**DEPARTMENT OF BIOTECHNOLOGY**

**AMENDMENTS MADE TO THE CURRICULUM AND SYLLABUS (2013) OF PROGRAM B.TECH BIOTECHNOLOGY BASED ON THE APPROVAL ACCORDED TO RESOLUTIONS IN THE 25TH ACADEMIC COUNCIL MEETING HELD ON 21.03.2014. THESE AMENDMENTS ARE EFFECTIVE FROM ACADEMIC YEAR 2014-15 ONWARDS.**

**The amendments include following:**

**1.** Addition of course **BT1072 CELL AND MOLECULAR NEUROSCIENCE** under departmental elective

**2.** Revision of Syllabus for **BT1016 ENZYME ENGINEERING AND TECHNOLOGY**

**3.** Revision of Syllabus for **BT1059 BIOREMEDIATION TECHNOLOGY**

**4**. Revision of syllabus for **BT1060 METAGENOMICS**

**5.** Revision of syllabus for **BT1029 PROTEIN ENGINEERING AND PROTEOMICS**

**Add the following course under Departmental electives**

| Course code | Category | Title of the course | L | T | P | C |
|---|---|---|---|---|---|---|
| BT1072 | P | CELL AND MOLECULAR NEUROSCIENCE | 3 | 0 | 0 | 3 |

**1. Syllabus of BT1072 CELL AND MOLECULAR NEUROSCIENCE**

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT1072** | **CELL AND MOLECULAR NEUROSCIENCE** | **3** | **0** | **0** | **3** |
| | **Total No. of Contact Hours - 45** | | | | |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

| **PURPOSE** | |
|---|---|
| To provide basic understanding of the nervous system and its cellular and molecular aspects of functioning in healthy and diseased condtions. | |
| **INSTRUCTIONAL OBJECTIVES** | |
| 1. | To study the anatomy and physiology of nervous system. |
| 2. | Discuss the importance of cellular and molecular basis of its functions in health and diseases, technology, etc. |

**UNIT I- OVERVIEW OF THE NERVOUS SYSTEM (8 hours)**

Cellular components of the Nervous system: Neuron, Glia-Neural circuits, Organization of the nervous system: Structural and functional aspects of the neural systems-Behavior

**UNIT II- NEURAL SIGANLING AND NEUROCHEMICALS (8 hours)**

Electrical signals: Voltage-dependent membrane permeability-Ion channels and transporters-Synaptic transmission-Neurotransmitters and their receptors-Molecular signaling in neurons-Synaptic plasticity

**UNIT III- SENSORY AND MOTOR SYSTEMS (12 hours)**

Somatic sensory system-Pain-Visual and Vestibular pathways-Motor neuron circuits-Motor neuron control by the CNS-Construction and modification of neural circuits-Repair and Regeneration in nervous system

**UNIT IV- BRAIN FUNCTIONS (9 hours)**

Cognition-Speech and Language-Sleep and Wakefulness-Emotions-Memory-Sex and Sexuality-Neuroanatomical basis for brain functions-Interactions between neuroendocrine system and immune system-its role in health and disease

**UNIT V- NEURODEGENERATIVE DISEASES (8 hours)**

Diseases and injuries of the nervous system—Neuromuscular disorders-Basal ganglia disorders: Parkinson's disease—Spinal cord injury—Traumatic brain injury—Stroke—Dementia

**TEXT BOOK**

1. Dale Purves, George J. Augustine, David Fitzpatrick, William C. Hall, Anthony-Samuel LaMantia, Leonard E. White, "*Neuroscience*," Sinauer Associates, Inc., 5th Edition, 2012.

**REFERENCE**

1. Eric R. Kandel, James H. Schwartz, Thomas M. Jessell, "*Principles of Neural Science*," McGraw-Hill, 5th Edition, 2012.

| **BT1072 CELL AND MOLECULAR NEUROSCIENCE** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course designed by** | | **Department of Biotechnology** | | | | | | | | | | |
| 1 | Student Outcomes | a | b | c | d | e | f | g | h | i | j | k |
| | | | X | | | | | | | | | X |
| 2 | Mapping of instructional objectives with student outcomes | 1 | | 2 | | 3 | | | | | | |
| 3 | Category | General (G) | | Basic Sciences(B ) | | Engg.Sci.& Tech. Arts (E) | | | | Professional Subjects (P) | | |
| | | | | | | | | | | X | | |
| 4 | Broad Area ( for courses under 'P' only) | Biotechnology | | | Bioprocess Engineering | | | Chemical Engineering | | | | |
| | | X | | | -- | | | -- | | | | |
| 5 | Approval | 24th meeting of Academic Council, April 2014 | | | | | | | | | | |

**2. Revised Syllabus for BT1016 ENZYME ENGINEERING AND TECHNOLOGY**

| | | | | | |
|---|---|---|---|---|---|
| **BT1016** | **ENZYME ENGINEERING AND TECHNOLOGY** | **L** | **T** | **P** | **C** |
| | **Total No. of Contact Hours - 45** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

| **PURPOSE** | |
|---|---|
| The PURPOSE of this course is to provide an opportunity to understand the theoretical concepts of enzyme technology principles and applications. | |
| **INSTRUCTIONAL OBJECTIVES** | |
| 1. | To understand the basics and mechanisms of enzyme catalysis |
| 2. | To impart knowledge on reaction kinetics of free and immobilized enzymes |
| 3. | To study about the sources, production and industrial applications of enzymes |

**UNIT I - INTRODUCTION TO ENZYMES (8 Hours)**

Classification of enzymes- Characteristics of enzymes - **Structural Components of Enzymes**: Role of Coenzymes and Cofactors- specificity of enzyme action, **Factors affecting enzyme activity**: pH- temperature, **Enzyme substrate complex formation models**: lock and key- induced fit- Various m**echanisms of enzyme catalysis**: acid base- covalent bonding- proximity

**UNIT II – ENZYME KINETICS I (10 Hours)**

**Kinetics of single substrate reactions**: Michaelis–Menten Kinetics – Evaluation of Michaelis – Menten parameters- Line Weaver Burk plot- Eadie Hofstee plot - Hanes woolf plot - Eisenthal and Cornish Bowdon plot - turnover number, **Kinetics of multi-substrate reactions**: Ternary-complex mechanisms- Ping–pong mechanisms.

**UNIT-III ENZYME KINETICS II (10 Hours)**

**Kinetics of Enzyme Inhibition**: Reversible and irreversible enzyme inhibition - competitive, uncompetitive and non competitive enzyme inhibition – substrate and feedback inhibition, **Allosteric enzymes**: MCW model and KNF model, **Methods of immobilization of enzymes**, **Kinetics of immobilized enzymes**: Effects of external mass transfer and intra - particle diffusion, Enzyme Deactivation kinetics.

**UNIT –IV PRODUCTION, PURIFICATION AND CHARACTERIZAION OF ENZYMES (9 Hours)**

Enzyme sources: Extraction from plant, animal and microbial sources - Production and purification of intracellular and extracellular industrial enzymes – Comprehensive flow sheet for enzyme purification: Techniques for enzyme purification- Analysis of yield, purity and activity of enzymes -Determination of molecular weight of enzymes

**UNIT –V INDUSTRIAL APPLICATIONS OF ENZYMES (9 Hours)**

**Enzyme reactors- Application of enzymes in food industries**: brewing, baking- **Food processing:** High fructose corn syrup production- Detergent industry- Textile industry – leather - pulp and paper industry - **Medical and diagnostic applications of enzymes**: Biosensors.

**REFERENCES**

1. Trevor Palmer and Philip L Bonner .“*Enzymes : Biochemistry, Biotechnology, Clinical Chemistry*”, East- West Press, 2004.
2. Shuler, M.L. and F. Kargi, “*Bioprocess Engineering : Basic Concepts*” 2nd Edn, Pearson, 2002.
3. Blanch, H.W and D.S. Clark. “*Biochemical Engineering*”. Marcel & Dekker, Inc., 1997.
4. Bailey, J.E and D.F. Ollis, “*Biochemical Engineering Fundamentals*”, 2nd Edition, McGraw-Hill, 1986.
5. Nicholas C. Price and Lewis Stevens, “*Fundamentals of Enzymology*”, Oxford University Press, 1982.
6. Alan Wiseman, “*Handbook of Enzyme Biotechnology*”, 3rd Ed, Ellis Harwood Publications, 1999.

| **BT1016 ENZYME ENGINEERING AND TECHNOLOGY** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course designed by** | | **Department of Biotechnology** | | | | | | | | | | |
| 1 | Student **Outcomes** | A | b | c | d | e | f | g | h | i | j | k |
| | | | X | X | | | | | X | | | |
| 2 | Mapping of instructional objectives with student **outcomes** | | 2 | 3 | | | | | 1 | | | |
| 3 | Category | General (G) | | Basic Sciences (B) | | | Engg. Sci. & Tech. Arts (E) | | | Professional Subjects (P) | | |
| | | | | | | | | | | X | | |
| 4 | Broad Area (for courses under ‘P’ only) | Biotechnology | | | Bioprocess Engineering | | | Chemical Engineering | | | | |
| | | -- | | | X | | | -- | | | | |
| 5 | Approval | 23rd meeting of Academic Council, May 2013 | | | | | | | | | | |

**3. Revised Syllabus for BT1059 BIOREMEDIATION TECHNOLOGY**

| | | | | | |
|---|---|---|---|---|---|
| **BT1059** | **BIOREMEDIATION TECHNOLOGY** | **L** | **T** | **P** | **C** |
| | **Total No. of Contact Hours - 45** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

The PURPOSE of this course is to introduce the use of living organisms such as plants and microbes or their systems to the treat contaminants. In addition, the course is expected to develop an efficient, eco-friendly and economical novel alternative treatment technologies.

**INSTRUCTIONAL OBJECTIVES**

| | |
|---|---|
| 1. | To impart sufficient scientific understanding of the current environmental tribulations and global concern. |
| 2. | To focus the process of bioremediation, mechanisms, types, success stories& monitoring strategies. |
| 3. | To focus the advance molecular techniques to facilitate bioremediation technology. |
| 4. | To focus on advanced nuclear remediation program. |
| 5. | To apply the concepts of bioremediation technology to the real time problems. |

**UNIT I BIOREMEDIATION (9 Hours)**

**Introduction to Bioremediation**: Types of Bioremediation, Factors affection Bioremediation .Bioremediation Mechanisms.Limitations of Bioremediations. **Microbes for Bioremediation** :Essential Chararcteristics of Microbes for Bioremediation, Microbial Adapadation for Adverse conditions. Microbes involved in Bioremediation. Metabolic process involved in bioremediation. **Bioremediation Techniques** : Insitu & Exsitu bioremediation techniques. Phytoremediation

**UNIT II SPECIFIC BIOREMEDIATION TECHNOLOGIES (9 Hours)**

Application, specific advantages and disadvantages of specific bioremediation technologies - land farming, prepared beds, biopiles, composting, bioventing, biosparging, pump and treat method, constructed wet lands, use of bioreactors for bioremediation.

**UNIT III BIOREMEDIATION OF CHLORINATED COMPOUNDS AND MOLECULAR TECHNIQUES IN BIOREMEDIATION (9 Hours)**

Bioremediation of phenols, chlorinated phenols, chlorinated aliphatic compounds, heterocyclic compounds, cyanides, dyes; Rhizoremediation: a beneficial plant-microbe interaction; Molecular techniques in bioremediation- Enhanced biodegradation through pathway engineering; Biodegradation of polyhalogenated compounds by genetically engineered bacteria.

**UNIT IV NUCLEAR WASTE BIOREMEDIATION (9 Hours)**

Spent fuel characterisation, storage and disposal; Partitioning, transmutation and conditioning; Measurement of Radioactivity in the environment; Basic **actinide research.**

**UNIT V. HEAVY METAL AND OIL SPILL BIOREMEDIATION (9 Hours)**

**Heavy metal pollution & sources;** Microbial interactions with heavy metals - resistance &tolerance ;**Microbial transformation**; Accumulation and concentration of metals. Biosorption of heavy metals by microbial biomass and secondary metabolites – **Biosurfactants.** Advantages of biosurfactants over chemical surfactants.; Biotechnology and oil spills; Improved oil recovery.

**REFERENCES**


1. Bruce E. Rittmann, Perry L. McCarty, "*Environmental Biotechnology: Principles and Applications"* McGraw-Hill, 2001.
2. Phillip L. Buckingham , Jeffrey C. Evans," *Hazardous Waste Management"* Waveland Pr Inc; Reissue edition 1, 2010.
3. S. K. Agarwal, "*Environmental Biotechnology*", APH Publishing, 2000
4. Martin Alexander, "*Biodegradation & Bioremediation"*, Academic press, 1999.
5. Karrely D., Chakrabarty K., Omen G.S, "*Biotechnology and Biodegradation*", Portfolio Pub. Co., 1990.
6. P. Rajendran, P. Guansekaran, "*Microbial Bioremediation*", Mjp Publishers, 2011.


| **BT1059 BIOREMEDIATION TECHNOLOGY** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course designed by** | | **Department of Biotechnology** | | | | | | | | | | |
| 1 | Student **Outcomes** | a | b | c | d | e | f | g | h | i | j | k |
| | | | X | | | | | | | | | X |
| 2 | Mapping of instructional objectives with student **outcomes** | 1 | | 4 | | 2 | | | | | | |
| 3 | Category | General (G) | | Basic Sciences (B) | | Engg. Sci. & Tech. Arts (E) | | Professional Subjects (P) | | | | |
| | | | | X | | | | | | | | |
| 4 | Broad Area ( for courses under 'P' only) | Biotechnology | | Bioprocess Engineering | | Chemical Engineering | | | | | | |
| | | P | | -- | | -- | | | | | | |
| 5 | Approval | 23rd meeting of Academic Council, May 2013 | | | | | | | | | | |

4.. Revised Syllabus of **BT1060 METAGENOMICS**

| BT1060 | METAGENOMICS | L | T | P | C |
|---|---|---|---|---|---|
| | **Total No. of Contact Hours – 45** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

The purpose of this course is to provide focus on next generation DNA sequencing technology to describe the ecological roles of microbial communities in different environments. It also provides how the metabolic functions, taxonomic distribution, diversity, evenness and species richness of microbial communities varies across environment.

**INSTRUCTIONAL OBJECTIVES**

| | |
|---|---|
| 1. | To use metagenomic data to describe the taxonomic make-up, functional potential and ecological processes of microbial communities from a range of environments |
| 2. | To apply next generation sequencing technology. |
| 3. | To assemble and annotate genomes by identifying genes |

**UNIT -1 ENVIRONMENTAL GENOMICS (9 Hours)**

**Environmental Metagenomics** – Introduction; Pure culture and in consortium ; Cultivable and Non-cultivable microbial analysis; Recombination DNA technology and DNA cloning; Types of vectors, applications of recombination DNA technology; Molecular fingerprinting techniques (RFLP, T-RFLP, ARISA, DGGE, rDNA library, and FISH); Stable isotope probing (SIP); Suppressive subtractive hybridization (SSH); Differential expression analysis (DEA); Microarrays & Metagenome sequencing; Next-generation sequencing approaches to metagenomics

**UNIT II - STABLE ISOTOPE PROBING AND OLIGONUCLEOTIDE MICROARRAYS (9 Hours)**

Direct linking of microbial populations to specific biodegradation and biotransformation processes by stable isotope probing of biomarkers- PhyloChip & GeoChip-Detection of xenobiotic-degrading bacteria by using oligonucleotide microarrays

**UNIT III LIBRARY CONSTRUCTION & ANALYSIS OF METAGENOMIC LIBRARIES (9 Hours)**

**Cataloging microbes:** phylogenetic tree and construction - Construction of a metagenomic library; Analysis of Metagenomic Libraries; Sequence-based Metagenomics Analysis; Function-based Metagenomics Analysis; **Phylogenetic analysis** and Comparative genomics Softwares & Tools

**Unit IV – METAGENOMICS CASE STUDIES (9 Hours)**

**Metagenomic analysis of soil microbial communities**; Metagenomic analysis of marine microbial communities; **Metagenome of the Microbial Community in Acid Mine Drainage** ; **Metagenomic Analysis of Bacteriophage**; Metagenomics and Its Applications to the Study of

the Human Microbiome; Archaeal Metagenomics: Bioprospecting Novel Genes and Exploring New Concepts.

**UNIT V- METAGENOMICS IN ENVIRONMENTAL STUDIES (9 Hours)**

**Application of Metagenomics to Bioremediat**ion ; Applications of Metagenomics for Industrial Bioproducts; Escherichia coli host engineering for efficient metagenomic enzyme discovery; Next-generation sequencing approaches to metagenomics; Stable isotope probing: uses in metagenomics; DNA sequencing of uncultured microbes from single cells

**REFERENCES**


1. Diana Marco Universidad Nacional de Cordoba, Argentina, "*Metagenomics: Theory, Methods and Applications"*, Caister Academic Press,2010.
2. Diana Marco Universidad Nacional de Cordoba,Argentina "*Metagenomics: Current Innovations and Future Trends"*,Caister Academic Press,2011.
3. Joanna R. Freeland, Heather Kirk, Stephen Petersen, "*Molecular Ecology*", Mc Graw Hill, 2nd Edition "2012.
4. Beebee T.J.C., D G. Rowe," *An Introduction to Molecular Ecology*", Mc Graw Hill, 2004.


| **BT1060 METAGENOMICS** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course designed by** | | **Department of Biotechnology** | | | | | | | | | | |
| 1 | Student Outcomes | a | b | c | d | e | f | G | h | i | j | k |
| | | | X | | | | | | | | | X |
| 2 | Mapping of instructional objectives with student outcomes | 1 | | 4 | | 2 | | | | | | |
| 3 | Category | General (G) | | Basic Sciences(B) | | Engg. Sci. & Tech. Arts (E) | | | Professional Subjects (P) | | | |
| | | | | | | | | | X | | | |
| 4 | Broad Area ( for courses under 'P' only) | Biotechnology | | Bioprocess Engineering | | | | Chemical Engineering | | | | |
| | | x | | -- | | | | -- | | | | |
| 5 | Approval | 23rd meeting of Academic Council, May 2013 | | | | | | | | | | |

**5. Revised Syllabus of BT1029 PROTEIN ENGINEERING AND PROTEOMICS**

| | | | | | |
|---|---|---|---|---|---|
| **BT1029** | **PROTEIN ENGINEERING AND PROTEOMICS** | **L** | **T** | **P** | **C** |
| | **Total No. of Contact Hours – 45** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

The course aims at imparting knowledge on proteins through a detailed study of protein structure, its characteristics property and significance in biological systems with strategies for modifying the structures for desirable properties in industry. It briefs about the different analytical techniques for elucidation of protein structure.

**INSTRUCTIONAL OBJECTIVES**

| | |
|---|---|
| 1. | To appreciate the structure function correlation and the prediction of properties of protein based on its sequence. |
| 2. | To observe the similarities in structure at basal level in a group of having similar function, thereby predicting the strategies to modify and design novel proteins. |
| 3. | To emphasize the role of analytical methods to determine protein structure and protein – protein interactions |

**UNIT I – STRUCTURE FUNCTION DYNAMICS CORRELATION (9 Hours)**

Basic structural concepts – Primary, secondary, tertiary and quaternary structures. Ramachandran plot, super secondary structures – motif and domain. Protein folding and mechanisms.

**UNIT II – STRUCTURE FUNCTION ENGINEERING (10 Hours)**

The correlation of structure and function in – transcription factors, serine proteinases, membrane proteins, signal transduction proteins and recognition in immune system.

**UNIT III – PREDICTION AND DESIGN OF PROTEINS (10 Hours)**

Examples of designed proteins (enzymes) with enhanced stability and efficiency, playing a significant role in industries. A case study for – introduction of disulfide bonds (T4 lysozyme), reduction of free sulfhydryl groups, removal of metal requirements in certain proteins, streptokinase, introduction of complementary determining region in antibodies and to increase enzyme activity.

**UNIT IV – PROTEIN STRUCTURE CHARACTERIZATION (8 Hours)**

Proteomes, - Protein digestion and separation techniques. Role of Mass spectrometry in protein identification - MALDI TOF - Tandem MS and SALSA - peptide mass fingerprinting.

**UNIT V – PROTEOMICS APPLICATION (8 Hours)**

Mining proteomes, protein expression profiling, identifying protein – protein Interactions and protein complexes, mapping- protein identification, new directions in proteomics.

**REFERENCES**

1. Carl Brandon & John Tooze, "*Introduction to Protein Structure*," "2nd Edition" Garland Publishing, 1999

2. Paul R. Carey, "*Protein Engineering and Design*," Academic Press, 1996.
3. Daniel C. Liebler, "*Introduction to Proteomics – Tools for the New Biology*," Humana Press, 2001

| **BT1029 PROTEIN ENGINEERING AND PROTEOMICS** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course designed by** | | **Department of Biotechnology** | | | | | | | | | | |
| 1 | Student **Outcomes** | a | b | c | d | e | f | g | h | i | j | k |
| | | X | X | | | | | | | | X | X |
| 2 | Mapping of instructional objectives with student **outcomes** | 1 | 2 | | | | | | | | 3 | 3 |
| 3 | Category | General (G) | | Basic Sciences (B) | | Engg. Sci. & Tech. Arts (E) | | | Professional Subjects (P) | | | |
| | | | | | | | | | X | | | |
| 4 | Broad Area ( for courses under 'P' only) | Biotechnology | | | | Bioprocess Engineering | | | Chemical Engineering | | | |
| | | X | | | | -- | | | -- | | | |
| 5 | Approval | 23rd meeting of Academic Council, May 2013 | | | | | | | | | | |