

DEPARTMENT OF BIOTECHNOLOGY

Course Structure & Syllabi for MINOR programme in Biotechnology (To be applicable from BTech 2010-batch onwards).

Semester	Course Code	Course Title	L-T-P-C
3 rd	BT201M	Essentials of Biochemistry	3-0-0-6
4 th	BT202M	Molecular Biotechnology	3-0-0-6
5 th	BT301M	Cellular Biotechnology	3-0-0-6
6 th	BT 302M	Bioprocess Technology	3-0-0-6
7 th	BT401M	Bioanalytical Techniques and Bioinformatics	3-0-0-6
		Total credits	15-0-0-30

BT 201M Essentials of Biochemistry (3-0-0-6)

Preamble:

This course has been formulated keeping in mind that the students who will take this course will have non-biology background, except that they may have some knowledge based on BT101. The first part on foundations of biochemistry is to prime the students about biological systems in general and the need for studying biochemistry. The portion on Water related subtopics will help in appreciation of the aqueous environment in which biochemical reactions happen. Bioenergetics needs to be discussed. This helps in convincing the students that Biochemistry is not committing to memory all the metabolic pathways. Telling the students about the thermodynamic principles applied to biochemical reactions allows them to understand that metabolic pathways have “thermodynamic” basis and hence pathways can be understood logically. Metabolism in the syllabus does not include “all the metabolic” pathways. However, it should include some elementary metabolic pathways (The ones which involve energy storage and energy utilization). No biochemistry can be complete without a section on Enzymes.

Course contents:

Foundations of Biochemistry- cellular, chemical, physical, genetic, and evolutionary; Water-properties and its role in biochemical reactions; Bioenergetics and metabolism- Bioenergetics and thermodynamics, phosphoryl group transfers and ATP, biological oxidation reduction reactions, pathways for synthesis and utilization of energy rich substrates; Hormones-definition and classifications; Integration and regulation of metabolism- hormonal regulation of glucose metabolism, glucose-alanine cycle, cori cycle; Enzymes- classification and mechanism of action.

Texts:

1. J. M. Berg, J. L. Tymoczko and L. Stryer, *Biochemistry*, W. H. Freeman and Company, New York, 2006.
2. D. L. Nelson and M. M. Cox, *Lehninger Principles of Biochemistry*, 5th Ed., Macmillan Worth, 2007.

BT 202M Molecular Biotechnology (3-0-0-6)

Preamble:

The course covers the fundamental aspects of DNA structure and cells. The basic concept of molecular biology has been elucidated. Therefore, the course is very important to lay the foundation of other related courses in biotechnology.

Course contents:

Cellular and subcellular organization; Genome architectures; Mechanisms of cell division; Microbial growth; Molecular aspects of DNA replication, transcription and translation; DNA mutations and repair; Concepts of gene regulations; Microbial genetics- conjugation, Transformation and transduction; Aspects of genetic engineering.

Texts:

1. B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts, P. Walters, *Molecular Biology of Cell*, 5th Ed, Garland Publishing, 2007.
2. L. M. Prescott, J. P. Harley and D. A. Klein, *Microbiology*, 6th Ed, McGraw Hill, 2005.

References:

1. S. B. Primrose and R. M. Twyman , *Principles of Gene Manipulation*, Blackwell Science, 2006.
2. B. Lewin, *Genes IX*, International Edition, Pearson Education, 2008

BT 301M Cellular Biotechnology (3- 0- 0- 6)

Preamble:

Seeing the immense capabilities of Biotechnology, in general, and isolated cell culture technology, in particular, the course “*Cellular Technology*” is proposed. Many of the approaches associated with the culture of cells in the laboratory demand an experienced eye, especially in selection of cultures that are most likely to retain and express their totipotency. Consequently, the course is designed in a way that students from various disciplines may get acquainted with basic and applied aspects of cellular processes and techniques.

Course contents:

Cell Biotechnology; Cell culture media and techniques; Cell and tissue engineering; Stem cells; Organ transplantation and immunotolerance; Cloning and cell sorting; Tissue differentiation and development; Somaclonal variation; Synthetic seed development; Cryopreservation, Cell culture products; Transgenic plants and animals.

Texts:

1. M.R. Davey and P. Anthony, *Plant Cell Culture: Essential Methods*, Wiley-Blackwell, UK, 2010
2. B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts, P. Walters, *Molecular Biology of Cell*, 5th Ed, Garland Publishing, 2007.

References:

1. S. S. Bhojwani and M. K. Razdan, *Plant Tissue Culture: Theory and Practice*, Elsevier, USA, 1996.
2. A. Slater, N. Scott and M. Fowler, *Plant Biotechnology: The Genetic Manipulation of Plants*, Oxford University Press, UK, 2003.
3. R. Smith, *Plant Tissue Culture: Techniques and Experiments*, 2nd Ed, Academic Press, USA, 2000.

BT 302M Bioprocess Technology (3-0-0-6)**Preamble:**

This minor from the Department of Biotechnology would prepare students for careers in the field of bioprocess engineering, which includes pharmaceutical engineering and manufacturing. This minor provides broad over view of integrated biological processes. Students with interdisciplinary background would learn biotechnology of modern manufacturing processes. This minor is suitable for students in chemical engineering, biological sciences and chemistry, although students from all majors are welcome.

Course contents:

Basic structure of bioprocesses; Metabolic stoichiometry; Microbial and enzyme kinetics; Transport phenomena in bioprocess systems- gas-liquid mass transfer in cellular systems, determination of oxygen transfer rates; Media and air sterilization; Principles, design and operation of bioreactors- specific requirements for mammalian, plant and microbial systems; Production of secondary metabolites; Bioprocess monitoring and control; Scale up; Downstream processing; Bioprocess economics and safety.

Texts:

1. M. L Shuler and F. Kargi., *Bioprocess Engineering*, Prentice Hall Inc., 2002.
2. J. E. Bailey and D. F. Ollis, *Biochemical Engineering fundamentals*, 2nd Ed., McGraw-Hill, 1986

References:

1. H. J. Rehm and G. Reed, *Biotechnology-A multi- Volume Comprehensive Treatise*, 2nd Ed, Vol 3, Wiley-VCH, 1993.
2. P. B. Kaufman, L. J. Cseke, S. Warler, J. A. Duke, and H. L. Brielmann, *Natural Products from Plants*, CRC Press LLC, 1999.
3. M. Moo-Young, *Comprehensive Biotechnology*, Vol. 2, Pergamon Press, 2004.
4. F. Dicosmo and M. Missawa, *Plant Cell Culture Secondary Metabolism: Towards Industrial Application*. CRC LLC, 1996.
5. Aiba, A. E. Humphrey, and N. F. Millis., *Biochemical Engineering*, Academic press, London, 1965
6. Pauline M. Doran., *Bioprocess Engineering Principles*, Academic press, 1995
7. Harvey W. Blanch and Douglas S. Clark., *Biochemical Engineering*, Marcel Dekker Inc., 1997.
8. Scragg.A.H., *Bioreactors in biotechnology - A Practical approach*:1991
9. Atkinson, B. & Mavituna . F., *Biochemical Engineering and Biotechnology Handbook*, McGraw Hill, 2nd Ed. , 1993.

BT 401M Bioanalytical Techniques and Bioinformatics (3-0-0-6)

Preamble:

The course is designed to provide students basic understanding related to various techniques used in Biotechnology and Bioinformatics.

Course contents:

Modern approaches in Bioanalysis and Bioassays; Spectroscopic techniques: UV-Vis, Fluorescence and Mass; Light Microscopy; Live cell imaging; Scanning probe microscopy; Flow cytometry; Electrophoretic and Chromatographic techniques; Surface Plasmon Resonance; Nucleic acid amplification and sequencing; Computational approaches in analyzing protein and nucleic acid sequences; Analysis of protein structures; Computer aided drug design and screening.

Texts:

1. A. Manz, N. Pamme and D. Iossifidis, *Bioanalytical Chemistry*, World Scientific Publishing Company, 2004
2. D. Baxevanis and B. F. F. Ouellette, *Bioinformatics – A practical Guide to the analysis of Genes and Proteins*, 2nd Ed, John Wiley and Sons Inc., 2001.

References:

1. D. L. Spector and R. D. Goldman (Eds.), *Basic Methods in Microscopy, Protocols and concepts from cells: A Laboratory Manual*, Cold Spring Harbor Laboratory Press, 2006
2. T. Lengauer; *Bioinformatics - From Genomes to Drugs, Vols 1 & 2*, Wiley-VCH, 2002.
3. R. D. Goldman, J. R. Swedlow and D. L. Spector, *Live Cell Imaging: A Laboratory Manual*, Cold Spring Harbor Laboratory Press; 2nd Ed., 2009