UNIVERSITY OF RAJASTHAN
JAIPUR

SYLLABUS

M.SC. Biotechnology

Semester Scheme

II[nd] Semester Exam June 2017

M. Sc. Biotechnology Semester Scheme 2016-18 Exam June 2017

SECOND- SEMESTER

S. No.	SUBJECT CODE	Course Title	Course Category	Credit	Contact hours per week			EoSE duration (Hrs.)	
					L	T	P	Theory	P
1.	BTH 801	Molecular Biology	CCC	4	4	0	0	3	0
2.	BTH 802	Virology & Immunology	CCC	4	4	0	0	3	0
3.	BTH 803	Biological Molecules	CCC	4	4	0	0	3	0
4.	BTH 811	Gen. Biotech. Lab.	CCC	6	0	0	9	0	6
5.	BTH A01	Bioinformatics & Biostatistics	ECC	4	4	0	0	3	3
6.	BTH B02	Industrial Biotechnology & Biosafety	ECC	4	4	0	0	3	3
7.	BTH C03	Biodiversity, Ecology and Evolution	ECC	4	4	0	0	3	3
8.	BTH A11	Bioinformatics & Biostatistics Lab	ECC	2	0	0	3	0	3
9.	BTH A12	Industrial Biotechnology & Biosafety Lab	ECC	2	0	0	3	0	3
10.	BTH A13	Biodiversity, Ecology and Evolution Lab	ECC	2	0	0	3	0	3

II Semester – Molecular Biology (BTH- 801)

Genetic material: The Structures of DNA and RNA / Genetic Material, Types of DNA, Types of genetic material, DNA topology - linking number, topoisomerases; Organization of DNA in Prokaryotes, Viruses, Eukaryotes. (6)

DNA Replication: Genome and its organization; Prokaryotic and eukaryotic DNA replication. Unit of replicon, enzymes involved, mechanisms of DNA replication, origin and replication fork, fidelity of replication, accessory proteins involved in DNA replication. (6)

Antisense and Ribozyme Technology: Molecular mechanism of antisense molecules, Biochemistry of Ribozymes –Hammerhead, hairpin, RNAse P and other ribozymes, applications of antisense and ribozyme technology. (6)

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Transcription-Prokaryotic, Eukaryotic transcription, transcriptional factors and machinery, RNA polymerases, Regulatory elements and mechanisms of transcription regulation-formation of initiation complex, transcription activators and repressors, capping, elongation and termination, RNA processing, RNA editing, structure and function of snRNA & snprotein, spliceosome, type III intron, splicing of eukaryotic RNA , polyadenylation, structure and function of mRNA; RNA transport, nuclear export of m- RNA, m-RNA stability. catabolite repression, attenuation and antitermination.

(11)

Regulation at transcriptional level : Signal transduction- Environmental signals to Cell surface, intracellular communication; Protein DNA interaction, Transcriptional complex and activation of smart gene; Activation of transcription by Gene battery; Processing regulation i.e. splicing in different manner e.g. Troponin gene; Repression of transcription- Gene silencing . (5)

Translation -Prokaryotic and eukaryotic translation, the translation machinery, tRNA structure and function, Genetic code (nuclear and orgenell). Ribosome subunits its molecular structure and function; Formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, aminoacylation of t –RNA, aminoacyl tRNA synthetase, termination of translation, proof-reading; translational inhibitors; Co- and Post- translational modification of proteins. (12)

Regulation at translational level : Activation and Repression of translation through mRNA binding protein, Phosporylation of eukaryotic initiation factors of translation; Repressor protein, Cytoplasmic control of mRNA stability. (4)

Regulation of gene expression in prokaryotes and eukaryotes - Panoply of operon; Spatial (Tubulin gene in plants) & temporal (Globin gene in animals) regulation; Tissue specific gene regulation. (4)

Protein Localization: Synthesis of Secretory and membrane proteins, intracellular protein traffic-import into nucleus, mitochondria, chloroplast and peroxisomes, Receptor mediated endocytosis. (6)

Suggested Laboratory Exercises:

1. Preparation of culture medium (LB) for *E.coli (both solid and liquid)* and raise culture of *E.coli*.
2. Isolation of genomic DNA. and its quantification
3. Perform DNA amplification by PCR.
4. Isolation of RNA.
5. Demonstration of antibiotic resistance
6. Metabolic labellling of proteins and immunoprecipitation.
7. Any other practical based on theory syllabus.

Suggested Readings:

1. Voet, D. and Voet, JG. (2013). Biochemistry (4th edition), John Wiley & Sons.
2. Segel, IH. (1976). Biochemical Calculations (2nd ed.), John wiley & sons inc.
3. Voot, D. and Voet, JG. (2004). Biochemistry (4th ed.), J Wiley and Sons.
4. Berg J.M., Tymoczko J.L. and Stryer L (2002), **Biochemistry, W.H. Freeman**
5. Frefilder, D. (). Physical biochemistry, W.H. Freeman & company.
6. Work, TS. and Work, E. (1980). Laboratory Techniques in Biochemistry and Molecular Biology, online version; *www.sciencedirect.com/science/bookseries/00757535*
7. Rao, CNR. (1999). Understanding Chemistry, Universities press, Hydrabad.
8. Wilson, K. & Goulding, KH. (1986). A Biologist's Guide to principles and Techniques of practical biochemistry, ELBS Edition.
9. Cooper, TG. (1994).Tools of Biochemistry,
10. Malacinski, GM. (2005). Essentials of Molecular Biology, Jones and Barllett publications.
11. Creighton, TE. (1993). Proteins-Structure and Molecular properties, WH freeman and company.
12. Branden, C. and Tooze, J. (1991). Introduction to protein structure, Garland publishing, New York.
13. Kendrew, J. (1994). Encyclopaedia of Molecular Biology, Blackwell scientific publications,oxford.
14. Taford, C. (). Physical chemistry of Macromolecules, John Wiley and Sons.
15. Cantor, CR. and Schimmel, PR. (1080). Biophysical chemistry, WH Freeman.
16. Marie-Claire Bellissent-Funel (ed.) (1992). Protein Structure by Max Perut Perutz. In: Hydration Processes in Biology: Theoretical and Experimental Approaches.
17. Gelvin, S.B. and Schilperoort, R.A. (eds.) (1994). Plant Molecular Biology Manual. 2nd edition, Kluwer Academic Publishers, Dordrecht. The Netherlands.
18. Glick B.R. and Thompson, J.E. (1993). Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.
19. Glover, D.M. and Hames, B.D. (Eds.) (1995). DNA Cloning 1 : A Practical Approach, Core Techniques, 2nd edition. PAS, IRL Press at Oxford University Press, Oxford.
20. Shaw, C.H. (Ed.) (1988). Plant Molecular Biology: A Practical Approach, IRL Press, Oxford.

21. Rana, S.V.S., 2012. Biotechniques, theory and practices (Third edition), Rastogi publications, Meerut.
22. Glick, BR. And Pasternak, JJ. (1994). Molecular Biotechnology Principles and Applications of Recombinant DNA. Panima Publishing Corp, New Delhi.
23. Watson, JD., Gilman, M., Witkowski, J and Zollar, M. (1992). Recombinant DNA (Sec. Ed.). Scientific American Books, New York.

II semester: Pathogenesis, Virology and Immunology (BTH-802)

Disease development: Introduction and history, Host parasite relationship, Host colonization and factors predisposing to infection. Types of toxins (exotoxins, endotoxins, entrotoxins) and their structures; mode of action (biochemical, physiological); nonspecific and specific defense mechanisms. (5)

Microbial Diseases- Infectious disease & transmission; Respiratory infections caused by bacteria and viruses; Tuberculosis; Disease transmitted by animals (rabies), insects (malaria) and ticks (rickettsias). Food and water borne diseases; Emerging and resurgent infectious diseases. Plant diseases caused by microbes. (10)

Viruses: Nomenclature and classification; morphology and ultra-structure; Capsid and their arrangements; Genetics of viruses; distinctive properties of viruses. (5)

Animal and human viruses: Epidemiology, life cycle, pathogenecity and diagnosis. Prevention and treatment of RNA viruses: Enteroviruses, Orthomyxoviruses, Paramyxoviruses and Rhabdoviridae. DNA viruses: Poxviridae. Herpesviridae, Adenoviridiae, Hepadna virus. Viral vaccines, interferons, and antiviral drugs. (10)

Effect of viruses on plants: Symptomatology, histopathology, physiology and pathogenicity. Common viral diseases of plants (TMV, Cauliflower mosaic virus and Potato virus X). Transmission of plant viruses through vectors (insects, nematodes, fungi) and without vectors (contact, seed, pollen transmission). Brief account of diagnostic techniques in plants; infectivity assay of plant viruses, indicator plants, histochemical tests and vector control. (15)

Immunology: Brief history, innate responses, innate and acquired immunity, organization and structure of lymphoid organs. Nature, biology and types of antigens and super antigens.

Antibody structure and types; theories of antibody production; Antigen antibody interaction. (7)

Cells of immune system: Lymphocyte (B-cells, T-cells and natural killer cells); Antigen Presenting cells (Macrophages, B cells, dendritic cells), killer T cells, also called cytotoxic T lymphocytes (CTLs). (3)

Hybridoma technology & monoclonal antibodies and its applications, regulation of immune responses- Hypersensitivity, Autoimmunity, Immune response during bacterial (tuberculosis), parasitic (malaria), and viral (HIV) infections, congenital and acquired immune deficiencies, immune techniques. (5)

Suggested Laboratory Exercises:

1. Study of various symptoms produced in plants due to virus infection.
2. Study of viral diseases of plants/ animals/ human (Specimen/ photographs)
3. Different type of viruses (Photographs/ sketches).
4. Raising virus free plants through apical meristem culture.
5. Blood film preparation and identification of cells.
6. Immunization, Collection of Serum.
7. Double diffusion and Immuno-electrophoresis.
8. Radial Immuno diffusion.
9. Purification of IgG from serum.
10. Separation of mononuclear cells by Ficoll-Hypaque.
11. Con-A induced proliferation of thymocytes (by MTT method).
12. ELISA.
13. Immunodiagnostics (demonstration using commercial kits).
14. Any other practical based on theory syllabus.

Suggested Readings:

1. Morag C and Timbury M.C. 1994. Medical virology-X Edition. Churchill Livingstone,London.
2. Dimmock NJ, Primrose SB. 1994. Introduction to Modern Virology,IV Edition,Blackwell Scientific Publications,Oxford.

3. Conrat HF, Kimball PC and Levy JA. 1994. Virology (III Edition), Prentice Hall, Englewood cliff, New jersey. USA.
4. Matews, RE. 1992. Functionals of plant virology, Academic press, San Diego.
5. Topley and Wilson's 1995. Text Book on principles of Bacteriology, virology and Immunology, Edward Arnold, London.
6. Lennetter, 1984. Diagnostic procedures for viral and Rickettsial diseases. American public Health association, NY.
7. William Hayes, 1985. The genetics of Bacteria and their viruses. Blackwell Scientific Publishers, London.
8. Ronald M. Atlas. 1995. Principles of microbiology. Mosby Year Book Inc. Missouri 63146.
9. Kenneth M. Smith, 1996. Plant viruses. Universal Book Stall, New Delhi.
10. Walkey D.G.A.1985. Applied Virology. International Books & Periodicals supply service. New Delhi.
11. Maramarosch Karl, 1992. Plant Deseases of viral, viroid, Mycoplasma & uncertain etiology. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi, Bombay, Calcutta.
12. Powar, C.B. and Daginawala, H.F. 2003. General Microbiology Vol. II. Himalaya Publishing House.Mumbai.
13. Biswas, A. Biswas, SK. 2006. An Introduction to Viruses. Vikas Publishing House Pvt. Ltd., New Delhi.
14. Agrios, G.N. 1997. Plant Pathology, Academic Press. NY. USA.
15. Kuby Immunology, (4th Edition) R.A. Goldsby, Thomas J. Kindr Barbara, A. Osbarne, (Freeman) & Co. New York.
16. Bloom, BR. Lambert, PH. 2000. Immunology: A short course (4th Edition), John Wiley & Sons
17. Roitt, .M.1998. Essentials of Immunology, ELBS, Blackwell Scientific publishers, London.
18. Gerhardt. P. Murray, R. Ce., Wood W.A., and Kreig N.R.(eds.) 1994. Methods for General and Molecular Bacteriology . American Society for Microbiology, Wasington D.C.
19. Pelczar MJ. Chan ECS. Krieg NR. Microbiology (5th Edition) Tata McGraw Hill, Delhi.
20. Kumar, S. 2012. Textbook of Microbiology, Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi.

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II Semester –Biological macromolecules & Enzymology (BTH- 803)

Amino acids and peptides:

Classification, chemical reactions and physical properties. Biosynthesis of amino acid (Reductive amination, Transamination, GS-GOGAT system). Protein structure (primary, secondary, tertiary & quartenary), Protein folding, Glyco and lipoproteins -structure and function, Globular, Fibrous proteins; Hydrophobic and hydrophilic interactions, Ramachandran plot, Circular Dichroism,. SDS- PAGE, Diagonal Electrophoresis, DNA - protein interactions (Yeast mono hybrid system); Protein sequencing. Biological importance of proteins. (15)

Nucleotides: Biosynthesis of purines & pyrimidene. By denovo and salvage pathways. (5)

Carbohydrate: Classification and reactions , structure and function of mono, disaccharides, and polysaccharides. Methods for compositional analysis. (5)

Lipids: Classification, structure, biosynthesis and functions of glycerol phospholipids, sphingolipids and cholesterol. (5)

Secondary metabolites: General introduction and significance, Difference from primary metabolites. Alkaloids, Flavonoids & Steroids. (5)

Principles of thermodynamics : First and second law, concept of free energy high energy compounds. (4)

Enzymes: classification, nomenclature, Structure: concept of holoenzymes, coenzyme, apoenzyme, isoenzymes and prosthetic groups; Allosteric enzymes. **Properties:** physiochemical and biological properties, role of enzymes as catalysts; substrate specificity, Mechanism of enzyme action (active site, chemical modification) and regulation (Zymogens, Isozymes). (7)

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Kinetics of enzyme action and regulation: Michalis Menten Equation, Km value. enzyme inhibitors, Kinetics of bi-bi substrate reaction, regulation of enzyme activity, feed back inhibition. Enzyme catalysis in solution, effect of organic solvents on enzyme catalysis, Immobilization of enzymes and its application. Determination of active sites. Functional proteins- structure and drug target (enzyme and receptors). Effects of substrate, temperature, pH and inhibitors on enzyme activity and stability, Enzyme engineering. Importance and applications of enzymes. Industrial aspects of enzymology,

(14)

Suggested Laboratory Exercises:

Separation and Characterization of macromolecules: molecular shape and size; molecular weight; by liquid chromatography, electrophoresis and spectroscopy

1. Reactions of amino acids, sugars and lipids.
2. Isolation, purity determination and quantitation of cholesterol,
3. Electrophoresis of Proteins
4. Quantification of Proteins and Sugars.
5. Analysis of oils-iodine number,saponification value, acid number.
6. UV. Visible and IR Spectroscopy- absorption spectra.
7. Separation techniques- Centrifugation, Chromatography (Ion exchange.TLC etc.)
8. Electrophoresis.
9. Separation techniques : Demonstration of HPLC.
10. Enzyme: Purification and Kinetic analysis.
11. Electrophoresis of DNA-linear, circular
12. Hybridoma technology
13. Any other practical based on theory syllabus

Suggested Readings:

1. Biochemistry, D.Voet and J.G.Voet,John Wiley & Sons.
2. Biochemical Calculations,Irwin H.segel,John wiley and sons inc.
3. General Chemistry,Linus Pauling,W.H.Freeman & Company.
4. Organic Chemistry,DJ Cram and GS Hammond,McGraw Hill.
5. Biochemistry, D Voot and JG Vet,J Wiley and Sons.

6. Physical biochemistry,D Frefilder,W.H. Freeman & company.
7. Laboratory Techniques in Biochemistry and Molecular Biology,Work and work.
8. Understanding Chemistry,CNR Rao,Universities press,Hydrabad 1999.
9. A Biologist's Guide to principles and Techniques of practical biochemistry,K.Wilson & KH goulding,ELBS Edition 1986.
10. Tools of Biochemistry by T.G. cooper.
11. Essentials of Molecular Biology, David friefilser.jones and Barllett publications.
12. Proteins-Structure and Molecular properties.TE creighton,WH freeman and company.
13. Genes VII,B.Lewin.Oxford university press.
14. Introduction to protein structure.c.Branden and J.Tooze,Garland publishing,New York.
15. Encyclopaedia of Molecular Biology, J.Kendrew,Blackwell scientific publications,oxford.
16. Physical chemistry of Macromolecules,taford,C.,John Wiley and Sons.
17. Introduction to Biophysical Chemistry.RB Martin,McGraw Hill,New York.
18. Biophysical chemistry,Cantor,WH Freeman.
19. Protein Structure, by Max Perut Perutz.

BTH A01 (Bioinformatics & Biostaties)

Introduction to computer: Characteristics of Computers, Uses of computers, Types and generations of Computers. Basic Computer Organization: Basic components, CPU, ALU, memory hierarchy, registers, input- output devices (hardware and software) and their functions; User Interface with the Operating System, System Tools.

(10)

Data Representation: Basic concepts about data and information, Representation of data in computers in binary of integers and real numbers, 1's Complement, 2's Complement, Addition and subtraction of binary numbers , bits and bytes, Computer's words coding (ASCII, Unicode and EBCDIC), Numeric data. Conceptual understanding of assemblers, compilers, operating system; Introduction to programming languages, C. Perl.

(10)

Handling of Data and Statistical Analysis: Brief description, classification and tabulation of data and its graphical representation. Measures of central tendency and dispersion: mean,

median, mode, range, standard deviation, variance, idea of two types of errors and level of significance, test of significance (F test, T test, Z test and chi- square Test);. Probability distributions (Binomial, Poisson and normal); sampling distribution; simple linear regression and correlation. Application of computers in Biostatical problems.

(10)

Multimedia: Introduction, Characteristics, Elements, Applications (2)

Information retrieval: LAN, WAN, introduction to internet, WWW. NICNET, ERNET, VSNL, ISDN, E-mail, Publication on worldwide web, on line publishing ventures e.g., Biomed, online international database access. Motif analysis and power point presentation, Microsoft doc & Excel.

(6)

General Awareness & Applications: IT Act, System Security (virus/firewall etc.) I-Tax,Reservations, Banking. Proteomics, genomics, metabolomics. (7)

Biological database: primary sequence database (Protein and DNA database), secondary database, composite databases. Sequences alignment and Database searching: Evolutionary basis of sequence alignment, optimal alignment methods, substitution scores and Gap penalties. Statistical significance of alignment, Database similarity searching; FASTA, BLAST. Paintise database searching: EMBOSS, multiple sequence alignment; CLUSTAL W, BTIS, and Network in India. **Protein and nucleic acid data bases**: Structural comparison at secondary and tertiary levels. Computer aided drug designing. Computational techniques in structural analysis. Nanoparticles

(15)

Suggested Laboratory Exercises:

1. Dot-matrix comparison – understanding sliding window – window size (word size) and stringency
2. Familiarizing with the Operating System, Control Panel, Networking Configuration, Firewall setting
3. Document Preparation.
4. Pair wise alignment
5. Multiple sequence alignment.

6. Making Patterns (prosite syntax) and consensus sequence from multiple sequence alignments.
7. Spreadsheet Handing, Working with worksheets, Creating a spreadsheet, entering and formatting information, basic functions and formulas, creating charts, tables and graphs.
8. Analysis of data and calculation of standard deviation and variance.
9. Test of significance (F test, T test, Z test and chi- square Test).
10. Searching protein sequence databases with FASTA and BLAST.
11. Compositional analysis of DNA – GC/AT content - codon usage - codon bias.
12. Understanding ORF and gene prediction.
13. Protein structure visualization.
14. Secondary structure prediction online.
15. Understanding the bioinformatics behind human, rice, yeast and *E.coli* genome projects.
16. Any other practical based on theory syllabus

Suggested Readings:

1. Rajaraman, V. (2010). **Fundamentals of Computers,** Fourth Edition, PHI.
2. Goel, Anita, (2010). **Computer Fundamentals** Dorling Kindersley (India)
3. Goel, Anita, **Computer Fundamentals – Free PDF Downloads**
   i. *booksily.net/pdf/anita-goel-computer-fundamentals*
   ii. *bookily.net/pdf/computer-fundamentals-anita-goel-2013-unit-1*
   iii. *pu.ibirat.com/.../Computer%20Fundamental%20By%20Goel%20An*
   iv. *www.e-bookspdf.org › Download*
4. David W. Mount, (2004). Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press
5. Durbin, RM., Eddy, SR., Krogh, A., Mitchison, G. (2013). Biological Sequence Analysis; Probabilistic Models of Proteins and Nucleic Acids. Cambridge University Press.
6. Baxevanis, A D. and Ouellette, BF Francis. (2005). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins (Third Ed). John Wiley and Sons, USA.

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BTH B02: Industrial Biotechnology and Bio safety

Selection of industrial microorganisms: industrial cultures- bacteria, algae, fungi and actinomycetes. Primary and secondary screening, Isolation and preservation of microorganisms for industrial products. Strain development- mutation, selection and recombination. Immobilisation of microbial cells and their application. (8)

Microorganism as bio-resource for human needs: Mushroom cultivation technology. Biofertilizers and their application, biopesticide in disease management; Rhizobacteria for plant growth promotion and disease managment including parasitic nematodes; Bacteria and soil fungi in plant disease management; Reclamation of mining wastelands, Application of fungi for biodegradation of cellulosic waste and ethanol production. Bioplastics and biopolymers. Biosensors- application in industry. (10)

Fermentation process: design- overview of aerobic and anaerobic fermentation process. Fermentor systems- types. Fermentation process and factors affecting fermentation process. Design of fermentation media, Substrates used as carbon and nitrogen sources.

(8)

Microbial fermented products: Organic acids (lactic acid, acetic acid & gluconic acid), Amino acid (Aspartic acids), Alcohol and beverages (acetone- butanol, beer, wine). Enzymes (proteases, amylases, lipases, cellulases & pectinases).

(8)

Health care products and food additives: Antibiotics- penicillin, streptomycin and erythromycin. Vaccines- BCG, hepatitis- B & recombinant vaccines; Vitamins- B_{12}, D & C; dairy products- cheese, yoghurt and other products., health care and environment.

(10)

Metabolic Engineering and industrial Products: Plant secondary metabolites, control mechanisms and manipulation of phenylpropanoid pathway, alkaloids, Industrial enzymes, biodegradable plastics, polyhydroxybutyrate, therapeutic proteins.

(10)

Biosafety: Security measures, laboratory information management system (LIMS).
Laboratory safety- safety policies. health hazardous compounds, chemicals (xenobiotic compounds), solvents, poisons, isotopes, radioactive materials, explosives and biological strains (bacterial, fungal etc.) and their waste management. Biosafety Cabinets, Storage of hazardous material and disposal of biological and radioisotope wastes.

(6)

Suggested Laboratory Exercises:

1. Isolation of industrially important microorganisms for microbial processes.
2. Comparative studies of Ethanol production using different substrates.
3. Microbial production of citric acid using *Aspergillus niger*.
4. Microbial production of antibiotics (Penicillin).
5. Cultivation techniques of mushrooms.
6. Selection of efficient PGPR and mycorrhizae and their affect on growth
7. Preparation of list of the hazardous chemicals and their biosafety measures.
8. Any other practical based on theory syllabus

Suggested Readings:

1. Aiba, S., Humphrey AE. and Millis, N.F. 1973. Biochemical Engineering, Univ.of Tokyo Press, Tokyo.
2. Atkinson, B. (1974). Biochemical Reactors, Pion Ltd. London.
3. Baily,J.E. and Oils,D.F., (1986). Biochemical Engineering fundamentals, McGrow Hill Book Co.,New York.
4. Enfors S.O. & Haggstrom L. 2000. Bioprocess Technology:Fundamentals and Applications, KTH,Stockholm.
5. Jackson, AT., (1991) Process Engineering in Biotechnology, Prentice Hall, Engelwood cliffs.
6. Shuler, ML. and Kargi, F., (1992). Bioprocess Engineering: Basic Concepts, Prentice Hall,Engelwood Cliffs.
7. Stanbury, PF. and Whitaker, A., (1995). Principles of Fermentation Technology, Pergamon Press, Oxford. London.
8. Nielson, J. and Vissadsen, J., Bioreaction Engineering Principles, Plenum Press.
9. Shuler, ML.(Ed.), (1989). Chemical Engineering Problems in Biotechnology, AICHE.

10. Lee, JM. (2009). Biochemical Engineering, Prentice Hall Inc.
11. Vieth, WF., (1999). Bioprocess Engeering-Kinetics, Mass Transport, Reactors and Gene Expression, John V.& Sons Inc.
12. Rai, B. and Dkhar, MS. (1998). New trends in Microbial Ecology, Deptt. Of Botany, NE Hill Univ. Shillong & ISCON, Varanasi.
13. Rai, B., Upadhyay, RS. and Dubey, NK. (1998). Trends in Microbial Exploitation, ISCON, Varanasi.
14. Glick, BR. And Pasternak, JJ. (1994). Molecular Biotechnology Principles and Applications of Recombinant DNA. Panima Publishing Corp, New Delhi.
15. Watson, JD., Gilman, M., Witkowski, J and Zollar, M. (1992). Recombinant DNA (Sec. Ed.). Scientific American Books, New York.
16. Kumar, HD. (1998). Modern Concept of Biotechnology, Vikas Publlishing House, New Delhi.

BTH C03 (BIODIVERSITY, ECOLOGY AND EVOLUTION)

(Credits-2)

Introduction to Biodiversity, Different types of Biodiversity and Concepts. Values and uses of Biodiversity (food, genes, biocontrol agents, natural products and medicines). Measures of biodiversity (alpha, beta- and gamma). **15 hrs**

Vegetation types of India. Hotspot biodiversity areas in India, Red Listed plants and RED Data Book, Threatened plants and animals of India. Role of biotechnology in reintroducing commercially and economically important plants to wild. **15 hrs**

Conservation biodiversity, Sustainale uses of plant genetic resources and biotechnology assisted plant conservation - In situ and ex situ methods. Molecular markers and their application in plant conservation. **15 hrs**

Concept and dynamics of ecosystem, Components of Ecosystem- Biotic and Abiotic, Food chain, Food web, and energy flow. Trophic levels and ecological pyramids. Biogeochemical cycles. UNIT-5 Theories of Evolution (Lamarckism, Neo –Lamarckism, Darwinism, Neo-Darwinism and De Vries theory of mutation), Molecular evolution. Theory of natural selection. Gene pool and gene frequencies. Mechanism of Isolation. Genetic basis of evolution. **15 hrs**

PRACTICALS:-

1. VEGETATION MAPS OF INDIA
2. IDENTIFICATION OF LOCALLY AVAILABLE MEDICINAL PLANTS AND THEIR USE.

3. EVALUATING DIVERSITY IN FRUITS AND VEGETABLES AND THEIR MORPHOLOGICAL DIFFERENCES
4. STUDY AND SIMPLE TESTS FOR GUMS, RESINS, DYES , FIBRES FROM PLANTS

REFERENCES:-

1. An advanced Text Book of Biodiversity (2004) K.V.Krishnamoorthy, Oxford &IBH, New Delhi.
2. Biodiversity and Conservation (2004). Joshi PC and Namitha Joshi, APH Publishing Company, New Delhi.
3. Biodiversity and Conservation (2001) Melchias Oxford and IBH Publishing Company Pvt Ltd., New Delhi
4. Fundamentals of Ecology (1971) E.P Odom B Saunders &co, Philadelphia, USA.
5. Evolution (1975) Savage, Amerind Publishing Company Ltd, New Delhi.
6. The Theory of Evolution (1993) John Marynard Smith, Canto.
7. Evolution (2004) Mark Ridley, Wiley-Blackwell.

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