Progressive Education Society's
Modern College of Arts, Science and Commerce, Ganeshkhind, Pune

MSc Biotechnology

Course: **BT-101** Subject: **Advanced Biological Chemistry (**4C**)**

Class: M.Sc.I (Biotechnology); Pattern: 2013 (Semester 1) (Credit System)

Name of the Teacher: **Dr. Vinay Kumar**

Course Outcomes (CO):

The students on successful completion of the subject/course should be able to:

1. To understand the basic principles of biochemistry
2. To illustrate the disorders (inherited) related with errors in cellular metabolism or biochemical reactions
3. To explain the concepts of metabolome and metabolomics including integration of primary and secondary metabolisms
4. To illustrate the processes involved in phytochemical investigations for isolating specific secondary metabolites
5. To apply the principles of metabolomics for controlled metabolic flux analysis
6. To analyze the secondary metabolites using advanced characterization methods
7. To hypothesize how metabolic engineering can be used for directed production of desired metabolites
8. To design the process how plant secondary metabolites with therapeutic values can be isolated

Overall the students will understand the basic concepts and principles of biological chemistry with current trends and future perspectives in this field.

Progressive Education Society's
Modern College of Arts, Science and Commerce, Ganeshkhind, Pune

MSc Biotechnology

Course: **BT-101** Subject: **Advanced Biological Chemistry (**4C**)**

Class: M.Sc.I (Biotechnology); Pattern: 2013 (Semester 1) (Credit System)

Name of the Teacher: **Dr. Vinay Kumar**

Course Specific Outcomes (CSO):

Course BT-101 Advanced Biological Chemistry	**Course specific outcomes**	**Methodology**	**No. of lectures**
Specific Biomolecules and their structure & function Crabohydrates Lipids – Lipoproteins, signaling molecules and hormones Proteins- peptide hormones, growth hormones, kinases Cytokine receptors	This unit deals with the major life-defining biomolecules including carbohydrates, lipids, proteins and signaling molecules and hormones, their biochemistry and importance and roles in living beings.	• Conventional method • Interactive learning through Power-point presentation, illustrations using day to day examples and discussion	8
Protein Biochemistry Primary, Secondary, Tertiary, quaternary Structure Post translational Modifications: Protein folding- Molten globule, chaperon, Protein Misfolding Protein Processing: Proteolytic cleavage (Pre, Pro, removal Protein Modifications: Glycosylation Phosphorylation Lipids attachment Glycolipids Protein degradation: Lysosomal & proteosomal ubiquitination	Through studying this unit the students will learn about the protein-biochemistry including their structure at primary, secondary, tertiary as well quaternary levels. In this unit, the students will learn about the PTMs including protein modifications and degradations under specific conditions and their importance. This sub-unit deals with the processing of proteins. The students will learn about the modifications via major phenomena including glycosylation, phosphorylation and dephosporylation and attachments of lipids. The unit focuses on understandings about protein degradation, the process, importance and mechanisms including ubiquitination, somoylation etc.	• Conventional method • Interactive learning through Power-point presentation, illustrations using day to day examples and discussion • Class assignments	15

Enzymes: Activity, Regulation, Kinetics single substrate, Enzyme in diagnostics	The students learn about the enzymes, their activities, specific activities, regulation of enzyme activities and enzyme kinetics, besides use of enzymes in diagnostics		
Disorders of Metabolism Introduction Nutritional disorder: PEM(Kwashiorkar and Marasmus),Obesity Metabolic disorders: Diabetes Inborn errors of metabolism: Protein-PKU, Alkaptonuria and Maple syrup and Gauchers Carbohydrates: glycogen storage disorders, Cori's disease and Pomes disease Lipids: Atherosclerosis Nucleic acids: Gout, Lesch-Nyhan syndrome, Sickle cell anemia	This unit will make the students understand about the disorders due the abnormal chemical reactions in metabolisms The students will learn about the disorders due to lack nutrients for healthy functioning, or disability of a person to absorb nutrients from food. The unit focuses on various aspects of metabolic disorders especially diabetes and role of biotechnology in curing. Students learn about the rare genetic (inherited) disorders in which the body cannot properly turn food into energy. This unit focuses on disorders, particularly acquired ones due to the abnormal carbohydrate metabolisms. Here the students learn about the disorders due to abnormalities in lipid metabolism. Major diseases due to errors in nucleic acid metabolisms will be discussed under this unit.	• Conventional method • Interactive learning through Power-point presentation, illustrations using day to day examples and discussion • Class assignments	7
Metabolomics Overview of primary metabolism, Integration of Metabolism	This unit will make the students understand details about the metabolome including primary and secondary and metabolomics. Detailed discussions about the integration of primary and secondary metabolisms, especially in plants. This unit will cover the concept of	• Conventional method • Interactive learning through Power-point presentation, illustrations using day to day examples and discussion	15

The Metabolome: Metabolic flux, Metabolic flux analysis Metabolic engineering: 2 examples Polyketides Synthesis, Xenobiotics	metabolome and flow of energy and processes through it. The analysis of this rate of flow and its possible manipulations using metabolic engineering for desired metabolite production, with suitable examples on xenobiotics including polyketides..		
Phytochemsitry Introduction to secondary metabolism, primary metabolite as precursors of secondary metabolites Purple pathways for secondary metabolite synthesis: Mevalonate pathway Shikimate pathway Isoprene Unit Pathway (IPP) Variation of species: temporal & special variation Study of secondary metabolites for: structure, classification, properties & Therapeutic Plant sources as examples for each type: Alkaloids Phenols Terpenes Phytochemical investigation: Extraction methods & Qualitative & Quantitative Analysis	This unit will involve detailed discussions focused on plant secondary metabolism and metabolites, their connection with primary metabolites, various pathways for secondary metabolite synthesis in plants All major pathways involved in plant secondary metabolites like phenolics, terpenoids and N-containing compounds will be taught to students. Ecogeographical variations in terms of quality and quantity of plant secondary metabolites will be covered, highlighting the concept of 'chemodems'. Secondary metabolites' major classes including plant phenolics, isoprenoids, and alkaloids/flavonoids will be taught in this unit, including theraperutic properties of all of them. Plant sources for all three major classes of secondary metabolites will be covered under this unit. Details of phytochemical investigations started from collection, identification, extraction, fractionation, pure compound isolation and chemical characterization and quantification of secondary metabolites will be taught under this unit.	• Conventional method • Interactive learning through Power-point presentation, illustrations using day to day examples and discussion	15

References:

1. Proteins: biotechnologyand biochemistry, 1st edition (2001), Gary Walsch, Wiley, USA
2. Trease and Evans' Pharmacognosy, 16th edition (2009), William Charles Evans, Saunders Ltd. USA.
3. Enzymes: Biochemistry, Biotechnology & Clinical chemistry, (2001) Palmer Trevor, Publisher: Horwood Pub. Co., England.
4. Outlines of Biochemistry: 5th Edition, Erice Conn & Paul Stumpf ; John Wiley and Sons, USA
5. Lehninger, Principles of Biochemistry. 5th Edition (2008), David Nelson & Michael Cox, W.H. Freeman and company, NY.
6. Outlines of Biochemistry: 5th Edition, (2009), Erice Conn & Paul Stumpf ; John Wiley and Sons, USA
7. Biochemistry: 7th Edition, (2012), Jeremy Berg, Lubert Stryer, W.H.Freeman and company, NY
8. Plant Physiology, Taiz L. and Zeiger T. (2012), Sinaeur Associtates, Vth Edition.
9. Biochemistry and Molecular Biology of Plants (2015), Buchanan et al. John Wiley and Sons, 2nd Edition
10. Research journals including Phytochemistry, Trends in Plant Sciences, Plant Physiology etc.

Progressive Education Society's

Modern College of Arts, Science and Commerce,
Ganeshkhind, Pune-16

Dept of Biotechnology

Course: **BT 102** Subject: **Molecular Biology** (4C)

Class: MSc I Biotechnology Pattern 2013 (Semester I) (Credit System)

Name of the Teacher: Dr. Mruthyunjaya. S

Course Outcome:

a) Students will be able to analyze the genomes of various organisms.

b) Students will be able to interpret Cot curves and Rot curves.

c) Students will understand the molecular mechanisms of various transposons.

d) Students will get exposure of different types of Post-translational modifications in proteins.

e) Students will be able to analyze of different types of DNA recombination in different species.

Course Specific Outcome (CSO):

Course: BT 102 **Subject: Molecular Biology**	**Course specific outcome (CSO)**	**Methodology**	**No. of lectures**
Genome Structure and Organization: Definition and organization of viral, prokaryotic and eukaryotic genomes. C value paradox and genome size, Cot curves, repetitive and non-repetitive DNA sequences, Cot ½ and Rot ½ values, satellite DNA, DNA melting and buoyant density. Gene families, clusters, Pseudogenes, super-families,	Students will be able to analyze sizes of genomes and Cot curves. Students will get knowledge about various repetitive and non-repetitive DNA sequences. They will also learn about various examples of gene families and super-families.	Conventional method and active learning	8

Organelle genomes			
DNA Replication: DNA polymerases and mechanisms of DNA replication in prokaryotes and eukaryotes DNA replication models, connection of replication to cell cycle, Gene amplification (rRNA) Reverse Transcriptase	Helps students to understand synthesis of DNA, and study of various enzymes required in the polymerization. Helps them to understand difference between microbes and eukaryotic cells.	Conventional method	5
DNA damage and Repair: Types of DNA damage, DNA repair mechanisms- nucleotide excision repair, base excision repair, mismatch repair, recombination repair, double strand break repair, transcriptional coupled repair	Helps to understand the etiology of cancer and various fatal diseases.	Conventional method	4
Recombination: Homologous and site-specific recombination, models for homologous recombination- Holliday junction, NHEJ, Proteins involved in recombination- RecA, RuvA, B, C, Gene conversion	This unit will impart knowledge about various types of recombination observed in different species. This module also gives information about the molecular mechanisms involved in recombination.	Conventional method	3
Gene Expression in Prokaryotes and Eukaryotes: Transcription: Basic mechanism in prokaryotes and eukaryotes. RNA polymerases Chromatin remodeling in relation to gene expression	Expression studies help students in further research and understand gene expression during controlled and stressed conditions.	Conventional method	20
Mobile DNA elements: Transposable elements in bacteria, IS elements, composite transposons, replicative and non-replicative transposons, Mu transposition, Controlling elements in TnA and Tn 10 transposition. SINES and LINES, retrotransposons	Students will be able to analyze different types of transposons. The molecular mechanisms involved in transposition will be understood by the students. They will also get exposure of transposons of human beings.	Conventional method	4
Protein Synthesis, Modifications and Transport: Components of protein synthesis, Mechanism of protein synthesis,	This unit will focus on the molecular mechanisms involved in protein synthesis. The students will be able to analyze all types of	Conventional method	15

Genetic code Regulation of protein synthesis, Post translational modifications Transport of proteins, Protein turnover and degradation	genetic codes and all kinds of post translational modifications in proteins. Students will also learn the process of transport of proteins and protein degradation.		

Types of evaluation

1. Formative evaluation: - Knowledge, Understanding, Application, Skill

- Tests, Seminar and assignments as a method of evaluation for Credit System.

2. **Summative evaluation:** -Term end examination and University examination

References:

1. Genes XI, 11th edition (2012), Benjamin Lewin, Publisher - Jones and Barlett Inc. USA
2. Molecular Biology of the Gene, 6th Edition (2008), James D. Watson, Tania Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Lodwick. Pearson Education, Inc. and Dorling Kindersley Publishing, Inc. USA
3. Molecular Biology, 5th Edition (2011), Weaver R., McGrew Hill Science. USA
4. Fundamentals of Molecular Biology, (2009), Pal J.K. and Saroj Ghaskadbi, Oxford University Press. India
5. Molecular Biology: genes to proteins, 4th edition (2011), Burton E Tropp, Jones & Bartlett Learning, USA

Progressive Education Society's
Modern College of Arts, Science & Commerce
Ganeshkhind, Pune – 16

Department of Biotechnology

Course: **BT-104** Subject: Cell Biology **(**4C**)**

Class: M.Sc.I (Biotechnology); Pattern: 2013 (Semester 1) (Credit System)

Name of the Teacher: Dr. Amrita Srivastav

COURSE OUTCOME

- Cell biology has grown, extensively in recent years and has an advanced 'interdisciplinary' networking potential with modern cutting edge technology. This has given it a separate status in fundamental research as well as in modern industrial enterprise.
- Cell biology focus has slowly shifted to not only current understanding of cell morphology and physiology but also on to technology development and application in life sciences. In the milieu of research and industrialization for economic development and social change, cell biology is an ideal platform to work for students.
- The current post graduate syllabus of cell biology deals with not only structure and functions of cell organelles but also how the cell transforms and alters during different phases of cell cycle and during different developmental stages in the life cycle of an individual.
- The versatile nature of the subject, cell biology involves many fundamental research fields from cell organelles to their functions, from physiology of stressed cells to programmed cell death, from cell communication to cell signalling and so on.
- The proposed credit-based curriculum and grading system adds much more to the existing syllabus of cell biology. The relevance and application of these studies on living organisms and their bioprocesses is extensively covered in this field with the help of technology.
- To help the students to build interdisciplinary approach
- To empower students to excel in various research fields of Life Sciences
- To inculcate sense of scientific responsibilities and social and environment awareness
- To help students build-up a progressive and successful career

Progressive Education Society's
Modern College of Arts, Science & Commerce
Ganeshkhind, Pune – 16

Department of Biotechnology

Course: **BT-104** Subject: **Cell Biology (**4C**)**

Class: M.Sc.I (Biotechnology); Pattern: 2013 (Semester 1) (Credit System)

Name of the Teacher: Dr.Amrita Srivastav

Course specific outcome (CSO)

Course: BT -104 **Subject: Cell Biology**	**Course specific outcome (CSO)**	**Methodology**	**No. of lectures**
Cell structure and cytoplasmic membrane system– structure and functions of organelles and membrane trafficking, Methods in Cell Biology Cell structure and function with inter relationship of cell organelles, energy transformation Cell membrane – Plasma membrane types and cytoplasmic membrane system- structural and functional organization Transport across plasma membrane and intra-cellular transport at molecular level	opens a wide arena for biomedical and cutting edge technological applications. It gives students an ability to think how a cell functions in totality, its different organelles are important to understand.	Conventional method	15
Cell signalling: communication between cells and environment Cytoskeleton- Structure- assembly and disassembly of cytoskeletal elements, role in cell division Extracellular matrix and cell junctions- relevance to tissue structure and function Signalling at cell surface, signalling molecules, hormones and receptors signalling pathways that control gene activity,	These topics are tremendously powerful in shaping this century and exciting biofuture for our students. Signaling is important for students to analyse how a cell responds to different stresses.	Conventional method	15

signal transduction and second messengers			
Cell differentiation, cell death, cell transformation Cell Cycle and its regulation Cell differentiation in plants and animals including terminal cell differentiation, Role of hormones and growth factors Programmed cell death Cell transformation and etiology of cancer	Life science, IT industries and research institutes are always on a lookout for trained cell biologists as an efficient work force in fundamental research and industries.	Conventional method and Active learning	15
Plant Cell Structure of Plant Cell, Plant cell wall - primary and secondary, biogenesis role in growth and development, Plamodesmata-structure and function Plastids - biogenesis, structure and types	Education and research sectors requires interdisciplinary trained workforce to develop future generations of science leaders.	Conventional method and Active learning	15

Types of Evaluation:

1) Formative Evaluation: -Knowledge, Understanding, Application, Skill

   -Tests, seminar and assignments as a method of evaluation for credit system.

2) Summative Evaluation: Term End Examination and University Examination

References:

1.Molecular Cell Biology. 7th Edition, (2012) Lodish H., Berk A, Kaiser C., KReiger M., Bretscher A., Ploegh H., Angelika Amon A., Matthew P. Scott M.P., W.H. Freeman and Co., USA

2. Molecular Biology of the Cell, 5th Edition (2007) Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Garland Science, USA

3. Cell Biology, 6th edition, (2010) Gerald Karp. John Wiley & Sons., USA

4. The Cell: A Molecular Approach, 6th edition (2013), Geoffrey M. Cooper, Robert E. Hausman, Sinauer Associates, Inc. USA

Progressive Education Society's
Modern College of Arts, Science & Commerce
Ganeshkhind, Pune – 16
Department of Biotechnology

Course: **BT-106** Subject: BT 106: Exercises in Molecular and Cell Biology (3C)

Class: M.Sc.I (Biotechnology); Pattern: 2013 (Semester 1) (Credit System)

Name of the Teacher: Dr.Amrita Srivastav

COURSE OUTCOME

- The proposed credit-based curriculum and grading system adds much more to the existing syllabus of cell biology. The relevance and application of these studies on living organisms and their bioprocesses is extensively covered in this field with the help of technology.
- To help the students to build interdisciplinary approach
- To empower students to excel in various research fields of Life Sciences
- To inculcate sense of scientific responsibilities and social and environment awareness
- To help students build-up a progressive and successful career

Course specific outcome (CSO)

Course: BT -104 **Subject: Cell Biology**	**Course specific outcome (CSO)**	**Methodology**	**No. of lectures**
Isolation of nuclei and chromatin Mononucleosome size determination by agarose gel electrophoresis Extraction and Analysis of Histones	It gives students an ability to think how a cell functions in totality, its different organelles are important to understand.	Conventional method	2
Isolation of RNA and analysis by agarose gel	Helps students to understand and analyse nucleic acids interpretations	Conventional method	2
Electron micrographs- Interpretation of photographs	Life science, IT industries and research institutes are always on a lookout for trained cell biologists as an efficient work force in fundamental research and industries.	Conventional method and Active learning	1
Isolation of mitochondria and lysosomes and assay of SDH and	Helps students to understand enzyme kinetics	Conventional method and Active learning	1

acid phosphatase activity respectively			
Programmed cell death during limb development In Chick	Helps students to understand the phenomenon of apoptosis in vivo	Practical	2
Cell types of plants - maceration of various tissue explants and identification of xylem vessels, tracheids, stomata, root hair etc.	Helps students to understand the functions and morphology of different cell types in plants .		1

Types of Evaluation:

3) Formative Evaluation: -Knowledge, Understanding, Application, Skill

-Tests, seminar and assignments as a method of evaluation for credit system.

4) Summative Evaluation: Term End Examination and University Examination

References:

1.Molecular Cell Biology. 7th Edition, (2012) Lodish H., Berk A, Kaiser C., KReiger M., Bretscher A., Ploegh H., Angelika Amon A., Matthew P. Scott M.P., W.H. Freeman and Co., USA

2. Molecular Biology of the Cell, 5th Edition (2007) Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Garland Science, USA

3. Cell Biology, 6th edition, (2010) Gerald Karp. John Wiley & Sons., USA

4. The Cell: A Molecular Approach, 6th edition (2013), Geoffrey M. Cooper, Robert E. Hausman, Sinauer Associates, Inc. USA

Progressive Education Society's
Modern College of Arts, Science and Commerce, Ganeshkhind, Pune

MSc Biotechnology

Course: **BT-105** Subject: **Exercises in Advanced Biological Chemistry (**4C**)**

Class: M.Sc.I (Biotechnology); Pattern: 2013 (Semester 1) (Credit System)

Name of the Teacher: **Dr. Vinay Kumar**

Course Outcomes (CO):

On successful completion, the students should be able to:

1. Perform protein estimation using spectrophotometric methods and separation of proteins using chromatographic techniques
2. Demonstrate the NATIVE-PAGE non-denaturing gel electrophoresis of enzymes
3. Calculate specific activities of enzymes lactate dehydrogenase and beta-galactosidase under variable parameters
4. Illustrate the solvent based crude extraction from plant material and qualitative detection of specific classes of secondary metabolites in the extract
5. Illustrate thin-layer chromatography for detection of specific secondary metabolite.

Course Specific Outcomes (CSO):

Course BT-105 **Exercises in Advanced Biological Chemistry**	**Course specific outcomes**	**No. of Practical**
Extraction, purification and characterization of protein precipitation, Dialysis	• To learn the techniques for extraction, purification and precipitation and characterization of proteins using different methods • To identify the most sensitive method for protein quantification	2
Column Chromatography- Gel filtration/ Ion exchange/ Affinity	• To learn about the principle and methodology for gel filtration and ion-exchange chromatography • To analyze the given samples using these techniques and interpret the results	2
Native & PAGE/ Quantification	• To learn NATIVE-PAGE technique for protein separation	1
Enzymology : Beta galactosidase: pH, Temperature, time, various Substrate concentration, inhibition, Km and Vmax and LB plot	• To learn Enzymology including enzyme kinetics • To compare and standardize the variable parameters for highest enzyme activities • To design and plot the appropriate graphs for enzyme activity	2

Enzymology : LDH: pH, Temperature, time, various Substrate concentration, inhibition, Km and Vmax and LB plot	• To learn Enzymology including enzyme kinetics • To compare and standardize the variable parameters for highest enzyme activities • To design and plot the appropriate graphs for enzyme activity	2
Phytochemical Methods: Extraction Methods: Preparation of extract, aqueous & organic solvents at least one Alkaloid, Phenolic and Glycoside each	• To learn phytochemical extraction including how to prepare solvent-extract and concentration *in-vacuo* • To design the experiment for chromatographic detection of specific phytochemical	2
Phytochemical Methods: Qualitative detection & Quantitative estimation	• To learn qualitative detection of secondary metabolite classes • The quantitative estimation of secondary metabolites	1

Evaluation:

Formative assessment: Continuation Assessment to Tests knowledge, understanding, analyzing, application and skill-developed by

- Written Unit Tests
- Journal/Lecture/Library notes
- Seminar presentations
- Home Assignments
- Open Book Test

Summative assessment: In the form of continues assessment and Term-end University examination

Course: **BT 301** Subject: **Animal Biotechnology** (4C)

Class: MSc II Biotechnology Pattern 2013 (Semester III) (Credit System)

Name of the Teacher: Dr. Mruthyunjaya. S

Course Outcome:

On completion of the course, students should be able to understand

a) different vectors that are used for generating transgenic animals.

b) all types of media used for culturing animal cells.

c) various cell lines used for production of therapeutic products.

d) different culture systems such as 2-dimensional culture and 3-dimensional cultures.

e) several animal husbandry techniques such as artificial insemination, embryo transfer technology.

Course Specific Outcome (CSO):

Course: BT 301 **Subject: Animal Biotechnology**	**Course specific outcome (CSO)**	**Methodology**	**No. of lectures**
Introduction to tissue culture: Definition, principle and significance of tissue culture. Culture media: natural, synthetic media, and sera. Introduction to the balance salt solutions and simple growth medium.	This study will impart the knowledge about the practice of animal tissue culture. Students can prepare various types of media. They can also prepare various buffers used in animal tissue culture.	Conventional method and Active learning	6
Various systems of tissue cultures: Primary culture: Behavior of cells, properties, utility with different examples, Explant culture, Suspension culture.	This unit will focus on different types of cultures employed for culturing animal cells. Students will be able to distinguish different types of cultures methods.	Conventional method	5
Cell lines, establishment and	Students will be able to establish	Conventional	5

maintenance: Normal and established cell lines: Their characteristic features and utility, Characteristics of cells in culture. Contact inhibition, anchorage (in) dependence, cell-cell communication , Cell senescence.	cell lines from different animal tissues. Student will also be able to distinguish normal cell lines and transformed cell lines.	method and Active learning	
Organ culture: Methods, behavior of organ explant, and utility of organ culture. Histotypic and organotypic cultures, Organ transplants, tissue engineering	This unit will emphasize on how to establish organ cultures from various organs. Students will learn the difference between Histotypic and organotypic cultures. Students will be exposed to the diverse field of tissue engineering and with their creativity can design new tissue engineering projects.	Conventional method	3
Growth studies: Cell proliferation, cell cycle, mitosis in growing cells. Freeze storing of cells and transport of cultures. Cell cloning and types of cloning, cell synchronization, micromanipulation, Cell transformation. Separation of cell types: Flow cytometry. Nuclear transplantation, Cell hybridization, Transfection studies.	Students can perform cell proliferation experiments such as MTT assay. Students can perform cryopreservation of cells and also can transport live cultures. They will be able to do cell cloning and cell transformation. They will be able to prepare the samples for flow cytometry and can even go for cell hybridization experiments. They will also be able to do transfection of animal cell lines.	Conventional method and Active learning	6
Application of animal cell culture: *In vitro* testing of drugs, in production of human and animal viral vaccines and pharmaceutical proteins. Mass production of biologically important compounds. Harvesting of products, purification and assays. Propagation of viruses (viral sensitivity of cell lines).	Student will be able to test drugs in cell lines. They will also be able to generate vaccines using animal models such as chick embryo. Students will learn how to use different chromatographic techniques for harvesting animal cell products. Students will also be able to propagate viruses in animal cell lines.	Conventional method and Active learning	4
Growing cells in serum free media: scaling up, Hybridoma &	Students will be able to culture cells in serum free media. This unit will impart knowledge to	Conventional method and Active learning	2

monoclonals	students about how to establish hybridoma and produce monoclonal antibodies.		
Stem cells: adult, embryonic, induced pluripotent stem cells: Concept, principles for identification, purifications, assessment of proliferation long-term maintenance and characterization.	Students will learn how to isolate embryonic stem cells and other types of stem cells. Students will get exposure about how to characterize different types of stem cells. They will also get knowledge about how to maintain stem cells for long periods.	Conventional method	10
Overview-livestock breed and their productivity: artificial breeding-methods and hazards,marker assisted breeding of livestock, Introduction to animal genomics, different methods for characterization of animal genomes, SNP, STR, QTL, RFLP, RAPD, genetic basis for disease resistance	This unit will impart knowledge about different animal husbandry techniques to students. They will also learn how to characterize genomes of cattle using different molecular markers. Students will be able to analyze molecular mechanisms of disease resistance.	Conventional method and Active learning	7
Transgenic animals: artificial breeding – in vitro fertilization and embryo transfer technology, artificial insemination, germ cell storage, Genetic modifications – methods, Transgenic fish and mammals (Mice, Sheep). Gene targeting: Targeted gene transfer. Mouse models for human genetic disorders, Knockout mice.	Students will be able to chose appropriate vectors for expressing a transgene in a specific cell type. Students will be able to trouble shoot the problems if they need to generate transgenic cells in their projects. Students will be able to design novel research projects involving studies on knockout mice.	Conventional method	10
Biosafety and bioethics issues: associated with developing transgenic animals	Students will be able to analyze biosafety and bioethics issues of their project work or any other experiments they are doing.	Conventional method	2

Types of evaluation

1. Formative evaluation: - Knowledge, Understanding, Application, Skill
- Tests, Seminar and assignments as a method of evaluation for Credit System.

2. **Summative evaluation:** -Term end examination and University examination

References:

1. R. Ian Freshney. Culture of Animal cells, 5rd Edition, 2010. A John Wiley & Sons, Inc., Publications, USA
2. R.W.Masters. Animal Cell Culture- Practical Approach, 3rd Edithion,2000, Oxford University Press. USA
3. Robert Lanza et al. *Essentials of Stem Cell Biology*", Academic Press, 2nd edition, 2006.USA
4. Text book of Animal Husbandary, 8th edition, (1998) G.C. Banerjee,Oxford and IBH Publishin co.Pvt. Ltd. India
5. Molecular Biotechnology: 4th edition. (2010), Glick B.R., Pasternak J.J., Patten C. L., ASM press, USA
6. Gene Transfer to Animal Cells, 1st edition (2005), R. M. Twyman, Taylor & Francis USA.

P.E.Society's

Modern College of Arts, Science and Commerce,

Ganeshkhind, Pune 411016

Department of Biotechnology

Class: M.Sc. II (Semester I)
Pattern: 2013 (Credit System)

Course: BT 302 **Sub: Bioprocess Engineering and Fermentation Technology**

Name of the Teacher: Dr. Uttara Oak

Course Outcome:

On successful completion, the students are able to

- Design bioreactors for the production of various products
- Predict important yield coefficients using the principles of stoichiometry and energetics of microbial growth
- Understand soluble and immobilized enzyme technologies for the production of industrial and medical products
- Present knowledge about major metabolic pathways and those related to biofuels production from microbes
- Analyse metabolic network and metabolic flux
- Specify required technologies to effectively utilize genetically engineered microorganisms for bioprocessing
- Estimate kinetic parameters from raw fermentation data

Course Specific outcomes- BT 302- Bioprocess Engineering and Fermentation

Unit	Title	Learning Outcome
1	Introduction to fermentation and Basic aspects of bioengineering Introduction to fermentation: Fermentation, types. Basic Aspects of Bioengineering: Design of Fermenter/ bioreactors – Design aspects of Stirred tank reactor and non- mechanically agitated bioreactors (Air lift and Bubble column) Kinetics of operation of bioreactors: Batch, Fed Batch and Continuous processes. Design and operation of immobilized cell reactors. Mass transfer, Aeration and agitation of fermentation broth: Mass transfer: Concept of mass transfer, Molecular diffusion and role in Bioprocess, Two – film theory, Convective mass transfer, volumetric mass transfer (*KLa* introduction), Liquid-Solid, Liquid-liquid and Gas- liquid mass transfer equations and significance in bioprocess. Aeration: Oxygen Uptake in cell cultures, Oxygen transfer from Gas bubble to Cell. Gas hold up, KLa importance, Determination of KLa, Factors affecting KLa. Agitation: Design of impellors and their flow patterns. Fermentation Broth rheology – Newtonian and Non Newtonian fluids, Factors affecting broth rheology, Power requirement for mixing Power number, Reynolds number, Flow regimes in fermentation tank (Laminar, turbulent and transition), Correlation between mass transfer coefficient and operating	• Recognize the fundamentals of fermentation technology, • Examine the application of biological and engineering principles to problems involving microbial, mammalian, and biological/biochemical systems • Learn design of different types of bioreactors and their applications in various bioprocesses, • Learn fermentation types and analyse kinetics of cell and product formation in batch, continuous and fed-batch cultures • Learn the factors affecting mass transfer in general and oxygen transfer in a bioprocess • Learn different types of impellers, the flow patterns they create in the fermentation vessel. • Correlate use of type of impeller w.r.t. medium viscosity, power requirements • Differentiate the rheological changes during fermentation process, • Assess power requirements in bioreactors

Course Specific outcomes- BT 302- Bioprocess Engineering and Fermentation		
Unit	**Title**	**Learning Outcome**
	variables.	
2	Fermentation Media, Sterilization and monitoring of process variables Media components and their optimization. Sterilization of media: Kinetics of destruction of microorganisms, indicator organism Del factor, designs of Batch and continuous sterilization (Del factor calculation), equipment used. Filter sterilization. Monitoring of process variables: Types of sensors, Measurement and control of various parameters (pH, Temperature, dissolved oxygen, microbial biomass, inlet and exit gases, fluid flow, Pressure, Foam) P.I. D. control, Computer control of variables. Scale Up and Scale Down.	• Learn about the various raw material used as medium component • Define its role as nutrient • Understand the rationale in medium optimization and formulation • Understand the kinetics of death • Learns the methods used for sterilization of media, gases and the process equipment • Learn about the instrumentation (Basic and advanced) used for monitoring and control of a bioprocess • Understand the concept of scale up and scale down
3	Molecular Engineering Important strains and pathways –Mutation, Protoplast fusion, Parasexual cycle and genetic engineering for strain improvements, product formation and inhibition pathways and their regulations; applications in medicine, agriculture and industry. Industrially important microorganisms, preservation, Culture collection centers	• Comprehend growth and metabolism, genetics and metabolic engineering • Evaluate factors that contribute in enhancement of cell and product , process improvement through metabolic manipulations • Product formation during fermentation process • Identify techniques applicable for Improvement of microorganisms based on known biochemical pathways and regulatory mechanisms
4	Production and Downstream processing Concept of primary (growth associated) and secondary metabolites (Growth non-associated) metabolites, kinetics of	• Comprehend the techniques and the underlying principles in downstream processing • Understand and apply various techniques involved in the a product isolation, purification and

Course Specific outcomes- BT 302- Bioprocess Engineering and Fermentation		
Unit	**Title**	**Learning Outcome**
	growth and product formation. Yield coefficient and efficiency. Downstream processing and unit operations, General strategy of downstream processing, Production, recovery (with principles of techniques involved) and applications of Vitamins (Vitamin C), Amino acids, Enzymes, Antibiotics, Organic acids, Vaccines, Biotransformation product (steroid), Cheese, Exopolysaccharides. Effluent Disposal strategies used for Textile, dye, dairy, paper and pulp industries Applications of microbes as/in: chemical factories, mixed culture, probiotics, ore leaching, biofuels. Role of plant and animal cells in bioprocess. Fermentation economics	formulation • Learn different methods applied for recovery of the said product at the industrial scale

References:

1. Stanbury, P. F. and Whittaker, A. (1984) Principles of Fermentation technology, Pergamon press
2. Peppler, H. L 1979, Microbial Technology, Vol I and II, Academic Press.
3. Casida, L. E., 1984, Industrial Microbiology, Wiley Easterbs, New Delhi
4. Prescott. S.C and Dunn, C. G., 1983 Industrial Microbiology, Reed G. AVI tech books.
5. A. H. Patel. (1985), Industrial Microbiology, Macmillan India Ltd.
6. Crueger, W. and Crueger, A. (2005) A Text Book Of Industrial Biotechnology, Panima, New Delhi.
7. Satyanarayan U, Biotechnology, Arunabha Sen Books allied Publishers.
8. Schuler,M. and Kargi,F.Bioprocess Engineering -Basic Concept, Prentice Hall of India, New Delhi.
9. Bioprocess Engineering Principles - Pauline Doran, Academic Press 1995
10. Operational Modes of Bioreactors, BIOTOL series - Butter worth, Heinemann 1992
11. Bioreactor Design & Product Yield, BIOTOL series - Butter worth Heinemann 1992
12. Lydersen, Bioprocess Engineering : Systems, Equipment & Facilities Ed. B. N.A. Delia & K.M. Nelson, John Wiley & Sons Inc,1993
13. Harrison,R, Todd, P(2006), Bioseparations science and Engineering, Oxford University Press

P.E.Society's

Modern College of Arts, Science and Commerce,

Ganeshkhind, Pune 411016

Department of Biotechnology

Class: M.Sc. II (Semester I)
Pattern: 2013 (Credit System)

Course: BT 307 **Sub:**
Exercises in Bioprocess Engineering

Name of the Teacher: Dr. Uttara Oak

Course Outcome:

On successful completion, the students are able to design experiments

- To enrich, isolate and purify a microbe showing a metabolic ability (production of primary or secondary metabolite)
- Grow the organism to produce the metabolite and detect its presence
- Optimize production, assay the product, predict yield

Course Specific outcomes- BT 307- Exercises in Bioprocess Engineering			
Sr. No.	**Topic**	**Learning Outcome**	**No. of Practicals**
1	Screening and identification (Genus Level) of a production strain (enzyme /antibiotic) from soil samples	• Learn methods for screening and identification of a production strain • Evaluate a better producer based on biochemical assay	1
2	Maintenance of the isolated production organism (Agar slants/ glycerol stocks /soil culture/	• Learn and evaluate a suitable method for preservation of production strain	1

Course Specific outcomes- BT 307- Exercises in Bioprocess Engineering			
Sr. No.	**Topic**	**Learning Outcome**	**No. of Practicals**
	lyophilization) at least two methods		
3	Optimization of different parameters of the isolated organism (conventional and Statistical design)	• Apply the conventional and statistical method for optimization of production parameters • Determine the most significant parameter for production	1
4	Inoculum build-up of the isolated organism for use in bench top fermentation	• Understand the difference in the lab scale and large scale process and method to develop inoculum	1
5	Study of Working of lab bench fermenter (with production of enzyme or antibiotic using screened organism), Study of different parts and assembly of the bench top fermenter	• Observe different parts of fermenter and Understand working of different parts • Experience the handling of lab bench fermenter, observe its working	1
6	Assay of product formed (Bioassay or Enzyme assay)	• Learn the concept of a bioassay/enzyme assay and quantitate the products	1
7	Solid state fermentation : Lab scale production of a product	• Learn the techniques for cultivation of mushrooms using solid state fermentation	1
8	Biosorption of dyes or metals using dead biomass. *Aspergillus niger* or brewer's yeast cells could be grown in liquid media, harvested and killed by autoclaving. Dried biomass to be used for biosorption (both the organisms are suitable for adsorbing Congo Red)	• Study biosorption of dyes on dead biomass and evaluate its application for treatment of dye containing effluents	1
9	Demonstration of working of industrial fermenters by visiting fermentation industry	• Experience the working and production of fermentation product at industrial scale	1

P.E.Society's

Modern College of Arts, Science and Commerce,

Ganeshkhind, Pune 411016

Department of Biotechnology

Class: M.Sc. II (Semester I)
Pattern: 2013 (Credit System)

Course: BT 303 **Sub: Database Management and Intellectual Property Rights**

Name of the Teacher: Dr. Uttara Oak

Course Outcome:

On successful completion, the students

- **Learn the basic concepts and appreciate the applications of database systems**
- **Learn and apply databases for knowledge building**
- **Are aware of their rights for the protection of their invention done in their project work**
- **Are able to understand the norms for getting registration in our country and foreign countries of invention, designs and thesis or theory written by the students during their project work**
- **Have knowledge of patents, copy right, trademarks, designs in biotechnology**

Course Specific outcomes- BT 303: Database Management and Intellectual Property Rights				
Unit	**Topic**	**Learning Outcome**	**Methodology**	**No. of Lectures**
1	**Database Management**	• Know the difference between databases, tools, repositories and be able to use each one to extract	• Power point presentations • Use if Internet • Research and	15
	Concept of Database, Organization of Database, Characteristics of Database,			4

Course Specific outcomes- BT 303: Database Management and Intellectual Property Rights				
Unit	**Topic**	**Learning Outcome**	**Methodology**	**No. of Lectures**
	Types of databases relevant to Biotechnology	specific information • Extract data from specific databases using accessions numbers, gene names etc	review articles	
	Principals of Data Management and data mining			2
	Essentials of Source Documentation: Maintaining and Managing Essential Documents; Recording and Reporting Non-Serious and Serious Adverse Events			5
	Importance and application of Databases – With one example each (PubMed, PubChem, OMIM, CTR etc.)			4
2	**Intellectual Property Rights**			15
	Characteristics and Types of Intellectual Properties	• Understand the rationale for and against IPR and especially patents • Understand why India has adopted an IPR Policy and be familiar with broad outline of patent regulations • Understand different types of intellectual property rights in general and protection of products derived	• Power point presentations • Use of Internet • Research and review articles	2
	Tools of IPR- Introduction and types Treaties, Conventions, Laws, Acts, agreements pertaining to Biotechnology *in vogue*			4
	Tools of IPRs- 1. Patents- prerequisites for patenting, Biological Patents – a. Plant b. Animal c. Microbial			6

Course Specific outcomes- BT 303: Database Management and Intellectual Property Rights				
Unit	**Topic**	**Learning Outcome**	**Methodology**	**No. of Lectures**
	patents 2.Process patents and Product patent with one case study each 3. Indian and International scenario	from biotechnology research and issues related to application and obtaining patents		
	Protection of Plant varieties and Plant breeders rights			1
	Industrial Designs- Designs of gadgets used in Biotechnology			2

References:

1. Dr. B.L.Wadehra 2011, Law Relating To Intellectual Property, Fifth Edition, *Universal Law Publishing Co.Pvt. Ltd.*

2. TIFAC 2002 Some questions and answers on Patents and Copyrights

3. H K Das 2010, Text book of Biotechnology,4th edition, Wiley India Pvt. Ltd, New Delhi

4. H S Chawala 2009, Introduction to Plant Biotechnology, 3rd Edition, Science Publishers

5. Hirvani R 2009, Patents in Plant Breeding: Guarding the Green Gold- Biotech News issue vol 4., No.4

6. Ganguli Prabuddh 2001, Intellectual Property Rights, Tata McGraw-Hill Publishing Company Ltd.

7. World Intellectual Property Rights (WIPO) web sitehttp://www.wipo.int/portal/index.html.en

P.E.Society's

Modern College of Arts, Science and Commerce,

Ganeshkhind, Pune 411016

Department of Biotechnology

Class: M.Sc. II (Semester I)
Pattern: 2013 (Credit System)

Course: BT 305
Sub: Bioinformatics

Name of the Teacher: Dr. Uttara Oak

Course Outcome:

On successful completion, the students

- **Will be able to describe the contents and properties of the most important bioinformatics databases,**
- **Perform text- and sequence-based searches**
- **Analyze and discuss the results in light of molecular biological knowledge**
- **Will be able to explain the major steps in pairwise and multiple sequence alignment**
- **Will be able to predict the secondary and tertiary structures of protein sequences**.

Course Specific outcomes- BT 305: Bioinformatics				
Unit	**Topic**	**Learning Outcome**	**Methodology**	**No. of Lectures**
1	**Introduction to Bioinformatics** Concepts and applications Biological Databases-	• Apply knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics • Apply existing software effectively to extract	• Power point presentation • Use of Internet • Working on algorithms in the	10

Course Specific outcomes- BT 305: Bioinformatics				
Unit	**Topic**	**Learning Outcome**	**Methodology**	**No. of Lectures**
	Concept, types, specialization, limitations, DBMS Data retrieval from various databases, Homology searching and their applications Sequence Alignments- Algorithms, Scoring Matrices, Multiple Sequence Alignment (MSA) Gene Annotation- Introduction	information from large databases and to use this information in computer modelling • Locate and use the main databases at the NCBI and EBI resources • Know the difference between databases, tools, repositories and be able to use each one to extract specific information • Extract data from specific databases using accessions numbers, gene names etc. • Explore the available annotation tracks for a gene of interest • Align two sets of sequences using both a global and local alignment approach • Explain the effect of changing parameters such as scoring matrices, gap penalties etc. • Interpret the output of a pairwise alignment and when the global or local alignment method is more appropriate to use	classroom	
2	**Molecular Modeling, Phylogenetic analysis** Acquisition and visualization of molecular structures Energy optimization methods Sequence and Structure based predictions-	• Manipulate a nucleotide alignment and run phylogeny jobs on a web server • Manipulate a simple nucleotide alignment in Fasta format and extract basic information from it • Manipulate real-world DNA alignments (mitochondrial DNA), and run Maximum Likelihood inferences and Bayesian		10

Course Specific outcomes- BT 305: Bioinformatics				
Unit	**Topic**	**Learning Outcome**	**Methodology**	**No. of Lectures**
	Simulation of Molecular interactions Phylogenetic analysis and tree construction methods	inferences		
3	**Structural Bioinformatics** Protein structure basics, Ramachandran plot, Protein structure- function relationship, SCOP and CATH Introduction to: Protein motifs and domain prediction, Protein profiles and Hidden Markov Model (HMM) Drug target finding. Immunoinformatics – databases, epitope prediction and vaccinology.	• Use the appropriate tools to predict the secondary structure for a protein sequence of interest • Query PDB with a sequence of interest to identify homologous protein sequences • Use PDB to extract information relevant to a protein structure of interest • Search for and identify homologous protein structures/template • Predict the structure for a protein sequence based on an identified template • Determine if the correct fold has been assigned to a model • Distinguish between good, medium, and poor quality structures	• Power point presentation • Use of Internet • Working on algorithms in the classroom	10

References:

1. A text book of bioinformatics (2008) Sharma, Munjal and Shankar. *Rastogi Publications, Meerut.*
2. An introduction to Bioinformatics Algorithms (2004) Neil Jones, Pavel Pevzner *A Bradford Book, The MIT Press, USA*
3. Bioinformatics - From Genomes to Drugs (2001) Thomas Langauer (editor) *Wiley-VCH; 1st edition, New York*
4. Bioinformatics-Sequence and Genome Analysis (2004) David W Mount *Cold Spring Harbor Laboratory Press; 2nd edition, USA*
5. BLAST (2003) Joseph Bedell, Ian Korf, Mark Yandell. *O'Reilly Media, USA*

6. Discovering genomics, Proteomics and Bioinformatics (2006) A. Malcoln Campbell, laurie J. Heyer *Pearson-Benjamin Cummings; 2nd edition, USA*
7. Essential Bioinformatics (2006) Jin Xiong *Cambridge University Press; 1st edition,Cambridge*
8. Genome analysis and bioinformatics (2009) Sharma T R *I.K. International Publishing House Pvt. Limited, Delhi*
9. Introduction to Bioinformatics (2008) Arthur M. Lesk *OUP, Oxford*
10. Introduction to genetic analysis (2008) Griffiths *et al W. H. Freeman, New York*
11. Introduction to genomics (2007) Arthur M. Lesk *OUP, Oxford*
12. Immunoinformatics (2008) Schönbach, Ranganathan, Brusic *Springer, New York*
13. Lehninger Principles of Biochemistry (2008) Nelson David, Cox Michael *W. H.Freeman 5th edition, New York*
14. Principles of proteomics (2004) Twyman Richard *Taylor & Francis, UK*
15. Protein Structure Prediction, methods and protocol (2000) David M. Webster *Springer,New York*
16. Proteomics from protein sequence to function (2001) Pennington SR, Dunn MJ., Stephen R *BIOS Scientific publication, Oxford, UK*
17. Intellectual property rights: basic concepts (2009) M M S Karki *Atlantic Publishers &Distributors, New Delhi*

Evaluation

Formative assessment: Tests knowledge, understanding, application and skill developed by

- Written Test and/or Mid Term Test
- Journal/Lecture/Library notes
- Seminar presentation
- Assignments
- An Open Book Test (with the concerned teacher deciding what books are to be allowed for this purpose

Summative assessment: In the form of Term end examination and University examination

Course: **BT 304** Subject: **Advanced Genetics** (3C)

Class: MSc II Biotechnology Pattern 2013 (Semester III) (Credit System)

Name of the Teacher: Dr. Mruthyunjaya. S

Course Outcome:

a) Different types of Cytoplasmic inheritance will be learnt by students.

b) Students will be able to analyze all practical cases of human clinical genetics.

c) Students will learn many diagnostic tools and techniques for the detection of human genetic disorders.

d) Different model systems in genetics will be learnt by students with practical examples.

e) Basic concepts of genetics of plant breeding will be learnt.

Course Specific Outcome (CSO):

Course: BT 304 **Subject: Advanced Genetics**	**Course specific outcome (CSO)**	**Methodology**	**No. of lectures**
Genetics of plant breeding: Genetic basis and mechanisms of pre- and post zygotic incompatibility	This module will impart knowledge about the basic concepts of genetics of plant breeding. Students will be able to understand all the molecular mechanisms of incompatibility. The genes involved in self incompatibility and cross incompatibility will also be learnt by students.	Conventional method	5
Genetics of somaclonal variations:	The genetic basis of somaclonal variations will be understood by the students. Students can design projects on somaclonal variations to improve the yield of Crop plants if they get any research opportunity.	Conventional method	3
Genetics of apomicts:	This unit will impart knowledge about the genetic basis of apomixis. Students will learn all types of apomixis found in plants. Students can analyze all the genes which play roles in apomixis.	Conventional method	2
Genetics of androgenic plants:	This unit will give an exposure about the generation of androgenic plants. Students	Conventional method	3

	will understand all the techniques involved in the generation of androgenic plants. Students will be able to use this knowledge for their projects or any other research work.		
Cytoplasmic inheritance:	This module will give information about all types of cytoplasmic inheritance such as plastid inheritance and mitochondrial inheritance. Numerous examples will make the students understand molecular mechanisms underlying cytoplasmic inheritance. Students will also be able to analyze genetic inheritance of many maternally inherited traits. Students will also be able to solve genetics problems involving maternal inheritance.	Conventional method	3
Genetics of population: with reference to Hardy –Weinberg principle and its applications	Students will be able to solve all population Genetics problems using Hardy Weinberg principle. Students can analyze genotypic ratios and allele ratios of any case. Students can also analyze the inheritance of genetic disorders using Hardy Weinberg principle.	Conventional method and active learning	4
Human genetics and methodologies: Clinical genetics, diagnostic tools and techniques for human genetic disorder	This unit will impart knowledge about human clinical Genetics and the Diagnostic tools used for detection of human genetic disorders. Students will be able to solve Genetics problems involving autosomal recessive inheritance or sex linked recessive inheritance or dominant inheritance.	Conventional method and active learning	10
Quantitative genetics: heritability of commercially important traits, QTL, inbreeding and estimation of inbreeding coefficient	Students will learn all kinds of quantitative inheritance. Students will be able to solve Genetics problems which involve qualitative traits and QTL. Students will be able to calculate inbreeding coefficient in any given Pedigree example.	Conventional method and active learning	5
Important model system in genetics: Drosophila, *C. elegans*, Zebrafish, *Arabidopsis*	This module will give an exposure about various model systems used in genetics. Students will be able to analyze inheritance patterns of many genetic disorders in different animal models.	Conventional method	10

Types of evaluation

1. Formative evaluation: - Knowledge, Understanding, Application, Skill
- Tests, Seminar and assignments as a method of evaluation for Credit System.

2. **Summative evaluation:** -Term end examination and University examination

References:

1. Williams EG, Clarke AE, Bruce Knox R (1994) – Genetic control of self incompatibility and reproductive development in flowering plants (Kluwer Academic Publ, Netherlands)
2. Franklin-Tong VE (2008) – Self incompatibility in flowering plants – evolution, diversity and mechanisms (Springer, Berlin Heidelberg)
3. Principles of plant genetics and breeding, 2nd edition(2012), Acquaah G, Wiley – Blackwell, UK
4. Developmental genetics, 1st edition, (2006) Miglani GS, IK International, India
5. Savidan Y, Carman JG, Dresselhaus T Eds (2001) – The flowering of apomixis: From mechanisms to genetic engineering (CIMMYT, IRD, European commission DG VI (FAIR)
6. Plant breeding: principles and methods, 11th edition (2009), B D Singh, Kalyani Publisher, India.
7. iGenetics, 3rd edition (2011), Peter Russel, Benjamin Cummings, USA
8. Strickberger MW (2006) - Genetics (Prentice Hall, India)
9. Hartl DL, Jones EW (2001) – Genentics: analysis of genes and genomes (Jones and Bartlett, Massachusetts)

Course: **BT 306** Subject: **Exercises in Animal Biotechnology** (3C)

Class: MSc II Biotechnology Pattern 2013 (Semester III) (Credit System)

Name of the Teacher: Dr. Mruthyunjaya. S

Course Outcome:

a) Students will learn how to establish primary culture from chick embryos.

b) Students will learn the art of subculturing of different cell lines.

c) Analysis of cell counts in different cell lines will also be learnt.

d) Students will learn how to perform chromosome preparation from animal cells.

e) Students will learn setting up of MTT assay for analyzing cell proliferation/ survival.

Course Specific Outcome (CSO):

Course: BT 306 **Subject: Exercises in Animal Biotechnology** (3C)	**Course specific outcome (CSO)**	**Methodology**	**No. of lectures**
Initiation of cell culture from chick embryo	This practicals will impart skills to students about how to establish primary cultures from chick embryo. Students will be able to establish cell lines from almost any animal tissue. Students will also learn to maintain primary cells for long duration.	Active learning	2
Subculture and maintenance of established cell line in laboratory	This experiment will give the necessary skills to students about how to subculture any given cell line in the laboratory. This will also give skills to students about how to maintain any given cell line for long periods in culture. Students will also learn how to trypsinize various cell lines.	Active learning	1
Growth studies by viable cell count analysis	Students will be able to count cells from any given animal cell line. Students will be able to analyze increase in cell growth by viable cell count analysis. They can also seed required number of cells in any culture dish.	Active learning	2
Effect of growth factors on cell proliferation	This practicals will give an exposure about the importance of growth factors in cell proliferation. Students will get knowledge about the various growth factors used in animal cell culture. Students will be able to use this knowledge for designing their project work or any other research work	Active learning	2
Chromosome preparation from cell line	This practicals will give students the skill to perform karyotyping. Students will be able to analyze any defects in the chromosomes. They	Active learning	2

	can analyze structural chromosomal aberrations or numerical chromosomal aberrations in transformed cells.		

Types of evaluation

1. Formative evaluation: - Knowledge, Understanding, Application, Skill

- Viva and Group discussion as a method of evaluation for Credit System.

2. **Summative evaluation:** - University examination

Progressive Education Society's
Modern College of Arts, Science & Commerce
Ganeshkhind, Pune – 16

Department of Biotechnology

Course: **BT-308** Subject: BT 308: Exercises in Bioinformatics (2C)

Class: M.Sc.I (Biotechnology); Pattern: 2013 (Semester 1) (Credit System)

Name of the Teacher: Dr.Amrita Srivastav

COURSE OUTCOME

- The proposed credit-based curriculum and grading system adds much more to the existing syllabus of bioinformatics. The relevance and application of these studies on living organisms and their bioprocesses is extensively covered in this field with the help of technology.
- To help the students to build interdisciplinary approach
- To empower students to excel in various research fields of Life Sciences
- To inculcate sense of scientific responsibilities and social and environment awareness
- To help students build-up a progressive and successful career.
- To help students to understand bioinformatics and different computer languges.

Course specific outcome (CSO)

Course: BT -308 Subject: Bioinformatics	**Course specific outcome (CSO)**	**Methodology**	**No. of lectures**
Publicly available Database study and searching PubMed, NCBI, DDBJ, EMBL, UniProt, PDB	Enables the students to understand different databases, so that they can use these dats for further research	Practical	1
Retrieval of sequences and Sequence analysis by: BLAST, FASTA	Helps in checking the validation of their research work esp the genes	Practical	1
Multiple Sequence Analysis: ClustalW (JalView), MUSCLE, T-coffee	Helps to understand different genes	Practical	1
Phylogenetic tree construction: Phylip, FIGTREE	Ancestral studies of different genes can be understood	Practical	1
Visualization and study of 3D molecular structures – RASMOL, Swiss PDB viewer	More detailed study of bioinformatics can be incorporated in	Practical	1

	research		
Potential energy calculations- Swiss PDB viewer	Understanding of proteins goes well	Practical	1
Mutation and energy minimization of proteins- Swiss PDB viewer	Biological Compounds and proteins can be predicted.	Practical	1
Homology Modeling- Swiss PDB viewer, ExPAsy	3D stuctures can be studied.	Practical	1
Protein classification, domain identification, signature matching PFAM, Prodom, Prosite	Validation of proteins can be done.	Practical	1
IMGT database search for IG, TR and MH		Practical	1

Types of Evaluation:

5) Formative Evaluation: -Knowledge, Understanding, Application, Skill

-Tests, seminar and assignments as a method of evaluation for credit system.

6) Summative Evaluation: Term End Examination and University Examination

References:

1.A text book of bioinformatics (2008) Sharma, Munjal and Shankar. Rastogi Publications, Meerut.

2. An introduction to Bioinformatics Algorithms (2004) Neil Jones, Pavel Pevzner A Bradford Book, The MIT Press, USA

3. Bioinformatics - From Genomes to Drugs (2001) ThomasLangauer (editor) WileyVCH; 1st edition, New York

4. Bioinformatics-Sequence and Genome Analysis (2004) David W Mount Cold Spring Harbor Laboratory Press; 2nd edition, USA

5. BLAST (2003) Joseph Bedell, Ian Korf, Mark Yandell. O'Reilly Media, USA

6. Discovering genomics, Proteomics and Bioinformatics (2006) A. Malcoln Campbell, laurie J. Heyer Pearson-Benjamin Cummings; 2nd edition, USA

7. Essential Bioinformatics (2006) JinXiong Cambridge University Press; 1st edition, Cambridge

8. Genome analysis and bioinformatics (2009) Sharma T R I.K. International Publishing House Pvt. Limited, Delhi

9. Introduction to Bioinformatics (2008) Arthur M. Lesk OUP, Oxford

10. Introduction to genetic analysis (2008) Griffiths et al W. H. Freeman, New York

11. Introduction to genomics (2007) Arthur M. Lesk OUP, Oxford

12. Immunoinformatics (2008) Schönbach, Ranganathan, Brusic Springer, New York

13. Lehninger Principles of Biochemistry (2008) Nelson David, Cox Michael W. H. Freeman 5th edition, New York 14. Principles of proteomics (2004) Twyman Richard Taylor & Francis, UK

15. Protein Structure Prediction, methods and protocol (2000) David M. Webster Springer, New York

16. Proteomics from protein sequence to function (2001) Pennington SR, Dunn MJ., Stephen R BIOS Scientific publication, Oxford, UK

17. Intellectual property rights: basic concepts (2009) M M S Karki Atlantic Publishers & Distributors, New Delhi

Progressive Education Society's
Modern College of Arts, Science and Commerce, Ganeshkhind, Pune

MSc Biotechnology

Program Outcomes of MSc Biotechnology:

After successful completion of this post-graduate degree program, the students should be able:

1. to understand the need and impact of biotechnological tools, techniques and solutions to the problems and issues pertaining to environment and society in view and need for sustainable solution
2. to be aware in social, ethical, and professional issues of contemporary practices in biotechnology and related fields
3. to design, perform experiments, analyze and interpret data for investigating complex problems in subjects covered in the program
4. to undertake the responsibilities as an individual and as a team in a multidisciplinary environment
5. to develop oral and written skills for effective communication
6. to acquire knowledge and competence for clearing various examinations to such as CSIR-NET, ARS-NET GATE, ICMR, and DBT for pursuing higher studies (M.Phil, Ph.D)
7. to design experiments and undertake research work
8. to develop commercially viable processes and technologies in biotechnology related areas
9. to acquire knowledge and competence for initiating start-ups in biotechnology related areas
10. to visualize the current and future trends in science, life sciences and inter-disciplinary fields.