UNIVERSITY OF KERALA

COMPLEMENTARY COURSE

BIOTECHNOLOGY
FOR
FIRST DEGREE PROGRAMME IN MICROBIOLOGY

UNDER

CHOICE BASED CREDIT-SEMESTER SYSTEM

(w.e.f. 2014 admission onwards)

BIOTECHNOLOGY-COMPLEMENTARY COURSE FOR FIRST DEGREE PROGRAMME IN MICROBIOLOGY

DISTRIBUTION OF CONTACT HOURS AND CREDITS

Course Code	Course Title	Semester I			Semester II			Semester III			Semester IV			Total	
		Contact hours		Credits	Contact hours		Credits	Contact hours		Credits	Contact hours		Credits	Contact hours	Credit
		T	P	C	T	P	C	T	P	C	T	P	C		
BT1131	Basics of Biotechnology	2		2										2	2
BT1231	Biophysics				2		2							2	2
BT1331	Cell Biology							3						3	3
BT1431	Molecular Biology										3			3	3
BT1432	Practical (BT1131, BT1231, BT1331 & BT1431)		2			2			2			2	4	8	4
															14

T=Theory; P=Practical; C= Credits

SYLLABUS
BIOTECHNOLOGY-COMPLEMENTARY COURSE FOR FIRST DEGREE PROGRAMME IN MICROBIOLOGY

SEMESTER I

BASICS OF BIOTECHNOLOGY

Course code : BT1131
Number of credits : 2
Number of contact hours: 36 hrs (Lecture); 36 hrs (Practical)

MODULE I
Origin and development of Biotechnology 8 hrs

Introduction and definitions, Historic perspectives- biotechnology in prehistoric times, microorganisms and fermentation, Origin of genetics, DNA and genetic Engineering, Hybridoma technology, Beginning of modern Biotechnology, Classical and modern concepts of Biotechnology, Scope of Biotechnology- Commercial potential, Biotechnology in India and its global trends, Major Biotechnology institutes and companies in India.

MODULE- II

Application of biotechnology 12 hrs

Bioprocess and Fermentation Technology, Biological fuel generation, Sewage and Effluent treatment; Safer and cheaper medicines by biotechnology, antibiotics, medicines from cell cultures, new medicines through genetic engineering, Biopharming; Crop improvement through Biotechnology, Herbicide tolerance, Insect resistance, Virus tolerance, other engineered products, Genetically modified Livestock and poultry ; Food and Beverage Biotechnology- Food and health, application of biotechnology in food processing, Traditional and modern food processing,

MODULE- III 9 hours

Recombinant DNA technology:

General account of cloning vehicles – plasmid, bacteriophages, cosmids and phagemids. Cutting and joining of DNA molecules – restriction endonucleases, ligases – Gene library.

Brief account of gene transfer techniques – Direct DNA uptake by protoplast – vector method Agrobacterium mediated, physical method- electroporation- shot gun method – microinjection.

MODULE IV **7 hours**

1. Methods in Biotechnology
    a. Isolation and purification of DNA from plant cells.
    b. Agarose gel electrophoresis
    c. PCR, RFLP, DNA sequencing, Southern blotting, ELISA.
2. Cryopreservation methods of biological materials.

Practicals **36 hours**

1. Safety aspects in Biotechnology
2. Preparation of Glasswares, Reagents, Buffers etc
3. Isolation of DNA from Plant and Animal tissues
4. Electrophoresis-PAGE and Agarose gel electrophoresis
5. Basics of DNA technology-Plasmid isolation, cloning etc
6. Estimation of DNA and RNA

REFERENCES

1. Sobti RC and Suparna S Pachauri 2009, Essentials of Biotechnology, Ane Books Pvt. Ltd

2. Abhilasha s Muthuriya (2009) Industrial Biotechnology. Ane Books Pvt. Ltd

3. Misra SP (2009) Plant Tissue Culture. Ane Books Pvt. Ltd

4. Victoriano Valpuesta 2004, Fruit and Vegetable Biotechnology, CRC Press. New

York. Ane Books Pvt. Ltd

5. Smith (2008) Biotechnology (5th Edition), Cambridge University Press India Pvt. Ltd

6. Colin Ratledge (2006) Basic Biotechnology, Cambridge University Press India Pvt. Ltd

7. Balasubramoniun D, CFA Bryce, K Dharmalingam, J Green and Kunthala

8. Jayaraman 2007, Concepts in Biotechnology, Universities Press

9. Janardhanan S and Vincent S 2007, Practical Biotechnology, Universities Press

10. Channarayappa 2008, Molecular Biotechnology, Universities Press

11. Gupta P. K. - Elements of Biotechnology (Rastogi publications).

SEMESTER II

BIOPHYSICS

Course code : BT1231
Number of credits : 2
Number of contact hours: 36 hrs (Lecture); 36 hrs (Practical)

MODULE I

Principles of thermodynamics: **5 hrs**

Laws of conservation of energy- first and second laws and its relevance in the biological system, entropy and enthalpy, Gibbs free energy, bioenergetics- endothermic and exothermic reactions of biological systems, energy change in the biochemical reactions, sources of heat limits to temperature, heat dissipation and conservation.

Electrical properties of biological compartments: **4 hrs**

Electricity as a potential signal, electrochemical gradients, membrane potential, ATP synthesis, and chemi-osmotic hypothesis

MODULE II

Biophysics of Photosynthesis **5 hrs**

Primary events in photosynthesis, light harvesting pigments, resonance energy transfer in photosynthetic pigments, fluorescence and phosphorescence, absorption spectra and action spectra of photosynthetic pigments, photosynthetic reaction center and accessory pigments, light reception in microbes, plants and animals,

Biophysics of Vision, Muscle movements and Hearing: **3 hrs**

Mechanism of vision, muscular movements and hearing, correction of vision faults, generation and reception of sonic vibrations, hearing aids.

Intra and intermolecular interactions in biological systems: **3 hrs**

Various types of molecular interactions, inter and itra molecular interactions, special and charge compatibility in molecular interactions.

MODULE III

Microscopy: **3 hrs**

Principle of Microscopy, various types of Microscopy- Simple, phase contrast, fluorescence and electron microscopy (TEM and SEM), Modern developments in Microscopy.

MODULE IV

Basic principles and working of instruments: 7 hrs

pH meter, spectrophotometer (UV and Visible) and colorimeter- Beer-Lambert law,

Brief account of densitometry, fluorimetry, manometry, polarography, centrifugation, atomic absorption spectroscopy, IR, NMR and X-ray crystallography and Mass spectrometry.19

Electrophoresis: **3 hrs**

Principle of electrophoresis, native gel electrophoresis, SDS electrophoresis, immuno electrophoresis, isoelectric focusing, polymerization of acrylamide and bis-acrylamide, electrophoresis in agarose gel and Submarine electrophoresis

MODULE V

Isotopes and radioisotopes: **3 hrs**

Isotopes and radioisotopes, radiations- ionizing radiations, Application of isotopes and radioisotopes in biological research, radioisotope tracer technique and autoradiography.

Practicals 36 hrs

Familiarizing the working of the following instruments

1. pH Meter – Use of pH Meter, Familiarization of the instrument and Preparation Phosphate buffers and determination of pH.
2. Spectrophotometer – Familiarization of the working of the instrument , Quantitative estimation of Sugars by Dinitrosalysilic acid and Proteins by Lowry's Method
3. Development of absorption spectra of chlorophyll or any other biological sample
4. Electrophoresis – demonstration of PAGE and Agarose Gel Electrophoresis

REFERENCES

1. A Textbook of Biophysics- R N Roy, New central Book Agency Pvt. Ltd, Calcutta.
2. Biochemistry., Voet, D & Voet, J.G
3. Biophysics- S.Thiruvia Raj, Saras Publications , Tamilnadu.
4. Biophysics, Volkenstein, M.V
5. Introduction to biophysical chemistry Martin
6. Introduction to Genetic Engineering & Biotechnology- A. J. Nair; Jones & Bartlett Publishers,

Boston,USA.

7. Lehninger's Biochemistry, Nelson D.L and Cox, M.M., Worth Publishers, New York
8. Molecular Biology of the gene, Watson et al.
9. Principles of Biotechnology- AJ Nair, Laxmi Publications, New Delhi

SEMESTER III

CELL BIOLOGY

Course code : BT1331
Number of credits : 3
Number of contact hours: 90 hrs (Lecture & Practical)

MODULE I **8 hrs**

An Overview of Cells: Overview of prokaryotic and eukaryotic cells, cell size and shape, Phages, Viriods, Mycoplasma and Escherichia coli.

MODULE II **14 hrs**

Tools and techniques of Cell Biology.Microscopic-Principles of Light microscopy; Phase contrast microscopy; Confocal microscopy; Electron microscopy (EM)- scanning EM and scanning transmission EM (STEM);

Fluorescence microscopy; Analytical: Flow cytometry- flurochromes, fluorescent probe and working principle; Spectrophotometry; Mass spectrometry; X-ray diffraction analysis. Separation: Sub-cellular fractionation- differential and density gradient centrifugation; Chromatography- paper, thin-layer, gel-filtration, ion-exchange, affinity and High-Performance Liquid Chromatography (HPLC).

MODULE III **10 hrs**

Composition of Cells: Molecules of cell, cell membranes and cell Proteins. The Nucleus: Nuclear Envelope- structure of nuclear pore complex, nuclear lamina, Transport across Nuclear Envelope. Chromatin: molecular organization, Nucleolus and rRNA Processing.

MODULE IV **10 hrs**

Mitochondria, Chloroplasts and Peroxisomes: Structural organization, Function, Marker enzymes, Mitochondrial biogenesis, Protein import in mitochondria, Semiautonomous nature of mitochondria and chloroplast, chloroplast DNA, Peroxisomes' assembly

MODULE V **12 hrs**

Protein Sorting and Transport: The Endoplasmic reticulum, The Golgi Apparatus, Mechanism of

Vesicular Transport, Lysosomes. Cytoskelton and Cell Movement: Structure and organization of actin filaments; actin, myosin and cell movement ,intermediate filaments; microtubules.

Practicals **36 hrs**

1. Separation of nucleic acid bases by paper chromatography.
2. Microscopy- Theoretical knowledge of Light and Electron microscope.
3. Study of the following techniques through electron / photo micrographs: Fluorescence microscopy, autoradiography, positive staining, negative staining, freeze fracture, freeze etching, shadow casting.
4. Study of structure of cell organelles through electron micrographs.

Permanent slide preparation:

1. Cytochemical staining of DNA-Feulgen.
2. Cytochemical staining of DNA and RNA- Methyl Green Pyronin (MGP).
3. Cytochemical staining of Polysaccharides-Periodic Acid Schiff's (PAS).
4. Cytochemical staining of Total proteins- Bromophenol blue.
5. Cytochemical staining of Histones -Fast Green.

REFERENCES

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott
3. Williams and Wilkins, Philadelphia.
4. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition. ASM Press &
5. Sunderland, Washington, D.C.; Sinauer Associates, MA.
6. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition.
7. Pearson Benjamin Cummings Publishing, San Francisco.

SEMESTER IV

MOLECULAR BIOLOGY

Course code : BT1431
Number of credits : 3
Number of contact hours: 90 hrs (Lecture & Practical)

MODULE I **10 hrs**

Introduction

History and significant discoveries in molecular biology,

Molecular basis of life, Experiments demonstrating DNA as the genetic material,

Structure of DNA, replication of DNA – both prokaryotic and eukaryotic, enzymes of DNA replication

MODULE II **10 hrs**

Genes

Structure of prokaryotic gene: operon, organization of operon, prokaryotic mRNA and its translation, polysomes.

Eukaryotic genes: structure of a gene, reading frame, and regulatory sequences, promoters and enhancers

MODULE III **10 hrs**

Gene expression:

Transcription- transcription products, types of RNA-mRNA, tRNA, rRNA and small nuclear RNA (snRNA);

Eukaryotic transcription, post-transcriptional modification of mRNA,

Translation- translation of prokaryotic and eukaryotic mRNA, different stages of protein synthesis,

Genetic code: properties of genetic code, codon assignment, start codon and termination codons

MODULE IV **12 hrs**

Gene regulation: prokaryotic gene regulation, regulation of operon, (lac, his and trp operon), catabolic repression;

Regulation of eukaryotic gene expression, level of control of gene expression, transcriptional factors, regulation of RNA processing, mRNA translation, mRNA degradation and protein degradation control, post translational modification of proteins.

MODULE V **8 hrs**

Eukaryotic chromosomes- molecular organization, nucleosomes, Insertional elements and transposons, different types of transposons52

MODULE VI **4 hrs**

Cytoplasmic genome – mitochondrial DNA-structure and important genes chloroplast DNA – structure, important genes and its expression

Practicals **36 hrs**

Experiments for Molecular biology

1. Instruments and equipments used in molecular biology and rDNA techniques.
2. Isolation of Genomic DNA
3. Examination of the purity of DNA by agarose gel electrophoresis.
4. Quantification of DNA by UV-spectrophotometer
5. Isolation and purification of plasmid DNA
6. Agarose gel analysis of plasmid DNA
7. Restriction digestion of plasmid DNA

REFERENCES

1. Applied Molecular genetics – R L Miesfeld; Wiley.Liss , New Delhi.
2. Basic Biotechnology- A. J. Nair, Laxmi Publications, New Delhi
3. Essential molecular Biology- A practical Approach, T A Brown; Oxford, New York
4. Gene VIII- Benjamin Lewin; Offord University Press.
5. Introduction to Genetic Engineering & Biotechnology- A. J. Nair; Jones & Bartlett Publishers, Boston,USA.
6. Introduction to Molecular biology- P. Paolella; Mc Graw Hill, New York
7. Molecular Biology of the gene – Watson, Baker, Bell Gann, Lewinw, Losick; Pearson Education Pvt.Ltd, New Delhi
8. Molecular cell biology H S Bhamrah; Anmol Publications Pvt. Ltd., New Delhi.
9. PCR 3 - Practical Approach – C. Simon Hearington & John J O'Leary; Oxford, New York

10. Principles of Gene manipulation- R.W.Old & S.B. Primrose; Blackwell Scientific Publications