DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD.

Syllabus of

B.Sc.III YEAR

BIOTECHNOLOGY

Semester-V & VI

[Effective from 2011-12 & onwards]

General Outline of courses/papers offered for Degree in B. Sc. Biotechnology.

Sr. No.	Paper No. Code	Title of the paper/course
Semester I –B. Sc. First Year		
1	I-PCH	Physical Chemistry
2	II-OCH	Organic Chemistry
3	III-MCD	Microbial Cell and Diversity
4	IV-BST	Biostatistics
5	V-INS	Instrumentation
6	VI-BML	Biomolecules
7	LC-I	Physical and Organic Chemistry
8	LC-II	Microbiololology and Biostatistics
9	LC-III	Instrumentation and Biomolecules
Semester II –B. Sc. First Year		
10	VII-OIC	Organic and Inorganic Chemistry
11	VIII-IPC	Inorganic and Physical Chemistry
12	IX-MGC	Microbial growth and control
13	X-BMT	Biomathematics
14	XI-MML	Macromolecules
15	XII-BTC	Biotechniques
16	LC-IV	Chemistry
17	LC-V	Microbiology and Mathematics
18	LC-VI	Macromolecules and Biotechniques
Semester III –B. Sc. Second Year		
19	XIII-BIM	Basics of Immunology
20	XIV-GVG	General Virology
21	XV-DVB	Developmental Biology
22	XVI-CSI	Chromosome structure and Inheritance
23	XVII-BEZ	Basics of Enzymology
24	XVIII-APL	Animal physiology
25	LC-VII	Immunology and Virology
26	LC-VIII	Developmental Biology and Inheritance
27	LC-IX	Enzymology and animal physiology
Semester IV –B. Sc. Second Year		
28	XIX-CBG	Cell Biology
29	XX-PPL	Plant Physiology
30	XXI-GEN	Genetics
31	XXII-CDG	Central Dogma
31	XXIII-AEZ	Advanced Enzymology
32	XXIV-AIG	Advanced Immunology
33	LC-X	Cell biology and Plant Physiology
34	LC-XI	Genetics and central dogma
35	LC-XII	Enzymology and Immunology

Semester V –B. Sc. Third Year		
36	XXV-REG	Regulation of gene expression
37	XXVI-ITB	Introduction to Bioinformatics
38	XXVII-PGE	Principles of Genetic Engineering
39	XXVIII-FDP	Fermentation Design and Process
40	XXIX-TCT	Tissue Culture Technology
41	XXX-CBC	Clinical Biochemistry
42	LC-XIII	Gene Expression and Basic Bioinformatics
43	LC-XIV	Genetic Engineering and Fermentation
44	LC-XV	Plant tissue culture and clinical Biochemistry
45	XXXI-CEG	Communication English –Additional course
Semester VI –B. Sc. Third Year		
45	XXXI-GNP	Genomics and Proteomics
46	XXXII-RDT	Recombinant DNA technology
47	XXXIII-FTC	Fermentation Technology
48	XXXIV –BET	BioEthics
49	XXXV-MML	Metabolism of macromolecules
50	XXXVI-EEL	Ecology and Evolution
51	LC-XVI	RDT and Fermentation Technology
52	LC-XVII	Metabolism and Ecology Evolution
53	LC-XVIII	Project in lieu of Bioethics and Genomics and Proteomics
54	XXXVII-SEG	Scientific English

Third Year B. Sc. Biotechnology
XXV -REG
Regulation of Gene Expression (3 Credits)

Unit 1: Basics of Gene Expression

Regulatory elements/ factors: Inculcate concepts with suitable examples for; Cis acting elements, Trans-acting factors. Exceptional proteins behaving Cis-acting. Regulation of transposition of Tn3 and Tn9. Modifications of Cis-acting elements to influence and to affect regulation. Influencing or affecting gene expression as a presence / or absence of functional form of protein factor. Concept of Activator, Co-activator, Repressor (with suitable examples). Examples with mechanisms; specific regulator and global regulator. DNA protein interactions, RNA protein Interactions –conditions favoring and affecting these interactions (this is to be dealt with ref to Motifs).

Unit 2: Bacterial Gene Expression

Concept of Operon, Regulation of gene expression; positive control –the *ara* operon, negative control –paradigm the *lac* operon and attenuation mediated control or post-transcriptional regulatory control –the *trp* operon. Must include structural organization of above operons, functional relevance of genes within, regulatory circuit, modes by which the operon can be regulated other than above mentioned mode. Concept of Catabolite Repression. Examples of non-catabolite sugars and their regulation, catabolite repression in amino acid metabolism –examples at molecular level.

Unit 3: Eukaryotic Gene Expression

Activators :- gene specific and generalized type of activator. Domains of activators, protein and DNA/ or RNA binding domain. Modification of activator. Enhancer mediated gene expression –examples. Gene expression of metallothionine gene expression. Response elements such as; steroid hormone response elements, metal response elements, Basal Expression response elements. Regulation of gene expression at a step of activation of basal apparatus, Post initiation gene expression – mechanism of relieving roadblock (stuttering of RNA polymerase) with example. Regulation of mRNA molecules involving both nonstop and nonsense mechanisms. Gene regulation with example –post transcriptional –yeast and *Drosophila* genes, insulators in genomic imprinting –concept and example.

References:

1. Biochemistry –Lehninger
2. Principles of Biochemistry –Nelson and Cox
3. Microbial genetics –David Frifelder
4. Molecular Biology –David Frifelder
5. Genes –IX
6. Genes -X
7. Principles of gene manipulations –Old and Primrose
8. Biochemistry –Jeremy M. Berg, John L. Tymoczko, and Lubert Stryer
9. Principles of Gene Manipulations LPE Pearson -Watson
10. Genetics –Strickberger

Third Year B. Sc. Biotechnology
XXVI -ITB
Introduction to Bioinformatics (3 Credits)

UNIT 1

The Internet and Biologist: Internet basics, FTP, Gopher, World wide web.
The Gen Bank Sequence Database: Introduction, Primary & Secondary databse, Format vs content: computer vs humans, GenBank Flat File dissection, GCG, ACDEB.
Structure Databases: Introduction to structures, PDB, MMDB, Structure file formats, Visualizing structural information, Database structure viewers.

UNIT 2

Information Retrieval from Biological Databases: Retrieving database entries, Integrated information retrieval: The entrez system, sequence databases beyond NCBI, Medical Databases
The NCBI Database: Introduction, SeqIDS, Bioseq: Sequences, Bioseqsets: Collections of sequences, Seq. Annot: Annotating the sequence, Seqdiscr: Describing the sequence
Sequence Alignment and Database Searching: Introduction, Evolutionary basis of sequence alignment, Optimal alignment methods, Substitution scores & gap penalties, Statistical significance of alignments, Database similarity searching, FASTA, BLAST, Low complexity regions, Repetitive elements

UNIT 3

Multiple Sequence Alignment: Progressive alignment methods, Motifs and patterns, Hocks, MOST, Probe, Presentation methods, Abscript
Phylogenetic Analysis: Elements of phylogenetic models, data analysis: Alignment, substitution model building, tree building and tree evaluation, building methods, searching for trees, hooting trees, Evaluating trees and data, phylogenetic software Some simple practical consideration
Predictive Methods Using Nucleotide Sequence: Framework, marking repetitive DNA, Database search, Codon bias detection, Detecting function sites in the DM, Integrated gene passing, Finding tRMA genes

UNIT 4

Predictive methods Using Protein Sequences: Protein identity based on composition, Propsearch, Physical properties based on sequences, secondary structure and folding classes, Sspread sopma, Specialized structures of features, Tertiary structure
Genome Mapping: Different types of maps: physical, genetical, etc. Synteny, Human genome project, Application of genome mapping, Chromosome maps.
Submitting DNA Sequences to the Databses: Introduction, Where to submit, What to submit, How to submit on the world wide web, How to submit with sequin.

References:

1. Developmental Biology-Gilbert
2. Foundations of Embryology – Patten
3. Cell and Developmental Biotechnology – Raj Narian Desikar
4. Text book of Bryophytes, Pteridophytes , Gymnosperms and Paleobotany - Subramurti
5. Plant Anatomy and Embryology- S.N. Pandey, A. Chadha
6. Teresa K Attwood and David J. Parry-Smith, Introduction to Bioinformatics, Pearson Education Asia, 2001
7. Bexavanis & Francis, Bioinformatics-A practical guide to the analysis of genes and proteins, John Wiley and Sons, 2001
8. Rushidi, Basics of Bioinformatics, CRC Publications, 2001
9. Irfan Khan and Atiya Khanum, Emerging trends in Bioinformatics, Ukaaz Publishers, 2002
10. David M. Hill, Craig Martiz and Barke Mable, Molecular systematics
11. Khan Imtiyaz alam ,Rai University, Hydrabad:- Elementry Bioinformatics
12. N. Gautam Bioinformatics- Databases and algorithm
13. Bioinformatics: A practical guide to the analysis of genes and proteins A.D. Baxevanis and B.F.F. Ouellette (Eds). 2002 John Wiley and Sons.
14. Bioinformatics: Sequence and Genome Analysis by D.W. Mount, 2001, Cold Spring Harbor Laboratory Press.

Third Year B. Sc. Biotechnology
XXVII - PGE
Principles of Genetic Engineering (3 Credits)

Unit 1: DNA modifications and DNA cutting

Systems safeguarding DNA –in detail. Concept of restriction endonuclease action with reference to DNA modification.
DNA cutting enzymes: Type I, Type II, Type IIs and Type III with reference to properties, essential co-factors, mode of action –specificity and limitations of their applications.
DNA modifying enzymes with reference to their structure, function, requirements, reaction and applications: Exonucleases, Endonucleases acting on both single strand and double strand, Polymerases, phosphorylating enzymes, Phosphate removing enzymes, Enzyme adding base/s to the end.
Nucleic acid Joining Enzymes: RNA ligase, DNA ligases.

Unit 2: Vectors
Concept and types of vectors for genetic engineering, Review of plasmids and modifying natural plasmids to construct a plasmid vector –example of pBR322 –applications, versatility and limitations, cloning of DNA with gene disruption strategy.
The pUC18/ pUC19 vectors –with reference to their desing, potential also as an inducible vector system.
Viral vectors: M13 life cycle and use of M13 as vector, M13mp1 and M13mp2 design, potential and limitations. Single strand preparations for sequencing reactions.
Study of λ-genome to estimate potential as vector system. Concept of insertion and replacement vectors –Two examples with design and application
Vectors with two replicons: Phagemids –concept, example with design and application potential and limitations.
Vectors for use in Eukaryotic cells- Vectors for plant cell: Ti-plasmid, viral Cauliflower mosaic virus, Binary vectors. Vectors for animal cell: P elements, SV40.
Artificial chromosomes, their limitations and applications.
Transcriptional and Translational fusion vectors –with examples at least two

Unit 3: Cloning and Sequencing
Shotgun cloning; with reference to use of plasmid as vector, mean of cloning foreign piece of DNA (Construction of Chimera), mean to construct genomic library, mean to select recombinant with the use of antibiotic marker –a direct selection example.
Generalized strategy of obtaining cDNA from mRNA as a template for PCR (do not teach PCR) or piece of DNA to be cloned in desired vectors.
DNA sequencing by chemical method, by Enzymatic method and Chemical synthesis of DNA.

References:

1. An introduction to Genetic Engineering –Desmond S T Nicholl ,Cambridge university press, 2nd Ed.
2. Recombinant DNA: A short Course, Watson J.D, CSHL press
3. Short course in Bacterial Genetics –J. H. Miller
4. Molecular Biotechnology Principles & Applications of Recombinant DNA, Bernard R Glick & Jack J Pasternak, ASM press.
5. Old R.W & Primrose S.B., Principles of Gene manipulations, Blackwell Scientific publications.
6. Ausbel S.M , Brent R, Current Protocols in Molecular Biology., Wiley International New York.
7. Maniatis I, Fritchh E.F ,& Sambrook J, Molecular cloning.
8. D.M Glover , DNA cloning, A practical approach.
9. Methods in Enzymology series, vol 152, 185, Academic press inc, Sandiego.
10. Genes V –Benjamin Lewin

Third Yeat B. Sc. Biotechnology

XXVIII -FDP

Fermentation Design and Process (3 Credits)

1. **THE ISOLATION, PRESERVATION AND IMPROVEMENT OF INDUSTRIALLY**
   IMPORTANT MICRO-ORGANISMS: The isolation of industrially important micro-organisms:
   Isolation methods utilizing selection of the desired characteristic , Enrichment liquid culture and solidified media, Screening methods
   The preservation of industrially important micro-organisms: Storage at reduced temperature, Storage on agar slopes, Storage under liquid nitrogen, Storage in a dehydrated form, Dried cultures, Lyophilization, Quality control of preserved stock cultures.
   The improvement of industrial micro-organisms: The selection of induced mutants synthesizing improved levels of primary metabolites, Modification of the permeability, The isolation of induced mutants producing improved yields of secondary metabolites where directed selection is difficult to apply, The isolation of auxotrophic mutants, The isolation of resistant mutants, Mutants resistant to the analogues of primary metabolic precursors of the secondary metabolites ,The isolation of revertant mutants ,
2. **The use of recombination systems for the improvement of industrial micro-organisms** :
   The application of the parasexual cycle, The application of protoplast fusion techniques, The application of recombinant DNA techniques.

3. **Design of Fermentor**:
   Basic design of fermenter: Culture vessel, aerators, agitators, valves, foam separators, ports, cooling and heating devices. Characteristic features of bioreactors. Types of bioreactors: continuous stirred tank reactors (CSTR), packed bed reactors, fluidized bed reactors, plug flow reactors, tube reactors, airlift fermenter, bubble column, tower fermenter. Online monitoring and computer control and computer control of fermentation process.
   3. Fermentation Kinetics: Microbial growth: Batch , continuous, fed batch and steady state processes and their kinetics, Oxygen transfer, mass transfer, heat transfer. Methods of sterilization in fermentation process
4. **Downstream processing :** General steps in DST: Recovery of products, extraction, purification.

References

1. Principles of fermentation technology by Stanbury Whitekar and Hall Pergaman, McNeul, Harvey.
2. Biotechnology – A textbook of industrial microbiology by Creuger and Creuger
3. Bioprocess Engineering Principle by Doran Academic press.

Third Year B. Sc. Biotechnology
XXIX -TCT
Tissue Culture Technology (3 Credits)

Unit 1: Terminology- Totipotency, Competency, Determinism, Requirements of tissue culture facilities, surface sterilization of materials, Basic procedure for Aseptic Tissue transfer, Culture media, composition of media, phytohormones, media components (Vitamins, Unidentified supplements, carbohydrate for energy source, Nitrogen source and organic supplements, complex substances, Activated charcoal) An appraisal of different media, Hormones: Auxins, cytokinins, Gibberellins, Abscisic Acid, ethylene.

Unit 2: Establishing callus and cell culture, Dynamics of callus growth, callus subculture and maintenance, Growth Measurements, Organ cultures-Shoot cultures, root cultures. Somaclonol variation, cell suspension culture, **Plant Propagation—Meristem Cultures, Somatic Embryogenesis** and their practical applications, Plant Cell Cultures and Pharmaceuticals, and pigment Compounds.

Unit 3: Culture Media: **Natural media** –Plasma Clot, biological fluids tissue extract, Importance of Serum in media. **Chemically defined media**. Primary Culture – Cell lines, isolation of tissue, enzyme disaggregation, and mechanical disaggregation. Secondary Culture – transformed animal cells and continuous cell lines.

Unit 4: Transfection of animal cell lines. Selectable Makers. Production of Vaccines in animal Cells. Production and Applications of monoclonal antibodies. Growth factors promoting proliferation of animal cells- EGF, FGF, PDGF, IL-1, IL-2, NGF and Erythropoietin. Transgenic Animals- Techniques and Applications (Transgenic mice and sheep).

References:

1. Plant Cell and Tissue Culture- A Tool in Biotechnology Basics and Application, Karl-Hermann Neumann, Ashwani Kumar, Jafargholi Imani, Springer-Verlag Berlin Heidelberg
2. Plant Tissue Culture: Theory and Practice, S.S. Bhojwani, M.K. Razdan - Elsevier Science.
3. Culture of Animal Cells. A Manual of Basic Technique, Freshney, Wiley
4. Cell Culture Lab Fax. Eds. M. Butler & M. Dawson, Bios Scientific Publications Ltd., Oxford.
5. Animal Cell Culture Techniques. Ed. Martin Clynes, Springer.
6. Methods in Cell Biology, Vol. 57, Animal Cell Culture Methods. Ed. Jenni P. Mather and David Barnes. Academic Press.
7. Cell Growth and Division: A Practical Approach. Ed. R. Basega, IRL Press.

Third Yeat B. Sc. Biotechnology
XXX -CBC
Clinical Biochemistry

Unit 1: Basic concepts of clinical biochemistry, scope of clinical biochemistry in diagnostics, brief review of units and abbreviations used in expressing the concentrations and standard solutions, quality control. Manual versus automation in clinical biochemistry. Normal value of important constituents in blood, CSF and urine. Collection and preservation of blood, serum, plasma, urine, CSF. Chemical and microbial analysis of blood, urine, sputum and CSF. Basics and application of Colorimeter, Turbidometer, Nephlometer and Spectrophotometer, RIA, ELISA in clinical biochemistry. Defination of functional and non-functional plasma enzyme, isozyme and diagnostics test, enzyme pattern in health, disease and diagnostics related to plasma lipase, choline esterase, alkaline phosphatase, SGPT, SGOT, LDH, CKP, VDRL, immobilized enzymes in diagnostics. Hormonal disorders related to endocrine secretions eg. Thyroid etc.

Unit 2: Antibiotic sensitivity testing. Clearance test for urea, eosinophil sedimentation rate, Packed Cell Volume. Food infection and adulteration. Nutrition and chronic diseases. Physical and biochemical changes in ageing. Different theories in ageing, importance of superoxide dismutase in ageing, plasticity and regeneration.

Unit 3: Inborn errors related metabolic disorders, Galactosemia, Glycogen storage diseases, Phenylketonuria, type I and II Diabetes, Hypoglycemia, Lipid malabsorption, Statorrehea, Albinism. Chromosome aberration related disorders and their symptoms, diagnosis of Down’s syndrome, Turner’s syndrome. Neurological and psychiatric disorders as Schizophrenia, Depression, Dementia, Alzheimer’s disease, Wilson’s disease etc. metabolic disorders as gout, Atherosclerosis, Multiple sclerosis.

References:

1. Clinical biochemistry by Kaplan L.A. and Pesce A.J.C.V. Mosby 1998.
2. Clinical biochemistry by W.J. Marshall and S.K. Bangery, Chirchill Livinston N.Y. 1995
3. Textbook of Medical Laboratory Techniques P. B. Godkar and D.P. Godkar, second edition Bhalani publication.
4. Practical Clinical Biochemistry by Gowenlock.
5. Biochemical Aspects of Human Diseases by Elkeles and Tavill
6. Fundamentals of Biochemistry, A. C. Deb.
7. Biochemistry, Pamela Champe and R. Harvey 2 nd edition.
8. Text book of Microbiology Ixth edition Anantnarayan

Third Year B. Sc. Biotechnology

XXXI -GNP
Genomics and Proteomics (3 Credits)

UNIT 1

Protein structure, secondary structure and super-secondary structure. Mechanisms of protein folding, tertiary folds. Formation of oligomers. Relationship between protein structure and function. Prions.

UNIT 2

Structure prediction and human proteomics. Mutant proteins. Use of computer simulations and knowledge-based methods in the design process. De-novo design; making use of databases of sequence and structure. Protein structure and drug discovery, Proteins in disease

UNIT 3

The structure, function and evolution of the human genome. Strategies for large-scale sequencing projects. Human disease genes. Expression.

UNIT 4

Bioinformatics for the analysis of sequence data; approaches for determining gene expression patterns and functions.

Reference

1) Lesk, Arthur M, Introduction to Informatics, 2nd Edition, Oxford University Press, 2005, ISBN 0 19 9277877. http://www.oup.com/uk/orc/bin/9780199277872/freelecturer/figures/
2) Lesk, Arthur M, Introduction to Protein Science, Oxford University Press, 2004, ISBN 0 19 926511 9. http://www.oup.com/uk/orc/bin/9780199265114/resources/figures/
3) Nature, Genome gateway: http://www.nature.com/nature/supplements/collections/humangenome/index.html
4) Science, Human Genome special issue http://www.sciencemag.org/content/vol291/issue5507/index.dtl
5) This Unit Web site: http://www.lsbu.ac.uk/biology/proteomics/
6) Campbell, A. Malcolm and Heyer, Laurie J., Discovering Genomics, Proteomics & Bioinformatics, Benjamin Cummings, 2002.
7) Fersht, A. Structure and Mechanism in Protein Science, W. H. Freeman (1999).
8) Carey P. R. (Ed.) Protein engineering and design, Academic Press (1996).
9) Strachan T. and Read A. P. Human Molecular Genetics, 2nd edition. Bios (1999)
10) Glick, Bernard R. and Pasternak J. J., Molecular Biotechnology: principles and applications of recombinant DNA, 2nd ed. ASM Press (1998)
11) Brown T. A. Genomes, Bios (1999)
12) Attwood T. K. and Parry-Smith D. J. Introduction to Bioinformatics, Longman (1999)
13) Rees A R., Sternberg M. J. E. and Westsel R., Protein Engineering - a practical approach, IRL Press (1992).

14) Walker J. M. and Rapley R., Molecular Biology and Biotechnology, 4th ed. Royal Society of Chemistry (2000).

Third Year B. Sc. Biotechnology
XXXII -RDT
Recombinant DNA Technology (3 Credits)

Unit 1: Isolation, Identification, and Characterization of DNA Fragments:

Nucleic Acid Purification methods, Yield Analysis,
Radiolabelling of Nucleic acids: Probe preparation by random primer, nick translation, end labelling. Primer extension labelling, Non radioactiv probes, molecular probes (Immunogenetics purposes)
Southern and Northern Hybridization –principle, method and listing applications only
Techniques of introducing DNA into cell-calcium chloride transformation & High efficiency transformation by electroporation, Agrobacterium-mediated transformation, Protoplast transformation, Particle gun

Unit 2: Molecular Tools and Applications:

Polymerase Chain Reaction-Essential features, design of primers, DNA polymerases for PCR, study with reference to principle, methodology and single application in detail, conventional PCR, RT-PCR.
Mutagenesis: random mutagenesis and directed mutagenesis(primer extension method, error prone PCR methods)
Applications of rDNA technology – in understanding genes & genomes, in biotechnology (protein production & protein engineering), in medicine & forensics, transgenic plants & animals, Organism cloning, Engineering of β-carotene, engineering of abzymes and phage display for hormone engineering.
Mappping: promoter (Foot printing analysis), Transcriptional start site (Primer extension), Size of transcirpt –run off and run on assay.

Unit 3: Gene Cloning strategies and analysis
Cloning strategies- cloning from mRNA, cloning from genomic DNA, Cosntruction of Genomic library Maniatis Strategy, cDNA cloning with conventional cDNA and full length cDNA.
Genetic selection and screening methods- Chromogenic substrates, insertional inactivation, complementation
Screening using nucleic acid hybridization – Nucleic acid probes, screening clone banks
Immunological screening for expressed genes
Analysis of cloned genes- in vitro mRNA translation, restriction mapping, blotting techniques, DNA sequencing

References:

11. An introduction to Genetic Engineering –Desmond S T Nicholl ,Cambridge university press, 2nd Ed.

12. Recombinant DNA: A short Course, Watson J.D, CSHL press

13. Molecular Biotechnology Principles & Applications of Recombinant DNA, Bernard R Glick & Jack J Pasternak, ASM press.

14. Old R.W & Primrose S.B., Principles of Gene manipulations, Blackwell Scientific publications.

15. Ausbel S.M , Brent R, Current Protocols in Molecular Biology., Wiley International New York.

16. Maniatis I, Fritchh E.F ,& Sambrook J, Molecular cloning.

17. Winneker From Genes to Clones.

18. Setlow & Hollander A, Genetic Engineering: Principles & Methods, Plenum Press.

19. D.M Glover, DNA cloning, A practical approach.

20. Methods in Enzymology series, vol 152, 185, Academic press inc, Sandiego.

Third Year Biotechnology
XXXIII -FTC
Fermentation Technology (3 Credits)

Unit I Microbial Fermentations

Media formulation, Industrial production, Downstream processing, Biosynthesis, Regulation and metabolic control of:

Organic acid – Citric acid

a) Enzyme- Protease
b) Organic solvent – Ethanol
c) Amino acid- Lysine

Unit II Modern trends in Microbial Production

Media formulation, Industrial production, Downstream processing, Biosynthesis, Regulation and metabolic control of: a) Antibiotic- Penicillin

a) Vitamin- Vitamin B_{12}
b) Microbial Polysaccharide- Xanthan

Vaccines – Polio vaccine

a) Mass production and field applications of Rhizobium, Azotobacter, Azolla biofertilizers.
b) Biopesticides - Principles and applications of biopesticide w.r.t *Bacillus thuringiensis*
c) Milk Products- Cheese production
d) Single cell protein

References:

1. Casida, L. E., 1984, Industrial Microbiology, Wiley Easterbs, New Delhi
2. Peppler, H. L 1979, Microbial Technology, Vol I and II, Academic Press.
3. Stanbury, P. F. and Whittaker, A. 1984 Principles of Fermentation technology, Pergamon press
4. Prescott. S.C and Dunn, C. G., 1983 Industrial Microbiology, Reed G. AVI tech books.
5. A. H. Patel. (1985), Industrial Microbiology, Macmillan India Ltd.
6. Indian Pharmacopia and British Pharmacopia (Latest Edn).
7. Comprehensive Biotechnology volume 3 – Murray Moo- Young
8. Basic biotechnology- Colin Ratledge & Bijon Kritinsen, Cambridge university press, UK
9. Biotechnology: A textbook of microbiology by Cruger and Cruger, Sinaeur associates.
10. Industrial Microbiology by G.Reed (Ed.), CBS Publishers (AVI Publishing Co.)

Third Year B. Sc. Biotechnology
XXXIV -BET
Bioethics (3 Credits)

Unit 1
Biotechnology and Society: Introduction to science, technology and society, biotechnology and social responsibility, public acceptance issues in biotechnology, issues of access, ownership, monopoly, traditional knowledge, biodiversity, benefit sharing, environmental sustainability, public vs. private funding, biotechnology in international relations, globalisation and development divide.

Unit 2
Bioethics: Legality, morality and ethics, the principles of bioethics: autonomy, human rights, beneficence, privacy, justice, equity etc.
Ethical issues – ethical issues against the molecular technologies. Bioethics – Necessity of Bioethics, different paradigms of Bioethics – National & International. Legal issues – legal actions taken by countries for use of the molecular technologies. Social issues - public opinions against the molecular technologies. Intellectual Property Rights – Why IPR is necessary, TRIPS & IPR, IPR – national & international scenario, IPR protection of life forms.

Unit 3
Biotechnology and Bioethics: The expanding scope of ethics from biomedical practice to biotechnology, ethical conflicts in biotechnology - interference with nature, fear of unknown, unequal distribution of risks and benefits of biotechnology, bioethics vs. business ethics, ethical dimensions of IPR, technology transfer and other global biotech issues.

Unit 4
Biosafety concepts and issues: Rational vs. subjective perceptions of risks and benefits, relationship between risk, hazard, exposure and safeguards, biotechnology and biosafety concerns at the level of individuals, institutions, society, region, country and the world.
Biosafety in the laboratory institution: Laboratory associated infections and other hazards, assessment of biological hazards and levels of biosafety, prudent biosafety practices in the laboratory/ institution
Biosafety regulations in the handling of recombinant DNA processes and products in institutions and industries, biosafety assessment procedures in India and abroad

Text / Reference Books:

1. Thomas, J.A., Fuch, R.L. (2002). Biotechnology and Safety Assessment (3rd Ed). Academic Press.
2. Fleming, D.A., Hunt, D.L., (2000). Biological safety Principles and practices (3rd Ed). ASM Press, Washington.
3. Biotechnology - A comprehensive treatise (Vol. 12). Legal economic and ethical dimensions VCH.
4. Encyclopedia of Bioethic

Third year B. Sc. Biotechnology
XXXVI -MML
Metabolism of Macromolecules

Unit I: **Carbohydrate Metabolism**
Importance of glucose in metabolism, glucose transport, Definition, concept, Metabolic map with enzyme and overall Balance sheet of Net gain of ATP; Glycolysis, TCA, HMP, Gluconeogenesis.
Electron transport & Oxidative phosphorylation, components involved in Electron transport, Respiratory chain, Oxidative phosphorylation & mechanism. Energies of oxidative phosphorylation.
Unit II**: Lipid Metabolism**:
Fatty acid are activated and transported in Mitochondria. Oxidation of fatty acid (Palmitic acid) Fatty acid biosynthesis : Formation of malonyl COA from Acetyl COA, FAS – Multienzyme complex & Reaction of palmitic acid.
Unit IV: **Biosynthesis of Amino Acid**
Metabolic fates of amino groups, Deamination, Decarboxylation & Transamination reactions.
Biosynthesis of phenylalanine, Tyrosine & Tryptophan; Biosynthesis of Chorismate, Chorismate
to Tryptophan, Phenylalanine & Tyrosine with chemical reaction and enzymes.
Unit V: **Biosynthesis of nucleotides**: - Denovo & Salvage pathway (introductory).
Denovo purine nucleotide synthesis from PRPP to IMP, IMP to AMP& GMP;
Pyrimidine nucleotide biosynthesis Denovo.

References:
Biochemistry by Lubert Stryer,III edn,1988. W.H. Freeman & Co.
Principles of Biochemistry by Lehninger, II edn, 1978, Worth Publisher Inc.
Biochemistry by Zubay, III edn, 1933, W.C Brown Publisher.
Outline of Biochemistry by Cohn and Stump.
Practical Biochemistry by D. Plummer.
Practical Biochemsitry by J. Jayraman

Third Year B. Sc. Biotechnology
XXVII -EEL
Ecology and Evolution (3 credit)

Unit 1: Introduction: Definition of ecology, branches of ecology, ecological tools and techniques, significance of ecology for man.

Unit 2: Environment: Definition, types, Abiotic and biotic factors, Biotic communities, Ecosystem and its structure: abiotic & biotic living components, food chains and its types (Grazing, detritus), food pyramids, energy flow in ecosystems.

Unit 3: Evolution: Introduction, theories of organic evolution, Examples and types of natural selection, classification of evolution, evidence for evolution through cladogenesis and natural selection, evolutionary trends and systematics

Unit 4: Adaptation, Adaptive radiation, Speciation: Nature of speciation, Modes of speciation, instantaneous speciation.

References:

1. Darwin's Universe: Evolution from A to Z by Richard Milner
2. Cell biology, genetics,Molecular biology, evolution and ecology by P.S Verma and V.K Agrawal
3. Fundamentals of ecology by Eugene Odum

Third Year B. Sc. Biotechnology
Lab Cours XIII
Gene Expression and Bioinformatics (3 Credits)

Section A:

1. Isolation of Lactose negative mutants and mapping the mutation with reference to the *lacZ* or *lacY* genes only.
2. Study of catabolite repression with the example of *gal* operon
3. Study of non-catabolite repression.
4. Study of impact of catabolite repression on amino acid metabolism
5. Yeast β-galactosidase assay.
6. Two-hybrid system demonstration (demonstration thru kit –could be asked in examination).
7. Isolation of Trptophan negative mutant and theoretical mapping.
8. Isolation of Arabinose negative mutant and theoretical mapping.
9. Study of the β-galactosidase assay of the *lacY and lacZ* mutants.
10. Study of mutants isolated with mutagen with reference to differential - galactosidase activity.

Section B:

1. Retrieving Nucleotide sequences from databases
2. Retrieving protein sequences from databases
3. Demonstration on submitting nucleotide/ protein sequence to database
4. Estimating scores with and without gap penalties
5. Allignment of nucleotide sequence
6. Alignment of protein sequence
7. Searching for homologues
8. Searching for paralogues
9. Searching for orthologues
10. Retrieving homologues DNA sequence using protein as query and vice versa

Third Year B. Sc. Biotechnology
Lab Course XIV
Genetic Engineering and Fermentation design (3 Credits)

Section A:

1. Isolation of plasmid DNA from resistant clinical isolates
2. Transformation of resistance from clinical strain to laboratory strain (sensitive)
3. Blue-white selection assay
4. Study of restriction fragments of λ-DNA
5. Study of impact of methylation on restriction activity.
6. Shotgun cloning –demonstration of plasmid resistance transfer
7. Shotgun cloning –to introduce chimeric construct
8. Preparation and demonstration of cDNA
9. Shotgun cloning –cloning of cDNA
10. Cloning of DNA with gene disruption strategy

Section B

1. Study of fermenter design and parts.
2. Isolation of industrially important microorganisms from soil.
3. Isolation of microorganisms producing secondary metabolites.
4. Extraction and purification of secondary metabolites.
5. Study of Growth Curve
6. Study of bacteria and fungi in relation to their optimum growth conditions i.e pH, temp, Media components etc.

Third Year B. Sc. Biotechnology
Lab Course XV
Tissue Culture Technology and Clinical Biochemistry (3 Credits)

Section A:

1. Plant tissue culture media preparation & sterilization.
2. Induction of callus using suitable explants
3. Anther culture.
4. Suspension culture.
5. Micropropagation.
6. Embryo Rescue.
7. Plant regeneration from callus.
8. Animal cell culture Preparation of media and filter sterilization
9. Anchorage Dependent Cell Culture
10. Anchorage Independent Cell Culture
11. Cell Viability analysis –by staining method

Section B:

1. Residual chlorine in water.
2. Qualitative test for food adulteration in food.
3. Analysis of blood group.
4. Haemocytometric analysis.
5. Serum protein fractionation.
6. Blood haemoglobin determination. Erythrocyte sedimentation rate (ESR).
7. Packed cell volume (PCV).
8. Glucose tolerance test (GTT).
9. Liver function test (SGPT, SGOT, alkaline phosphatase, serum bilirubin).
10. Cardiac function test (Serum cholesterol, LDH- cholesterol, CKP, Triglycerides).
11. Kidney function test (blood urea, creatinine, serum Na^+ K^+).

Third Year B. Sc. Biotechnology

LCXVI

R-DNA Technology and Fermentation Technology (3 Credits)

Section A:

1. Isolation of genomic DNA from bacterial cell.
2. PCR amplification of isolated bacterial genomic DNA using universal primers
3. Extraction and purification of amplified DNA fragment from gel.
4. Ligation of amplified DNA fragment in cloning vector (T/A cloning)
5. Transformation E. coli and screening of recombinants by blue white selection
6. Plasmid Isolation and Characterization from recombinant bacterial colonies
7. Restriction digestion for confirmation of cloned DNA
8. Sequencing of clones
9. Preparation of Biotinylated Probes by Nick Translation
10. Southern Hybridization using Biotinylated probe

Section B:

1. Citric Acid Fermentation and CT
2. Ethanol fermentation and CT
3. Vitamin B12 fermentation and CT
4. Xanthan production,
5. Azotobacter as biofertilizer
6. BT biopesticide preparation
7. Study of cheese production
8. SCP.

Third Year B. Sc. Biotechnology
LC XVII
Metabolism, Ecology and Evolution (3 Credits)

Section A:

1. Detection of Phospholipids content in oil.
2. Isolation & Detection of Succinate dehydrogenase.
3. Separation of DNA, RNA, Protein from tissue extract.
4. Estimation of amino acid by ninhydrin Method.
5. Estimation of aromatic amino acid by Folin-Phenol reagent.

Section B:

1. Isolation of microorganisms from different habitats and study their morphological and biochemical characteristics.
2. Study of Symbiotic association between microbes and plant -mycorrhiza
3. Study of plant plant interactions –orchids
4. Stud of Symbiotic association between microbes and sea animal – bioluminescence
5. Study of Parasitism –plant –plant
6. Poisonous sea fishes –demonstration
7. Mapping plant diversity of specific location

Third Year B. Sc. Biotechnology

LC XVIII

Projec in lieu of Genomics –proteomics and Bioethics (3 Credits)

Project

1) Project should be NOT less than 10000 word
2) One copy of the project should be hand-written
3) Other 3 copy typed and submit to Collage/ Institute / Department
4) Project should be written in International standard With minimum 25 references
5) Project may pertain to above mentioned themes or relevant to any course studied in last three years.