

St. Xavier's College (Autonomous),  
Mumbai



Syllabus of the courses offered by the  
Post Graduate Department of Biotechnology  
(2015 onwards)



**St. Xavier's College – Autonomous  
Mumbai**

## **Syllabus**

**For 1<sup>st</sup> Semester Courses in M. Sc in Biotechnology  
(June 2015 onwards)**

## **Contents**

### **Syllabus for the following courses:**

#### **Theory Courses**

MS.BTS.1.01	Biomolecules
MS.BTS.1.02	Immunology
MS.BTS.1.03	Genomes and Transcription
MS.BTS.1.04	Membrane Studies and Cell cycle regulation

#### **Practical Courses**

MS.BTS.1.01PR	Basic Laboratory Skills
MS.BTS.1.02PR	Biochemistry
MS.BTS.1.03PR	Immunology
MS.BTS.1.04PR	Genomes

## M.Sc. - I SEMESTER 1

**COURSE: MS. BTS.1.01**

**BIOMOLECULES**

**Overall learning objectives:**

**60 Lectures**

- To understand the structure, function, and purification of proteins
  - To understand the topology of DNA
  - To understand the basic concepts in neurobiology
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**UNIT 1:**

**Protein structure and purification**

**15 lectures**

**Learning objectives:**

- To understand the architecture of proteins
- To know the techniques of separation and purification of proteins and understand the underlying principles.

**Topics:**

1. Primary structure of proteins and their determination – end group analysis; cleavage of disulphide bond; separation, characterization of polypeptide chain; specific peptide cleavage reactions.
2. Secondary structure – Ramachandran plot, helical structure, beta structure
3. Tertiary structure- fibrous (Collagen) and globular (Myoglobin) structure. Protein stability, protein denaturation.
4. Quaternary structure – (Haemoglobin) subunit interaction, symmetry, subunit composition determination
5. Protein purification: Principles and methods

**UNIT 2:**

**Protein folding**

**15**

**lectures.**

**Learning Objective:**

- To understand the protein folding mechanism
- To study the molecules assisting protein folding

**Topics:**

1. Protein folding
2. The different pathways of protein folding and its co-relationship with protein stability
3. Molecular chaperons

**UNIT 3:****DNA Topology****15 lectures****Learning objectives:**

- To understand the higher order structure of DNA and super-coiling parameters with enzymatic manipulation

**Topics:**

1. Different forms of DNA, - A/B/C/Z and RL form of double helical DNA, Triple Helix,
2. Nucleic acid binding protein – Leucine Zipper, Zinc fingers
3. OB fold, Beta Barrel, Helix-turn-helix, Helix-loop-helix
4. Linking number, Supercoiling, Topoisomerases

**UNIT 4:****Neurochemistry****15 lectures****Learning objective:**

- To understand the basic organisation and functional aspects of neurons
- To understand the molecules involved in neurotransmission.
- To gain an understanding of the effects of neurotoxins in functioning of the nervous system

**Topics:**

1. Anatomy and functions of neuron
2. Organization of brain
3. Neuronal pathways and systems
4. Propagation of nerve impulse
5. Ion conducting channels.
6. Synapses and gap junction
7. Neurotoxins
8. Neurotransmitters

**References:**

1. J. Berg, J. Tymoczko & L. Stryer , Biochemistry, 5<sup>th</sup> edition , W. H. Freeman & Company publisher , 2002
2. G. Zubay, Biochemistry, 4<sup>th</sup> Edition, Wm .C. Brown Publishers , 1999
3. David E. Metzler, Biochemistry, The chemical reactions of living cells, Volume I and II., Elsevier, 2003
4. Nelson and Cox, Lehninger's Principles of Biochemistry, fourth edition, Macmillan Worth Publisher , 2004
5. Donald Voet and Judith Voet. Biochemistry third edition, John Wiley and sons, Inc publisher, 2004
6. Thomas Devlin, Textbook of Biochemistry with clinical correlations, Fifth Edition, John Wiley and sons, Inc publisher, 2002

7. Campbell and Farrell, Biochemistry, fourth and fifth ed, Thomson Brooks/Cole, 2005
8. R Murray, D Granner, P Mayes, Harpers Illustrated biochemistry, 26th Edition, McGraw Hills
9. William Nyhan, Nadia A Sakati, Diagnostic Recognition of Genetic Disease, Library of Congress cataloguing in publication data.
10. Arthur M Lesk, Introduction to Protein science Architecture, Function and Genomics , 1998 Oxford publishers

**Overall learning objectives:****60 Lectures**

To understand the structure and function of molecules involved in innate and adaptive immunity.

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**UNIT 1****Immunoglobulins****15 lectures****Learning objectives:**

- To understand the source and production of blood cells involved in immunity.
- To understand the structure, diversity, synthesis, and secretion of Immunoglobulins

**Topics:**

1. Haematopoiesis
2. Immunoglobulin fine structure
3. Immunoglobulin super family
4. Multigene organization of Ig gene
5. Variable region gene rearrangement
6. Generation of antibody diversity
7. Class switching among constant regions.
8. Synthesis, assembly, and secretion of Immunoglobulins

**UNIT 2: MHC and Regulation of immune response****15 lectures****Learning objective**

- To understand the mechanism of antigen processing and presentation.
- To understand the mechanism of B cell and T cell activation and the signalling pathways involved therein.
- To understand the importance of T cell regulation

**Topics:**

1. Cellular distribution of MHC molecule
2. Antigen processing and presentation
3. Exogenous and endogenous antigen processing
4. Self - MHC restriction of T cells
5. Presentation of non-peptide antigens
6. Activation of B lymphocytes
7. Activation of T lymphocytes
8. T-cell regulation

**UNIT 3:****Cytokines****15 lectures****Learning objective**

- To understand cytokine as the signalling molecule of the immune system, its regulation and effect on the outcome of diseases.

**Topics:**

1. Properties
2. Receptors
3. Antagonists
4. Diseases
5. Therapeutic use of cytokines

**UNIT 4**

**Immuno-deficiency**

**15 Lectures**

**Learning objective:**

- To understand the mechanism of natural and pathogen induced immunodeficiency

**Topics:**

1. Primary immunodeficiency
2. Secondary immunodeficiency

**References:**

1. Goldsby, T J. Kindt, Osborne, Janis Kuby, Immunology, fifth Ed, Freeman, and company, 2003
2. Roitt, Brostoff, Male, Immunology, sixth Ed, Mosby, An imprint of Elsevier science Ltd, 2006
3. Abbas, Abul K & Lichtman, Cellular and molecular immunology. Fourth edition, W B Saunders company, 2000
4. Ian R Tizard, Immunology, An introduction, fourth edition. Thomson Publisher, 1994
5. Wener Luttmann, K Bratke, M. Kupper, D Myrtek, Immunology the experimental series publisher, 1998
6. C V Rao, An introduction to Immunology, Narosa Publishing house, 2004
7. S C Rastogi, Elements of Immunology, CSB Publishers and distributors, 2006
8. Gordan Reeve and Ian Todd, Immunology, fourth edition. Blackwell Publishing House
9. S Ye and I N M Day, Microarray and Microplates, Bio's publishers, 2003
10. Kenneth Murphy; Paul Travers; Mark Walport, Janeway's Immunobiology, 7<sup>th</sup> Edition , Garland Publishers , 2007

**Overall learning objectives:**

**60 Lectures**

- To understand the content, constitution, and assembly of genomes in the eukaryotic system
  - To elucidate the transfer of information from genes to RNA in detail
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**UNIT 1**

**Genomes: anatomy and sequence assembly methods**

**15 Lectures**

**Learning objective:**

- To understand the anatomy of eukaryotic genome and its significance
- To understand the methodology of genome sequencing.

**Topics:**

1. Human nuclear genome
  - Genetic features of nuclear genome
  - Noncoding DNA
2. Human mitochondrial genome
3. Genomes of model organisms- *Saccharomyces cerevisiae*, *Caenorhabditis elegans*, *Arabidopsis thaliana* and *Drosophila melanogaster*
4. Human Genome Project: strategies and outcome
  - Assembly of a contiguous DNA sequence using shotgun method, clone contig method and whole genome shotgun sequence method.

**UNIT 2 Transcription Initiation in prokaryotes and eukaryotes**

**15 Lectures**

**Learning objective:**

- To understand the interaction of proteins with DNA in the assembly of transcription machinery and its execution

**Topics:**

1. DNA-Protein interactions during Transcription Initiation
2. Regulation of Transcription initiation.

**UNIT 3**

**Synthesis and Processing of RNA**

**15 Lectures**

**Learning Objective:**

- To understand the elongation, termination, and post transcriptional modification of the primary transcript

**Topics:**



1. Synthesis of eukaryotic mRNAs by RNA polymerase II
2. Intron splicing
3. Synthesis and processing of Non-coding RNAs: Transcript elongation and termination by RNA polymerases I and III
4. Introns in eukaryotic pre-rRNA and pre-tRNA
5. Processing of Pre-RNA, Degradation of mRNAs

**UNIT 4                      Regulation of Genome Activity**

**15 Lectures**

**Learning objective:**

- To study the regulation of gene activity using specific examples

**Topics:**

1. Genome rearrangements
2. Gene silencing by modification of histones and DNA
3. RNA in gene regulation,
4. Regulation of Genome Activity During Development:
  - a. Vulva development in *Caenorhabditis elegans*
  - b. Development in *Drosophila melanogaster*.

**References:**

1. Benjamin Lewin, Gene VII, 2000, Oxford University Press Publishers
2. T A Brown, Genomes 3, third edition, 2007, Garland Science Publishing.
3. Simmons, Gardner, Principles of genetics ,8<sup>th</sup> edition John Wiley and sons, Inc publishers, 2006
4. Donald Voet and Judith Voet. Biochemistry third edition, 2004, John Wiley and sons, Inc
5. T D. Watson and others, Molecular biology of the gene, 6<sup>th</sup> edition, 2004, Pearson education ltd.
6. G M Cooper, The Cell, a molecular approach, Library of Congress cataloguing in publication data.
7. Griffiths, A. and Miller J, An introduction to genetic analysis , W.H. Freeman , 2000
8. Lodish. H, Berk, A Molecular cell biology, 4<sup>th</sup> John, 2000 Wiley and sons, Inc

**COURSE: MS.BTS.1.04 MEMBRANE STUDIES AND CELL CYCLE REGULATION**

**Overall learning objectives:**

**60 Lectures**

- To understand the architecture and function of membranes with aspects of cellular signalling
- To understand cell cycle and cell death process.

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**UNIT 1**

**Membrane Architecture**

**15 Lectures**

**Learning objective:**

- To understand the types of lipoproteins and their role in diseases

**Topics:**

1. Membrane Structure
2. Lipoproteins – structure, association with proteins and function
3. Types of Lipoproteins (Membrane and Plasma)
4. Lipoprotein Metabolism, role of Lipoproteins in diseases.

**Unit 2**

**Membrane Studies**

**15 Lectures**

**Learning Objectives:**

- To study the membrane structure, functions, and their utility in pharmaceuticals

**Topics:**

1. Membrane dynamics and functions
2. Solubilisation of the membrane by using different detergents.
3. Liposome structure and their uses in drug targeting
4. Membrane transport: facilitated diffusion (Glut 1) and Primary and Secondary active transport (P,F, ABC, symporter, and antiporter)

**UNIT 3:**

**Biosignaling**

**15 Lectures**

**Learning objective**

- To elucidate the cellular signalling in control of gene activity and sensory pathways

**Topics:**

1. Cell signalling pathways that control gene activity-
  - TGF-Beta and activation of Smads
  - Regulation of TGF-Beta by negative feedback loops.

- Cancer and loss of TGF-Beta signalling
  - Activation of gene transcription by seven-spanning cell surface receptors: Wnt and Hedgehog
2. Sensory transduction in vision, olfaction, and gustation

**UNIT 4:                      Cell cycle and its regulation                      15 Lectures**

**Learning objective:**

- To understand eukaryotic cell cycle and its regulation
- To understand cell death and its regulation

**Topics:**

1. Cell cycle phases
2. Control of mitosis by cyclins, MPF activity and cyclin dependant kinases
3. Checkpoints in cell cycle regulation
4. Cell death and its regulation

**CIA: Essay Writing**

**References:**

1. Mathews, Van Holde, Biochemistry, second ed. , The Benjamin/ Cummins publishing Company
2. Donald Voet and Judith Voet. Biochemistry third edition, 2004, John Wiley and sons, Inc.
3. T D. Watson and others, Molecular biology of the gene, 6<sup>th</sup> edition, 2004, Pearson education Ltd.
4. Benjamin Lewin, Gene VII, 2000, Oxford University Press Publishers
5. Karl Branden and John Tooze, introduction to Protein structure , 2<sup>nd</sup> ed, garland publishers, 1999.
6. Lodish. H, Berk, A Molecular cell biology, 4<sup>th</sup> John, 2000 Wiley and sons, Inc

## PRACTICALS

### Overall Objectives:

1. To learn basic laboratory skills and good laboratory practices
2. To learn the basic techniques of extraction, separation, purification, and characterisation of different Biomolecules from organisms and biological fluids
3. To learn how to plan and execute experiments and analyse the data obtained.

### COURSE MS. BTS.1.01PR

### Basic laboratory Skills

1. Introduction to good laboratory practices and quality control
2. Preparation of solutions and buffers
3. Calibration of instruments: pH meter, analytical balance, UV-spectrophotometer, colorimeter
4. Calibration of apparatus used for measuring: glass pipettes, auto pipettes and measuring cylinders
5. Validation: Autoclave, Laminar air flow
6. Introduction to microbial techniques.
  - a. Sterility testing
  - b. Identification of *E. coli* and *S.aureus*
7. Scientific communication: Gathering scientific data.
  - Written communication: Guide to clear writing , forms and styles of writing , Illustration
  - Communication theory and practice
  - Concept of Plagiarism

### COURSE MS. BTS.1.02PR

### Biochemistry

#### A. Protein separation and quantification

1. Protein Estimation using the following methods:
  - Biuret assay
  - Bradford's assay
  - Folin-Lowry assay
  - UV spectrophotometer
2. Protein Separation by electrophoresis:
  - Polyacrylamide gel electrophoresis

- Horizontal gel electrophoresis (slab)
  - Paper electrophoresis
3. SDS PAGE
  4. Protein gel staining techniques:
    - Coomassie brilliant blue, silver staining , TCA and Ponceau staining
    - Activity staining: LDH
  5. Protein Purification techniques:
    - Protein Precipitation
    - Ion exchange Chromatography
    - Gel filtration
    - Affinity Chromatography
  6. Viscosity studies of proteins

### **B. Protein sequence analysis (Bioinformatics)**

1. Primary sequence analysis
2. Secondary sequence analysis
3. Tertiary sequence analysis

### **COURSE MS.BTS.1.03PR                      Immunology**

1. Study of serum globulins using electrophoresis.
2. Isoagglutination titre study
3. Single Radial Immunodiffusion
4. Study of purified Immunoglobulins using SDS PAGE

### **CIA: Experiment based**

### **COURSE 4 MS. BTS. 1.04PR                      Genomes and Transcriptomes**

#### **A. Extraction of DNA and quantification**

1. Extraction of Genomic DNA Extraction from Bacteria
2. Extraction of Genomic DNA Extraction from Human samples
  - Cheek cells
  - Blood
3. Estimation of nucleic acids using UV.

#### **B. Nucleotide sequences and analysis (Bioinformatics)**

1. Human genome study
2. Intron Exon finder, ORF finder and Nucleotide composition analysis
3. Study of tandem repeats
4. Restriction Map analysis

**References:**

1. Biochemical calculations (2<sup>nd</sup> Ed, 2004) Irwin H Segel, Wiley Publications
2. Principles and techniques of Biochemistry and molecular biology (7<sup>th</sup> Ed, 2010) Keith Wilson and John Walker, Cambridge university Press
3. Biochemistry Laboratory (2<sup>nd</sup> Ed, 2012) Rodney Boyer, Pearsons Publication
4. Goldsby, T J. Kindt, Osborne, Janis Kuby, Immunology, fifth Ed, Freeman, and company, 2003
5. Biotechnology explorations (2000), Shepler J and Cassin P, ASM Press
6. Anthony Wilson, Handbook of Science Communication, IOP publishing Ltd. CRC press (1999)



**St. Xavier's College – Autonomous**

**Mumbai**

**Syllabus**

**For 2<sup>nd</sup> Semester Courses in M. Sc in Biotechnology**

**(June 2015 onwards)**

**Contents**

**Syllabus for the following courses:**

**Theory Courses**

- MS.BTS.2.01 Metabolism and Plant Cell culture
- MS.BTS.2.02 Clinical Immunology
- MS.BTS.2.03 Molecular Biology
- MS.BTS.2.04 Advanced Analytical Techniques

**Practical Courses**

- MS.BTS.2.01PR Metabolism and Plant Cell culture
- MS.BTS.2.02PR Clinical Immunology
- MS.BTS.2.03PR Molecular Biology
- MS.BTS.2.04PR Analytical techniques

## **M.Sc. - I SEMESTER 2**

**COURSE: MS. BTS.2.01**

**METABOLISM AND PLANT CELL CULTURE**

**Overall learning Objectives:**

**60 Lectures**

- To understand metabolic pathways and their interrelationships
- To study the nutritional diseases associated with abnormal metabolism
- To study plant metabolism

**Unit 1 Carbohydrate and Lipid metabolism**

**15 Lectures**

**Learning objective**

- To understand how energy is stored in carbohydrates and the diseases caused by excessive accumulation of glycogen.
- To study lipogenesis

**Topics:**

1. Carbohydrate metabolism
2. HMP, Uronic acid pathway
3. Glycogenolysis
4. Glycogen storage diseases
5. Lipid metabolism: synthesis of essential fatty acids and its biological significance.

**Unit 2 Protein and Nucleic acid Metabolism**

**15 Lectures**

**Learning objectives:**

- To study the metabolic pathways of amino acids and nucleic acids and associated disorders

**Topics:**

1. Metabolism of amino acids
  - Biosynthesis of phenylalanine, tyrosine, threonine, and methionine
  - Metabolic breakdown of amino acids
2. Disorders of amino acid metabolism
3. Biosynthesis and degradation of purines and pyrimidines
4. Regulation of metabolism
5. Disorders of Nucleic acid metabolism

**Unit 3 Plant metabolism**

**15 Lectures**

**Learning objectives:**

To study the fundamentals of carbohydrate and nitrogen metabolism in plants

**Topics:**



1. C-3 cycle and C-4 cycles
2. CAM, glyoxylate pathway
3. Photosynthetic formation of hydrogen
4. Nitrogen fixation and role of nitrogenase

#### **Unit 4**

#### **Plant cell culture**

**15 Lectures**

#### **Learning objective:**

To understand the technique involved in culturing different types of plant cells/ tissues *invitro* and its applications.

#### **Topics:**

1. Cell suspension cultures (batch and continuous) and immobilised cell culture systems
2. Secondary metabolism and *in vitro* culture systems for secondary metabolites (including hairy root culture techniques)
3. Cryopreservation and conservation of germplasm
4. Protoplast culture and its applications
5. Somatic embryogenesis
6. Biotransformation of precursors using plant cell culture

#### **CIA: Quiz**

#### **References:**

1. J. Berg, J. Tymoczko & L. Stryer , Biochemistry, 5<sup>th</sup> edition , W. H. Freeman & Company publisher , 2002
2. Nelson and Cox, Lehninger's Principles of Biochemistry, fourth edition, Macmillan Worth Publisher , 2004
3. Donald Voet and Judith Voet. Biochemistry third edition, John Wiley and sons, Inc publisher, 2004
4. Thomas Devlin, Textbook of Biochemistry with clinical correlations, Fifth Edition, John Wiley and sons, Inc publisher, 2002
5. R Murray, D Granner, P Mayes, Harpers Illustrated biochemistry, 26th Edition, McGraw Hills
6. Plant Cell and Tissue Culture - A Tool in Biotechnology, Basics and Application, Karl-Hermann Neumann, Ashwani Kumar, Jafargholi Imani, 2009 Springer-Verlag Berlin Heidelberg
7. Introduction to Plant Tissue Culture- M K Razdan

**COURSE: MS. BTS. 2.02**

**CLINICAL IMMUNOLOGY**

**Overall learning objectives:**

**60 L**

- To understand the response of the human body towards allergens, grafts, tumors and infections.
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**Unit 1**

**Hypersensitivity**

**15 Lectures**

**Learning objective:**

- To study the classification and mechanism of hypersensitivity

**Topics:**

1. Gel and Coomb's Classification
2. Type I, II, III, IV hypersensitivity
3. Autoimmunity: Organ specific, systemic, mechanism, treatment

**. Unit 2**

**Transplantation**

**15 Lectures**

**Learning objective:**

- To understand the types of transplantation and immune response towards it

**Topics:**

1. Basis of Graft rejection,
2. Clinical manifestation of graft rejection
3. Immune tolerance
4. Immunosuppressive therapy
5. Clinical transplantation.

**Unit 3**

**Tumor immunology**

**15 Lectures**

**Learning objective:**

- To understand the immune response involved in tumour progression and antibody-based therapeutics.

**Topics:**

1. Oncogenes and cancer induction
2. Tumor of immune system and Tumor antigens
3. Tumor evasion of immune system
4. Cancer immunotherapy

**Unit 4**

**Immune Effector Mechanisms**

**15 Lectures**

**Learning objective:**

- To understand the immune response to infections

**Topics:**

1. The inflammatory process
  - a. Role of neutrophils and other mediators in inflammation
  - b. Localised, systemic, and chronic inflammation
  - c. Anti-inflammatory agents
2. Immune response to bacterial and viral infection.

**CIA: Writing a Review Article****References:**

1. Goldsby, T J. Kindt, Osborne, Janis Kuby, Immunology, fifth Ed, Freeman, and company.
2. Roitt, Brostoff, Male, Immunology, sixth Ed, Mosby, An imprint of Elsevier science Ltd
3. Abbas, Abul K & Lichtman, Cellular and molecular immunology. Fourth edition, W B Saunders company
4. Ian R Tizard, Immunology, An introduction, fourth edition. Thomson Publisher
5. Wener Luttmann, K Bratke, M. Kupper, D Myrtek, Immunology the experimental series publisher
6. S Pathak & U Palan, Immunology essential and fundamental, Second edition, Parveen Publishing House
7. S C Rastogi, Elements of Immunology, CSB Publishers and distributors
8. Gordan Reeve and Ian Todd, Immunology, fourth edition. Blackwell Publishing House
9. S Ye and I N M Day, Microarray and Microplates, Bio's publisher



To study the application of recombinant microbes and plants

**Topics:**

1. Plant engineering to overcome abiotic and biotic stress
  - a. Insect Resistance
  - b. Virus Resistance
  - c. Herbicide Resistance
  - d. Salt and Drought Stress
2. Plant engineering for modification of nutrient content:
  - Amino Acids, Lipids, Vitamins, Iron
3. Synthesis of commercial products - Restriction Endonucleases

**CIA: Essay Writing**

**References:**

1. Benjamin Lewin, Gene VII, Oxford Publishers
2. T A Brown, Genome, Second edition, Bios Scientific publishers
3. Old and Primrose, Principles of Gene Manipulation. Blackwell Science publishers
4. Simmons, Gardner, Principles of genetics , John Wiley and sons, Inc publishers
5. Donald Voet and Judith Voet. Biochemistry third edition, 2004, John Wiley and sons, Inc
6. T D. Watson and others, Molecular biology of the gene, 6<sup>th</sup> edition , 2004 , Pearson education ltd.
7. G M Cooper, The Cell, a molecular approach, Library of Congress cataloguing in publication data.
8. Griffiths, A. and Miller J, An introduction to genetic analysis , Freeman
9. Lodish, Berk, A Molecular cell biology, John Wiley and sons, Inc
10. Sambrook J, Russell., Molecular cloning, Vol I, II , III, CSHL Press
11. T A Brown, Gene cloning and DNA analysis, Bios Scientific publishers
12. Bernard Glick , Jack Pasternak and Cheryl Patten, Molecular Biotechnology- principles and applications of Recombinant DNA, 4<sup>th</sup> ed, ASM Press, 2010

**COURSE: MS.BTS.2.04**

**ADVANCED ANALYTICAL TECHNIQUES**

**Overall learning objectives:**

**60 L**

- To understand the principles and applications of various analytical techniques used to study biomolecules.
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**Topics:**

**Unit 1**

**Spectroscopy**

**15 Lectures**

**Learning Objectives:**

- To understand the conformation and structural details of biomolecules using spectroscopic techniques

**Topics:**

Basic principles, instrumentation, and applications of the following:

1. Fluorescence spectroscopy
2. ORD
3. CD spectroscopy
4. NMR
5. ESR.

**Unit 2**

**Advances in Microscopy and X-Ray Crystallography**

**15 Lectures**

**Learning objective:**

- To study the current methods and applications of advanced biological imaging systems
- To gain knowledge of techniques used to obtain the structural insights of proteins

**Topics:**

- **Advanced Microscopy**
  1. Different versions of advanced microscopy
  2. Electron microscopy
  3. Confocal Microscopy
- **X-Ray Crystallography**  
Principles, instrumentation, and application of X ray crystallography.

**Unit 3**

**Gene amplification technique**

**15 lectures**

**Learning Objectives:**

To understand the principle and application of gene amplification

**Topics:**

1. PCR and its types
  - Nested
  - Arms
  - Inverse
  - Real Time
  - SSCP
2. Molecular diagnostics
  - Bacterial infections
  - Fungal infections
  - Viral infections
  - Parasitic infections

**Unit 4**

**Advanced Analytical Techniques**

**15 lectures**

**Learning objectives:**

- To understand the working mechanism and data analysis of high throughput techniques

**Topics:**

1. 2-D PAGE
2. HPLC
3. Mass spectrometry
4. MALDI-TOF-MS/MS
5. Biochips (DNA, Protein and Biosensors)

**CIA: Group Presentation**

**References:**

1. Donald Voet and Judith Voet. Biochemistry third edition, 2004, John Wiley and sons
2. R Cotterill , Biophysics, An Introduction , John Wiley and sons, Inc
3. Skoog, Holler, Nieman. , Principles of instrumental analysis , Thomson publishers
4. Daniel M, Basic Biophysics 2004 , Student Edition
5. Bartlett & Stirling , PCR protocols, 2<sup>nd</sup> ed ., Humana publishers
6. David Spector and Robert Goldman, Basic methods in microscopy. Cold spring harbour laboratory press, 2006
7. Douglas Chandler and Robert Robertson, Bioimaging – current concepts in light and electron microscopy, Jones, and Bartlett publishers, 2009.

**PRACTICALS**

**Overall Learning Objectives:**

- To learn the basic techniques in understanding metabolism and recombinant DNA technology

- To plan, execute experiments and analyse the data obtained.

**COURSE: MS. BTS. 2.01PR METABOLISM AND PLANT CELL CULTURE**

1. Determination of acid value and iodine value of lipids
2. Determination of phosphorus content in nucleic acid
3. Estimation of Uric acid from serum or urine
4. Estimation of Urea from serum or urine
5. Estimation of Creatinine from serum or urine
6. Isolation of chloroplast by sucrose gradient centrifugation
7. Measurement of chlorophyll content
8. Measurement of proton uptake
9. Separation of photosynthetic pigments by chromatography
10. Plant Tissue Culture: Stock solution Preparation, Media Preparation, Surface sterilization, Callus induction,

**Bioinformatics:**

- Study of metabolic databases

**CIA:** Bioinformatics/ Experiment based

**COURSE: MS. BTS.2.02PR**

**Clinical immunology**

1. Dot-ELISA
2. Antibody/ antigen capture ELISA
3. Western blot technique
4. Lymphotoxicity studies
5. Flow cytometry ( instrumentation and data representation)

**CIA:** Experiment based

**COURSE: MS. BTS.2.03PR**

**Molecular biology**

1. Isolation of DNA from yeast
2. Isolation of RNA from yeast/ *E.coli*
3. Creation of genomic library
  - i. Isolation of genomic DNA
  - ii. Isolation of Plasmid DNA
  - iii. Restriction Digestion



- iv. Ligation
- v. Transformation
- 4. Expression of recombinant proteins
- 5. PCR amplification of 16srRNA
- 6. RFLP analysis

**Bioinformatics:**

- 1. Primer Designing
- 2. Translation and reverse translation
- 3. Vector study
- 4. Gene finding

**CIA:** Experiment Based/ Bioinformatics

**COURSE: MS. BTS. 2.04PR**

**Analytical techniques**

- 1. Quality assurance and Quality Control
- 2. Instrumentation and Data interpretation of the following techniques
- 3. HPLC
  - a. Gas chromatography
  - b. 2D electrophoresis
  - c. Mass spectrometry

**CIA:** Data interpretation/ Paper Presentation

**References:**

- 1. Principles and techniques of Biochemistry and molecular biology (7<sup>th</sup> Ed, 2010) Keith Wilson and John Walker, Cambridge university Press
- 2. Biochemistry Laboratory (2<sup>nd</sup> Ed, 2012) Rodney Boyer, Pearsons Publication
- 3. Plant tissue Culture (1995)– Kalyan Kumar De, New Central Book Agency
- 4. Goldsby, T J. Kindt, Osborne, Janis Kuby, Immunology, fifth Ed, Freeman, and company, 2003
- 5. Molecular Cloning : Laboratory Manual Vol I, 2001 , Joseph Sambrook, David William Russel, CHL Press



**St. Xavier's College – Autonomous**

**Mumbai**

**Syllabus**

**For 3<sup>rd</sup> Semester Courses in M.Sc in Biotechnology**

**(June 2015 onwards)**

**Contents**

**Syllabus for the following courses:**

**Theory Courses**

MS.BTS.3.01	Biostatistics And Bioinformatics
MS.BTS.3.02	Animal Cell Biotechnology
MS.BTS.3.03	Bioprocess Technology
MS.BTS.3.04	Environmental Biotechnology and Intellectual Property Rights

**Practical Courses**

MS.BTS.3.01PR	Bioinformatics
MS.BTS.3.02PR	Animal Cell Culture
MS.BTS.3.03PR	Bioprocess Technology
MS.BTS.3.04PR	Environmental Biotechnology

## M.Sc. - I SEMESTER 3

**COURSE CODE: MS. BTS. 3.01**

### **BIOSTATISTICS AND BIOINFORMATICS**

**UNIT 1 Introduction to Biostatistics 15 Lectures**

**Topics:**

1. Measure of central tendency ( mean, median and mode)
2. Measure of dispersion (Standard deviation , variance, and coefficient of variance)
3. Z- test (one mean , two means and paired)
4. t- Test (one mean, two means , paired and cochran's )
5.  $\chi^2$  test ( test of homogeneity, Independence Goodness of fit)
6. P- value for all tests ( Reading tables)

**UNIT 2 Applied Biostatistics 15 Lectures**

**Topics:**

1. Statistical Experimentation : Introduction , test , control
2. Experimental design and terms
3. Theory of probability , density function ( Estimation etc)
4. The standard Normal distribution
5. Hypothesis Testing : step, errors
6. Nonparametric tests: Sign , Wilcoxon, and Mann- Whitney test

**UNIT 3 Databases and Sequence Alignment 15 Lectures**

**Topics:**

1. **Study of biological databases**
  - a. Biological data and databases , classification
  - b. Examples of databases ( sequence , structure , classification , genome , microarray , secondary databases)Submission of sequences
  - c. Biological data retrieval Study of data formats
2. **Sequence alignment : meaning and types (Pairwise and multiple sequence alignment , Global and local alignments )**
  - a. BLAST : types , method , parameters
  - b. Multiple sequence alignment : goal and application , principle and methods, tools used
  - c. Phylogenetic analysis and importance
  - d. Sequence logo and consensus sequences

**UNIT 4 Protein Structure Visualization, Prediction, Genes and Genome Analysis 15 Lectures**

**Topics:**

1. Study of proteins
  - a. Protein structure prediction
  - b. Homology modelling
  - c. Protein structure visualization and significance
  - d. Bioinformatics basis of protein classification: CATH and SCOP
  - e. Protein families

2. DNA/ gene sequence analysis:
  - a. Why analyze DNA
  - b. Gene finding : approaches and tools
  - c. Motif finding types and tools
  - d. Microarrays and microarray data analysis
  - e. SAGE

**Reference Books:**

**Biostatistics:**

1. Wayne W Daniel (1999), Biostatistics: a foundation for analysis in health sciences, John Wiley, and sons
2. N Gurumani (2004), Introduction to Biostatistics, MJP Publishers.

**Bioinformatics:**

1. David Mount (2004) Bioinformatics: Sequence and Genome Analysis. 2<sup>nd</sup> edition, Cold Spring Harbor Laboratory Press, New York.
2. Jonathan Pevsner (2009) Bioinformatics and Functional Genomics. 2<sup>nd</sup> edition, John Wiley and Sons, New Jersey.
3. Teresa K. Attwood and D. J. Parry Smith (1999) Introduction to Bioinformatics. 1<sup>st</sup> edition , Pearson Education Limited , England
4. Andreas D. Baxevanis and B. F. Francis Ouellette (2001) Bioinformatics A Practical Guide to the Analysis of Genes and Proteins. 2<sup>nd</sup> edition, A John Wiley & Sons, Inc., Publication
5. Arthur M. Lesk (2005) Introduction to Bioinformatics , 2<sup>nd</sup> edition Oxford University Press
6. Jean-Michel Claverie and Cedric Notre dame Bioinformatics for Dummies, 2<sup>nd</sup> edition, Wiley Publishing, Inc.

**COURSE CODE: MS. BTS. 3.02 ANIMAL CELL BIOTECHNOLOGY**

**UNIT 1 Animal Cell Culture 15 Lectures**

**Topics:**

1. Biology of cultured cells
2. Primary Culture and development of cell lines – normal and tumor.
3. Maintenance of cells in culture : subculture, contamination, and cryopreservation
4. Characterisation of cells in culture.
5. Transformation , immortalisation, and Differentiation
6. 3-D culture : organ culture, histiotypic culture and organotypic culture
7. Cytotoxicity

**UNIT 2 Human Embryogenesis and *In Vitro* Fertilization 15 Lectures**

**Topics:**

1. Embryonic development stages [fertilisation, post fertilisation, Implantation]
2. Establishment of germ layers and their fate
3. Immunology of pregnancy
4. IVF Technology

**UNIT 3                      Stem cells and tissue engineering                      15 Lectures**

**Topics:**

1. Types of stem cells: ES, Adult, iPSCs, Cancer stem cells
2. Characterisation of stem cells
3. Applications of stem cells in therapeutics
4. Ethical issues and regulations in stem cell research
5. Fundamentals of tissue engineering: Growth Factors, morphogens, Extracellular Matrix, Cell adhesion and migration, Inflammatory and Immune responses to tissue engineered devices
6. Biomaterials : Polymeric scaffolds , Calcium Phosphate Ceramics ,Bio mimetic materials
7. Applications of tissue engineering

**UNIT 4                      Biopharmaceuticals                      15 Lectures**

**Topics:**

1. Scale up in cell culture ( types of bioreactors for suspension and monolayer cultures and process control)
2. Therapeutic peptides/ Biosimilars- production and dynamics
  - a. Production methodology
  - b. Pharmacokinetics and Pharmacodynamics
    - i. Insulin
    - ii. Tissue plasminogen activator
    - iii. Interferon – alpha
    - iv. Erythropoietin
    - v. Vaccines
    - vi. Monoclonal antibodies

**Reference Books:**

1. Culture of Animal Cells, R Ian Freshney, Wiley Publications, 5<sup>th</sup> / 6<sup>th</sup> Ed
2. Principles and Practice of Animal Tissue culture, Sudha Gangal, Universities Press, 2007
3. Animal Cell Culture: Essential Methods , John M Davis, John Wiley & Sons
4. ] Kaushik Deb and Satish Totey. (2009) Stem Cells Basics and Applications. Tata McGraw Hill.
5. Gary Stein and Maria B et al. (2011) Human Stem Cell Technology and Biology. Wiley Blackwell.
6. R. Ian Freshney, Glyn N. Stacey, Jonathan M. Auerbach. (2007) Culture of Human Stem Cells. John Wiley & Sons
7. Robert Lanza, Robert Langer, Joseph P. Vacanti. (2011) Principles of Tissue Engineering. Academic Press.
8. Inderbir Singh & GP Pal. (2007) Human Embryology. MacMillan Publishers.
9. Thomas W. Sadler. (2009) Langman's Medical Embryology. Lippincott Williams & Wilkins.
10. Scott F Gilbert.(2000) Developmental Biology, 6th edition. Sinauer Associates.
11. Gordana Vunjak-Novakovic, R. Ian Freshney. (2006) Culture of Cells for Tissue Engineering. John Wiley & Sons.
12. Daan J. A. Crommelin, Robert D. Sindelar. (2002) Pharmaceutical Biotechnology: An Introduction for Pharmacists and Pharmaceutical Scientists. Taylor & Francis.
13. Bernard R. Glick, Jack J. Pasternak, Cheryl L.Patten. (2010) Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press.

## **COURSE CODE: MS. BTS. 3.03 BIOPROCESS TECHNOLOGY**

### **UNIT 1 Principles of Bioprocess Technology 15 Lectures**

#### **Topics:**

- Industrial substrates and stoichiometry
- Kinetics of microbial growth, substrate utilization and product formation: Batch , Fed- Batch and continuous processes
- Scale up concepts with respect to fermenter design and product formation
- Solid state fermentation
- Processes using recombinant organisms: hosts, vectors, genetic instability.

### **UNIT 2 Process dynamics 15 Lectures**

#### **Topics:**

- Gas exchange and mass transfer: O<sub>2</sub> transfer, critical oxygen concentration, determining the oxygen uptake rate.
- Heat transfer
- Sterilization – processes, thermal death curve, in situ sterilization

### **UNIT 3 Downstream Processing 15 Lectures**

#### **Topics:**

1. Flocculation and floatation
2. Filtration
3. Centrifugation
4. Cell disruption
5. Liquid extraction
6. Precipitation
7. Adsorption
8. Dialysis
9. Reverse osmosis
10. Chromatography
11. Crystallization and drying

### **UNIT 4 Industrial Products 15 Lectures**

1. Polysaccharides/ biopolymers/micro polymers- Xanthan gum, Dextran
2. Enzymes – proteases, amylases, pectinases, lipases
3. Nutraceuticals – Probiotics and prebiotics
4. Antibiotics – erythromycin
5. Vitamin B<sub>12</sub>

#### **References:**

#### **Bioprocess Technology**

1. Wulf Crueger and Anneliese Crueger (1990) Biotechnology: A Textbook of Industrial Microbiology. Panima Publishers. New Delhi

2. Michael L. Shuler, Fikret Kargı (1992) Bioprocess Engineering: basic concepts. Prentice Hall Publishers. New York.
3. Stanbury P.F., Whitaker A, Hall S.J. (1999) Principles of Fermentation Technology. 2<sup>nd</sup> edition, Butterworth-Heinemann
4. Glazer A.N. & Nikaido H. (1995) Microbial Biotechnology: Fundamentals of Applied Microbiology. W.H. Freeman & Company, New York.

**COURSE CODE: MS. BTS. 3.04**

**ENVIRONMENTAL BIOTECHNOLOGY AND INTELLECTUAL PROPERTY RIGHTS**

**UNIT 1                                      Pollution Remediation and Biotechnology                                      15 Lectures**

**Topics:**

1. Biodegradation of xenobiotic compounds:
  - a. Priority pollutants and their health effects
  - b. Microbial basis of biodegradation
2. Bioremediation :
  - a. Meaning , Types , Process with examples
  - b. Phytoremediation
  - c. Metal remediation
3. Biotechnology and environmental pollution control
  - a. Biotechnology in control of Industrial pollution
  - b. Biotechnology for pollution abatement ( air and water )
4. Biopesticides
5. Microbial plastics
6. Industrial process and clean technology
7. Solid waste management

**UNIT 2                                      Environmental Management and Monitoring                                      15 Lectures**

**Topics:**

1. Environmental management : problems and need
2. Environmental management Plan: scope , EMP preparation , Need of EMP
  - Environmental Impact Assessment : Objectives of EIA
  - EIA and International organizations
  - Stages of EIA process
  - EIA in India : Process
  - Stages of Environmental clearance process
  - ISO 14000, Environmental audits, and ethics

**UNIT 3                                      Basic Concepts of Patenting                                      15 Lectures**

**Topics:**

1. Biotechnology and the law: objective, evolution, basic structure of gene techniques, applications, commercial potential of biotech inventions, rational for IPR protection
2. Patenting biotech inventions: objectives, concepts of novelty and concepts of inventive step, microorganisms, and moral issues in patenting biotech inventions
3. Plant varieties protection: objectives, justification, criteria for protection, international position, plant varieties protection in India, plant varieties protection under TRIPs
4. Patenting issues related to Biosimilars.

**UNIT 4    Geographical Indications and Traditional Knowledge: Concepts and Case Studies  
15 Lectures**

**Topics:**

1. Protection of geographical indications : objectives, justification, international position, multilateral treaties, national level, Indian position



2. Protection of traditional knowledge : objective, concept of traditional knowledge, holders, issue concerning, bioprospecting and bio-piracy, alternative ways, protectability, need for a sui generis regime, traditional knowledge on the international arena, traditional knowledge at WTO, traditional knowledge at the national level, traditional knowledge digital library
3. Case study related to basmati rice, erythropoietin, t-PA, glivec
4. Permissible and non-permissible biotech patenting in India

### **Reference Books:**

#### **Environmental Biotechnology:**

1. Indu Shekhar Thakur (2006) Environmental Biotechnology: Basic Concepts and Applications, I. K. International Pvt Ltd, 2006
2. Gareth M. Evans and Judith C. Furlong (2003) Environmental Biotechnology Theory and Application, John Wiley & Sons Inc.
3. Alan H. Scragg (2006) Environmental Biotechnology , 1<sup>st</sup> edition , Oxford University Press
4. S.K. Agarwal (2007) Environmental Biotechnology , APH Publishing Co-operation , New Delhi
5. Alexander N. Glazer and Hiroshi Nikaïdo (2010) Microbial Biotechnology, 2<sup>nd</sup> edition, Cambridge University press.
6. A.G. Murugesan and C. Rajakumari (2006) Environmental Science and Biotechnology Theory and techniques MJP Publishers , Chennai
7. Gwendolyn Holmes Bruce *et al*, (2000), Handbook of Environmental management and technology, Wiley Intersciences Publishers

#### **Intellectual Property Rights**

1. Prabudha Ganguly, (2001) Intellectual Property rights- unleashing the knowledge economy, Tata McGraw Hill Publishing Company Ltd.
2. Alexandra George (2006) Globalisation and Intellectual Property, Ashgate publishing company
3. Maarten Bode, (2008) Taking traditional knowledge to the market, Orient Longman Publishers
4. Sudeep Chaudhuri (2005), the WTO and India's Pharmaceutical industry, Oxford University Press.
5. Vandana Shiva (2002), Protect or Plunder? Understanding Intellectual Property Rights, Zed Books.

## PRACTICALS

### COURSE CODE: MS. BTS. 3.01PR

### BIOINFORMATICS

1. Study of databases
2. Sequence alignment :
  - a. Nucleotide BLAST
  - b. Protein BLAST
  - c. Study of orthologous and paralogous sequences using BLAST
3. Sequence alignment and applications :
  - a. Multiple sequence alignment
  - b. Phylogenetic analysis
  - c. Studying consensus sequences
  - d. Generation of sequence Logo using multiple aligned sequences
4. Analysis of nucleotide and protein sequences
  - a. Gene finding
  - b. Motif finding
  - c. Conserved domain identification
5. Classification of proteins using CATH and SCOPE
6. Study of proteins:
  - a. Homology modelling
  - b. Visualization of proteins using various visualization tools

### COURSE CODE: MS. BTS. 3.02PR ANIMAL CELL CULTURE

1. General aseptic techniques ,preparation, Media preparation
2. Primary culture using chick embryo and Subculture of cell line
3. Cytotoxicity testing using MTT and SRB
4. Karyotyping and G- Banding using human blood cells.

### COURSE CODE: MS. BTS.3.03PR

### BIOPROCESS TECHNOLOGY

1. Alcohol production from the yeast *Saccharomyces cerevisiae* and alcohol estimation by dichromate method
2. Invertase production from the yeast *Saccharomyces cerevisiae* and its purification
3. Xanthan gum production and purification from *Xanthomonas campestris*
4. Vit B<sub>12</sub> bioassay
5. Solid state fermentation

### COURSE CODE: MS. BTS.3.04PR ENVIRONMENTAL BIOTECHNOLOGY

1. Bio compost analysis
  - a. Analysis of physical parameters
  - b. Analysis of chemical parameters

#### References:

1. David Mount (2004) Bioinformatics: Sequence and Genome Analysis. 2<sup>nd</sup> edition, Cold Spring Harbor Laboratory Press, New York.
2. Culture of Animal Cells, R Ian Freshney, Wiley Publications, 5<sup>th</sup> / 6<sup>th</sup> Ed
3. Methods in Biotechnology (1997), Hansmauder Schmauder, Taylor and Francis Publications
4. Environmental Biotechnology: theory and techniques: A. E Murugesan, 2007, MJP Publications, Chennai



**St. Xavier's College – Autonomous  
Mumbai**

## **Syllabus**

**For 4<sup>th</sup> Semester Courses in M.Sc in Biotechnology  
(June 2015 onwards)**

### **Contents**

**Syllabus for the following courses:**

#### **THEORY COURSES**

- |             |   |
|-------------|---|
| MS.BTS.4.01 | Drug Designing and Nanotechnology         |
| MS.BTS.4.02 | Entrepreneurship and Research Methodology |

#### **PRACTICAL COURSES**

- |               |                      |
|---------------|----------------------|
| MS.BTS.4.01PR | Research Methodology |
| MS.BTS.4.02PR | Entrepreneurship     |
| MS.BTS.4 PR   | Research Project     |

## M.Sc. - I SEMESTER 4

**COURSE: MS. BTS. 4.01 DRUG DESIGNING AND NANOTECHNOLOGY**

**Overall Learning Objective:**

**60 Lectures**

- To gain an exposure to recent techniques in biopharmaceutical drug discovery
- To understand the

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**Unit 1 Drug Development 15 Lectures**

**Learning Objective:**

- To understand the quantitative structure – activity relationships of drug molecules
- To know the steps of drug discovery process

**Topics:**

1. Steps involved in drug discovery , Production and characterisation, Preclinical studies, and Validation studies.
2. Computer aided drug designing and docking.
  - a. General Principles of CADD
  - b. Types of drug designing
    - Ligand based molecular interactions.
    - Structure based Drug designing.
    - Examples of Ligand and structure-based drug designing
  - c. Applications and importance of CADD

**Unit 2 Clinical Research 15 Lectures**

**Learning objective:**

- To understand the relevance of clinical research in drug discovery process

**Topics:**

1. Introduction
2. Good clinical practice guidelines
3. Ethical aspects of clinical research
4. Clinical research methodologies and management
5. Regulatory requirements
6. Data management

**Unit 3****Regulatory Affairs and Pharmacovigilance****15 Lectures****Learning Objective:**

- To understand the role of monitoring of drugs before and after release by regulatory authorities

**Topics:**

1. ICH
2. FDA
3. Investigational New Drug Applications
4. Documents
5. Communication (Review period and approval period)
6. Classifications of Adverse Events
7. Scope of Drug Safety Problems
8. Drug Safety and FDA

**Unit 4****Nanotechnology in medicine****15 Lectures****Learning objective:**

- To study the concept of nanotechnology, synthesis of nanoparticles and its applications
- To understand the applications of emerging nanotechnology in treating diseases

**Topics:**

1. Introduction to nanotechnology:
  - a. Introduction to nanotechnology and bio-nanotechnology
  - b. Important nanoparticles / materials, bio nanorobots/molecular motors nano motors and their uses (in brief)
2. Synthesis of nanoparticles:
  - a. Common Strategies for synthesis of nanomaterials with examples, (Biological methods for nanoparticle synthesis)
  - b. Characterization methods
3. Applications of nanotechnology:
  - a. Nano sensors, and Carbon nanotubes and their applications in biology
  - b. medical nanotechnology
    - Nano pharmaceuticals : Nanobiotechnology for drug discovery and drug delivery
    - Nano-diagnostics : Nano particles for the detection and treatment of cancer, Nano arrays for molecular diagnostics , Nanoparticles for Molecular Diagnostics, nano barcode
    - Role of nanotechnology in biological therapy , nano devices in medicine and surgery
    - Worldwide Development and Commercialization of Nanomedicine

**CIA: Written Assignment**

**References:**

1. Daan J. A. Crommelin, Robert D. Sindelar. (2002) *Pharmaceutical Biotechnology: An Introduction for Pharmacists and Pharmaceutical Scientists*. Taylor & Francis.
2. Thomas M. Jacobsen, Albert I. Wertheimer. (2010) *Modern Pharmaceutical Industry: A Primer*. Jones & Bartlett Publishers.
3. Oliver Kayser, Rainer H. Müller. (2006) *Pharmaceutical Biotechnology*. John Wiley & Sons.
4. Gary Walsh. (2006) *Biopharmaceuticals: Biochemistry and Biotechnology*. John Wiley & Sons.
5. Tommy Liljefors, Povl Krogsgaard-Larsen, Ulf Madsen. (2010) *Textbook of Drug Design and Discovery*. 4<sup>th</sup> Edition. CRC Press
6. Mansoor M. Amiji (Editor). (2006) *Nanotechnology for Cancer Therapy*. CRC Press.
7. Gabor , Hornyak, Joydeep Dutta , Harry F. Tibbas ,(2009) *Fundamentals of Nanotechnology* ,CRC Press
8. Kewal K. Jain (2008) *The handbook of nanomedicine*. Humana Press
9. Scott E. McNeil ( 2009) , *Nanoparticle therapeutics: a personal perspective*, Wiley Interdisciplinary Reviews: Nanomedicine and Nanobiotechnology , Vol 1 Issue 3

**COURSE: MS. BTS. 4.02**

**ENTREPRENEURSHIP AND RESEARCH METHODOLOGY**

**Overall learning objective:**

**60 Lectures**

- To Understand the commercial potential of research and business in Biotechnology
- 

**Unit 1**

**Management principle**

**15 Lectures**

**Objective:**

- To provide students from a non-management orientation with a brief idea on the various functions in an organization, the role of various departments and how they function together in the creation of a successful and profitable company.

**Topics:**

1. Organizational Structure
  - Various Departments and the Roles they play
2. Marketing Management:
  - Understanding the role of marketing in Organizations
  - Customer Satisfaction and its importance
  - Marketing Research and its importance
  - Brief Introduction to Buying Behaviour
  - Understanding the Microenvironment (Strengths and Weaknesses vis-à-vis your company and its competition)
  - Understanding the Macro Environment (Opportunities and Threats – PEST Analysis)
  - Brief Introduction to Demand Forecasting
  - Market Segmentation and Target Markets
  - 5P's (Product, Price, Place, Promotion, People)
3. Finance Management
  - Understanding the role of finance in Organizations
  - Functions of a Finance Manager, Accountants, etc.
  - Financial Statements
  - Cash Flow
  - Taxes
  - Interest Rates
  - Risk and Rate of Return
  - Break-even analysis
4. Human Resource Management
  - Understanding the role of a HR Manager in Organizations
  - HR Planning, Resourcing and Retention
  - Training and development

- Performance Management
- Grievance handling
- Labour Laws and its importance

5. Other functions :

- Operations
- Research & Development
- Administration

**Unit 2**

**Entrepreneurship**

**15 Lectures**

**Objective:**

- To make students aware of entrepreneurship and motivate them to identify opportunities and dispel any fears they may have even in considering the same through Case Studies and talks by Entrepreneurs.

**Topics:**

1. Entrepreneurship
  - Meaning of entrepreneur
  - Advantages and Disadvantages of being an Entrepreneur.
  - Function of an entrepreneur
  - Types of entrepreneurs
  - Evolution of entrepreneurship in India
  - Factors affecting development of entrepreneurship.
  - Stages in entrepreneurial process
  - Role of entrepreneurs in economic development entrepreneurship in India.
  - Case Studies of Entrepreneurs (Good and Bad)
  - Visit and Lectures by Entrepreneurs
2. Women Entrepreneur :
  - Case Studies of Successful Women Entrepreneurs
  - Challenges faced by Women Entrepreneurs
  - Govt. Policy on Women Entrepreneurs
3. Micro Small & Medium Enterprises (MSME)
  - Role and Importance in Economic Development,
  - Impact of Liberalization, Privatization and Globalization on MSME,
  - Effect of WTO/GATT, PEST Analysis w.r.t. India
4. Sources of Finance
  - Sources of Finance available
  - How to prepare a business Plan
  - What do financiers look for in a business plan?
  - Institutional Support-Different Schemes, TECKSOK, KIADB, KSSIDC, KSIMC, DIC single window Agency SISI, NSIC, SIDBI, KSFC
  - Case Studies



**Unit 3****Business of Biotechnology****15 Lectures****Learning objective:**

- To understand the commercial applications and the current market status of biotechnology and related areas like pharmaceutical and diagnostics.

**Topics:**

1. Process Economics: Cost estimates, Process design, Design Exercise, Capital Costs estimates, Operating costs estimates.
2. Biotechnology companies, their care and nurturing
3. Investment in Biotechnology: seed investment, private investors, Venture capitalists, Corporate Partners, Grants.
4. Management in Biotechnology
5. Growth of biotechnology industry in India

**Unit 4****Introduction to research methods****15 Lectures****Learning objective:**

- To understand the basis of research methodology

**Topics:**

1. Meaning , objective, and types of research
2. Research approaches, Research Process and Criteria for Good Research
3. Research problem: definition , techniques involved , illustration
4. Research design : meaning , Important Concepts and basic Principles of Experimental Designs

**CIA: Writing a Business Plan****Reference books:**

1. Dynamics of Entrepreneurial Development & Management” Vasant Desai ,Himalaya Publishing House
2. “Entrepreneurship Development – small Business Enterprises” Poornima M Charanthmath Pearson Education – 2005
3. Entrepreneurship Development” S S Khanka S Chand &
4. Basic Biotechnology, Colin Ratledge and Bjorn Kristiansen, Cambridge University Press- 2<sup>nd</sup> Ed,2001
5. C.R. Kothari, Research methodology: methods and techniques, 2<sup>nd</sup> edition, New Age International Publishers, 2004
6. James Morris, A students guide to writing in the life sciences, The President and Fellows of Harvard University, 2007

## **PRACTICAL**

### **Overall Learning Objective:**

- To train the students in different aspects of scientific research and entrepreneurship

**4.01PR:** Research Methodology

**4.02PR:** Entrepreneurship

**4 PR:** Project for 4-5 months with Dissertation -300 Marks

**CIA:** Project Proposal, Literature Survey, Rough Draft and Poster Presentation