. (2009) 2nd ed.

LBTM - 409: ENVIRONMENTAL Management Technology

Unit I

Role of biotechnology in water purification systems. Types and kinetics of biological treatment, Advanced waste water treatment, Biological Processes for Industrial and domestic effluent, Treatment, Aerobic Biological Treatment,Anaerobic Biological Treatment.

Unit-II

Bioremediation-Biotechnology for clean environment, Biomaterials as substitutes for non-degradable materials, Metal microbe interactions.

Unit III

Heavy Metal Pollution and impact on environment, Microbial Systems for Heavy Metal Accumulation, Biosorption, molecular mechanisms of heavy metal tolerance

Unit IV

Bioremediation- Biotechnology for clean environment. Bioindicators and biosensors for detection of pollution. Biotechnology for Hazardous Waste Management.

Unit V

Persistent organic pollutants, Xenobiotics, Biological Detoxification of PAH, Biotechniques for Air Pollution Control. Solid Waste Management.

Books

1. Amann, R.I. Stromley, J. Stahl :(2010) Applied & Environmental Microbiology
2. Dash (2011) Concepts of Ecology
3. Chattergy (2009) Environmental Biotechnology
4. Varma & Agarwal (2012) Environmental Biology
5. B.K. Sharma (2010) Environmental Chemistry
6. Peavy & Rowe (2010) Environmental Pollution
7. Asthana & Asthana (2009) Environment Problems & Solutions
8. Environmental biotechnology (2008) B.D. Sing
9. Dash (2011) Concepts of Ecology
10 Chattergy (2009) Environmental Biotechnology
11. Varma & Agarwal (2012) Environmental Biology

Practical schme for PG examination .

Major Practical	Marks : 24
Minor Practical	Marks : 12
Spotting /Quiz (05)	Marks : 10
Viva-Voce	Marks : 10
Practical Record	Marks : 04

Total : 60