Post Graduate Diploma in Applied Microbiology - Cell and Molecular Biology

(Semester I-II)

Choice Based Credit System (CBCS)

Effective from June 2016

Accredited Grade A by NAAC

(CGPA 3.05)

Department of Biochemistry
Saurashtra University
Rajkot
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<th>Course</th>
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## Examination Marks Distribution

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SEMESTER-I

CCMB-101 ADVANCED CELL BIOLOGY

UNIT 1: Cells, Cell Organelles & Membrane Biochemistry

Evolution and Introduction of Cell Types including Cellular Specialization and Differentiation, Differences in Plant and Animal Cells, Eukaryotic Cell Organelle’s Structure, Functions and Biochemistry, Structure and Biochemical Aspects of Specialized Plant Cell Organelles, Cell Plate, Primary and Secondary Cell Walls, Plasmodesmata, Importance of Vacuoles, Chemical Composition and function of Biomembranes, Model of Lipid Membranes, Differences between Biomembranes and Artificial Phospholipids Membranes, Models of Plasma membranes and techniques to study fluidity

UNIT 2: Tissue Organization and Cytoskeleton:

Cell Differentiation, Organogenesis, Morphological, Functional and Biochemical Maturation of Tissues, Cytoskeleton: Microtubules Polymerization, Dynamic, and Functions, Microtubules in Cell Division, Role of Cytoskeleton Filaments in Cancer

UNIT 3: Cell Cycle

Phases of Cell Cycle, Functional Importance of each Phase, Molecular Events during Cell Cycle, Check Points, Cyclins and Protein kinases, MPF (maturation promoting factor), Regulation of Cell Cycle. Apoptotic Pathway and Cell Death.

UNIT 4: Signaling Pathway

Signal transduction, G proteins, cyclic nucleotide and kinase signaling, phospholipid and Ca++ signaling, growth factor and cytokine signaling, MAP kinase cascades, signaling via regulated proteolysis
CCMB-101 ADVANCED CELL BIOLOGY

Objectives

➢ To equip students with a basic knowledge of the structural and functional properties of cells.
➢ To examine properties of differentiated cell systems and tissues.
➢ Aspect of cell cycle and cell death.
➢ To introduce the fascinating mechanism of cell signaling along with brief overview on developmental biology.
➢ To provide thorough knowledge on classical genetics.

Outcomes

Students will understand the structures and purposes of basic components of cell, especially membranes and organelles. Appreciate the cellular components underlying cell division along with a deep insight to cell division, cell death and uncontrolled cell division. Students will learn the basic principles of inheritance and patterns of heredity. Students will test and deepen their mastery of genetics by applying this knowledge in a variety of problem-solving situations.
CCMB-102 MOLECULAR BIOLOGY AND METHODOLOGIES

Unit-1: Basic genetics
Mendelian principles: Dominance, segregation, independent assortment, deviation from Mendelian inheritance. Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests, Extensions of Mendelian principles, Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.

Unit-2: Advanced genetics

Unit-3: Molecular dogma
DNA replication, repair and recombination, RNA synthesis and processing, Protein synthesis and processing, Control of gene expression at transcription and translation level

Unit-4: Methods in Molecular biology
Cloning, Cloning vectors, Selection and expression of suitable vectors, cDNA libraries and Genomic libraries, DNA sequencing, Site directed mutagenesis, Hybridization techniques, PCR techniques, Molecular markers, Transgenic animals and Plants, Applications of recombinant technology
CCMB-102 MOLECULAR BIOLOGY AND METHODOLOGIES

Objectives:

- Detailed understanding of prokaryotic and eukaryotic replication, types of DNA polymerases and inhibitors of DNA replication
- To gain detail on prokaryotic and eukaryotic transcription, translation and gene expression regulation
- In depth study of various types of vectors, hybridization technique and its application
- To develop an understanding of advanced technologies like RFLP, Sequencing, SSR, REMAP, SCAR and various types of PCR

Outcome:

Students will choose appropriate experimental strategy for research in basic and molecular biology. To perform laboratory techniques in basic biology, molecular biology, and advanced techniques. Explanation and integration of biological principles, as applied to basic and molecular biology. Development of strong diversified background in modern biology, appropriate to the individual student goals. Develop critical-thinking, and problem based learning skills. This paper will open an understanding of current trends in molecular and genetic research, and critically appraise published work. Students will be prepared to demonstrate an ability to design, undertake, and interpret, a research project, presented in the form of a dissertation.
CCMB-103 DEVELOPMENTAL BIOLOGY

Unit-1 Introduction and overview of animal development
Developmental control of gene expression, Cell signaling, Determining cell fate and cell commitment, Fertilization and cleavage, Gastrulation and Neurulation

Unit-2 Examples of induction and cell fate determination
Early inductive events in Xenopus: Axis formation, Early inductive events in Xenopus: the Nieuwkoop center and the Organizer, Early inductive events in Xenopus, continued (neural fate), Examples of determination of cell fate in the nervous system: the cerebral cortex, Examples of determination of cell fate in the nervous system: the retina, Consequences of molecular evolution

Unit-3 Developmental Genetics
Introduction to developmental genetics: approaches and techniques, introduction to C. elegans, Developmental genetics in practice: studying events controlled by maternal transcripts as well as later signaling events using C. elegans, Developmental genetics in practice continued: using epistasis and mosaic analysis to determine how genes products interact, Developmental genetics in practice: studying early events in Drosophila development, Drosophila axis formation and embryonic patterning, Drosophila segmentation and segment identity (Hox genes), Developmental genetics in practice: Mouse transgenics: techniques and applications

Unit-4 Patterning: genes, environment and plasticity
Organizing the limb, Pattern formation in the nervous system: Axon guidance, Neuronal plasticity, Sex determination, Dosage compensation, Epigenetics: Imprinting, Stem cells and medical applications for humans
CCMB-103 DEVELOPMENTAL BIOLOGY

Objectives:

- Detailed understanding of prokaryotic and eukaryotic replication, types of DNA polymerases and inhibitors of DNA replication
- To gain detail on prokaryotic and eukaryotic transcription, translation and gene expression regulation
- In depth study of various types of vectors, hybridization technique and its application
- To develop an understanding of advanced technologies like RFLP, Sequencing, SSR, REMAP, SCAR and various types of PCR

Outcome:

This paper captivates student interest, opening minds to the wonder of developmental biology, whilst covering required material with scientific rigour. The present paper reflects the exciting new age of genomics, genetic regulatory networks and digital visualization techniques while keeping focus on the major questions of animal development.
ICMB - 101: ANALYTICAL TECHNIQUES

UNIT 1: Microscopy and Autoradiography

UNIT 2: Spectroscopy
Basic Principles of Spectroscopy, UV, IR, Raman, ESR, ORD. CD and Structure of Proteins using NMR and ESR. Neutron and X-Ray Diffraction for Elucidation of 3D Structure. Molecular Modelling, Mass Spectrometry

UNIT 3: Chromatographic Techniques
Basic Principle and types of Chromatography. Gas Chromatography, GC-MS, LC – MS / MS. Ion Exchange Chromatography, Gel permeation, Affinity and Reverse Phase Chromatography. HPLC and FPLC

UNIT 4: Centrifugation and Electrophoretic Techniques
Principle and Applications of Centrifugation Techniques. Basic Principles of Electrophoresis, Agarose Gel, Native and SDS-PAGE. Isoelectric Focusing, 2D-PAGE and their uses in Protein Research. Fractionation and Blotting Techniques

CMB-104 Class presentations

CMB-105 Practicals
SEMESTER – II

ECMB-101: ANIMAL CELL TISSUE CULTURE

UNIT 1: Introduction
History, Biology of cell culture, Laboratory design and layout, equipments, aseptic condition, safety, bioethics and validation

UNIT 2: Media
Culture vessels, substrates, defined media supplements, serum free media, media preparation and sterilization

UNIT 3: Various Cell Culture
Primary culture, subculture and cell lines, cloning and selection, cell separation, characterization, differentiation, transformation and immortalization

UNIT 4: Techniques and Media
Contamination, cryopreservation, quantification, cytotoxicity, special cell type culture, culture of tumor cells, organotypic culture, scale up and specialized techniques
ECMB-101: ANIMAL CELL TISSUE CULTURE

Objectives:

- Understating the basics of animal tissue culture i.e. laboratory design and requirements
- To acquire a knowledge of various types of media and methodologies
- An understanding of the various types of cell cultures and separation techniques
- In-depth knowledge and understanding of cell preservation, scale up and special cell cultures

Outcome:

The expected learning outcomes of this course is to attain a working knowledge of discrimination between the different types of cell culture technologies. Detailed criteria for consideration for scale up of cell culture and media composition. Students will gain knowledge in identifying the appropriate cell model for a large scale process and explaining recent developments in cell and tissue engineering.
ECMB-102: BIOINFORMATICS AND BIOSTATISTICS

UNIT 1: Basics of Bioinformatics
Introduction to Bioinformatics: Definition and History of Bioinformatics, Internet and Bioinformatics, Introduction to Data Mining, Applications of Data Mining to Bioinformatics Problems and Applications of Bioinformatics

UNIT 2: Biocomputing and Softwares in Bioinformatics

UNIT 3: Biological Databases & Protein Engineering
Nucleic acid sequence databases: GenBank, EMBL, DDBJ, Protein sequence databases: SWISS-PROT, TrEMBL, PIR_PSD, Genome Databases at NCBI, EBI, TIGR, SANGER, PDB, NDB, CCSD, Prosite, PRODOM, Pfam, PRINTS, CATH, SCOP, DSSP, FSSP, DALI, Site directed mutagenesis, Role of Bioinformatics in Protein Engineering.

UNIT 4: Statistical Tests in Biology
Mean, Median, Mode, Student’s t Test, Meaning of Significance and Significance Levels Analysis of Variance. Analysis of Covariance, Regression and Correlation Analysis, Chi square test, Confidence limits
ECMB-102: BIOINFORMATICS AND BIOSTATISTICS

Objectives:

- Detailed understanding of genome projects, related disciplines of Bioinformatics use of Databases and Tools in Biological Discovery, Major Bioinformatics Resources
- To gain detail on biological databases like primary sequence databases, protein three dimensional databases, Protein Structure Mathematical model databases, PCR and quantitative PCR primer databases, Chemical Databases, Drug & Drug Target / Therapeutic Target Databases, Disease databases, Immunological database.
- In depth study of various types of tools including sequence submission tools, Chemical molecule designing software, Protein & Chemical molecule visualization tools, Docking software, Molecular dynamics software; QSAR, ADME Toxicity prediction, Allergen prediction, Venomics & Antivenomics.
- To develop an understating of statistical methods and calculations

Outcome:

Students will choose appropriate experimental strategy for research in basic and applied biology. Explanation and integration of bioinformatics principles and its applications to basic and applied biology. Students will gain in silico training on data mining, database searching, software application, quantitative analysis and interpretation, molecular modeling, QSAR and various DNA, RNA and Protein analytical tools. Moreover, this paper enables students to acquire the knowledge of statistical analysis and its principles.
CCMB-106: Dissertation Thesis work / Research Project Work include thesis work and viva voce examination

Dissertation research work is offered to students of Semester II to carry out research according to the provision of objectives and teacher guide. Students are eligible to apply in other national and international level research institutes, Universities and industries of high repute to pursue six month dissertation research project for the partial fulfillment of PG Diploma degree.
REFERENCE BOOKS

1. Analytical Biochemistry by Holme, D. J. & Peck, H.
2. Biochemical calculation by Segel
3. Laboratory Manual in Biochemistry by Jayraman
5. Biochemistry by Champe
6. Biochemistry by Todd, W. B., Mason, M., Bruggen, R. V. & Macmillan.
7. Biochemistry by Voet & Voet
9. Biochemistry by Mathews
11. Biochemistry by Zubay, J.
12. Biochemistry by Stryer
13. Cell Biology Protocols by Harris, R., Graham, J. & Rickwood, D.
17. Fundamentals of Biostatistics by Bernard Rosner
18. Fundamentals of Protein Structure and Function by Buxbaum, E.
19. Instant Notes in Biochemistry by Hames, B. D. & Hooper, N. M.
20. Introduction to Molecular Biology by Paolella, P.
21. Introduction to Protein Architecture: The structural biology of proteins by Lesk, A. M.
22. Introductory Biostatistics by Chap T. Le
23. Modern Experimental Biochemistry by Boyer, R.
24. Molecular Biology of The Cell - Bruce Alberts
25. Molecular Cell Biology by Lodish, H.
27. Genes IX by Lewin, B.
28. Essential Molecular Biology by T. A. Brown
29. Principles Of Gene Manipulation And Genomics by Primarose
30. Molecular Cloning by Russell Sambrook
31. Analytical chemistry by Skoog
32. Nutritional Biochemistry by Tom Brody
33. Plant Biochemistry by Heldt, H-W.
34. Plant Physiology By Taiz and Zeiger
35. Principles of Biochemistry by Zubay, J.
36. Protein Biochemistry and Proteomics: Experimental series by Rehm, H
37. Proteins: structure and function by Whitford, D.
38. Culture of Animal Cells by Freshney R. I.
39. Animal Cell Culture by Masters
40. Bioinformatics Methods and Applications by Rastogi, S.C.
41. Bioinformatics for Dummies by Jean-Michel Claverie
42. Textbook of bioinformatics by Subramaniam, C.
43. Review & Research papers from Bioinformatics & related Journals
50. Fundamentals of Biostatistics by Bernard Rosner 5th Ed.