St. Xavier's College (Autonomous),

Mumbai

Syllabus of the courses offered by the

Post Graduate Department of Biotechnology

(2016 onwards)

St. Xavier's College – Autonomous

Mumbai

Syllabus

For 1st Semester Courses in M.Sc in Biotechnology

(June 2016 onwards)

Contents

Syllabus for the following courses:

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

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-relation 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. Organization of brain
2. Anatomy and functions of neuron
3. Ion conducting channels
4. Neuronal pathways and Propagation of nerve impulse
5. Synapses and gap junction, synaptic transmission
6. Neurotoxins
7. Neurotransmitters
8. Neuromuscular junction: Physiologic anatomy, molecular biology of acetylcholine formation and release, Drugs enhancing and blocking the transmission at NMJ, Myasthenia Gravis

CIA- Quiz + Bioinformatics

References:

1. J. Berg,J. Tymoczko & L. Stryer , Biochemistry, 5th edition , W. H. Freeman & Company publisher , 2002
2. G. Zubay , Biochemistry, 4th 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 , Macmilan 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 cataloging in publication data.
10. Arthur M Lesk , Introduction to Protein science Architecture, Function and Genomics , 1998 Oxford publishers

COURSE: MS. BTS.1.02 IMMUNOLOGY

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 region
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: Effector molecules in Immune Response 15 lectures

Learning objective

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

Topics:

1. **Complement system:** Functions of Complement, Components, Activation and Regulation.
2. **Cytokines:** Properties, Receptors, Antagonists, Diseases, 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

CIA: Summary Writing

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 Rastongi, 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, Bios publishers, 2003
10. Kenneth Murphy; Paul Travers; Mark Walport, Janeway's Immunobiology , 7th Edition , Garland Publishers , 2007

COURSE MS. BTS. 1.03 Molecular Biology

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 15 Lectures

Learning objective:

- To understand the anatomy of eukaryotic genome and its significance

Topics:

1. Human nuclear genome
   - Genetic features of nuclear genome
   - Non coding 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 Mapping of Genomes 15 Lectures

Learning objective:

- To understand the methodology of genome sequencing.

Topics:

1. Genetic Mapping: DNA markers for genetic mapping
2. Physical Mapping: Restriction Mapping, Fluorescent in situ hybridization (FISH), Sequence tagged site (STS) mapping

UNIT 3 Transcription 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
- To understand the elongation, termination and post transcriptional modification of the primary transcript

Topics:

1. DNA-Protein interactions during Transcription Initiation
2. Regulation of Transcription initiation.
3. Synthesis of eukaryotic mRNAs by RNA polymerase II
4. Intron splicing
5. Synthesis and processing of Non-coding RNAs: Transcript elongation and termination by RNA polymerases I and III
6. Introns in eukaryotic pre-rRNA and pre-tRNA
7. Processing of Pre-RNA, Degradation of mRNAs

UNIT 4: Translation and Post translational modifications 15 Lectures

Learning objective:

- To study the mechanism of translation and post translational modifications

Topics:

1. Basic mechanisms of RNA to Protein conversion
2. Post-translational Processing
3. Processing by proteolytic cleavage
4. Processing by chemical modification
5. Protein Degradation

CIA: Group Presentation

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 ,8th 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, 6th edition, 2004, Pearson education ltd.

6. G M Cooper, The Cell, a molecular approach, Library of Congress cataloging 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 , 4th 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.

UNIT 1 **Membrane Architecture** **15 Lectures**

Learning objective:

- To understand the structure and assembly of membranes.
- To understand the types of lipoproteins

Topics:

1. Membrane Structure and dynamics
2. Solubilisation of the membrane by using different detergents
3. Lipoproteins – structure, association with proteins and function
4. Types of Lipoproteins

Unit II **Membrane Studies** **15 Lectures**

Learning Objectives:

- To study the membrane functions and their utility in pharmaceutics

Topics:

1. Membrane functions
    a. Membrane transport : facilitated diffusion (Glut 1) and Primary and Secondary active transport (P,F, ABC, symporter and antiporter)
    b. Intracellular membrane transport: Transport of molecules between nucleus and cytosol, Endoplasmic reticulum
2. Liposome structure and their uses in drug targeting

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, 6th 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 , 2nd ed, garland publishers, 1999.
6. Lodish. H, Berk, A Molecular cell biology , 4th 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 and scientific communication Skills

1. Introduction to good laboratory practices
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 principles of Quality assurance and Quality control
7. Scientific communication:
    - Gathering scientific data from various sources.
    - Written communication : Guide to clear writing , forms and styles of writing
    - Oral communication variants
    - Concept of Plagiarism

CIA: Experiment Based/ Problem solving

COURSE MS. BTS.1.02PR Basic Microbiological and Molecular Biology Techniques

1. Introduction to basic microbial techniques
    a. Identification of micro organisms
    b. Sterility testing
2. Extraction of Genomic DNA Extraction from Bacteria
3. Extraction of Genomic DNA Extraction from Human samples
    a. Cheek cells
    b. Blood
4. Quantification of Biomolecules using UV (nucleic acids and proteins)
5. **Nucleotide sequences and analysis (Bioinformatics)**
    1. Human genome study
    2. Intron Exon finder, ORF finder
    3. Exploring genome databases.
    4. Study of tandem repeats

COURSE MS. BTS.1.03PR Biochemistry

A**. Protein separation and quantification**

1. Protein Estimation using the following methods:
    - Biuret assay
    - Bradford's assay
    - Folin-Lowry assay
2. Protein Separation by electrophoresis:
    - Polyacrylamide gel electrophoresis (native and SDS)
    - Horizontal gel electrophoresis (Slide and Slab)
3. Protein gel staining techniques:
    - Coomassie brilliant blue , Silver staining , TCA and Ponceau staining
    - Activity staining : LDH
4. Protein Purification techniques:
    - Protein Precipitation
    - Ion exchange Chromatography
    - Gel filtration
    - Affinity Chromatography
    - Study of purified Immunoglobulins using SDS PAGE
5. Viscosity studies of proteins

B. Protein sequence analysis (Bioinformatics)

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

CIA: Experiment based

COURSE MS.BTS.1.04PR Basic Immunology Tools

1. Isoagglutination titre study
2. Single Radial Immunodiffusion
3. Dot-ELISA
4. Antibody/ antigen capture ELISA

CIA: Experiment based

References:

1. Biochemical calculations (2nd Ed, 2004) Irwin H Segel, Wiley Publications
2. Principles and techniques of Biochemistry and molecular biology (7th Ed, 2010) Keith Wilson and John Walker, Cambridge university Press
3. Biochemistry Laboratory (2nd 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), Sheppler 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 2nd Semester Courses in M.Sc in Biotechnology

(June 2016 onwards)

Contents

Syllabus for the following courses:

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 lipid metabolism and its clinical implications.

Topics:

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

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, glyoxalate 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 application of plant cell culture in secondary metabolite production

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. Biotransformation of precursors using plant cell culture
4. Cryopreservation and conservation of germplasm

CIA: Quiz

References:

1. J. Berg,J. Tymoczko & L. Stryer , Biochemistry, 5th edition , W. H. Freeman & Company publisher , 2002
2. Nelson and Cox, Lehninger's Principles of Biochemistry, fourth edition , Macmilan 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.

Unit 1 Immune Effector Mechanisms 15 Lectures

Learning objective:

- To understand immune effector mechanisms in inflammation and 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.

Unit 2 Hypersensitivity and Autoimmunity 15 Lectures

Learning objective:

- To study the classification and mechanism of hypersensitivity
- To understand Autoimmunity.

Topics:

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

.Unit 3 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 4 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. Tumors of immune system
3. Tumor antigens
4. Tumor evasion of immune system
5. Cancer immunotherapy

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 Rastongi, Elements of Immunology, CSB Publishers and distributors
8. Gordan Reeve and Ian Todd, Immunology, fourth edition. Blackwell Publishing House

COURSE: MS. BTS.2.03 Molecular and Cellular Biotechnology

Overall learning objectives: 60 L

- To understand the regulation of genome activity
- To study the basics of recombinant DNA technology
- To understand basic concepts and techniques in animal cell biotechnology

UNIT 1 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.*

Unit 2: DNA vectors 15 Lectures

Learning objectives:

To understand the construction of specific vectors for protein studies and high capacity genomic libraries

Topics:

1. Expression vectors
    a. For maximizing protein synthesis
    b. To facilitate protein purification
    c. To promote protein solubilisation
    d. To promote protein export
2. Vectors for making RNA probes
3. BACs and PACs

Unit 3 Application of rDNA technology 15 Lectures

Learning objectives:

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

UNIT 4 Animal Cell Culture 15 Lectures

Learning Objective:

- To understand the concepts and techniques involved in culturing animal cells *in vitro*.
- To understand the applications of *invitro* culturing of cells

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

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 , 6th edition , 2004 , Pearson education ltd.
7. G M Cooper, The Cell, a molecular approach, Library of Congress cataloging in publication data.
8. Griffiths, A. and Miller J , An introduction to genetic analysis , Freeman
9. Lodish.H, 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, 4th ed, ASM Press, 2010
13. Culture of Animal Cells, R Ian Freshney, Wiley Publications, 5th / 6th Ed
14. Principles and Practice of Animal Tissue culture, Sudha Gangal, Universities Press, 2007
15. Animal Cell Culture: Essential Methods , John M Davis, John Wiley & Sons

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.

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, 2nd ed ., Humana publishers
6. David Spector and Robert Goldman, Basic methods in microscopy. Cold spring harbour laboratory press, 2006
7. Doughlas Chandler and Robert Robertson, Bioimaging – current concepts in light and electrom microscopy, Jones and Bartlett publishers, 2009.

PRACTICALS

Overall Learning Objectives:

- To learn the basic techniques in understanding metabolism and recombinant DNA technology
- To learn the basic techniques in animal cell culture
- To plan, execute experiments and analyse the data obtained.

COURSE: MS. BTS. 2.01PR Biochemical Techniques and Assays

1. Determination of acid value and iodine value of lipids
2. Determination of phosphorus from serum
3. Estimation of cholesterol from the serum sample
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 by DCPIP
9. Separation of photosynthetic pigments by chromatography
10. Vitamin B12 bioassay
11. Enzymatic assay (Invertase)

CIA: Experiment based

COURSE: MS. BTS.2.02PR 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
7. Preparation of glycerol stocks

CIA: Experiment based

COURSE: MS. BTS.2.03PR Animal Tissue culture

1. General aseptic techniques and preparation
2. Media preparation
3. Primary culture using chick embryo
4. Subculture of cell lines
5. Karyotyping and G- Banding using human blood cells.

CIA: Experiment based / paper based

COURSE: MS.BTS.2.04PR ANALYTICAL TECHNIQUES DATA INTERPRETATION

1. Study of western blotting technique
2. Instrumentation and Data interpretation of the following techniques
   a. HPLC
   b. Gas chromatography
   c. 2D electrophoresis
   d. Mass spectrometry
   e. Flow cytometry
3. Study of metabolic pathway databases eg: KEGG
4. Primer designing
5. Primer validation and study of PCR condition
6. Study of properties of nucleotide sequence : nucleotide count , translation , reverse translation
7. Study of in silico restriction digestion
8. Study of vectors
9. Gene finding

CIA: Data interpretation/ Paper Presentation

References:

1. Principles and techniques of Biochemistry and molecular biology (7^{th} Ed, 2010)Keith Wilson and John Walker, Cambridge university Press
2. Biochemistry Laboratory (2^{nd} 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
6. Culture of Animal Cells, R Ian Freshney, Wiley Publications, 5^{th} / 6^{th} Ed

St. Xavier's College – Autonomous

Mumbai

Syllabus

For 3rd Semester Courses in M.Sc in Biotechnology

(June 2016 onwards)

Contents

Syllabus for the following courses:

Theory Courses

Practical Courses

COURSE CODE: MS. BTS. 3.01

BIOSTATISTICS AND BIOINFORMATICS

Overall Learning Objective: **Total Lectures: 60**

- To understand core applied biostatistical concepts and methods
- To deepen the knowledge in basic computational science for the management and analysis of biological data

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UNIT 1 **Introduction to Biostatistics** **15 Lectures**

Learning objective:

- To understand the basic concepts of biostatistics

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 mean , paired and cochran's)
5. χ^2 test (test of homogenecity, Independence Goodness of fit)
6. P- value for all tests (Reading tables)
7. Regression
8. ANOVA

UNIT 2 **Applied Bio-Statistics** **15 Lectures**

Learning Objective:

- To understand the application of biostatistics in biological study

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. Non parametric tests: Sign , Wilcoxon and Mann- Whitney test

UNIT 3 Databases and Sequence Alignment 15 Lectures

Learning Objectives:

- To understand and access various types of data relating to molecular biology available on internet portal
- To understand to the concept of sequence alignment of biological macromolecules

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

Learning Objective:

- To analyse the protein sequences, retrieve and visualise protein structures
- To analyse gene sequences and its expression

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

    CIA: Problem Solving

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. 2nd edition, Cold Spring Harbor Laboratory Press, New York.
2. Jonathan Pevsner (2009) Bioinformatics and Functional Genomics. 2nd edition, John Wiley and Sons, New Jersey.
3. Teresa K. Attwood and D. J. Parry Smith (1999) Introduction to Bioinformatics. 1st 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. 2nd edition, A John Wiley & Sons, Inc., Publication
5. Arthur M. Lesk (2005) Introduction to Bioinformatics , 2nd edition Oxford University Press
6. Jean-Michel Claverie and Cedric Notredame Bioinformatics for Dummies, 2nd edition, Wiley Publishing, Inc.

COURSE CODE: MS. BTS. 3.02 Application of Biotechnology

Overall learning objective: **Total Lectures: 60**

- To understand basic concepts of human embryology
- To understand the potential of animal cells , organ engineering and genetic engineering in Therapeutics and Industrial Biotechnology

UNIT 1 Human Embryogenesis and *In Vitro* Fertilization 15 Lectures

Learning objectives:

- To understand the biology and technology of human embryo generation

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 2 Stem cells and tissue engineering 15 Lectures

Learning Objective:

- To understand the potential of stem cell therapeutics
- To understand the concepts in generation of human tissues *invitro*

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 3 Biopharmaceuticals 15 Lectures

Learning objective:

- To understand the method of production and uses of modern day therapeutic molecules

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

UNIT 4: Molecular Farming and Protein Engineering

Learning Objectives:

- To understand the application of genetic engineering techniques in therapeutics and industrial biotechnology

Topics:

- Chloroplast engineering
- Edible vaccine
- Directed mutagenesis – oligonucleotide directed and PCR amplified
- Protein engineering – increasing enzymatic activity, stability and specificity; modifying metal cofactor requirements

CIA: Written Assignment

Reference Books:

1. Kaushik Deb and Satish Totey. (2009) Stem Cells Basics and Applications. Tata McGraw Hill.
2. Gary Stein and Maria B et al. (2011) Human Stem Cell Technology and Biology. Wiley Blackwell.
3. R. Ian Freshney, Glyn N. Stacey, Jonathan M. Auerbach. (2007) Culture of Human Stem Cells. John Wiley & Sons
4. Robert Lanza, Robert Langer, Joseph P. Vacanti. (2011) Principles of Tissue Engineering. Academic Press.
5. Inderbir Singh & GP Pal. (2007) Human Embryology. MacMillan Publishers.

6. Thomas W. Sadler. (2009) Langman's Medical Embryology. Lippincott Williams & Wilkins.
7. Scott F Gilbert.(2000) Developmental Biology, 6th edition. Sinauer Associates.
8. Gordana Vunjak-Novakovic, R. Ian Freshney. (2006) Culture of Cells for Tissue Engineering. John Wiley & Sons.
9. Daan J. A. Crommelin, Robert D. Sindelar. (2002) Pharmaceutical Biotechnology: An Introduction for Pharmacists and Pharmaceutical Scientists. Taylor & Francis.
10. 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

Overall Learning Objective: **Total Lectures: 60**

- To understand the microbial growth , fermentation and product formation from the view point of industrial purpose

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UNIT 1 Principles of Bioprocess Technology 15 Lectures

Learning Objectives:

- To understand basics of bioreactor kinetics and mathematical equations regarding bioreactors.
- To understand the idea of scale-up and aeration of bioreactors in detail.

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 fermentor design and product formation
- Solid state fermentation
- Processes using recombinant organisms: hosts, vectors, genetic instability.

UNIT 2 Process dynamics 15 Lectures

Learning Objective:

- To study the concept of mass and heat transfer

Topics:

- Gas exchange and mass transfer: O_2 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

Learning Objectives:

- To understand how to purify microbial products (extra- and intracellular) after fermentation.
- To understand the techniques used in purification of fermentation products.

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

Learning objective:

- To understand source, method of production and applications of microbial products.

Topics:

1. Polysaccharides/ biopolymers/micro polymers- Xanthan gum, Dextran
2. Enzymes – proteases, amylases, pectinases, lipases
3. Neutraceuticals – Probiotics and prebiotics
4. Antibiotics – erythromycin
5. Vitamin B_{12}

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. 2nd 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

Overall Learning Objective **Total Lectures: 60**

- To understand the concepts of environmental biotechnology
- To understand the concepts of IPR and its applications in Biotechnology

UNIT 1 Pollution Remediation and Biotechnology 15 Lectures

Learning Objective:

- To understand the role of microorganisms and plants to mitigate environmental pollution

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. Phytoremedaition
    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

Learning Objective:

- To understand the concepts of environmental management and threat assessment

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

Learning objective:

- To understand the rationale for patenting in biotechnology and its commercial applications

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

Learning Objective:

- To understand the concepts of geographical indications, traditional knowledge and their utility in biotechnology

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, bio-prospecting and bio-piracy, alternative ways, protectibility, 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

CIA: Assignment

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 , 1st edition , Oxford University Press
4. S.K. Agarwal (2007) Environmental Biotechnology , APH Publishing Co-operation , New Delhi
5. Alexander N. Glazer and Hiroshi Nikaido (2010) Microbial Biotechnology, 2nd 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

Overall Learning Objectives:

- To learn the basics of *in - silico* analysis of biological data
- To understand experimental design for *in vitro* cytotoxicity assays.
- To learn the basic techniques in fermentation.
- To plan and execute experiments and analyse the data obtained.

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

CIA: Bioinformatics Problem solving

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

- Cytotoxicity testing using MTT and SRB

CIA: *In vitro* study (Mini project)

COURSE CODE: MS. BTS.3.03PR BIOPROCESS TECHNOLOGY

- Process development (upstream and downstream) eg. Alcohol production from the yeast *Saccharomyces cerevisiae*

CIA: Experiment based

COURSE CODE: MS. BTS.3.04PR ENVIRONMENTAL BIOTECHNOLOGY

- Internal Project

References:

1. David Mount (2004) Bioinformatics: Sequence and Genome Analysis. 2nd edition, Cold Spring Harbor Laboratory Press, New York.
2. Culture of Animal Cells, R Ian Freshney, Wiley Publications, 5th / 6th 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 4th Semester Courses in M.Sc in Biotechnology

(June 2016 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

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

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 principles of Quality assurance and control in pharmaceutical industry
- To understand the role of monitoring of drugs before and after release by regulatory authorities

Topics:

1. Quality assurance and control: concept
2. GMP and HACCP in pharmaceutical industry
3. Documentation – SOPs and Validation overview
4. ICH and FDA
5. Investigational New Drug Applications
6. Documents and Communication (Review period and approval period)
7. Classifications of Adverse Events
8. Scope of Drug Safety Problems
9. 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 nano-particles / materials, bionanorobots/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. Nanosensors, 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, nanobarcode
      - Role of nanotechnology in biological therapy , nano devices ain 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. 4th 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

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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 Micro Environment (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 and Entrepreneur
    - Function of an entrepreneur
    - Types of entrepreneur
    - 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
5. Research ethics

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- 2nd Ed,2001
5. C.R. Kothari, Research methodology: methods and techniques, 2nd 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