DEPARTMENT OF BIOTECHNOLOGY

(UGC-SAP and DST-FIST & PURSE Sponsored Department)

ALAGAPPA UNIVERSITY

(A State University Re-Accredited with "A" Grade by NAAC)

Karaikudi 630 003

M.Sc., Biotechnology Programme

501101–BIOCHEMISTRY (Core – 3 credits)

COURSE DEPICTION

Program: **M.Sc.**	Semester : **I (2016-17)**
Course Title: **Biochemistry**	Class Time: 10-11 AM: W,11-12 AM: M,F
Name of Course Teacher	**Dr. K. Pandima Devi**
Mobile: **+91 9790358700**	Email : **devikasi@yahoo.com**

Course Brief

Biochemistry is the science that deals with the study of various biomolecules that occur in living cells and organisms and also with the metabolic and chemical reactions occurring within them. It is also concerned with the entire range of life forms beginning from the obligate intracellular parasites such as viruses to simplest of prokaryotic organisms to complex human beings. Biochemistry has become the fundamental language for all the biological sciences as life depends on biochemical reactions and it is very much essential to know them for better living. The field of biochemistry and medicine are closely related. Health and disease of living organisms depend on the accustomed balance and abnormalities of biomolecules, biochemical reactions, or biochemical processes occurring in the body. Exploring these biochemical reactions with the recent advancement in biochemical knowledge have shed light on many areas of medicine. Biochemical approaches are often being considered as an important tool in identifying the causes of diseases and in designing appropriate therapies. Currently the smart use of various biochemical laboratory tests have become an integral part of disease diagnosis and monitoring the treatment. A high understanding of biochemistry and of other related basic disciplines such as cell biology, molecular biology and genetics is essential for the judicious practice of medicine and related other health sciences.

The principal aim of this course is to provide the students with the clear understanding of the molecular composition of living cells, their structure, organization and function. This course also focuses on the better understanding about the biological macromolecules like proteins, their different structural forms, polysaccharides, and nucleic acids. The course also shed knowledge to the students on the chemical structure, different intermolecular forces involved in the formation of

molecules, their thermodynamics and kinetics, and functionality to understand how biological molecules work. Biochemistry leads to a range of career preferences allowing students to grab various employment opportunities as chemical oceanographers, environmental scientists, pharmaceutical chemists, chemical engineers and chemical information specialists. Overall, the goal of this course is to impart fundamental working knowledge to the students on the biochemical perception and techniques which will be essential for their future job and scientific endeavors.

Text Books:

1. Harpers Illustrated Biochemistry (29th edition) by Murray et al., The McGraw-Hill companies, Inc
2. Lehninger Principles of Biochemistry (6th Edition) by Nelson DL and Cox MM, Macmillan worth Publishers.

Reference Books:

1. Biochemistry (4th Edition) by Voet D and Voet JG, John Wiley and Sons, USA
2. Enzymes-Biochemistry, Biotechnology and Clinical Chemistry (2008) by Palmer T. Affiliated East-West Press Pvt Ltd, India.

Course Objectives:

The objectives of the course is to make the students

1. Understand the basic concepts of cellular structure, its organization and the functions and importance of various biomolecules.
2. Learn various energy production mechanisms in cells.
3. Describe the laws of thermodynamics and their importance in biological phenomenon
4. Describe the various metabolic pathways involved in cells for its normal functioning.

Course Outcomes:

On successful completion of Analytical Biochemistry course, students will be able to:

i.	Acquire knowledge on the building blocks of the macromolecules, their chemical properties and their modification and their importance in normal functioning of living organisms.
ii.	Understand the metabolic pathways and identify how the genetic abnormalities disturb the normal homeostasis and link with pathological conditions
iii.	Understand the applications of biochemistry in medicine, agriculture, and pharmaceuticals

Course outline:

1. Basic concepts of cellular architecture
2. Structure and functions of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins)
3. Biological energy transducers- electron transport chain and oxidative phosphorylation
4. Energy production in living cells (glycolysis, TCA cycle)
5. Structure and functions of membrane and membrane proteins
6. Ion channels and pumps and their importance in transport of signaling molecules
7. Metabolism of carbohydrates, lipids, amino acids and nucleic acids
8. Genetic dysfunctions in metabolic pathways and metabolomics
9. Enzyme classification and their kinetics
10. Application of enzymes in agriculture, medicine and industries

More books for Reading and Referencing:

Author (s)	**Title**
Rodney F. Boyer	Modern Experimental Biochemistry
Nicholas C. Price, Lewis Stevens	Fundamental of Enzymology- Cell and Molecular Biology of Catalytic Proteins
Robert A. Copeland	Enzymes: A practical introduction to structure, mechanism and data analysis
Ashok Pandey, Colins Webb, Carlos Ricardo Soccol, Christian Larroche	Enzyme Ttechnology
Miroslava Ļuperlovíl -Culf	NMR Metabolomics in Cancer Research
Jeremy M. Berg, John L. Tymoczko, Lubert Stryer	Biochemistry
Colleen Smith, Allan D. Marks, Michael Lieberman	Markôs Basic Medical Biochemistry- A Clinical approach
D.E. Vance and J.E Vance	Biochemistry of Lipids, Lipoproteins and Membranes
David E. Metzler	Biochemistry: The chemical reactions of living cells

Course Schedule: Core- 501101–Biochemistry (Core – 3 credits)

Syllabus	**Schedule**
Unit 1: Chemical bonding in biological systems, pH and buffers. Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction). Principles of biophysical chemistry: pH, biological buffers, Thermodynamics and bioenergetics- concept of entropy, and free energy changes in biological reactions, Redox reactions, Role of high energy phosphates. thermodynamics (laws and quantities). Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins). Stability of proteins and nucleic acids.	**10 Days**
Unit 2: Biological energy transducers: Structure and functions of ATP, electron transport chain and oxidative phosphorylation, photosynthesis-light	**8 Days**

and dark reaction. Bioenergetics: glycolysis, TCA cycle, coupled reaction, group transfer.	
Unit 3: Structure of model membrane: lipid bilayer, fluid mosaic model, electrical properties of membranes, membrane proteins (intrinsic, extrinsic, lipid-linked proteins), transport mechanisms (mediated and non-mediated), ion channels and pumps.	**7 Days**
Unit 4: Metabolism of carbohydrates (glycolysis; gluconeogenesis; pentose phosphate pathway), lipids (fatty acid oxidation and biosynthesis), amino acids biosynthesis, nucleotides (de novo synthesis and salvage pathways). Disorders of lipid, carbohydrate, nucleic acid, amino acid metabolism. Inborn errors of metabolism. Metabolomics.	**6 Days**
Unit 5: Enzyme nomenclature and classification. Coenzymes and cofactors. Coenzymes derived from vitamins. Principles of catalysis, Mechanism of enzyme catalysis. Catalytic power and specificity of enzymes. Enzyme kinetics and general properties of enzymes like effect of pH, temperature. Extraction, assay and purification of enzymes. Role of enzymes in agriculture, industry, and medicine. Structure, mode of action and metabolic functions of vitamins. Deficiency diseases associated with vitamins. Clinical and industrial applications of enzymes. Abzymes, Ribozyme and Isozymes. Enzyme engineering and enzyme immobilization.	**8 Days**
5 days left for CIA Tests and Seminars	

501102–MICROBIOLOGY (Core – 3 credits)

COURSE DEPICTION

Program: **M.Sc. Biotechnology**	Semester : **I (2016-17)**
Course Title: **Microbiology**	Class Time: **11-12: Wed and 12-1 Tue. & Friday.**
Name of Course Teacher	**Dr. A. Veera Ravi**
Mobile: **+91 9487149249**	Email : **aveeraravi@rediffmail.com**

Course Brief: Microbiology is an essential part of various scientific studies, such as biotechnology, genetics, immunology, molecular biology, medicine, biochemistry, ecology, agriculture, industrial processes, etc. These fields apply microbiology in their daily measures. Because of the broad range of its applications, understanding the basics of microbiology is vital to the completeness as biologists. This syllabus deals with the microorganismsô morphology, structure, classification, physiology, metabolism, reproduction and most importantly their economical importance. In other words, this syllabus distinguish the role of the microbes that is the microbes can do (beneficial) and should not be allowed to do (pathogens) as for as plants, animals and human beings are concerned. This core course mainly covers the applications of microorganisms in human and animal health. It also deals with industrial applications of microorganisms such as vinegar, wine, sauerkraut, pickles, beer, green olives, soy sauce, buttermilk bread, cheese, and yoghurt productions. The main aim of this syllabus is to familiarize students with understanding basic concepts and advanced knowledge in microbiology.

Text Book:

1. Microbiology (2013), Ninth edition by L.M. Prescott, J.P. Harley and D.A. Klein, McGraw Hill, Boston.
2. Medical Microbiology (1997) by D. Greenwood, R. Slack and J. Peutherer, ELST with Churchill Livingstone, Hong Kong

Reference Books:

i. Environmental Microbiology (2015), Third edition, I.L. Pepper, C.P. Gerba and Terry J. Gentry. Elseiver Publication, New Delhi, India.

ii. Microbial Technology (2004) by H. J. Peppler and D. Perlman, second edition, Elsevier, academic press.

Course Objectives: To make the students:

i. To acquire knowledge about history of microbiology, classification, microbial anatomy, physiology, the basic principle of growth and metabolism and microbial diversity.

ii. To understand the basic descriptions of different prokaryotic, eukaryotic and other life-forms and how they exploit these principles; the natural ecology of microorganisms; the human use of microorganisms; and how microorganisms function in disease.

iii. To understand basic molecular methods in assessing microbial diversity using Denaturing Gradient Gel Electrophoresis (DGGE), Terminal Restriction Fragment Length Polymorphism (T-RFLP) and Amplified Ribosomal DNA Restriction Analysis (ARDRA).

Course Outcomes: The students shall be able to:

i. Explain the historical perspectives of microbiology
ii. Describe the use of Bergeyôs Manual of Systematic Bacteriology and its criteria for the taxonomy of prokaryotes.
iii. Understand and list the structural differences between eukaryotic and prokaryotic cells.
iv. Understand the role of beneficial microorganisms in the environment and the application to benefit mankind.
v. List and describe the mechanisms of action of major chemotherapeutic agents that control microorganisms.
vi. Explain about factors responsible for the virulence of different pathogenic microorganisms.
vii. Explain about molecular methods in assessing microbial diversity.

Course Outline: Core: Microbiology (3 Credits)

i. Introduction to Historical perspectives of microbiology

ii. Landmark discoveries relevant to the field of microbiology.

iii. Important criteria used for classification (morphological, ecological, biochemical, molecular and numerical criteria) of microorganisms.

iv. Introduction to domain and kingdom concepts in classification of microorganisms

v. Introduction to classification of Bacteria according to Bergeyôs manual.

vi. Introduction to diversity of prokaryotic microorganisms.
vii. Background of microbial pathogens, epidemiology and their pathogenicity mechanisms.
viii. The medically important aspects of microbiology in both basic and clinical aspects of bacteriology, virology and mycology**.**
ix. Drug resistance mechanisms and sensitivity to antibiotics
x. Introduction to experimental molecular methods in assessing microbial diversity
xi. Merits and demerits of culture dependent and culture independent methods in analyzing microbial diversity.
xii. Introduction to metagenomics library construction, function driven & sequence driven analysis.
xiii. The role of microorganisms on the earth (symbiosis, mutalism, commensalism and parasitism)
xiv. The importance of microorganisms in the production of useful human products such as antibiotics, enzymes, organic acids, wine, beer, cheese, yogurt and vitamins.
xv. The nutraceuticals application of probiotics and gives an important background regarding biological control agents.
xvi. Introduction to biological causes of degradation and deterioration of oil, plastics and xenobiotics.

More books for Reading and Referencing

Microbiology: An Introduction (2014), Twelth edition. Gerard J. Tortora, Berdell R. Funke, Christine L. Case.
Alcamoôs Fundamentals of Microbiology (2011), Fifteenth edition. Jeffery C. Pommerville and I. Edward Alcoma. Chicago, Sudburg, Mass: Jones and Bartlette Publishers.
Molecular Microbiology ï Diagnostic Principles and Practice (2004), D.H. Persing, ASM Press, Washington, USA.
Microbial Functional Genomics (2004) by J.Zhou, D.K. Thomson. Y.Xu. J.M. Tiedje, J.Wiley & Sons Publishers
Microbial Ecology. Fundamentals and Applications (2000) by R. M. Atlas and R. Bartha. 8. Microbiology (1993) by M.J. Pelzer Jr., E.C.S. Chan and N.R. Kreig, McGraw Hill Inc., New York.

Course Schedule: Core: Microbiology (3 Credits)

Syllabus	**Schedule**
Unit 1: Historical perspectives of microbiology: Landmark discoveries relevant to the field of microbiology. Important criteria used for classification (morphological, ecological, biochemical, molecular and numerical criteria) of microorganisms. Domain and Kingdom concepts in classification of microorganisms, Classification of Bacteria according to Bergeyôs manual. Diversity of prokaryotic microorganisms.	**12 Days**
Unit 2: Microbial Anatomy ï Bacterial Cell structure & Organization. Bacterial endospores. Archaeal cell structures. Viruses, General properties of Viruses, RNA & DNA Virus, Classification of virus ï Baltimore, Virions & Prions. Microbial Physiology. Nutrition, Growth and Metabolism of microorganisms - Respiration, Fermentation,	**10 Days**

Photosynthesis.	
Unit 3: Microbial Diseases and Host Pathogen Interaction: Normal microbiota; Reservoirs of infection; Nosocomial infection, Emerging microbial diseases. Mechanism of microbial pathogenicity, Toxins, Drug resistance, Sensitivity tests. Bacterial pathogens ï *Staphylococcus, Streptococcus, Escherichia & Salmonella.* Viral pathogens ï Rabies, Enterovirus, Retrovirus, Oncogenic and HINI viruses. Fungal Diseases: Histoplasmosis, Aspergillosis, Cryptococcosis and Candidiasis.	**10 days**
Unit 4: The expanse of microbial diversity, estimates of total number of species, measures and indices of diversity: Molecular methods in assessing microbial diversity: Denaturing Gradient Gel Electrophoresis (DGGE), Terminal Restriction Fragment Length Polymorphism (T-RFLP), Amplified Ribosomal DNA Restriction Analysis (ARDRA). Merits and demerits of culture dependent and culture independent method. Microbial functional genomics ï Metagenomics, Construction of metagenomic library, analysis of metagenomic library ï function driven analysis, sequence driven analysis. Stable isotopic probing for molecular ecology.	**12 days**
Unit 5: Microorganisms in the environment - Air, Water & Soil. Microbes from extreme environment. Industrial microbiology: Use of microbes in fermentation, production of antibiotics, enzymes, organic acids, wine, beer, cheese, yogurt and vitamins. Role of Microorganism on the earth-Symbiosis, mutalism, commensalism and parasitism. Probiotics and Biological Control Agents (BCA).Biodegradation and biodeterioration of oil, plastics and xenobiotics.	**9 days**
5-8 days left for CIA Tests, Quizzes, Seminars, etc.	

501103–CELL BIOLOGY (Core – 3credits)

COURSE DEPICTION

Program: **M.Sc. BIOTECHNOLOGY**	Semester : **I (2016-17)**
Course Title: **Core 3:Cell Biology (501103)**	Class Time: **10-11: Tuesday** **11-12: Monday** & **Thursday**
Name of Course Teacher	**Dr.M.Ramesh**
Mobile: **+91 9442318200**	Email : **mrbiotech.alu@gmail.com**

Course Brief:

Cell biology (formerly called cytology) is a branch of biology that covers aspects ranging from fundamentals of the structure and function of cells of higher organisms (both plants and animals) as the basic unit of living things and as the building blocks of multi-cellular organisms. The course integrates principles from many disciplines, including chemistry, physics, genetics, biochemistry and physiology, for a complete understanding of cell function. This important core course will focus on the key topics in cell biology and add details to various concepts that have been previously exposed to the students in their Undergraduate courses. Most of the recent advancements in plant and animal science are the result of a complete understanding of cellular components and their individual and coordinated functions. The curriculum is critically designed to provide a background in the basic cell biology that is essential for subsequent biology courses to be studied by the students in the second and third semester

and it also exposes students to top research areas and to instigate the development of analytical, technical and communicative skills required for today's biologists. The core course aims at providing all the students, having a diverse background, with the fundamental concepts and experimental tools in molecular cell biology to understand cell function in eukaryotes.

Text Books:

1. Cell and Molecular Biology (Eight Edition) (2005), De Roberties, E.D.P. and De Roberties, E.M.F. B.I.Waverly Pvt.Ltd. New Delhi.
2. Molecular Cell Biology (2007) (6th Edition) James Darnell, W. H. Freeman & Co. Cell Biology. Pollard, T.D. and Earnshaw. Publ. W.C. Saunders. Updated Edition. 3rd Edition ISBN 978-1-4160-2255-8. Pollard, T. D., and Earnshaw, W. C., Saunders Elsevier.

Reference Books:

1. Molecular Biology of the Cell (2014), 6th Edition, B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts and P Walter, Garland Publishing (Taylor & Francis Group), New York & London (ISBN: 9780815344322).
2. Molecular Cell Biology (2014), Harvey Lodish, 7th Edition, W.H.Freeman and Company, New York.

Course Objectives:

To make the students to:

1. Understand the basic concepts of prokaryotic and eukaryotic cell
2. Get comprehensive and concise overview of basic cell biology aspects
3. Understand the individual and coordinated functions of various cell organelles
4. Apply cell biology concepts in plant and animal biotechnology
5. Apply various assays in plant and animal biotechnology experiments
6. Understand the role of cellular and environmental factors causing cancer and premature aging.

Course Outcomes: The students undergoing this important core course shall be able to

i. Equip themselves with a basic knowledge of the structural and functional properties of cells
ii. Learn the basic concepts and theories of cell and become aware of the complexity (endomembrane system in eukaryotes) and harmony of the cell.
iii. Describe important functions of the cell, its microscopic structure and the structure of the key cellular components including membranes, various membrane bound organelles, the cytoskeleton network, and the genetic material.
iv. Get basic knowledge on practical techniques and approaches commonly used in molecular cell biology aspects such as protein sorting and aging studies
v. Understand cellular components and their functions at a particular stage of development and differentiation
vi. Describe the mechanisms for cell growth, cell division, cell expansion and cell differentiation.

Course Outline: Major Core 3: Cell Biology (3 Credits)

i.	General organization of eukaryotic plant and animal cells
ii	Architecture and function of intracellular organelles
iii	Organization and packaging of chromatin
iv	Structural organization and functions of cytoskeletons
v	Model membrane structure and functions
vi	Mechanism and regulation of protein transport in semiautonomous organelles
vii	Protein insertion and processing in Endoplasmic reticulum and protein trafficking
viii	Cell cycle and its regulation.
ix	Basic process and mechanism of cell differentiation in higher plants
x	Nature, composition and organization of plant cell wall
xi	Organization of SAM and RAM and root apical meristem
xii	Interdependent nuclear-cytoplasm interactions
xiii	Cell fusion and its applications
xiv	Structural organization and function of cell machines
xv	Classification and cellular functions of chaperones
xvi	Necrosis and Apoptosis - Process and Mechanism.
xvii	Oncogenes, tumor suppressor genes, cancer and the cell cycle
xviii	Theories regarding tumor formation - Mutation, Virus, Metabolic and Hormonal disturbance theories of tumor. Cellular, Systemic Pace maker, Biological clock and Mutation theories of aging.

Additional books for Reading and Referencing

Author (s)	**Title**
Geoffrey M.Cooper and Robert E.Hausman	The Cell: A Molecular Approach (2016) 7th Edition, ASM Press, Washington D.C. & Sinauer Associates, Inc, Sunderland, Massachusetts.
Gerald Karp, Harris, D	Cell and Molecular Biology ï Concepts and Experiments (2016), (ed), John Wiley & Sons Inc, New York.

Benjamin Lewin	Genes IX (2007), 9th Edition, Jones and Barlett Publishers. ISBN: 0763740632.

Course Schedule: Core 3: Cell Biology (3 Credits)

Syllabus	Schedule
Unit 1: An overview of plant and Animal Cells. Structure and Organization of prokaryotic and eukaryotic cells. Structural organization and function of intracellular organelles (Nucleus, Endoplasmic Reticulum, Golgi complex, Mitochondria, Chloroplast, Lysosomes, Peroxisomes and vacuoles). Chromatin organization and packaging. Three dimensional organization and functions of Cytoskeletons (Microfilaments, Intermediate filaments, Microtubules and associated proteins).	**10 Days**
Unit 2: Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, and ion pumps. Intracellular protein sorting- Mechanism and regulation of intracellular transport in mitochondria, chloroplast, endoplasmic reticulum and nucleus. Electrical properties of membranes. Protein insertion and processing in Endoplasmic reticulum and protein trafficking from Endoplasmic reticulum to Golgi bodies. Cell cycle and its regulation. Molecular events during cell cycle, Check points, Cyclins and protein kinases.	**10 Days**
Unit 3: Cellular differentiation in plants ï Basic process and mechanism. Specific role of hormones and regulation of cellular differentiation. Plant cell wall-Nature, composition and organization. Organization of shoot and root apical meristem; shoot, root and flower development.	**9 days**
Unit 4: Nuclear-Cytoplasm interactions. Cell fusion and its applications. Properties of cancer cells. Proteasome ï structural organization and function. Chaperons-Classification and cellular functions. Necrosis and Apoptosis - Process and Mechanism.	**8 days**
Unit 5: Oncogenes, tumor suppressor genes, cancer and the cell cycle. Theories regarding tumor formation - Mutation, Virus, Metabolic and Hormonal disturbance theory. Aging Theories ï Cellular, Systemic, Pace maker, Biological clock and Mutation theory.	**8 days**
8 days assigned for CIA Tests, Quizzes, Seminars, etc.	

501104–MOLECULAR BIOLOGY AND GENETICS (Core – 3 credits)

COURSE DEPICTION

Program: **M.Sc., Biotechnology**	Semester : **I (2016-17)**
Course Title: **Molecular Biology and Genetics**	Class Time: **10-11: M,T and 12-1:W.**
Name of Course Teacher	**Prof. S. Karutha Pandian**
Mobile: + **91 9442318144**	Email : **sk_pandian@rediffmail.com**

Course Brief:

The course deals with the molecular level studies including DNA, RNA and protein; describes DNA as the genetic material, and the central dogma of life - replication, transcription and translation; demarcate the organization of genomes in prokaryotes and eukaryotes; explains the regulation of gene expressions and silencing; delineates the biology of bacteriophages and its lifecycles; delves into mutation, genetic recombination, genetic mapping, linkages and crossing over; scrutinize the causes of mutation, its types and the mechanisms to repair it; discriminate the methods of genetic transfers and decipher the mapping of genes; defines transposons and its mechanisms; discerns the human genetics and chromosomal aberrations.

Text Book: Molecular Biology of the Gene, 7th Edition (2014) by James D Watson, Tania A Baker, Stephen P Bell, Alexander Gann, Michael Levine and Richard Losick, Benjamin Cummings.

Reference Books:

i. Academic Cell - Molecular Biology, 2nd Edition (2013) by David P Clark and Nanette J Pazdernik.
ii. Essential Genetics, 6th Edition (2014) by Daniel L Hartl.

Course Objectives: To make the students:

i. Understand the essentials of molecular biology: replication, transcription and translation; enzymes involved in the central dogma of life, proofreading, inhibitors and post modifications.
ii. Thorough in prokaryotic and eukaryotic genome organization; lac & trp operon; regulation of transcription and translation in eukaryotes; lytic and lysogenic life cycle of bacteriophages; recombination in bacteriophage.
iii. Knowledgeable in mutant and it types, genetic recombination, linkage, multifactor crosses; mutation: causative agents, types and the mechanism of repair; complementation and intragenic complementation.
iv. Familiar with the methods of natural and artificial genetic transfer; mapping and structural analysis of genes; transposons.
v. Comprehend pedigree analysis, karyotypes, eugenics, epigenetics, chromosomal aberrations, phylogenetic inheritance and quantitative trait locus mapping.

Course Outcomes: The students shall be able to:

i.	Understand the occurrence of central dogma of life in the cell and the machineries involved to initiate and inhibit.

ii.	Fathom the genome organization and control of gene expressions in prokaryotes and eukaryotes.
iii.	Decipher the types of mutant, isolation and characterization of mutant, types of genetic recombination, and the phenomenon of mutation, types, their causative agents, detection and repair mechanism.
iv.	Comprehend the genetic transfer methods and gene mapping, gene structure analysis, transposons types, nomenclature and their mechanism.
v.	Aware of the genetic disorders in humans due to structural and numerical alterations in the chromosomes and its inheritance.

Course Outline: Core: MOLECULAR BIOLOGY AND GENETICS (3 Credits)

i. Structure and Types of DNA and RNA
ii. Mechanism of DNA replication, Enzymes involved, replication origin, replication fork, fidelity of replication, Inhibitors of DNA replication
iii. Replication in extra-chromosomal DNA
iv. Transcription - initiation, elongation and termination, RNA processing, RNA transport and Transcription inhibitors.
v. Translation - formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination
vi. Translational proof-reading, translational inhibitors, Post- translational modification of proteins.
vii. Genome Organization in Prokaryotes, regulation of gene expression: lac & trp operon.
viii. Genome Organization in eukaryotes, repetitive DNA and renaturation kinetics, Eukaryotic DNA Packaging, Regulation of transcription and translation
ix. role of chromatin in gene expression and gene silencing
x. Bacteriophage: Lytic and lysogenic lifecycle
xi. Types of mutants, Isolation and characterization of mutants and revertants; Genetic analysis of mutants
xii. Genetic recombination, Genetic mapping, Linkage and multifactor crosses, Deletion mapping, Complementation and Intragenic complementation
xiii. Mutation: causes, types, detection and repair
xiv. Methods of genetic transfers ï transformation, conjugation and transduction
xv. Mapping genes by interrupted mating, Fine structure analysis of genes-Linkage maps, tetrad analysis, mapping with molecular markers and by using somatic cell hybrids
xvi. Introduction to Transposable elements ï Discovery, types, Nomenclature and mechanism
xvii. Human genetics - Pedigree analysis, Lod score for linkage testing, karyotypes, genetic disorders.
xviii. Eugenics. Epigenetics & Genome Imprinting.
xix. Structural and numerical alterations of chromosomes - Deletion, duplication, inversion, translocation, ploidy and their genetic implications.
xx. Polygenetic inheritance, heritability and its measurements, QTL Mapping

More books for Reading and Referencing

Author (s)	**Title**
Williams S Klug, Michael R Cummings, Charolette A Spencer and Michael A Palladino	Concepts of Genetics
Larry Snyder, Joseph E Peters, Tina M Henkin and Wendy Champness	Molecular Genetics of Bacteria,
Burton E Tropp	Molecular Biology ï Genes to Proteins

S.R. Maloy, J. E. Cronan Jr., and D. Freifelder	Microbial Genetics
T. A. Brown	Genomes
S. B. Primrose and R. M. Twyman	Principles of Gene Manipulation and Genomics
David P Clark and Nanette J Pazdernik	Biotechnology
Lodish, Berk, Matsudaira, Kaiser, Krieger, Scott, Zipursky and Darnell	Molecular Cell Biology
R. M. Twyman	Advanced Molecular Biology
Gerald Karp	Cell and Molecular Biology
Robert Schleif	Genetics and Molecular Biology
Lizabeth A. Allison	Fundamental Molecular Biology
Alberts, Johnson, Lewis, Raff, Roberts and Walter	Molecular Biology of the cell
Lewis	Human Genetics Concept and Applications

Course Schedule: Core: Molecular Biology and Genetics (3 Credits)

Syllabus	**Schedule**
Unit 1: UNIT -1 DNA as the genetic material, Structure and Types. Replication - Mechanism of DNA replication in Prokaryotic and eukaryotic systems, Enzymes involved, replication origin and replication fork, fidelity of replication, extra-chromosomal replicons, Inhibitors of DNA replication. Structure and functions of different types of RNA. Transcription - Transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, elongation and termination, RNA processing (capping, polyadenylation, RNA editing, and splicing), RNA transport and Transcription inhibitors. Genetic code. Translation - Prokaryotic and eukaryotic translation machinery, Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post- translational modification of proteins.	**9 Days**
Unit 2: Genome Organization in Prokaryotes, regulation of gene expression: The Operon concept - i) lac and ii) trp; stringent response. Genome Organization in eukaryotes, repetitive DNA and renaturation kinetics, Eukaryotic DNA Packaging, Regulation of transcription and translation in eukaryotes, role of chromatin in gene expression and gene silencing. Biology of bacteriophage ॅ. Lytic growth of phage ॅ: DNA replication and phage production, recombination in the ॅ life cycle. Lysogeny: Immunity and repression, Lysogeny and prophage integration, prophage excision. Decision between lysis and lysogeny.	**7 Days**
Unit 3: Genetic nomenclature- Types of mutants, Isolation and characterization of mutants and revertants. Genetic analysis of mutants, genetic recombination (Homologous, non-homologous and site specific recombination), Genetic mapping, Linkage and multifactor crosses,	**8 days**

Deletion mapping, Complementation and Intragenic complementation; The need for isogenic strains for genetic analysis. Mutation - Causes (physical, chemical and biological) Types (lethal, conditional, biochemical, loss of function, gain of function) and detection. Mechanism of repair-photoreactivation, excision repair, recombinational repair. The SOS and adaptive responses and their regulation. Heat shock response.	
Unit 4: Methods of genetic transfers ï transformation, conjugation- *(Hfr*, triparental mating, self transmissible and mobilizable plasmids,) transduction (general and specialized), mapping genes by interrupted mating, Fine structure analysis of genes-Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids. Introduction to Transposable elements ï Discovery and types, Nomenclature - Insertion sequences - Mechanism ï Transposons of *E. coli*, Bacteriophage and Yeast.	**7 days**
Unit 5: Human genetics - Pedigree analysis, Lod score for linkage testing, karyotypes, genetic disorders, Eugenics. Epigenetics & Genome Imprinting. Structural and numerical alterations of chromosomes - Deletion, duplication, inversion, translocation, ploidy and their genetic implications., Polygenetic inheritance, heritability and its measurements, QTL Mapping.	**7 days**
5-8 days left for CIA Tests, Quizzes, Seminars, Case Presentations, etc.	

501105–LAB I: ANALYTICAL BIOCHEMISTRY (Core – 4 credits)

COURSE DEPICTION

Program: **M.Sc.**	Semester:**I (2016-17)**
Course Title: **Lab I- Analytical Biochemistry**	Class Time: 2 PM to 6 PM on Monday and Tuesday
Name of Course Teacher	**Dr. K. Pandima Devi**
Mobile: **+91 9790358700**	Email :**devikasi@yahoo.com**

Course Brief

Analytical biochemistry is a subdivision of biochemistry which emphasizes on the experimental methods involved in biological sciences. The fast development and massive enlargement of every single phase of biochemistry has not only noticeably enhanced our knowledge about the nature of life but has also made biochemistry the right language of life itself. Realizing the dynamic importance of this discipline of science, degree courses in analytical biochemistry are now offered in postgraduate level. For certain degree programmes, depending upon the course, the students are also offered this subject at undergraduate level, since analytical biochemistry is not taught to them at the school level.

The syllabus of Analytical Biochemistry has been framed to meet the requirements of our students who will be performing various biological experiments by applying the modern tools of

analytical biochemistry. Besides, the course might also support a suitable purpose for higher education in Biotechnology. The main goal of the course is to supply students with complete information on analytical biochemistry in the aspects of basic concepts, applications of the instruments used in biochemical analysis, separation techniques, clinical enzymology and so on. The course also highlights the application of analytical biochemistry concepts in the field of biotechnology to understand the regulation of protein signaling pathways, cell differentiation, cancer development and aging disorders. The syllabus for the course, which will be studied by the students in the first semester, is methodically designed to provide detailed information on the basic concepts of analytical biochemistry that is necessary for biotechnology course. It will also expose the students pursuing post graduation to the advanced research areas and will improve their analytical and practical abilities necessary for the current biotechnologists. Students experiencing the practical knowledge of this course will make themselves familiar with the basic knowledge of instruments used in biochemical analysis, which are progressively more essential in all forms of life sciences.

Text Books:

3. Laboratory Manual for Analytical Biochemistry and Separation techniques (2000) by P. Palanivelu, MaduralKamaraj University.
4. Experimental Biochemistry- A Student Companion (2005) by Beedu Sashidhar Rao and Vijay Deshpande, I. K. International Pvt, Ltd.

Reference Books:

3. Principles and Techniques of Practical Biochemistry (2010) by Wilson. K. And Walker. J. Pub: Cambridge Press.
4. Modern Analytical Chemistry (2000) by David Harvey, McGraw-Hill, New York, Vol.798.

Course Objectives:

The objectives of the course is to make the students

1. Learn the basic concepts and applications of instruments applied in biochemical analysis
2. Understand the clinical significance of enzymes
3. Describe the production techniques for extracellular enzymes and downstream processing methods
4. Describe the features of chromatography techniques and their biological applications.

Course Outcomes:

i.	On successful completion of Analytical Biochemistry course, students will be able to: Acquire basic knowledge on practical techniques and approaches

	commonly used in analytical biochemistry in the aspects of biochemical enzyme assays and separation techniques.
ii.	Realize the significance of electrophoretic techniques in molecular diagnosis
iii.	Understand about biostatistics and apply it for data analysis in the field of biological research.

Course outline:

1. Basic concepts and applications of the instruments used in biochemical analysis
2. Spectroscopy techniques-principle and applications
3. Blood samples- Collection and preservation for enzyme assays
4. Enzymes- Derivation of Michaelis- Menten equation and significance of Vmax, Km and optimum pH
5. Clinical enzymes- assay and significance
6. pH Meter: buffer preparation and pI determination
7. Chromatography techniques-separation of plant pigments
8. Extracellular enzymes- production and purification
9. Proteins- separation by Native and SDS PAGE and identification by 2D gels
10. Statistical analysis- probability and sampling distribution, tests of significance, analysis of variance, multivariate statistics

More books for Reading and Referencing:

Author (s)	**Title**
R. Eisenthal and M.J.Danson	Enzyme assays
Monika Wakasmundzka-Hajnos, Joseph Sherma	High performance Liquid chromatography in Phytochemical Analysis
Hobart H. Willard, Lynne L. Merritt , John A, Dean, Frank A. Settle	Instrumental Methods Of Analysis
Ipsita Roy and Munishwarn Gupta	Downstream processing of enzymes/proteins
Susan R. Mikkelsen and Eduardo Corton	Bioanalytical Chemistry
Rodney and Royer	Modern Experimental Biochemistry
Veer BalaRastogi	Fundamental of Biostatistics
David Harvey	Modern Analytical Chemistry
H.D Beckey	Principles of Field Ionization and Field Desorption Mass Spectrometry: International Series in Analytical Chemistry

Course Schedule: 501105. LAB I- ANALYTICAL BIOCHEMISTRY (Core – 4 credits)

Syllabus	Schedule
UNIT-1 Basic concepts and applications of the instruments used in biochemical analysis: Colorimetry, spectrophotometry and spectroflorimetry. Colorimeter: Evaluation of beers law, complementary colour and wavelength of coloured solutions. Spectrophotometer: Determination of carbohydrate by DNSA method and Protein estimation by Lowryôs and Bradfordôs method. Principle, instrumentation and application of Atomic Absorption spectroscopy, Circular dichroism spectroscopy, Electron spin resonance spectroscopy and Mass spectroscopy.	**6 days**
UNIT-2 Collection of samples for enzyme assays: whole blood, serum, plasma, tissue homogenate. Subcellular fractionation: mitochondria, cytosol, nuclei. Enzyme assays: Derivation of Michaelis- Menten equation and determination of Vmax, Km, optimum pH and optimum temperature. Clinical Enzymology: Clinical significance and assay of the enzymes- SGOT, SGPT, ALP, Amylase, ACP, Lipases. Estimation of blood glucose and determination of fasting, post-prandial and random blood sugar. Evaluation of risk of coronary heart disease-estimation of serum cholesterol.	**8 days**
UNIT-3 pH meter and preparation of buffers of pH range 2 to 11. Derivation of Henderson-Hasselbach equation and evaluation of pKa values in acid-base titrations. Determination of pI value of amino acids. Biochemical separation techniques: Separation of amino acids and sugars by ï Paper chromatography and plant pigments by TLC and HPTLC.	**4 days**
UNIT-4 Production of extracellular enzymes from bacteria/fungus and downstream processing a) Ultrafiltration b) Ammonium sulphate precipitation c) Dialysis d) Ion exchange chromatography e) Gel permeation chromatography f) HPLC. Principle, instrumentation and application of GC, FPLC and affinity chromatography. Centrifugation and types of rotors.	**5 days**
UNIT-5 Electrophoretic techniques- separation of proteins by Native and SDS PAGE. Identification of proteins by 2D gels. Radioactive labeling and measurement of radioactivity. Biostatistics- Measures of central tendency and dispersal; probability distributions (Binomial, Poisson and normal); Sampling distribution; Difference between parametric and non-parametric statistics; Confidence Interval; Errors; Levels of significance; Regression and Correlation; t-test; Analysis of variance; G2 test; Basic introduction to Multivariate statistics.	**5 days**
8 days left for CIA test	

501106–LAB II: MICROBIOLOGY (Core – 4 credits)

COURSE DEPICTION

Program: **M.Sc. Biotechnology**	Semester : **I (2016-17)**
Course Title: **Microbiology Lab**	Class Time: **2-6, T & F.**
Name of Course Teacher	**Dr. A. Veera Ravi**
Mobile: **+91 9487149249**	Email : **aveeraravi@rediffmail.com**

Course Brief: This core course is planned for science majors who need a microbiology course for their professional preparation, usually in an area of clinical importance including pharmacy, nursing, physicianôs assistant, dental assistant, and others. In addition, this course deals with the basic microbial techniques required in the field of biotechnology. This important core course will focus on the lab uses that imply aseptic techniques and develop studentôs skills necessary to handle microbes in health care settings, including the isolation, identification and characterization of unknown microbes. Students will be exposed to hands on training relating to isolation, purification and identification of microorganisms from different sources. This core course also uncovers the general principles for microbial growth, evolution and classification and gives description of different prokaryotes and eukaryotes. The core course equips the students with basic bacterial and fungal laboratory techniques as well as factual and laboratory knowledge for specific microorganisms types. This syllabus will provide students with understanding of microbial ecology and their practical uses which is related to basic biological concepts. The main aim of this course is to develop an opportunity to learn the skills necessary to understand concepts related to microbial life. This should permit students to establish a strong foundation for future research in advanced biology field and gives a good analytical power needed to make reasoned choices in their everyday life. This syllabus is critically designed to provide the information regarding the survival of microorganisms and their relationship and interaction within them and us.

Text Book: Microbiology (2013), Ninth edition by L.M. Prescott, J.P. Harley and D.A. Klein, McGraw Hill, Boston.

Reference Books:

i. Microbiology: A Laboratory Manual (2002) by J.G. Cappuccino and N. Sherman, Addison-Wesley.
ii. Laboratory Manual of Experimental Microbiology (1995) by R.M. Atlas, A.E. Brown and L.C. Parks, Mosby, St. Louis.

Course Objectives: To make the students:

i. Learn the techniques relating to microscopy, culture handling and maintenance, microbial biochemistry and physiology and molecular biology.
ii. understand the safety precautions required in microbiology laboratories.
iii. Employ the right staining methods and apply those methods to identify microorganisms
iv. Perform and evaluate the use of different biochemical tests in the laboratory for characterization of bacteria.
v. Perform the serial dilution and the standard plate count techniques.

Course Outcomes: The students shall be able to:

i. Familiarize with laboratory equipments used for working with microorganisms.
ii. Develop expertise to use microscopes in the laboratory
iii. Describe how microorganisms are collected, inoculated, cultured, incubated, and autoclaved
iv. Perform and evaluate the use of water and food analyses
v. Understand the methods to characterize the unknown bacteria
vi. Be proficient in writing scientific texts by accumulating information and results of each laboratory experiment in form of reports

Course Outline: Core: Lab II- Microbiology (4 Credits)

i. Safety measures in microbiology laboratory
ii. Introduction to laboratory instruments & equipments and standard laboratory practices.
iii. Microscopy- Bright field, Phase Contrast & Fluorescence microscopy
iv. Sterilization methods and preparation of culture media.
v. Enumeration of bacteria and fungi from Soil, Water, Air and Marine environmental samples.
vi. Techniques involved in isolation of pure bacterial culture.
vii. Preservation methods and maintenance of microbial cultures
viii. Staining methods- Simple staining, Negative staining & Differential staining techinques
ix. Measurement of microbes using micrometry
x. Motility determination by hanging drop method
xi. Measurement of growth- growth curve and generation time
xii. Factors affecting the bacterial growth- pH, Temperature and Salinity
xiii. Screening and identification of Amylase, Protease, Lipase, Gelatinase, DNase enzymes and antibiotic producing microorganisms
xiv. Mass cultivation of commercially important compounds producing microorganisms using bioreactors
xv. Water quality analysis - MPN method
xvi. Bacterial cell ï cell communication system
xvii. Biochemical characterization: Carbohydrate fermentation, IMVIC tests, starch hydrolysis, cellulose, gelatin, casein, catalase test, oxidase test, urease test, nitrate reduction, TSI.
xviii. Molecular methods employed in identification of culture dependent and culture independent bacterial organism

More books for Reading and Referencing

i.	Laboratory Manual in General Microbiology (2002) by N. Kannan. Panima Publishers.
ii.	Bergeyôs Manual of Determinative Bacteriology. Ninth edition (2000) by J.G.Holt, N.R.Krieg, Lippincott Williams & Wilkin Publishers.
iii.	Diagnostic Molecular Microbiology: Principles and Applications (1993) by D.H. Pershing, ed., American Society of Microbiology..
iv.	Handbook Medical Laboratory Technology (2014) by V. H. Talib, CBS Publishers.
v.	Laboratory exercise in Microbiology (2010) by John Harley, McGraw-Hill Education
vi.	Techniques for Microbiology ; A student handbook (2007) by John Lammert, Pearson Prentice Hall

Course Schedule: Core: Lab II: Microbiology (4 Credits)

Syllabus	**Schedule**
Unit 1: Safety measures in Microbiology laboratory. Introduction to laboratory instruments and equipments and standard laboratory practices. Microscopy: Bright field, Phase Contrast & Fluorescence microscopy. Sterilization and preparation of culture media, Enumeration of bacteria and fungi from environmental samples of Soil, Water, Air and Marine environments.	**12 Days**
Unit 2: Techniques for isolation of pure bacterial culture. Preservation and maintenance of microbial cultures. Stains and staining techniques, Simple staining, Negative staining & Differential staining techniques. Measurement of size of microbes ï micrometry method. Motility determination ï hanging drop method.	**10 Days**
Unit 3: Measurement of growth ï Growth curve, determination of growth rate and generation time, factors affecting bacterial growth ï pH, Temperature and Salinity. Assay of antibiotics and demonstration of antibiotic resistance. Screening and identification of Amylase, Protease, Lipase, Gelatinase, DNase enzymes and antibiotic producing microorganisms.	**13 days**
Unit 4: Mass cultivation of commercially important compounds producing microorganisms using bioreactors. Culture of anaerobes, Water quality analysis - MPN method, Microbial analysis of food samples. Probiotics and Bacterial cell ï cell communication system.	**8 days**
Unit 5: The general principles of bacterial characterization. Biochemical tests: Carbohydrate fermentation, IMVIC tests, starch hydrolysis, cellulose, gelatin, casein, catalase test, oxidase test, urease test, nitrate reduction, TSI. Molecular methods employed in identification of culture dependent and culture independent bacterial organism.	**10 days**
5-8 days left for CIA Tests, Quizzes, Seminars,2etc.	

SEMESTER II

501201–IMMUNOBIOLOGY (Core – 3 credits)

COURSE DEPICTION

Program: **M.Sc**	Semester : **II (2016-17)**
Course Title: **Biotechnology**	Class Time:**11-12: Monday, 12-1 PM: Wednesday & 10-11 AM: Friday**
Name of Course Teacher	**Dr. K. Pandima Devi**

Course Brief:

The course on Immunobiology has been designed critically to study the basic concepts of immunity. The term immunity is basically used to explain about the defense of biological system against any disease or toxin or infection. The primary goal of this course is to make the students understand about the host immune system which consists of many biological structures and processes. Through the various mechanisms of immunity, the biological systems have the ability to protect against chronic diseases that might be caused by certain foreign substances. Immunity has been recognized as a protective agent as well as antagonistic to infectious diseases. The mechanism of immune reactions also deliberates the protection against some harmful substances. The course will also help the students to understand on how the immune system works in a specific and non-specific manner to defend the host against infections by microorganisms. The structure and functional features of the elements of immune system are explained in this core course which will enable the students to understand the protection mechanisms that can establish a state of immunity against infection, immune-related diseases and its responsiveness.

The course of the study is critically designed to provide a background on the basic concepts of immunity that is essential for understanding the causes, consequences, or treatments of diseases of the human system.

Text Book:

1. Kuby Immunology (2007) by Thomas J. Kindt, Richard A. Goldsby and Barbara A. Osborne. W.H.Freeman and Company
2. Immunology (2006) by David Male, Jonathan Brostoff, David B Roth and Ivan Roit. Elsevier Publishers.

Reference Books:

1. Antibodies: A laboratory Manual, 2nd Edition (2014) Edited by Edward A. Greenfield, *Dana-Farber*. Cold Spring Harbour Laboratory Press.
2. Immunology (2006) by C. VamanRao. Narosa Publishing House Pvt, Ltd

Course Objectives:

1. Learn the basic principles of defense mechanism against infections.
2. Understand the structure and function of the molecules, cells, and organs involved in Immunity.
3. Explain the mechanism of how the immune system recognizes foreign antigen and the significance of self/non-self-discrimination
4. Describe how cell mediated and antibody-mediated immunity works to protect a host from pathogenic organisms and harmful substances

Course Outcomes:

On successful completion of Immuno Biology course, students will be able to:

i.	Obtain knowledge on the basic concepts of immune system, mechanisms of immunity and the development and maturation process of immune competent cells
ii.	Recognize the structures and functions of immunoglobulin molecules
iii.	Understand the mechanism of immunodeficiency diseases and autoimmunity against infection.
iv.	Realize the methods for the treatment of immune related diseases
v.	Know the interaction between antigen- antibody molecules

Course outline:

1. Immune system ï structure and function of the cells and types of immunity
2. Cytokines- Properties and functions
3. Immunoglobulins- Structure, function and its types
4. Organization and expression of Immunoglobulin Light and Heavy chain genes
5. Interactions of antigen-antibody reaction - affinity, avidity, valency
6. Immunogenicity- Immunogens, adjuvants, epitopes, haptens and carriers
7. The complement systems- classical and alternate pathway
8. Mechanisms of antigen processing and presentation of cells-cytosolic and endocytic pathways
9. Major histocompatibility complex (MHC)- structure and its interaction with peptide
10. Immune response to infectious diseases - bacterial, viral, protozoan and helminthes
11. Transplantation immunity - organ transplantation and HLA tissue typing
12. Hypersensitivity reactions- Type I, II, III and IV
13. Vaccine ï Introduction and types of edible vaccines

More books for Reading and Referencing:

Author (s)	Title
Charles A. Janeway, Paul Travers, Mark Walport and Mark Sholmchik	Immunobiology (The immune system in health and disease)
Stefan H. E. Kaufmann, Rafi Ahmed, Alan Sher.	Immunology of Infectious Diseases
Peter Wood	Understanding Immunology
M. Roit and Pete J. Delves	Essential Immunology
Ed Harlow and David Lane	Antibody Engineering
Noel R.Rose, Herman Friedman and John L. Fahey	Manual of Clinical Laboratory Immunology
R. Lanza, J. Gearhart, B. Hogan, D. Melton, R. Pedersen, E.D. Thomas, J.A. Thomson and M. West	Essentials of Stem Cell Biology
A.K. Abbas, A.H. Lichtman and S. Pillai	Cellular and Molecular Immunology

Course Schedule: 501201- IMMUNOBIOLOGY (Core – 3 credits)

Syllabus	Schedule
UNIT-1 Basic Concepts in Immunology. Immune system: lymphoid organs - primary and secondary; structure and functions; cells of the immune system. CD markers. Innate and Acquired/adaptive immune system: cells and molecules involved, Clonal selection theory, Activation, Maturation and Differentiation of B-Cell and T-Cell, T and B-cell receptors, Cell mediated and humoral immune response. Role of Toll like receptors in innate immunity.	**8Days**
UNIT-2 Characteristics and functions of Cytokines. Immunoglobulins (class, subclass, structure and function) and immunoglobulin genes (Organization and expression, Generation of antibody diversity). Immunogenicity- Immunogens, adjuvants, epitopes, haptens and carriers. T dependent and T independent antigens. Strength of antigen-antibody interactions: affinity, avidity, valency.	**7 Days**
UNIT-3 The complement systems: mode of activation, classical and alternate pathway. Immunization- active and passive. Mechanisms of antigen processing and presentation-cytosolic and endocytic pathways Antibody engineering.	**7 Days**
UNIT-4 Major histocompatibility complex (MHC): structure and its interaction with peptide. Immune response to infectious diseases ï bacterial (tuberculosis), viral (HIV), protozoan and helminths. Immune Dysfunction and its consequences: Autoimmune disorders, allergy and asthma.	**6 Days**
UNIT- 5 Transplantation immunity - Organ transplantation and HLA tissue typing. Hypersensitivity reactions- Type I, II, III and IV. Oncogenes and antioncogenes. Congenital and Acquired Immunodeficiencies. Inflammation. Hybridoma and monoclonals. Vaccine ï Introduction- types- Edible vaccines. Stem Cells and its clinical application- Human pluripotent stem cells (bone marrow, nerve cells, heart muscle cells and pancreatic islet cells).	**7 Days**
6-7 Days left for CIA test and Seminars	

501202–RECOMBINANT DNA TECHNOLOGY (Core – 3 credits)

COURSE DEPICTION

Program: **Biotechnology**	Semester : **II (2016-17)**
Course Title/code : **Recombinant DNA Technology/ 501202**	Class Time: **11-12: M,T &W.**
Name of Course Teacher	**Prof. S. Karutha Pandian**
Mobile: **+91 9442318144**	Email : **sk_pandian@rediffmail.com**

Course Brief:

Recombinant DNA technology, also called ñgenetic engineeringò is one of the main branches of biotechnology that deals with the manipulation of genetic material of any organism. This important course will enlighten the students to understand the mechanism of genetic modification, techniques used for genetic modifications. The course also highlights basic and advanced molecular techniques such as polymerase chain reaction (PCR), DNA sequencing-which covers conventional first generation sequencing technology (Sanger Sequencing) to high throughput second (Pyrosequencing & Illumina) and third sequencing technologies (Nanopore, SMRT sequencing), blotting, chromosome walking, chromosome jumping, DNA profiling. The proposed course will cover topics starting from manipulation of organisms at genome level to use of that organism at various fields including agriculture, medical and pharmaceutical industries

Text Book: Molecular cloning: A Laboratory Manual 4th Edition (2012) by Sambrook, j., Russel, D.W., Cold Spring Laboratory Press, Cold Spring, New York

Reference Books:

iii. **Gene Cloning and DNA Analysis**. An introduction (2006) by T.A Brown, Blackwell Scientific Publications.
iv. **Principle of Gene Manipulation and Genomics** (2006) by S.B. Primrose and R.M Twyman, Blackwell Scientific Publications.
v. **Molecular Biology of the Gene,** 6th edition (2008) by James D Watson, Tania A Baker, Stephen P Bell, Alexander Gann, Michael Levine and Richard Losick, Benjamin Cummings.
vi. **From Genes to Clones**: Introduction to gene technology (1987) by Winnacker, E.L.
vii. **Next generation sequencing** (2008) by Michael Janitz, Wiley-Blackwell Publications.

Course Objectives: To make the students:

iv. Understand the concepts, introduction of genetic engineering, introduction about restriction enzymes, ligases, polymerases, vectors, their types, sources and their roles in genetic engineering.
v. Knowledgeable in basic techniques of molecular biology and their applications in various aspects.
vi. Versed in all application aspects of recombinant DNA technology like production of protein and enzyme from cloned genes, production of therapeutic products as well as use of this subject in diagnosis and treatment of inherited disorder and infectious disease.

Course Outcomes:

After successful completion of above discussed syllabus of Recombinant DNA technology course, students will be able to:

➢ Understand and think about the basics of recombinant DNA technology
➢ To understand the role, use and types of different DNA modifying enzymes viz. Polymerases, Nucleases, restriction endonuclease, ligases etc.
➢ Acquire basic knowledge of DNA sequencing methods from conventional (Sanger sequencing) to High throughput Next generation sequencing technology, their principle, chemistry, theory and types.
➢ Students will able to understand the strategies and steps involved in construction of genomic and cDNA library, essential tools and role of each and every constituents.
➢ Syllabus will also provide plethora of information to students regarding basic molecular biology techniques like blotting and its different types, DNA footprinting as well as description of industrial application of rDNA Technology, therapeutic and enzymatic products and deployment of rDNA Technology in diagnosis and disease.

Course Outline: Core: Recombinant DNA technology (3 Credits)

i. Introduction and basic of genetic engineering, essential tools like DNA modifying enzymes-restriction endonuclease, ligases, Polymerases and thermostable enzymes like Taq polymerase.

ii. Introduction of vector and host cells, uses and sources of vectors (including both prokaryotic and eukaryotic), bacteriophage vectors, artificial chromosome (YACs, BACs, PACs and MACs), specialized purpose vectors-expression vector and gene fusion vectors.

iii. Introduction of cloning, cloning strategies, sticky and blunt ends, linker and adapters and their use in genetic engineering, steps involved in construction of genomic and cDNA libraries.

iv. Screening strategies used for screening of recombinants-antibiotic resistance, blue-white selection, use of fluorescent markers.

v. Labeling of nucleic acid (DNA&RNA) using radiolabel and non radiolabel probes.

vi. Theory and principles of different blotting techniques used to transfer biomolecules from gel to solid matrix for further analysis like Western blotting, Southern blotting, Northern blotting, Zoo blot and Dot blot.

vii. Without cell cloning (polymerase chain reaction), basic theory, principle, terminology and types of PCR-Hot start PCR, Touch-down PCR, Touch-up PCR, Nested PCR, Multiplex PCR, Reverse PCR, Asymmetric PCR and quantitative PCR.

viii. Introduction and basic of DNA sequencing, different generations of sequencing methods starting from first generation (Sanger sequencing) to High throughput Next (Second) generation sequencing-Roche/454,Illumina (Solexa), SOLiD sequencing, Ion semiconductor sequencing method and different types of platform for Next-Next (third) generation sequencing- Single Molecule Real-Time (SMRT) sequencing.

ix. Theory and principle of techniques: chromosome walking, chromosome jumping and DNA footprinting.

x. Application of rDNA technology at industrial level: Synthesis and purification of native and fusion proteins from cloned genes, therapeutic products of rDNA technology for use in human health care- insulin, growth hormones, alpha interferon, Hepatitis B vaccine and Factor VIII.

xi. Applications of rDNA technology in Medical and forensic science- DNA Profiling, Multiplex PCR, Diagnosis of inherited disorders and infectious diseases.

xii. rDNA technology in treatment - introduction to gene therapy, gene therapy for ADA and cystic fibrosis.

More books for Reading and Referencing:

Academic Cell - Molecular Biology, 2nd Edition (2013) by David P Clark and Nanette J Pazdernik.
Essential Genetics, 6th Edition (2014) by Daniel L Hartl.
Concepts of Genetics, 10th Edition (2012) by Williams S Klug, Michael R Cummings, Charolette A Spencer and Michael A Palladino
Molecular Genetics of Bacteria, 4th Edition (2013) by Larry Snyder, Joseph E Peters, Tina M Henkin and Wendy Champness
Academic Cell – Biotechnology, Update Edition (2012) by David P Clark and Nanette J Pazdernik
From Genes to Genomes ï Concepts and Applications of DNA technology. 3rd Edition (2012) by Jeremy W Dale, Malcolm Von Schantz and Nick Plant.
Metzker, M. L. (2010). **Sequencing technologies**ð the next generation. *Nature reviews genetics*, *11*(1), 31-46.(Review article)

Course Schedule: Core: Recombinant DNA technology (3 Credits)

Syllabus	Schedule
Unit 1: Tools of Recombinant DNA technology: The first unit of syllabus cover topics related to basic introduction about recombinant DNA technology and rDNA (chimeric DNA), its importance, tools like DNA modifying enzymes, their categories like **1**). Restriction endonuclease ï enzymes that cut dsDNA into fragment at specific nucleotide site, their types (restriction endonuclease -I,II,III), nomenclature, frequently used restriction endonuclease, their sources, recognition sites **2**). Nucleases- enzymes that degrade DNA molecule by breaking phosphodiester bond, types of different nucleases for degrading DNA, RNA and DNA-RNA hybrid, their sources, catalytic activity, cofactor needed for their efficient activity **3**). Polymerase ï enzymes that synthesize new complementary polynucleotide using an existing template, different types like Kornberg enzyme, reverse transcriptase, klenow fragment **4**). Ligase -enzyme that catalyzes the formation of phosphodiester bond.	**10 Days**
Unit 2: introduction of vectors and types : The second unit of this course aims to introduce students about frequently used vectors (transporting vehicle that carries foreign DNA), important feature of a cloning vector, vectors for prokaryotes ï both gram negative (specially emphasizing on E.coli) and gram positive bacteria, details about plasmid, plasmid based cloning vectors (pBR322 and pUC 19), capabilities of different kind of vectors in relation to carry foreign DNA, cloning vectors based on viral DNA (ə and M13 vector), hybrid vectors (Cosmid, Fosmid	**12 Days**

and Phagemid vector), high capacity vectors (YACs, BACs, PACs), shuttle vectors, introduction and use of specialized purpose vectors (expression and gene fusion vectors).	
Unit 3: Cloning strategies and recombinant screening : Third unit emphasizing on DNA cloning (production of large number of identical DNA molecule from single ancestral DNA molecule), cloning strategies, detail discussion about steps involved in cloning ï construction of rDNA molecule, transformation, selective propagation of clones, selection of transformed bacterial cells-antibiotic resistance genes, colour substance developing genes (Blue white screening), genomic DNA library and cDNA library construction and use of adapters and linkers. Unit also included topics related to important techniques viz. blotting (immobilization of nucleic acid and protein on to a solid surface for further study), nucleic acid hybridization (isotopic and non-isotopic labelling of nucleic acid). .	**10 days**
Unit 4: Without cell cloning and DNA sequencing: In fourth unit of syllabus, topics of discussion included without cell cloning (polymerase chain reaction): which include in vitro methods for amplifying defined target DNA sequence, basic theory behind PCR, types and application as well as various methods of DNA sequencing covering basic chain termination method (described by Sanger), different generation of DNA sequencing: High throughput sequencing technology (Next generation sequencing technology), includes 454 Roche Pyrosequencing, Illumina (Solexa) sequencing, SOLiD sequencing, Ion semiconductor sequencing, Single Molecule Real-Time (SMRT) sequencing, Nanopore sequencing, basic principle, chemistry and approaches like sequence by synthesis (SBS), Sequence by ligation (SBL) and Pyrosequencing. Unit is also devoted to understand the theory of some important techniques related to study of interaction different biomolecules: gel retardation assay, DNA footprinting (DNA and protein), phage display (protein-protein).	**13 days**
Unit 5: Biotechnological application of rDNA technology: Final chapter of syllabus discuss about application of rDNA technology: includes expression, synthesis and purification of desired protein from cloned genes, production of industrially important enzymes, different kind of therapeutic products routinely used in human health care: production of insulin, growth hormones, alpha interferon, and Hepatitis B vaccine. Moreover unit also cover topics related to application of rDNA technology in medical and forensic field: DNA profiling, diagnosis of inherited disorders, treatment using rDNA technology: gene therapy (technique used to remove defective gene responsible for cause of any disease).	**8 days**
5-8 days left for CIA Tests, Quizzes, Seminars, etc.	

501203–PLANT MOLECULAR BIOLOGY (Core – 3 credits)

COURSE DEPICTION

Program: **M.Sc. BIOTECHNOLOGY**	Semester : **II (2014-15)**
Course Title: **Core 9: Plant Molecular Biology (501203)**	Class Time: **10-11:Wednesday 11-12:Tuesday&Thursday**
Name of Course Teacher	**Dr.M.Ramesh**
Mobile: **+91 9442318200**	Email : **mrbiotech.alu@gmail.com**

Course Brief:

Molecular Biology is the branch of biology that studies the structure and function of macromolecules (DNA, RNA & Protein) that encode and regulate the flow of genetic information used by living organisms. Plant molecular biology is a highly specialized multidisciplinary science encompasses plant physiology, plant biochemistry and plant molecular biology and the aim of the course is to produce post graduates with knowledge of the structure and function of the whole plant at molecular level and the ability to apply both molecular and biochemical techniques to the manipulation of plants of agronomic importance and even genetically altering them to increase the usefulness of plants in everyday life. This highly specialized science course focuses on the scientific study of the structure and function of higher plant genes, cloning strategies, types of plant expression vectors, molecular markers, basis and principle of plant transformation through direct and indirect methods, generation of various types of genetically modified plants and their application to plants improvement. At the end of the course students will be able to differentiate between various transformations methods used for production of transgenic plants with their applications. Students undergoing this core course will equip themselves with an advanced knowledge of various types of transformation events and gain theoretical and technical skills that would empower them to assess and mitigate risks associated with transgenic plants. This course also gives students an exposure to the fundamentals of totipotency, tissue culture techniques for *in vitro* manipulations.

Text Books:

1. Plant Biotechnology and Genetics: Principles Techniques and Applications (2008), Edited by C. Neal Stewart Jr, John Wiley & Sons, Inc., Hoboken, New Jersey, ISBN: 978-0-470-043813.
2. Plant Genetic Engineering (2012), John H.Dodds, Cambridge University Press, Cambridge, London, ISBN: 9781107404571.
3. Introduction to Plant Biotechnology, 3rd Edition, H.S.Chawla, Oxford & IBH Publishing Co. Pvt. Ltd, India.

Reference Books:

1. Plant Biotechnology: The Genetic Manipulation of Plants (2008), 2nd Edition, Adrian Slater, Nigel W.Scott and Mark R. Fowler, Oxford University Press.
2. Phytoremediation: Methods and Reviews (2007), 1st Edition, Neil Wille, Humana Press, New York.

Course Objectives:

To make the students to:

vii. Understand the role of nuclear, chloroplast and mitochondrial genomes of higher plants.
viii. Familiarize with theoretical knowledge and also practical insights to understand the basic principles and application of plant tissue culture and recombinant DNA technology.
ix. Understand the use of molecular markers in assessing the genetic similarity and diversity of medicinal plants
x. Gain a deeper understanding of the specialized topics such as transplastomic plants, cryopreservation, phytoremediation terminator seeds, and various recent advances in the field of plant molecular biology.
xi. Understand the complexity of genome of higher plants and targeting of newly made proteins to different compartment of cell
xii. Gain theoretical knowledge about cloning of abiotic responsive genes in to binary vectors.

Course Outcomes: The students undergoing this important application oriented core course shall be able to

i. Narrate the architecture of nuclear, chloroplast and mitochondrial genomes of representative dicot and monocot plants.
ii. Differentiate protein coding and RNA coding genes, its structure, expression, and regulation under particular developmental condition.
iii. Explain how gene function and regulation is used in modern plant biotechnology for plant improvement.
iv. Gain knowledge Identify the basic methods and approaches used in molecular biology to utilize molecular markers
v. Discuss the pros and cons of transgenic plants

Course Outline: Major Core 9: Plant Molecular Biology (3 Credits)

i.	General organization of plant genome
ii	Structure of protein coding and RNA coding
iii	Organization of chloroplast genome in model crops
iv	Import of nuclear encoded chloroplast proteins to stroma and thylakoides of chloroplast
v	General organization of mitochondrial genome in *Zea mays*
vi	Import of nuclear encoded mitochondrial proteins to matrix and inner membrane of mitochondria
vii	Transplastomic plants and promiscuous DNA.

viii	Molecular markers for analyzing genetic diversity and crop improvement
ix	Principle and methods involve in artificial seed preparation
x	Encapsulation and Low temperature storage
xi	Cryopreservation of plant bioresources germplasm
xii	*Agrobacterium tumefaciens* and crown gall tumours
xiii	Mechanism of TDNA transfer and binary vectors
xiv	*Agrobacterium* - mediated transformation of food crops. Hairy root cultures
xv	Molecular biology of plant stress response
xvi	Direct transformation of plants by physical methods
xvii	Transposon Tagging. Molecular Farming
xviii	Transgenic crops ï Flavr Savr^{TM}, Bt Cotton, and Golden rice.
	Selectable markers and reporter genes used in plant gene expression vectors
xix	Virus resistance, pest resistance, herbicide tolerance,& abiotic stress tolerance plants
xx	Phytoremediation
xxi	Functional Proteomic approaches in Grass species

Additional books for Reading and Referencing

Author (s)	**Title**
Bob B.Buchanan	Biotechnology and Molecular Biology of Plants (2015) 2nd Edition, Edited by American Society of Plant Biologists, Berkeley, USA.
J. Hammond, P.McGarvey & V. Yusibov (Eds)	Plant Biotechnology-New Products & Applications (2000), Berlin, Germany: Springer-Verlag.
Maarten J. Chrispeels and David E.Sadava, Sudbury, MA	Plants, Genes and Crop Biotechnology (2003), 2nd Edition: Jones and Barlett Publishers.

Course Schedule: Core 9: Plant Molecular Biology (3 Credits)

Syllabus	Schedule
Unit 1: Architecture of genome in higher plants. Plant gene structure (Protein coding and RNA coding). Arabidopsis Genome Initiative (AGI).Organization of chloroplast genome in tobacco and rice. Targeting of nuclear encoded chloroplast proteins to different compartments of chloroplast. Coordinated expression. Organization of mitochondrial genome. Targeting of proteins to mitochondria. Genetic Engineering of Chloroplast genome and development of Transplastomic plants. Promiscuous DNA.	**10 Days**
Unit 2: Molecular markers - RAPD, ISSR, SCAR, STS, Microsatellites, AFLP and DNA Bar coding for analyzing genetic diversity and improvement. Biodiversity Conservation ï Importance and types, Artificial seeds ï Introduction, Principle and Methods .Applications of synseeds in commercial seed industry. Endangered germplasms, Encapsulation, Low temperature storage and Plant Conversion. Cryopreservation of plant bioresourse germplasm through Encapsulation Dehydration and Vitrification, Plant regrowth and genetic fidelity analysis.	**10 Days**
Unit 3: Agrobacterium tumefaciens and crown gall tumours. Basis of tumour formation. Mechanisms of TDNA transfer to plants. Co -integrate, binary and super binary Ti-plasmid based vectors for plant transformation. Agroinfection. Agrobacterium - mediated transformation of food crops. Hairy root cultures and in vitro production of commercially important secondary metabolites through elicitation. Marker Assisted Selection (MAS**).**	**9 days**
Unit 4: Molecular biology of plant stress response - drought, salinity, dehydration, UV, and osmotic stress. Direct and Indirect methods of gene transfer into plant cells and development of transgenic plants. Direct transformation of plants by physical methods (Biolistic, Microlaser, Ultrasonication and Silicon carbide WHISKER^{TM} method). Transposon Tagging. Molecular Farming - Polyhydroxybutyrate (PHB), Polyfructons and Cyclodextrans. Transgenic crops ï Flavr Savr^{TM}, Bt Cotton, and Golden rice.	**8 days**
Unit 5: Genetic engineering in plants - selectable markers and reporter genes used in plant gene expression vectors. Genetic engineering of plants for virus resistance, pest resistance, herbicide tolerance, abiotic stress tolerance, and delays of fruit ripening. Terminator seed technology. Phytoremediation ï types and methods. Functional Proteomic approaches in Grass species	**8 days**
8 days assigned for CIA Tests, Quizzes, Seminars, etc.	

501204–LAB III: MOLECULAR GENETICS (Core – 4 credits)

COURSE DEPICTION

Program: **M. Sc., Biotechnology**	Semester : **II (2016-17)**
Course Title: **Lab III: Molecular Genetics**	Class Time: **2-6: M&T**
Name of Course Teacher	**Prof. S. Karutha Pandian**
Mobile: **+91 9442318144**	Email : **sk_pandian@rediffmail.com**

Course Brief:

Molecular genetics is a field of study that deals with structure and function of genes at molecular level. This course is very fundamental and form the basis for all the advancements happened in the biotechnology era. It will augment the existing knowledge about inheritance, mutation, genetic mapping, genetic variation and related diseases. It will also extend the knowledge on application oriented view of molecular genetics such as mutations and gene therapy, genetic models of disease and development, molecular medicine and human genetics, molecular microbiology and infectious diseases, functional genomics and proteomics. It clearly elucidates the importance of genome structure and integrity, gene expression and function, gene sequencing and mapping.

Text Book: Molecular Biology of the Gene 6th edition (2008). Watson, Baker, Bell, Gann, Levine and Losick.

Reference Books

i) A Short Course in Bacterial Genetics (1992). Miller, J.H.
ii) Methods for General and Molecular Bacteriology (1994). Murray, R.G.F., Wood, W.A. and Krieg, N.B.
iii) Molecular Genetics of Bacteria 4th edition (2013). Snyder, L., Peters, J.E., Henkin, T.M. and Champness,W.
iv) Academic Cell - Molecular Biology, 4nd Edition (2014) by Clark, D.P. and Pazdernik, N.J.

Course Objectives: To make the students:

xiii. Understand the molecular and genetic mechanisms behind the recent advancements in the field of medicine and drug development.
xiv. Knowledgeable in mutagenesis, mutagen and its impact on phenotypic traits of an organism and also in isolating antibiotic resistant and auxotrophic mutants using various techniques.
xv. Well equipped in carrying out transformation such as Chemical mediated transformation, Competent cell preparation, Microinjection, Electroporation, Tri-parental mating and various ways to visualize the transformed colonies.
xvi. Understand and perform Generalized and Specialized Transduction, Genetic mapping by P1 transduction.

Course Outcomes: The students shall be able to:

i. Isolate single colony of bacteria and also to describe various stages of growth by measuring the rate of growth and plotting growth curve.

ii. Describe wide applications of bacteriophages in molecular genetics.
iii. Demonstrate mutagenesis, its types and techniques involved in isolation of mutants.
iv. Acquire knowledge to implement transduction in laboratory level and use transduction as a mode to perform genetic mapping.
v. Illustrate transposons, transposon mediated mutagenesis and applications of transposons in molecular biology.

Course Outline: Core: Lab III: Molecular Genetics (4 Credits)

i. Fundamental Concepts of structure and function of genes at molecular level.
ii. Single colony isolation and checking for genetic markers.
iii. Measurement of growth rate and one step growth curve using a T even phage.
iv. Titration of phage to analyze the infective capacity of phage.
v. Mutagenesis, types of mutagenesis and mutagens.
vi. Isolation of antibiotic resistant and auxotrophic mutants, Enrichment methods for auxotrophic and antibiotic resistant mutants and Ames test.
vii. Isolation of plasmid DNA from bacteria.
viii. Transformation and various techniques of transformation like Chemical mediated transformation; competent cell preparation, Microinjection, Electroporation and Tri-parental mating.
ix. Conjugation and Hfr Conjugation, Transduction-Generalized and Specialized Transduction
x. Isolation of specialized transducing phage.
xi. Applications of bacteriophages.
xii. Genetic mapping by conjugation and P1 transduction.
xiii. Transposons, Transposition and Types of transposons,
xiv. Transposon mutagenesis of chromosomal and plasmid DNA.
xv. Insertional inactivation.
xvi. Applications of Transposons in molecular biology.

More books for Reading and Referencing

Author (s)	**Title**
Daniel L Hartl.	Essential Genetics, 6th Edition(2014)
Williams S Klug, Michael R Cummings, Charolette A Spencer and Michael A Palladino	Concepts of Genetics, 10th Edition (2012)
S. B. Primrose and R. M. Twyman	Principles of Gene Manipulation and Genomics, 8th Edition (2016)
Burton E Tropp	Molecular Biology ï Genes to Proteins, 4th Edition (2012)
T. A. Brown	Genomes 3 (2007)
S.R. Maloy, J. E. Cronan Jr., and D. Freifelder, Jones and Bartlett Publishers, Sudbury, Massachusetts.	Microbial Genetics (2006)

Course Schedule: Core: Lab III: Molecular Genetics (4 Credits)

Syllabus	Schedule
UNIT-1 Single colony isolation and checking for genetic markers. Measurement of growth rate; one step growth curve using a T even phage. Titration of phages.	**6 Days**
UNIT-2 Mutagenesis; Mutagens. Site directed mutagenesis. Induced mutagenesis and isolation of antibiotic resistant and auxotrophic mutants; Enrichment methods for auxotrophic and antibiotic resistant mutants. Ames test.	**5 Days**
UNIT-3 Isolation of plasmid DNA from bacteria,Transformation- Chemical mediated transformation; Competent cell preparation, Microinjection, Electroporation, Tri-parental mating, Conjugation- Hfr Conjugation, Genetic mapping by conjugation.	**6 days**
UNIT-4 Transduction-Generalized and Specialized Transduction, Genetic mapping by P1 transduction. Isolation of specialized transducing phage. Applications of bacteriophages.	**6 days**
UNIT-5 Transposons, Transposition, Types of transposons, Transposon mutagenesis of chromosomal and plasmid DNA. Insertional inactivation. Applications of Transposons in molecular biology.	**5 days**
5-8 days left for CIA Tests, Quizzes, Seminars, Case Presentations, etc.	

501205–LAB IV: IMMUNOTECHNOLOGY (Core – 4 credits)
COURSE DEPICTION
501105–LAB IV- IMMUNOTECHNOLOGY (Core – 4 credits)

Program: **M.Sc.**	Semester : **II (2016-17)**
Course Title: **Lab IV- Immunotechnology**	Class Time: 2 PM to 5 PM on Monday and Tuesday
Name of Course Teacher	**Dr. K. Pandima Devi**
Mobile: **+91 9790358700**	Email : **devikasi@yahoo.com**

Course Brief

Immunotechnology is a branch of biomedicine which comprise of various techniques and experiments that range from basic to recent advancement in Immunology. The main focus of this course is to provide the opportunity to the students to learn the basic and advanced techniques which are currently utilized in immunological research. This course also encourages the students to learn about the research areas like oncology and infectious diseases. This laboratory course explains about a wide range of basic immunology concepts in a practical manner including immunity, immunization, antigen-antibody interaction, infection, antibody production, blood cell counting, cell culture and diagnostic techniques for infectious diseases. In addition, this course provides exposure to students of the recent advanced techniques applied in immunology research like fluorescent microscopy, B and T lymphocytes identification and enumeration, FACS, cell culture, RT-PCR, RIA, ELISA, ELISPOT, Western and Eastern blotting, indirect fluorescent antibody test, pregnancy test, FISH and GISH. Many of the human incurable diseases like cancer, autoimmune diseases, and neurodegenerative diseases have been strongly linked with the imbalance in the human immune system. Hence, learning about these techniques will encourage the students to do research in the field of human immunology involved in the incurable diseases.

Text Books:

1. A Textbook of Immunology & Immuno Technology (2010). B Annadurai. S. Chand Publishing
2. Principles and Practice of Animal Tissue Culture (2007). Sudha Gangal. Universities Press (India) Private Ltd

Reference Books:

3. Antibodies- A Laboratory Manual (2006) by Ed Harlow and David Lane, Panima Publishing Corporation.
4. Animal cell culture methods (2006). Jennie P. Mather, David Barnes. Elsiever.

Course Objectives:

The objectives of the course is to make the students

1. Understand the basic concepts in immunology by practical approach
2. Learn the various human hematological techniques
3. Understand human and animal cell culture methods
4. Study about the recent advancement in immunology and know about the diagnostic methods for human infectious diseases

Course Outcomes:

On successful completion of Immunotechnology course, students will be able to:

i.	Independently perform the experiments involved in human immunology research
ii.	Understand about the human immune system and infectious diseases
iii.	Acquire knowledge in recent advancement in human immunology.

Course outline:

1. Antibody generating methods
2. Monoclonal antibody production and hybridoma technology
3. Agglutination and precipitation test
4. Immunodiffusion and immunoelectrophoresis
5. Blood cell counts and PBMC isolation
6. B and T lymphocytes identification and enumeration
7. Cell culture media-preparation, cell lines-subculturing and disaggregation methods
8. Transient and stable transfection using epithelial cell lines
9. Immunodiagnostic methods
10. Diagnostic protocol for identification of infectious diseases

More books for Reading and Referencing:

Author (s)	**Title**
John. R. W. Masters	Animal cell culture
Mor Gil, Alvero, Ayesha	Apoptosis and Cancer. Methods and Protocols
J.M.Davis	Basic Cell Culture
Phillip Gerhard, RGE. Murray, Willis A. Wood and Noel R. Krieg	Methods for General and Molecular bacteriology
Noel R.Rose, Herman Friedman and John L. Fahey	Manual of Clinical Laboratory Immunology

Course Schedule: 501105. LAB IV- IMMUNOTECHNOLOGY (Core – 4 credits)

Syllabus	**Schedule**
Unit 1: Techniques to raise antibodies in animal models:- selection of animals (rats, rabbits, mice), preparation of antigens, route of injection and dosage, protocol of immunization, methods of bleeding and serum collection, conventional antibody preparation. Hybridoma technology and monoclonal antibody production. Application of monoclonals in biomedical research, in clinical diagnosis and treatment.	**6 days**
Unit 2: Detection of antigen-antibody reactions:- Agglutination reactions- Haemagglutination, passive HA. Precipitation reactions- precipitin ring test, immunodiffusion, immunoelectrophoresis. Immunohistochemical staining. Separation of serum proteins by electrophoresis	**5 days**
Unit 3: Immunohematology: Blood cell counts (Total RBC, WBC and differential count of WBC), blood grouping (ABO system and Rh grouping). Peripheral blood mononuclear cell separation and enumeration	**7 days**

of live, dead cells by MTT and Trypan blue methods. aApoptosis detection ï DAPI, Annexin V staining in a fluorescent microscope. Lymphocyte subset (B and T lymphocytes) identification and enumeration by FACS (Demonstration).	
Unit 4: Cell culture media-Types and preparation. Primary cultures (different sources, mechanical and enzymatic diagrregation) and established cell lines (sub-culturing, maintenance, large-scale cultures using bioreactors, microcarriers). Common cell lines and its applications. Detection and prevention of contamination of cell culture. Cell synchronization - preservation and revival of cells. Transient and stable transfection methods. Evaluation of host-pathogen interaction using C. elegans as model organism and monitoring the expression of Immunoglobulin genes by RT-PCR.	**8 days**
Unit 5: Immunodiagnostic procedures: RIA, ELISA, ELISPOT, Western and Eastern blotting, IFAT (indirect fluorescent antibody test). Diagnostic kits for identifying infectious agents: HIV, malaria, tuberculosis, hepatitis B surface antigen and detection of VDRL and pregnancy test. Immuno fluorescence microscopy. In situ localization - FISH, GISH.	**7 days**
5-8 days left for CIA Tests and Seminars.	

501301–BIOINFORMATICS (Core – 3 credits)

COURSE DEPICTION

Program: **M. Sc.,**	Semester : **III (2016-17)**
Course Title: **Bioinformatics**	Class Time: **10-11: W&F and 12-1 Thu.**
Name of Course Teacher	**Prof. S. Karutha Pandian**
Mobile: **+91 9442318144**	Email : **sk_pandian@rediffmail.com**

Course Brief:

This course contains fully revised and updated topics of bioinformatics which includes recent advancements in computer application. This course will give complete overview about the tools and softwares used to analyze the biological data. This course also highlights the application of softwares and algorithms used to analyze the biological data. The topics of this course work covers the biological database retrieval, open and proprietary databases, sequence alignment, phylogentic analysis, nucleic acid sequence and structure analysis, protein structure prediction, computing in proteomics, interaction between biomolecules, visualization of macromolecules, virtual screening, molecular docking and drug designing. The complete course gives thorough knowledge about different database retrieval, algorithms involved in alignment of sequences, software used in biomolecules structure, prediction and interaction, tools used to analyze the genomics and proteomics data and drug designing concepts.

Text Book: Bioinformatics. Sequence and Genome Analysis - David W. Mount

Reference Books

i. Introduction to Bioinformatics (2006) by T.K. Attwood and D.J. Parry-Smith, Pearson Education Asia.
ii. Microarray Data Analysis ï Methods and Applications (2007) by Michael J. Korenberg, Humana Press Inc.
iii. Practical Bioinformatic (2013) by Michael J Agostino,Garland Science, Taylor & Francis Group, LLC.
iv. Proteomics of Biological Systems (Protein Phosphorylation Using Mass Spectrometry Techniques) (2012) by Bryan M. Ham John Wiley & Sons, Inc.
v. Evolution after Gene Duplication (2010) by Katharina Dittmar and David Liberles Wiley-Blackwell.
vi. Bioinformatics (2006) N. Gautham, Narosa Publications

Course Objectives: To make the students:

i. Understand basics of bioinformatics which includes recent advancements in computer application
ii. Analyze the biological data using bioinformatics tools and softwares
iii. Know about specific application of softwares and algorithms used for the clear understanding of biological data.
iv. Knowledge about softwares used in biomolecules structure, prediction and interaction, tools used to analyze the genomics and proteomics data and drug designing concepts.

Course Outcomes: The students shall be able to:

i. Understand biological databases and how to retrieve the information from the databases
ii. Differentiate open and proprietary source software
iii. Learn about algorithms and matrices in global and local alignment
iv. Construct phylogentic tree using multiple sequence alignment
v. Analyze DNA sequencing data using electropherogram viewer, contig assembly software.
vi. Find vector contamination in DNA sequences and how to annotate and submit DNA sequences in public domain
vii. Understand gene prediction, RNA structure analysis, protein secondary and tertiary structure prediction and motifs with suitable example.
viii. Analyze proteome data using MASCOT, X!Tandom, SPC tools.
ix. Describe about protein interaction with DNA and RNA by interaction databsases
x. Knowledge about virtual screening. Molecular modelling and dynamics

Mini Project: Mini Project relevant to the course may be given as an assignment. Based on the project, the student needs to prepare their project report and submit in time. The following things should be followed by the students in executing their project work: a. I**ntroduce** the project stating its nature, scope, importance, etc. b. **Formulate** the objectives and hypotheses; c. **Design** the methodology (sampling, data collection tool design, tool, validation, chapterisation, etc); d. **Data:** Collect Edit, tabulate data and analyze the same; make your findings. E. **Write up the Project** Report starting from **(a) to (e)** describing each step in your project report meaningfully, logically with evidences supporting your findings and suitable divided into chapters as per chapterisation given already.

Course Outline: Core: Bioinformatics (3 Credits)

i. Biological databases ï Protein and nucleotide sequence and structure databases
ii. Retrieve the information from open access databases, Proprietary and Open Source software
iii. BLAST tool and its types
iv. Global and local alignment ï alignment methods, algorithms, matrices, etc
v. Phylogenetic tree construction using MEGA software
vi. DNA sequencing data analysis
vii. Software used for electropherogram viewer and finding vector contamination in DNA sequencing results.
viii. Submission of DNA sequencing data in public databases
ix. Gene expression data analysis using qPCR
x. DNA, RNA, Protein sequence and structure prediction
xi. Proteomics data analysis by MASCOT, X!Tandem, and SPC.
xii. Software used for Interaction databases - Protein-protein interaction, Protein-RNA interaction, Protein-DNA interaction
xiii. Application of Rasmol and Swiss PDB viewer
xiv. Screening of small compounds by molecular docking
xv. Molecular modeling, dynamics and simulation
xvi. Drug development process
xvii. Pharmacogenomics, pharmacodynamics properties
xviii. Softwares to find ADMET properties of drug.

More books for Reading and Referencing

Author (s)	**Title**
A.D. Baxevanis and B.F. Francis Ouellette	Bioinformatics - A Practical Guide to the Analysis of Genes and Proteins
Arthur M. Lesk	Introduction to Bioinformatics
Ziwei Huang	Drug Discovery Research
Claude Cohen	Guidebook on Molecular Modeling in Drug Design
Andrew Leach	Molecular Modeling - Principles and Applications
J-M Claverie and C. Notredame	Bioinformatics for Dummies
Michael J. Brownstein, Arkady B. Khodursky	Functional Genomics ï Methods and Protocols

Course Schedule: Core: Bioinformatics (3 Credits)

Syllabus	**Schedule**
Unit 1: Biological databases ï Retrieving information and sequences from databases. Open Access databases, Proprietary and Open Source software: Bioinformatics analysis packages available ï EMBOSS.	**8 Days**
Unit 2: Sequence Alignment - BLAST-Basic and Specialized. Sequence alignment - Global Vs local alignment, Pair wise alignment, Principles of sequence similarity search algorithms. Multiple sequence alignment,	**9 Days**

Alignment viewers, Formatting and editing multiple sequence alignments. Phylogenetic analysis-Principles and tools-MEGA.	
Unit 3: DNA Sequencing and gene prediction - Analysis of electropherogram; Contig assembly; Checking for vector contamination and chimeras; Sequence annotation and submission in public databases. Restriction mapping and Primer design using programs from public domain. Prediction of Genes and Regulatory sequences in DNA. q-PCR data analysis. RNA structure analysis, Protein secondary and tertiary structure prediction - and motifs	**10 days**
Unit 4: Proteomics data analysis and interaction databases - Introduction to proteomics, Computing in Proteomics- Database and search tools; MASCOT, X!Tandem, and SPC. Commercial software analysis of raw data spectrum. Interaction database and tools: Protein-protein interaction, Protein-RNA interaction, Protein-DNA interaction. Visualisation of macromolecules ï Rasmol, Swiss PDB Viewer,	**10 days**
Unit 5: Molecular docking and Drug designing - Virtual screening, Molecular modeling and docking. Molecular dynamics and simulation. Drug designing concepts ï Pharmacogenomics, Pharmacokinetics- Drug absorption, bioavailability, distribution, and excretion. Software tools (ADMET).	**8 days**
5-8 days left for CIA Tests, Quizzes, Seminars, Case Presentations, etc.	

501302–ANIMAL BIOTECHNOLOGY (Core – 3 credits)

COURSE DEPICTION

501302–ANIMAL BIOTECHNOLOGY (Core-- 3 credits)

Program: **M.Sc.**	Semester : **III (2016-17)**
Course Title: **Animal Biotechnology**	Class Time: Monday 12.00 AM-1.00 PM and Thursday 11.00AM-12.00 AM
Name of Course Teacher	**Dr. K. Pandima Devi**
Mobile: **+91 9790358700**	Email :**devikasi@yahoo.com**

Course Brief

Animal biotechnology is one of the modern branches of Biotechnology which deals with the use of science and engineering to modify living organisms in order to improve their suitability for pharmaceutical and agricultural applications. This field has gained enormous popularity because of its huge applications in our day-to-day life, starting from probiotics to vaccines. Consequently it has become indispensable to have a thorough idea on this current subject. Therefore this course has been designed to introduce the basic features of animal biotechnology to the students such as animal cell culture techniques, conventional and advanced methods for genetic manipulation to create transgenic animals, using gene knock out technology to make animals with a specific inactivated gene, producing nearly identical animals by somatic cell nuclear transfer (or cloning) and so on. This course is a primary source for the beginners which

will help them to understand the complex phenomena during their higher studies. Special features of the course include preliminary idea on various new topics such as stem cells and cancer cells. Also this course throws light on the pathways of gene regulation, function, gene transfer, gene therapy etc. The course also focuses on the application of these concepts to create recombinant animal viral vectors to produce vaccines, regulatory proteins etc. The set of courses is critically intended to afford background knowledge on diverse techniques associated with animal biotechnology that are necessary for a student to prosper by realizing the multifaceted issues related to this area for socio-economical and environmental benefit.

This course deals with how the central units of life (i.e. a cell) can be manipulated on laboratory bench according to the need of a biotechnologist and how the outcome can be used for various applications like production of large scale of desired proteins and other food supplements, and to combat diseased conditions. Moreover this course will provide a beginning to understand various technical approaches related to animal biotechnology and thus will help the students to become well versed in the subject in the subsequent years

Text Books:

1. Principles of Gene Manipulation (7^{th} Edition, 2006). Sandy Primrose, Richard Twyman and Bob Old. Blackwell Science
2. Biotechnology: Fundamentals and Applications (2004). S.S.Purohit. Students Edition
3. Animal Biotechnology and Ethics (1998). Edited by Holland AJ, Johnson A. Springer US

Reference Books:

1. Gene Cloning and Analysis (7^{th} Edition, 2016). T.A.Brown. Blackwell Science Ltd
2. Gene Expression Systems (2006). Edited by Joseph M. Fernandes and James P. Hoeffler. Academic Press
3. Molecular Biotechnology: Principles and Applications of Recombinant DNA (4^{th} Edition, 2010), Glick B R., and Pasternack J J., ASM Press, Washington, DC.

Course Objectives:

The objectives of the course is to make the students

1. Realize the basic concepts of animal cell culture.
2. Understand the basic properties of cancer cells.
3. Describe the principle and application of gene manipulation.
4. Illustrate how transgenic animals can be produced with a specific gene of interest and their clinical advantages.

Course Outcomes:

On successful completion of Animal Biotechnology course, students will be able to:

i.	Describe the mechanism of gene therapy and its uses.
ii.	Illustrate how different blood products like antibodies, hormones and vaccines are produced industrially.
iii.	Describe the features of stem cell and their application.
iv.	Differentiate between the different methods adopted for generating transgenic animals

Course outline:

1. Physical, chemical and biological methods for gene transfer and their respective application for creating transgenic animals.
2. Artificial insemination and embryo transfer.
3. Construction of various recombinant animal vectors.
4. Production of vaccines and hormones using eukaryotic expression vectors.
5. *Ex-vivo* and *in-vivo* gene therapy for HIV, Cancer treatment and organ transplantation.
6. Stem cell therapy and its advantages over conventional therapeutics.
7. Ethical issues related to stem cell research.

More books for Reading and Reference:

Author (s)	**Title**
S.B. Primrose and R.M. Twyman	Principles of Gene Manipulation and Genomics
Alan J. Cann	RNA Viruses: A Practical Approach
J.D. Watson, M. Gilman, J. Witowski and Mark Zoller	Recombinant DNA
B.R., Glick, and J.J. Pasternack,	Molecular Biotechnology: Principles and Applications of Recombinant DNA
Julia Lodge, Peter A. Lund, Minchin S. Taylor and Francis	Gene Cloning: Principles and Applications
Balasubramanian	Concepts in Biotechnology
H.D. Kumar	A textbook of Biotechnology
U. Sathyanarayana	Biotechnology

Course Schedule: 501302. ANIMAL BIOTECHNOLOGY (Core-- 3 credits)

Syllabus	**Schedule**
UNIT 1: Scope of animal biotechnology, Methods of transferring genes- physical, chemical and biological methods. Transgenic animals (Mice, Cows, Pigs, Sheep, Goat, Birds, fish and Insects). Transgenic animals as models for neurodegenerative disorders, carcinogenesis and hypertension. Assisted reproduction biotechnology: Artificial insemination and embryo transfer.	**5 days**
UNIT 2: Methods for the construction of recombinant animal viral vectors for	**6 days**

gene transfer into cell lines. Biology of Animal viral vectors - SV40, adeno virus, retro virus, vaccinia virus, herpes virus, adeno associated virus and baculovirus. Baculovirus in biocontrol.	
UNIT 3: Applications of yeast system to study eukaryotic gene function. Animal biotechnology for production of regulatory proteins, blood products, vaccines and hormones. Bioreactors for scaling up of products. Cell signaling (Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways).	**5 days**
UNIT 4: Gene therapy - Ex vivo and in vivo , viral and non- viral, Biotechnological applications for HIV diagnostics and therapy. DNA based diagnosis of genetic diseases. Phage display technology and its applications. History of stem cells. Preparation and applications of embryonic, adult and umbilical cord blood stem cells. Stem cell differentiation and transplantation. Bioethics and stem cell research.	**6 days**
UNIT 5: History of stem cells. Preparation and applications of embryonic, adult and umbilical cord blood stem cells. Stem cell differentiation and transplantation. 3D tissue culture and their application. Bioethics and stem cell research.	**4 days**
6 days left for tests and seminars	

501303–MARINE BIOTECHNOLOGY (Core – 3 credits)

COURSE DEPICTION

Program: **M.Sc. Biotechnology**	Semester : **III (2016-17)**
Course Title: **Marine Biotechnology Theory**	Class Time: **2:00-6:00 PM, Mon & Tue**
Name of Course Teacher	**Dr. A. Veera Ravi**
Mobile: **+91 9487149249**	Email : **aveeraravi@rediffmail.com**

Course Brief:

The fundamental objective of the course is to provide students with an extensive and concise knowledge of marine biotechnology aspects such as diversity of marine organisms, ensuring sustainable and safe aquaculture and fisheries, disease preventive therapeutic measures, development of renewable energy processes, bio-sensing and anti-fouling strategies etc. Marine biotechnology (also known as ñBlue Biotechnologyò) is the emerging discipline that explores the ocean to develop novel pharmaceuticals, chemical products, enzymes and other industrially important products and also plays a vital role in the advancement of biomaterials, health care diagnostics, aquaculture and seafood safety, bioremediation and biofouling. The entire course outlines how the marine environment is rich in biodiversity with novel species of microorganisms and macro-organisms, which could serve as a source for the variety of novel products and processes.

Students undergoing this important core subject will furnish themselves with thorough knowledge of the fundamental science and methodologies in marine biotechnology. This area is increasingly important in all forms of biotechnology. Many of the recent advancements in modern

biotechnology are the result of a better understanding of marine bio-diversity. An understanding of marine environment and knowing the diversity of micro and macro-organisms and its products is essential for research in bio-pharmaceutical fields such as cancer, bacterial, fungal, viral and other diseases.

Text Book:

1) Recent Advances in Marine Biotechnology: Vol-7 (2002) Milton Fingerman, CRC Press.

Reference Books:

1) Handbook of probiotics and prebiotics (2009) Y.K. Lee and S. Salminen, second edition, Wiley, A John Wiley and sonôs inc publication.
2) Advances in Biochemical Engineering/Biotechnology- Marine Biotechnology I & II ; (2005) Y. LeGal, R. Ulber, Springer Verlag Berlin Heidelberg.
3) Aquaculture Medicine, (2003), First edition, I.S. Bright Singh, S. Somnath Pai, Rosamma Philip and A. Mohan Das, Paico Printing Press, Kochi, India.
4) Drugs from the Sea. (2000), Fusetani N. Karger, Tokyo.
5) Recent Advances in Marine Biotechnology. Vol 2 (1998) by Fingerman, M., Nagabhushanam, R., Thompson, M. Oxford & IBH Publ.
6) Biotechnology and Biodegradation Advances in Biotechnology Series, Vol. 4 (1990) by Kamely, D Chakrabarty, A & Omum, G.S. Gulf Publishing Company, Houston.
7) The Microbiology of Deep-sea Hydrothermal Vents (1995) Karl, D. M. CRC Press, Boca Raton.
8)

9) Course Objectives:

The course is intended to make the students

i. To gain thorough knowledge of the fundamental science and methodologies in marine biotechnology. This area is increasingly important in all forms of biotechnology.
ii. To understand marine environment and knowing the diversity of micro and macro-organisms and its products is essential for research in bio-pharmaceutical fields such as cancer, bacterial, fungal, viral and other diseases.
iii. To learn cutting-edge techniques and experimental approaches of various biotechnological tools including DGGE, ARDRA and T-RFLP to identify the uncultivable bacteria, occurrence, characteristics and exploitation in the marine environment.
iv. To Concentrate on the importance of farming of fin-fish and shrimp, fin fish seed production and types of farming methods such as traditional, semi-intensive and intensive.
v. To develop interest in the research areas and to instigate the development of investigative, technical, communicative and research skills required for today's biologists.

Course Outcomes: The students shall be able to:

i. Acquire the basic concepts and theories of marine biodiversity and become aware of the bio-resources that enable them to prosper in their natural habitats.
ii. Acquire basic information on practical techniques and approaches commonly used in molecular biology aspects for bacterial and viral disease diagnosis in aquaculture.
iii. Understand the role of seaweeds and their major applications in the heavy metal removal.

iv. Explicate and know the importance of marine farming of fishes and shrimp in India, the live and artificial diets available for fishes and shrimp**.**

Course Outline: Core 14: 501303 – Marine Biotechnology (MAJOR CORE)

- **i.** Concepts on bioactive compounds obtained from marine organisms such as microorganisms (bacteria and fungi), seaweeds, sponges, corals, bryozoans and tunicates etc.,
- **ii.** Seaweeds as a source of polysaccharides (agar & agarose) and its significant applications in the removal of heavy metal pollutants from the environment.
- **iii.** Basic knowledge on hydrothermal vents and microbial communities present in the hydrothermal vent.
- **iv.** The significant features of each microbes present in the harsh environment and their applications such as industrially important enzymes from extremophiles.
- **v.** The cutting-edge techniques and experimental approaches of various biotechnological tools including DGGE, ARDRA and T-RFLP.
- **vi.** Green fluorescent protein (GFP) obtained from marine organism, different types of GFP, structure, composition and its biotechnological applications in various fields.
- **vii.** Probiotics and vaccines against disease causing bacterial pathogens and their importance in aquaculture.
- **viii.** Applications of PCR, gene probes and other molecular techniques for diagnosis of bacterial, fungal and viral pathogens in aquaculture.
- **ix.** Experimental approach on chromosomal manipulations of commercially important marine organisms and its applications.
- **x.** Transgenic fish technology: Growth hormone and anti-freeze genes and its applications in aquaculture, Importance of transposons.
- **xi.** Farming of fin-fish and shrimp, fin fish seed production and types of farming such as traditional, semi-intensive and intensive, microbial diseases and its prevention strategies among aquatic organisms, feeding strategies and different diets (live and artificial feed) for farming fishes and shrimp in aquaculture.

More books for Reading and Referencing

Name of the Book	**Author's Name**
Microbial ecology of the oceans	Krichman, D.L
Environmental impacts of Aquaculture	Kenneth, B.D.
Recent advances in Marine Biotechnology	Fingerman M
Introduction to Marine Ecology	Barnes R. S. K
A text Book of Marine Ecology	Balakrishna Nair, N. and D.M. Thampy
Handbook on Ingredients for Aquaculture feeds	Joachim W., Hertrampft and F.P Pascal

Course Schedule: Core 14: 501303 – Marine Biotechnology (MAJOR CORE)

Syllabus	Schedule
Unit 1: Marine Biotechnology - Marine organisms as sources of untapped resources. Bioactive compounds from marine organisms (Microorganisms, Sponges, Corals, Bryozoans and Tunicates). Seaweeds as a source of polysaccharides. Seaweeds for removal of heavy metal pollutants.	**7 days**
Unit 2: Hydrothermal vents: vent biodiversity, Hyperthermophilic and barophilic microorganisms and their applications. Biotechnological applications of extremozymes from extremophilic organisms. Unculturable bacteria, occurrence, characteristics and exploitation.	**10 Days**
Unit 3: GFP characteristics and applications. Probiotics bacteria and their importance in aquaculture.Vaccines for aquaculture. PCR and other techniques for identification of bacterial and viral pathogen in aquaculture. Gene probes and their applications in disease diagnosis.	**10 days**
Unit 4: Chromosomal manipulation of commercially important marine organisms. Transgenic fish technology. Transgenic fishes with growth hormone (GH) and antifreeze genes. Transposon in fishes.	**5 days**
Unit 5: Bacterial cell ï cell communication system - Quorum sensing and its inhibition ï types of autoinducers - QS inhibitor compounds and its role in expression of virulence genes among bacterial pathogens.	**4 days**
5-8 days left for CIA Tests, Quizzes, Seminars, Case Presentations, etc.	

501304–LAB V: RECOMBINANT DNA TECHNOLOGY (Core – 4 credits)

COURSE DEPICTION

Program: **M.Sc. Biotechnology**	Semester : **III (2016-17)**
Course Title: **Recombinant DNA Technology Lab**	Class Time: **2:00-6:00 PM, Mon & Tue**
Name of Course Teacher	**Prof. S. Karutha Pandian**
Mobile: **+91 9442318144**	Email : **sk_pandian@rediffmail.com**

Course Brief:

The course explicitly imposed an in-depth and concise view of gene manipulation in prokaryotes and eukaryotes followed by bioprocessing of gene product in large scale with various techniques associated. The gene manipulation includes isolation, quantification and separation of nucleic acids; partial digestion of chromosomal DNA with restriction enzyme followed by cloning and transformation of desired gene; construction and screening of genomic DNA library; DNA amplification and fingerprinting analysis, labelling and detection of nucleic acid sequences. The course also highlights the application of gene manipulation in model organism such as *C.elegans,* a well-known soil nematode which was the first multi cellular organism to be whole genome sequenced. Ultimately, application of gene manipulation is inflicted in bioprocessing of recombinant DNA (rDNA) derived products such as insulin, erythropoietin.

Text Book:

1) Molecular Cloning: A Laboratory Manual by Green and Sambrook.
2) Genome Analysis. A Laboratory Manual Vol I- Analysing DNA by Bruce Birren.

.**Reference Books:**

1) Cloning, Gene Expression, and Protein Purification. Experimental Procedures and Process Rationale by C. Hardin, J. Pinczes, A.Riell, D.Presutti, W.Miller and D.Robertson.

2) Analysis of Genes and Genomes by R.J. Reece

3) PCR by M. McPherson and S. Moller.

4) www.wormbook.org

5) Gene Cloning and DNA Analysis: An Introduction T. A. Brown.

6) Principles of Gene Manipulation and Genomics by S. B. Primrose and R. M. Twyman,

Course Objectives:

The course is designed to make the students

i. Functional understanding of nucleic acid (DNA and RNA) isolation in prokaryotes & eukaryotes and principle techniques used for their quantification and separation.
ii. Focus on cloning, construction of genomic DNA libraries followed by the library screening which would be the next stage of gene manipulation.
iii. In-depth understanding of various techniques involved in gene amplification, DNA fingerprinting, labelling and detection of nucleic acid sequences.
iv. Concentrate on the importance of model organisms such as *Caenorhabditis elegans* and its growth, maintenance and isolation & amplification of nucleic acids.
v. Indulgent in fermentation, bioprocess development of recombinant DNA (rDNA) products and downstream processing of rDNA product in large scale.

Course Outcomes: The students shall be able to:

i. Acquire practical knowledge of nucleic acids isolation, methodology for their quantification and separation in prokaryotes and eukaryotes.
ii. Comprehend the basics of cloning which are necessary large scale processing of rDNA products, southern blotting and hybridization.
iii. Frame the precise gene amplification technique for a particular experiment
iv. Understand different types of bioreactor, mode of reactor operation downstream processing necessary for bioprocessing**.**

Course Outline: Core 15: Lab V: Recombinant DNA Technology

(4 Credits)

i. Fundamental Concepts of chromosomal DNA isolation from plant, bacteria and animals, RNA isolation from E.coli
ii. Quantification of nucleic acid UV Spectrophotometer and Nano Spectrophotometer

iii. Isolation of nucleic acids by agarose gel electrophoresis
iv. Partial digestion of chromosomal DNA with restriction enzyme, Cloning of gene of interest into cloning vectors followed by transformation into competent cells
v. Screening of the Library such as Southern blotting and hybridization
vi. Polymerized chain Reaction (PCR) for gene amplification and its types- Gradient PCR, Touchdown PCR, Nested PCR, Hot start PCR and Colony PCR
vii. Other amplification techniques- 16S rDNA amplification, ITS gene amplification
viii. DNA fingerprinting which includes multilocus and single locus DNA profiling, ARDRA, RFLP, RAPD, DNA microarray
ix. Labelling and detection of nucleic acid sequences: End-Labeling (3ô- and 5ô-), Random priming and Nick translation using radioactive non-radioactive labeling techniques.
x. Different stages in the life cycle of *C. elegans.*
xi. Growth, maintenance and identification of wild-type and mutant *C. elegans*
xii. PCR from single worm
xiii. Expression of GFP-tagged proteins on live *C. elegans* model and expression of cloned genes in *E.coli*
xiv. Fermentation ï different types of bioreactor and its mode of operation, bioprocessing of recombinant DNA products.
xv. Downstream processing includes 1. Removal of Insoluble (Filtration and Microfiltration, Centrifugation, Cell Disruption), 2. Isolation of Products (Extraction, Adsorption), 3. Purification (Chromatography, Precipitation, Electrophoresis), 4. Polishing (Crystallization, drying)
xvi. Analysis of expressed proteins by SDS-PAGE, native PAGE, Zymogram and Western blotting

More books for Reading and Referencing

Name of the Book	**Author's Name**
Academic Cell - Molecular Biology	David P Clark and Nanette J Pazdernik
Molecular Biology of the Gene	James D Watson, Tania A Baker, Stephen P Bell, Alexander Gann, Michael Levine and Richard Losick, Benjamin Cummings
Essential Genetics	Daniel L Hartl
Concepts of Genetics	Williams S Klug, Michael R Cummings, Charolette A Spencer and Michael A Palladino
Molecular Genetics of Bacteria	Larry Snyder, Joseph E Peters, Tina M Henkin and Wendy Champness
From Genes to Genomes ï Concepts and Applications of DNA technology	Jeremy W Dale, Malcolm Von Schantz and Nick Plant

Course Schedule: Core 15: Lab V: Recombinant DNA Technology (4 credits)

Syllabus	**Schedule**

Unit 1: Isolation of chromosomal (bacterial, plant and animal) DNA. Isolation of RNA from Gram negative bacteria. Quantification of DNA by DPA method and quantification of RNA by orcinol method. Quality and quantity checking of DNA and RNA by UV Spectrophotometer, Nano Spectrophotometer and Agarose gel electrophoresis.	**4 days**
Unit 2: Partial digestion of chromosomal DNA with restriction enzyme. Construction of genomic DNA Library using plasmid vectors. Screening of the Library - Southern blotting and hybridization. Sub-cloning in M13 and plasmids.	**6 Days**
Unit 3: PCR Types - Gradient PCR, Touchdown PCR, Nested PCR, Hot start PCR and Colony PCR. PCR for Molecular identification of microbes - 16S rDNA amplification, ITS gene amplification and cloning in T/A vector- Sequencing of 16S rDNA insert; DGGE, TRFLP.DNA fingerprinting - Multilocus and single locus DNA profiling, ARDRA, RFLP, RAPD. DNA microarray. Labelling and detection of nucleic acid sequences: End-Labeling (3ô- and 5ô-), Random priming and Nick translation using radioactive non-radioactive labeling techniques.	**10 days**
Unit 4: Growth and maintenance of *C. elegans*. Identification of wild-type and mutant *C. elegans*. Isolation of genomic DNA and RNA from different stages of *C. elegans*. Single worm PCR. Studies on expression of antimicrobial genes. Expression of GFP-tagged proteins on live *C. elegans* model. Real Time PCR and Reverse Transcriptase PCR. Expression of cloned genes in *E. coli*.	**4 days**
Unit 5: Fermentation - Downstream processing of protein products/bioactive compounds- recovery and purification of products- Column Chromatography, TLC, HPLC, FPLC. Analysis of expressed proteins by SDS-PAGE, native PAGE, Zymogram and Western blotting.	**4 days**
5-8 days left for CIA Tests, Quizzes, Seminars, Case Presentations, etc.	

501305–LAB VI: PLANT BIOTECHNOLOGY (Core – 4 credits)

COURSE DEPICTION

Program: **M.Sc. BIOTECHNOLOGY**	Semester : **III (2015-16)**
Course Title: **Core 16 - Lab VI: Plant Biotechnology (503305)**	Class Time: **2-6:Wednesday & Thursday**
Name of Course Teacher	**Dr.M.Ramesh**
Mobile: **+91 9442318200**	Email : **mrbiotech.alu@gmail.com**

Course Brief:

Plant biotechnology is an integration of several sciences including genetics, biochemistry, microbiology, agriculture, plant breeding, medicine, pharmacology, environmental sciences and so on. So it is clearly an interdisciplinary science surrounding not only biology, but also other subjects, including physics, chemistry, mathematics and engineering. Plant biotechnology course emerged as an exciting area of plant sciences by creating several new opportunities for the manipulations of

plants *in vitro*. The tools of biotechnology can be applied to any living system such as plants, animals or microorganisms to obtain products or processes that are directly or indirectly useful to mankind. Lab in Plant Biotechnology course provides an elaborate and complete education in which the students (with plant molecular biology knowledge gained in the second semester) learn underlying principles of various experiments, concepts, theories, key methodologies, practical exposure and equip themselves with a wide range of skills and knowledge base employed in plant biotechnology research. Plant tissue culture has contributed greatly to understanding the factors responsible for growth, development, differentiation and other vital processes of plant cells, tissues & organs *in vitro*. The collection of techniques contributed immensely towards plant improvement, plant protection and also for large-scale production of industrially important compounds by gene manipulation and elicitation. More than that laboratory course in Plant Biotechnology is a multidisciplinary area of specialization with wide applications in Research & Development of pharmaceutical and agriculture based industries. Emphasis will be placed on developing Good Laboratory Practices, including novel and innovative thinking, proper utilization of technique, record-keeping, and scientific writing.

Text Books:

1. Introduction to Plant Biotechnology, 3rd Edition, H.S.Chawla, Oxford & IBH Publishing Co. Pvt. Ltd, India.
2. Plant Tissue Culture : Theory and Practice, Revised Edition - 2004, S.S. Bhojwani and M.K. Razdan, Elsevier Science Publications, The Netherlands

Reference Books:

1. Methods in Plant Molecular Biology. A Laboratory Course Manual (1995) Pal Maliga Cold Spring Harbor Laboratory Press.
2. Plant Biotechnology-Laboratory manual for Plant Biotechnology (2008), H.S. Chawla, Oxford & IBH Publishing Co. Pvt. Ltd.

Course Objectives:

To make the students to:

vi. Understand the principles, practices and application of plant tissue culture techniques
vii. Obtain practical skills (in basic plant tissue culture and advanced molecular biology techniques) and to enhance studentsô understanding of the knowledge learned from the theory lectures in the second semester.
viii. Have hands-on experience and training in genetic engineering techniques
ix. Learn preparation of nutrient media, sterilization techniques, and development of axenic cultures through in vitro culture, cryopreservation, and genetic modification through transformation.
x. Analyze transgenic plants with biochemical assays and molecular analysis such as PCR and Southern hybridization.

Course Outcomes: The students undergoing this important core practical course shall be able to

i. Explain the various components of major plant tissue culture media, e.g. macro and micronutrients, growth factors, vitamins, hormones, and other choice of components.
ii. Explain the various steps taken to establish and optimize media for particular purposes

in particular species
iii. Familiar with sterile techniques, media preparation, DNA extraction methods, and isolation of specific gene
iv. Apply tissue culture techniques for the large scale production of food crops and medicinal plants with economically useful traits.
v. Apply knowledge of molecular markers for the identification of traits in various genomes.
vi. Apply genetic engineering concepts to induce biotic and abiotic stresses in plants
vii. Perform a variety of molecular biology techniques, including restriction digestion, polymerase Chain Reaction, and Biolistic ^{TM} transformation.

Course Outline: Lab VI: Plant Biotechnology (4 Credits)

i.	Preparation of stock solutions and nutrient media
ii	Processing of explants (mature seed, leaf base, shoot tip and node) for aseptic culture initiation
iii	Sterilization of nutrient media and surface sterilization of explants collected from field for aseptic culture initiation.
iv	Establishment and maintenance of callus and suspension culture.
v	Subculture and regeneration of shoots and roots
vi	Shoot tip culture.
vii	Molecular marker analysis of conserved and wild type medicinal plants for genetic stability and diversity.
viii	Acclimatization and hardening of micropropagated plants.
ix	Micropropagation of endangered medicinal plants
x	Synthetic seed preparation through gel entrapment and plant conversion
xi	Low temperature storage and Cryopreservation of plant genetic resources from endangered medicinal plants.
xii	Introduction of binary plasmids into Agrobacterium cells by triparental mating.
xiii	Isolation and purification of Ti-plasmid DNA
xiv	Cloning of abiotic responsive genes into binary vector.
xv	*Agrobacterium tumefaciens* - mediated transformation of plants

xvi	Transient gus gene expression by histochemical method.
xvii	PCR analysis of putatively transformed plants.
xviii	*Agrobacterium rhizogenes*- mediated transformation of medicinal plans.
xix	Biolistic transformation of food crops

Additional books for Reading and Referencing

Author (s)	**Title**
Amla Batra,	Fundamentals of Plant Biotechnology (2001), Capital Publishing Company, New Delhi.
R.A. Dixon	Plant Cell Culture-A - Practical Approach (2006), 2nd Edition, IRL Press, Oxford.

Course Schedule: Core 16: Lab VI: Plant Biotechnology (4 Credits)

Syllabus	**Schedule**
Unit 1: Preparation of stock solutions and nutrient media for callus culture initiation and plant regeneration. Processing of various explants (mature seed, leaf base, shoot tip and node) for culture initiation. Aseptic techniques-Sterilization of nutrient media. Pretreatment and surface sterilization of various explants collected from field for aseptic culture initiation.	**9 Days**
Unit 2: Establishment and maintenance of callus and suspension culture. Subculture and regeneration of shoots and roots from callus cultures through organogenesis and somatic embryogenesis. Shoot tip culture. RAPD and ISSR analysis of in vitro conserved and wild type medicinal plants for genetic stability and diversity. Acclimatization and hardening of micropropagated plants.	**8 Days**
Unit 3: Micropropagation of endangered medicinal plants using various explants. Synthetic seed preparation from intact regenerable explants of medicinal plants through gel entrapment. Plant conversion from synthetic seeds. Low temperature storage and Cryopreservation of plant genetic resources from endangered medicinal plants. Encapsulation dehydration and Encapsulation vitrification.	**7 days**

UNIT-4 Genomic DNA extraction and purification ï Principle and methods. Isolation and purification of Ti-plasmid DNA. Introduction of binary plasmids into Agrobacterium cells by Triparental mating. Cloning of abiotic responsive genes into binary vector.	**6 days**
Unit 5: *Agrobacterium tumefaciens* - mediated transformation of plants - Culture initiation, explant preparation, preincubation, co-cultivation, selection, and regeneration. PCR analysis of putatively transformed plants. Transient ß-glucuronidase (GUS) gene expression assays in transformed intact explants and callus tissues by histochemical method. *Agrobacterium rhizogenes*-mediated transformation of medicinal plants. Biolistic transformation of food crops ï Principle and method.	**6 days**
8 days assigned for CIA Tests, Quizzes, Seminars, etc.	

ELECTIVE COURSES

501501–BIOPHYSICS AND INSTRUMENTATION (Core – 3 credits)

Program: M. Sc. (Biotechnology)	**Semester: I**
Course Title: BIOPHYSICS AND INSTRUMENTATION	**Timings: 12-1 PM (M, Th & F)**
Course Teacher	**Dr. K. Balamurugan**
Contact email	**bsuryar@yahoo.com**

COURSE BRIEF:

The subject Biophysics deals with the combination of biology and approaches of physics to study the complex nature of life. It provides a qualitative analysis of biological experiments regarding proteins, lipids, nucleic acid and carbohydrate. This subject provides a clear picture of the physical phenomenon such as the response of an organism to the food, prey, external and internal stimulus during the normal conditions. These observable facts are due to the regulation of various events that deals with cell to cell interaction, which is a consequence of interactions between RNA, DNA and biosynthesis of Proteins, Lipids and Carbohydrates. The qualitative and quantitative analysis of these events can be done by using various sophisticated techniques (instrumentation) which has been included in the syllabus

TEXT AND REFRENCE BOOKS:

1. Biophysical Chemistry Part I, II and III (2004) by Charles R. cantor & Paul R. Schimmel, W.H. Freeman and Company, USA
2. Biochemistry (2004) by Donald Voet & Judith G. Voet, John Wiley and Sons, USA

3. Lehninger's Biochemistry (2006) by Nelson, D.L. & Cox, M.M. W.H. Freeman and company, USA.
4. Principles and practice of bioanalysis (2004) by Richard F.venn, Taylor & Francis, London, New York.
5. Basic methods in microscopy: Protocols and concepts from cells: A laboratory manual (2006) by David L. spector & Robert D. Goldman, Cold Spring Harbor Laboratory Press, New York.
6. Instrumental Methods of Analysis (1986) by Willard, Herrit, Dean and Settle, CBS Publishers and Distributors.

COURSE OBJECTIVES

I. To provide basic principles of important biomolecules

II. To provide basic information about biological and biophysical instrumentation and measurement techniques commonly used in biology

III. To provide thorough knowledge of the various principles in biophysical concepts and the understanding of technologically advanced instrumentation which can be used by the students in their future career

IV. To establish the relationship between the importance of structure and function at the molecular level of biomolecules

V. To prepare students for competitive exams for higher studies/courses in molecular and medical biophysics by incorporating the outcome of latest genomics and proteomics tools

COURSE OUTLINE:

The subject content includes interdisciplinary concepts that provide a wide berth to serve students from various fields such as Botany, Zoology, Biochemistry, Microbiology, Veterinary Science, Biotechnology, Nanotechnology, Molecular Biology, Structural Biology, Bioinformatics and Bioengineering. The understanding of basic biology is important to comprehend the use of advanced technology to aid in biomolecule analysis.

The subject has been divided into five units from basic concepts to use advanced technology in analyzing the building blocks of life (Lipids, Carbohydrates, Proteins, DNA and RNA). For better understanding, provided below the topics included in each unit.

UNIT 1: The physical parameters of biomolecules such as structural, biophysical and chemical properties of water are being covered in this unit. The types of bonding present in macromolecules

that provides stability during an interaction are provided in detail. The unit provides the students from various fields a common platform of understanding. Water is a constituent of every living organism and plays an important role in providing an environment suitable for various biophysico-chemical reactions. Therefore, understanding of physical and chemical properties of water in presence and absence of biomolecules is important for the analysis.

UNIT-2: This unit is on proteins that play an important role in our normal day to day life. Therefore, understanding the various levels of protein organization is important. The structural organization of proteins provides an insight to understand various diseases. The forces stabilizing and influencing such organizations are also covered in this unit. The functional relationship and structural polymorphism between DNA, t-RNA and micro-RNA are also studied as they play important roles in translation, synthesis and modulation of proteins.

UNIT-3: This unit focuses on radiation biophysics that deals with the use of radioisotope technology in biological science. The unit follows a systematic approach in understanding the radio isotopes to safety aspects that should be taken care when using radioisotopes. In addition, the measurement of radio activity by using various instruments and its application in biological studies such as molecular imaging are being provided. Techniques of concentrating and purifying biological samples are also included in this unit.

UNIT-4: Basic to advanced seperation techniques along with their general principles; definitions and their application are included in this unit. Advanced techniques that can be used for separation and resolving of biomolecules such as DNA, RNA, Lipids, Proteins, Carbohydrates are included in this unit.

UNIT-5: The unit comprises of biophysical quantitative and qualitative analytical methods used for complex biopolymer structures. Each bioanalytical method is defined for specific studies with the basic principle, sample preparation, detection, analysis, demerits and merits along with application are being included in this unit. Introduction to advanced instrumentations such as MS, FT-IR, NMR, X-ray diffraction, ESR spectroscopy, Fluorescence spectroscopy, SEM, TEM and Confocal microscopy are being covered in this unit.

COURSE OUTCOME

Each unit is designed to accommodate students from multiple disciplines, therefore the students are expected to understand the basic concepts of biophysics and its involvement in biological processes that can be utilized as a parameter for the analysis of biomolecular samples. The student also will study in depth the structure and molecular function of the important biomolecules such as

Proteins, Lipids, Carbohydrates, DNA and RNA along with their interaction between each other. The student will be equipped with knowledge of various separation techniques required for different biomolecules which could be used in future. The understanding of various detection methods for different biomolecular structure through advanced techniques can give an overall perception of the use of these instruments which can equip the student for future career perspective.

APPLICATION FOR FUTURE CAREER: The subject provides an overall understanding of the basic concepts in biophysics as well as the use of different instruments in biophysical-chemical analysis of biomolecules. The subject will help the students to get knowledge for ease understanding of the methodology required for separation and analysis of biological regulators of their interest during future studies. The subject also equips the student to analyze the questions posed with respect to biophysical analysis of biological samples during competitive examination or interview.

COURSE SCHEDULE

Syllabus	Schedule
UNIT-1 Basic concepts of Biophysics: Bonding: Strong (covalent, ionic, peptide and coordinate bonds) and Weak interactions (Hydrogen bonding and Van der Waals forces) in macromolecules. Structure and properties of water: Hydrophobic and hydrophilic interactions. Principles of biophysical chemistry (pH, buffers, reaction kinetics, thermodynamics, Colligative properties).	**15 Days**
UNIT-2 Organization of proteins at different levels - primary, secondary, tertiary and quaternary structure of protein; forces stabilizing structure of protein; protein folding, Ramachandran plot; Structure- Function relationships; Structural polymorphisms of DNA, tRNA and micro-RNA	**15 Days**
UNIT-3 Radiation Biophysics or Radioisotope techniques: Stable and radio-isotopes. Measurement of radioactivity in biological samples: Gas ionization (GM counter), Scintillation counter, autoradiography and dosimeter. Radiation units; Safety aspects in handling radioactive isotope; Application of radioactive isotopes in biological studies. Molecular imaging of radioactive materials. Concentration - Lyophilization and rotatory vaccum concentration; Diffusion techniques - Dialysis, Electrodialysis, Osmosis and Reverse osmosis.	**15 Days**
UNIT-4 Separation techniques: Centrifugation - Basic principles of sedimentation, types of centrifuges and rotors. Preparative ultracentrifugation -	**15 Days**

differential and density gradient; Chromatography: General principles and definitions, R*f* value. Methods based on polarity - Partition chromatography, adsorption chromatography, TLC, HPTLC, gas liquid chromatography, and reverse phase liquid chromatography. Methods based on partition - Gel filtration and Affinity chromatography. HPLC, Nano-LC and FPLC. Ion-exchange chromatography. Electrophoresis - basic principles, PAGE - Native-PAGE, SDS-PAGE, Isoelectricfocussing and 2Dimensional gels. Capillary electrophoresis. Principle and application of Agarose gel electrophoresis, denaturing agarose gel electrophoresis, Pulse-field gel electrophoresis, Mobility shift electrophoresis.	
UNIT-5 Basic principles of biophysical methods used for analysis of biopolymer structure, X-ray diffraction, fluorescence, ORD\CD, NMR, IR, MS and ESR spectroscopy, Surface plasma resonance methods. Symmetry, space group crystal lattices, Braggôs law in real & reciprocal space Use of analytical microscopy in elucidating the structure function relationship in prokaryotes: Light Microscopy: Microscopic optics, components of microscope, Basic principles and methods of Bright-field, Dark-field, Phase contrast, interference contrast, Fluorescence, Confocal Microscopy, Transmission Electron Microscopy, Scanning Electron Microscope, Atomic Force Microscopy. Image processing methods in microscopy. Different fixation and staining techniques for EM, freeze-etch and freeze- fracture methods for EM, image processing methods in microscopy.	**15 Days**
~10 days for CIA tests, Quizzes, Seminars, Interactive sessions, Hands on Training sessions, etc.,	

501502–MARINE ECOSYSTEM AND PRINCIPLES OF OCEANOGRAPHY
(Core – 3 credits)

COURSE DEPICTION

Program:	Semester : **II (2016-17)**
Course Title/code : **Marine Ecosystem and Principles of Oceanography / 501502**	Class Time: **Three hours/week**
Name of Course Teacher	**Dr. A. Veera Ravi**
Mobile: **+91 9487149249**	Email : **aveeraravi@rediffmail.com**

Course Brief:

The core objective of this course is to provide students with a basic knowledge of marine environment, oceanography and the response mechanisms to environmental changes that influence the marine environment. There are two major themes prevalent throughout the course. The first one is the marine ecosystems pertaining to biological oceanography deals with salt marshes, intertidal zones, estuaries, lagoons, mangroves, coral reefs, deep sea, and sea floor. The second theme revolves around the physical and chemical oceanography also known as oceanology, is the branch of geography that studies about the ocean. Physical oceanography covers a wide range of topics, including ecosystem dynamics, ocean currents, waves and geophysical fluid dynamics, plate tectonics and the geology of the sea floor.

The fundamental objective of the course is to provide students with an extensive and concise knowledge of marine ecosystems, phytoplankton communities, intertidal ecology, estuaries and salt marshes, tropical communities (coral reefs and mangroves), oceanic nekton, benthic associations, the deep sea environment and marine biodiversity. Also provide knowledge about some basic oceanography including origin, growth and significance of waves, tides and currents and some basic principles of winds and oceanic circulation. This course also highlights the basic information about seawater, commonly used oceanographic instruments and sampling procedures in the field of oceanography.

Text Book: Marine Biology, (2005), First Edition, SK. Dubey,

Dominant Publishers, New Delhi

Reference Books:

viii. Marine Biology ï an ecological approach (fifth edition) (2001) by J.W. Nybakken.. Addison Wesley Longman Inc.
ix. An Introduction to World Oceans (sixth edition) (2000), A.C. Duxbury, A.B. Duxbury, K.A. Sverdrup, Mc Graw Hill Publishers.
x. Fundamentals of Ecology (1996) by Eugene P Odum. Nataraj Publishers.
xi. Textbook of Marine Ecology (1989) by Nair, N.B. & Thampy, D.M. Macmillan Company of India (Wasani).
xii. Oceanography (second edition), (1995) by T. Garrison. Wadsworth Publishing Company.
xiii. An Introduction to Marine Ecology, Barnes, R.S.K. and R.N. Hughes, (1999), Third edition, Blackwell Science.

Course Objectives: The student will be able to:

xi. Acquire the basic concepts and theories of marine ecosystem and tropical communities such as mangroves and coral reefs that enable them to prosper in their natural habitats.
xii. Critically evaluate the main hypotheses explaining how marine ecosystems function.
xiii. Understand the marine diversity that support unique communities of organisms and provide invaluable ecosystem services for human survival and well-being.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

- Describe the ocean environment in terms of intertidal ecosystems, estuaries, salt marshes, plankton, nekton and benthic communities.

➢ Identify the major taxonomic groups living in the marine biodiversity of the ocean.
➢ Carry out ecological surveys to determine major threats on marine biodiversity.
➢ To understand the strategies of the ocean environment in terms of waves, tides and water movement.
➢ Observe, analyse and identify the growth, decay and significance of physical and chemical parameters of the marine environment.
➢ Examine the composition and elements of sea water
➢ List out and know the structure of oceanographic instruments and its working principle.
➢ Apply the knowledge on sample collection by using various sampling procedures.
➢ Demonstrate the mechanisms involved in bioluminescence production, biological rhythm and factors contribute for primary and secondary productions in the marine food web.
➢ Classify and aware about the potential effects of global warming, green house effect and acid rain in the marine environment.

Course Outline: Core: Marine Ecosystem and Principles of Oceanography (3 Credits)

i. Introduction to marine environment, ecological factors ï light, temperature, salinity, pH, and pressure on marine environment.

ii. Introduction to marine ecosystems including intertidal ecosystems such as rocky, sandy and muddy shores, the structure and function of marine communities and ecosystems includes salt marshes, estuaries, deep sea, plankton, nekton and benthos.

iii. The applications of molecular tools such as Denaturant Gradient Gel Electrophoresis (DGGE), Temperature Gradient Gel Electrophoresis (TGGE), Random Amplified Polymorphic DNA (RAPD), Restriction Fragment Length Polymorphism (RFLP).

iv. Methods involved in conservation and maintenance of endangered species, major threats to marine diversity and include management strategies to provide sustainable benefits.

v. The fundamental principles of waves, tides and currents (Western and Eastern boundary currents).

vi. Theory and principles of concepts of winds and oceanic circulation (El Nino Southern Oscillation).

vii. Theoretical knowledge about source and composition of seawater, elements present in the seawater, major gases dissolved in the seawater.

viii. Structure, working principle of advanced oceanic instruments used for sampling and general sampling procedure.

ix. Marine food web dynamics, Primary and Secondary productions and factors influencing primary production.

x. Properties of light in sea and biological consequences orientation, bioluminescence and biological rhythm. Introduction to know information about the impacts of global warming, ozone depletion, climate change, green house effect and acid rain and its potential effects to the marine ecosystem.

More books for Reading and Referencing:

Chemical Oceanography	Millero, Frank J
Descriptive physical oceanography	L.D. Talley, G.L.Picard and W.J. Emery and J.H. Swift.

Textbook of Marine Ecology,	Nair, N.B. and Thampy, D.M.
Marine Biology ï an ecological approach	J.W. Nybakken.
Methods of Seawater Analysis, ,	K.Grasshoff, K.Kremling and M. Ehrhardt (Eds),
Marine Ecology	O. Kinne.

Course Schedule: Marine Ecosystem and Principles of Oceanography

(3 Credits)

Syllabus	Schedule
Unit 1: Divisions of marine environment. Impact of ecological factors ï light, temperature, salinity, pH, and pressure on marine environment. Marine ecosystems: Intertidal ecosystems - Rocky, Sandy and Muddy shores, Estuaries, Salt marshes, Mangroves, Coral reefs, Coral bleaching & its diseases. Deep sea, Plankton, Nekton and Benthos. In this topic, animated descriptions of power points will be used to describe the complex process of the structure and mechanism by easily understandable manner.	**10 Days**
Unit 2: Marine biodiversity, molecular methodologies in measuring biodiversity, Maintenance and conservation of endangered species - captive breeding, habitat fragmentation, ecosystem restoration and rehabilitation. Threats to marine biodiversity ï overexploitation, physical alteration, pollution and alien species.	**12 Days**
Unit 3: Introduction to waves and tides, Origin, Growth, Propagation and Decay of Waves, Significance of Wave Height and Period. Spring and Neap tides and tide generating forces. Currents-Western and Eastern boundary currents, Somali current, thermohaline and abyssal circulation. Winds and general oceanic circulation. ENSO (El Nino Southern Oscillation)). Likewise, concepts of winds and oceanic circulation (El Nino Southern Oscillation) also discussed in this unit. In this area, animated images and explanation of power points will be used to illustrate the various types of currents and circulation.	**10 days**
Unit 4: Composition of seawater. Major and minor elements in the seawater. Dissolved gases in the seawater: their source and sinks. Oceanographic instruments and general sampling procedures.	**13 days**
Unit 5: Marine food web dynamics, Primary and Secondary productions and factors influencing primary production. Properties of light in sea and biological consequences orientation, bioluminescence & biological rhythm. Global Warming - climatic changes- Ozone depletion, UVï B, Green house effect, acid rain and its potential effects.	**8 days**
5-8 days left for CIA Tests, Quizzes, Seminars, etc.	

501503–FERMENTATION AND BIOPROCESS TECHNOLOGY
(Core – 3 credits)

COURSE DEPICTION

Program: **M.Sc. Biotechnology**	Semester : **III (2016-17)**
Course Title: **Fermentation And Bioprocess Technology (Elective – 3 credits) Theory**	Class Time:
Name of Course Teacher	**Dr. A. Veera Ravi**
Mobile: **+91 9487149249**	Email : **aveeraravi@rediffmail.com**

Course Brief:

The fundamental objective of the course is to provide students with an extensive and concise knowledge about bioprocess principles and strategies to optimize the production of byproducts from industrial important microbial strains. Students will learn the concepts of bioprocessing and its application in industries, media design, cultivation, fermentation technology, bioreactor design and optimization of cellular behavior. The laboratory component provides the hands-on experience benefitting the students with right skills required for industrial, academic and research career. Further, this course also provides exposure to understand the basic concepts and fundamental principles of the fermentor.

Through this course, students will understand the fundamental concepts of fermentation; aerobic and anaerobic fermentation, production of biotechnologically important products, exopolymers and steps involved in upstream and downstream processes.

Text Book:

1) Principles of Fermentation Technology (2003) by P.F. Stanbury, A.Whitaker and S.J.Hall, Butterworth Heinemann.
2) P. M. Doran: Bioprocess Engineering Principles, Academic Press, Harcourt Brace and Company, Publishers, 2nd Edition, 2013.

Reference Books:

1. Comprehensive Biotechnology. The Principles, Applications and Regulations of Biotechnology in Industry, Agriculture and Medicine, Vol 1, 2, 3 and 4 (2004). Edited by M. M. Young, Reed Elsevier India Private Ltd, India.
2. Fermentation Microbiology and Biotechnology (2002) by E.M.T.EL. Mansi and C.F.A. Bryle, Taylor & Francis Ltd, UK.
3. Biotechnology: A Textbook of Industrial Microbiology (2000) by Wulf Cruege

and Anneliese Crueger, Punima Publishing Corporation, India.

4. Encyclopedia of Bioprocess Technology. Vol 1-5 (1999) Edited by Flickinger, M.C & Drew S.W.

Course Objectives:

Furnish themselves with thorough knowledge of the fundamental science and methodologies in the various concepts of fermentation. This area is increasingly important in all forms of biotechnology.

i. Understanding of strain improvement and knowing the isolation and screening of industrially important microbes.
ii. To impart in-depth knowledge on the cutting-edge techniques and glimpse on various experimental approaches such as sterilization, fermentation, agitation and Computer application in control of bioprocess.
iii. Impart practical skills to the students to immobilize industrially important enzymes for fermentation processes.

Course Outcomes: The students shall be able to:

i. Describe the basic concepts and theories of the growth kinetics of microbial cells
ii. Recognize the fundamentals of fermentation technology.
iii. Assess power requirements in bioreactors, modeling of bioprocesses, traditional and new concepts in bioprocess monitoring, and the biological basis for industrial fermentations and cell cultures.
iv. Understand the differences between aerobic and anaerobic fermentation and the classification of microorganisms based on their respiratory action.
v. Use the most common equipment, materials and methods related to fermentation processes, microbial growth and cultivation and sterilization.
vi. Produce, analyze and interpret data from bioprocesses.

Course Outline: 501303 – Fermentation and Bioprocess Technology (3 Credits)

i. Concepts on basic principles of Biochemical Engineering. Isolation and screening of industrially important microbes etc.,
ii. Medium Design and kinetics of microbial cell cultivation.

iii. Basic knowledge on bioprocess principles and strategies to optimize the industrial cellular strains.

iv. The significant features of improvement of strains for increased yield and other desirable characteristics.

v. The cutting-edge techniques and experimental approaches of various fermentation technologies, Bioreactor design principles and operating mode.

vi. Instrumentation and control of bioprocesses, Demonstration of various parts with the Laboratory Fermenter.

vii. Basic principles of Cell Separation: Filtration and Centrifugation etc. and Cell disruption ï Mechanical & Non-mechanical methods.

viii. Experimental approach on Bioprocess for the production of biomass, primary and secondary metabolites.

ix. Fundamentals of Cell and Filtrate Processing: Precipitation, Centrifugation, Filtration, Dialysis, Reverse osmosis, Chromatography, Drying, Crystallization and Product Formulation

x. Biotechnologically important Antibiotics (ϐ-lactum), Solvents (acetone) Amino acid (Lysine), Organic acids (Citric acid), Alcohols (Ethanol), Ind. Enzymes (Protease/Amylase) and Biopharmaceuticals (Insulin/Interferon etc.).

More books for Reading and Referencing

Name of the Book	**Author's Name**
Biotechnology: A Text Book of Industrial Microbiology	W. Crueger & A. Crueger
Bioprocess Engineering	M. Shuler and F. Kargi
Cell Culture Bioprocess Engineering	Wei-Shou Hu
Bioprocess technology, kinetics and reactors	Moser, A

Course Schedule: 501303 – Fermentation and Bioprocess Technology (3 Credits)

Syllabus	**Schedule**
Unit 1: Basic principles of Biochemical Engineering. Isolation and screening of industrially important microbes. Improvement of strains for increased yield and other desirable characteristics.	**7 days**
Unit 2: Concepts of basic modes of fermentation - Batch, Fed batch and Continuous fermentation. Bioreactor designs. Air and media sterilization, Aeration & agitation in bioprocess. Scale up fermentation processes. Instrumentation & control bioprocess. Computer application in control of bioprocess.	**10 Days**
Unit 3: Fermentation economics of large-scale fermentation.	**10 days**
Unit 4: Downstream processing. Bioprocess for the production of biomass,	**5 days**

primary and secondary metabolites, extracellular enzymes, biotechnologically important intracellular products and exopolymers.	
Unit 5: Immobilization of enzymes and microbial cells, Secondary metabolites.	**4 days**
5-8 days left for CIA Tests, Quizzes, Seminars, Case Presentations, etc.	

501504–MARINE NATURAL PRODUCTS (Core – 3 credits)

COURSE DEPICTION

Program: **M.Sc. Biotechnology**	Semester : **III (2016-17)**
Course Title: **Marine Natural Products Theory**	Class Time: **Three hours/week**
Name of Course Teacher	**Dr. A. Veera Ravi**
Mobile: **+91 9487149249**	Email : **aveeraravi@rediffmail.com**

Course Brief:

The fundamental objective of this course is to explore students with an extensive and concise knowledge of natural products obtained from marine resources and will focus on metabolic pathways associated with prominent marine products to illustrate major metabolic trends in the marine environment. A diversity of marine natural products will be examined in a multidimensional discussion of structure, biological activity, and biosynthesis at the mechanistic, enzymological and genomic levels. Students will gain deep insights into the major classes of marine secondary metabolites and the biosynthetic processes used in their creation. Significant in class and homework assignments will provide students opportunities to develop their skills in deducing origins of natural products, the process for their assembly, and deduction of structures from genetic sequence information.

Marine Natural Products course deals with the study of bioactive compounds derived from marine flora and fauna. Among the topics covered are marine toxins and venoms, repellent and alarm substances, marine chemical ecology, biosynthesis and functions of secondary metabolites and "state of the art" methods used for the isolation and purification of compounds derived from marine organisms.

Text Book:

1) Fusetani, N. (2000). Drugs from the Sea. John Wiley & Sons, New York.

Reference Books:

10) Marine Biotechnology Vol I. Pharmaceutical and Bioactive Natural Products (1993) Edited by D.H. Attaway and O.R. Zaborsky, Plenum Press, USA
11) Highlights of Marine Natural Products Chemistry (1972-1999). D. J. Faulkner, Natural Products Report, 2000, 17, 1-6
12) Marine Pharmacology. D. J. Faulkner, Antonie van Leeuwenhoek, 2000, 77, 135-145

13) Biosynthesis of Marine Natural Products: Microorganisms and Macroalgae. B. S. Moore, Natural Products Report, 1999, 16, 653- 674
14) Recent Advances in Marine Biotechnology. Vol 2 (1998). Fingerman, M., Nagabhushanam, R., Thompson, M.
15) Marine Natural Products- Diversity and Biosynthesis. Current Chemistry Vol 167 (1993). Scheuer PJ
16) Marine Natural Products reviewing the literature Published in 1995. Faulkner DJ.
17) Scheuer, Paul J. (1973). Chemistry of Marine Natural products. John-Wiley & Sons, New York.

Course Objectives:

The course is intended to make the students

i. To equip students with knowledge of natural products obtained from a range of sources including marine plants and organisms with the emphasis on the medicinal properties of substances.
ii. Understand of the diversity of micro and macro-organisms and its products is essential for research in bio-pharmaceutical fields such as cancer, bacterial, fungal, viral and other diseases.
iii. To know how selected compounds can be synthesized including a description of some industrially important enzymes.
iv. Concentrate on the importance of Biotechnological application of commercially important enzymes from marine microorganisms and Extremozymes from Extremophiles.
v. Understand how bioactive natural products are believed to work; to place natural products in the wider context of bioactive compounds.

Course Outcomes: The students shall be able to:

i. Procure the basic concepts and familiarity with a range of natural products and their medical uses.
ii. Gain basic information on practical techniques and approaches commonly used in bioactive compounds extraction.
iii. Understand the role of seaweeds and as sources of Medicine, polysaccharides and food.
iv. Explicate and know the importance of alginates and its major applications for transplantation**.**
v. Know the mode of action of selected natural products.
vi. Predict the type of compound class/chemical functionality likely to be present in an extract
vii. To purify and characterize the active principles present in the biological materials using various chromatographic techiniques.

Course Outline: 501507. MARINE NATURAL PRODUCTS (Elective – 3 credits)

i. Concepts on bioactive compounds obtained from seaweeds as sources of Medicine and Food.

ii. General information on Macroalgal polysaccharides: - Properties, applications and manufacture of agar, agarose and carrageenan. Alginate- general uses and applications of alginate microcapsules for transplantation of cells.

iii. Types of important products: Antibiotic, anti-tumour, tumour-promotor, anti-inflammatory, analgesic, cytotoxic, anti-viral anti-fouling compounds of marine origin

iv. Marine algae as a source of eicosanoids and related compounds from marine algae and its significant applications in the production of fatty acids such as DHA and EPA.

v. Basic knowledge on biotechnological applications of commercially important enzymes from marine microorganisms, Extremozymes from Extremophiles.

vi. Theories of Global CO2 levels and reduction by ocean farming.

vii. Significance and Applications of chitosan in separation and purification of metals.

viii. Molecular biology and applications of adhesive proteins from green mussel.

More books for Reading and Referencing

Marine Biotechnology Vol I. Pharmaceutical and Bioactive Natural Products (1993) Edited by D.H. Attaway and O.R. Zaborsky, Plenum Press, USA
Highlights of Marine Natural Products Chemistry (1972-1999). D. J. Faulkner, Natural Products Report, 2000, 17, 1-6
Marine Pharmacology. D. J. Faulkner, Antonie van Leeuwenhoek, 2000, 77, 135-145
Biosynthesis of Marine Natural Products: Microorganisms and Macroalgae. B. S. Moore, Natural Products Report, 1999, 16, 653- 674
Recent Advances in Marine Biotechnology. Vol 2 (1998). Fingerman, M., Nagabhushanam, R., Thompson, M.
Marine Natural Products- Diversity and Biosynthesis. Current Chemistry Vol 167 (1993). Scheuer PJ
Marine Natural Products Reviewing the literature Published in 1995. Faulkner DJ.

Course Schedule: 501507. Marine Natural Products (Elective – 3 credits)

Syllabus	**Schedule**
Unit 1: Marine macroalgae/seaweeds as sources of Medicine and Food.	**5 days**

Macroalgal polysaccharides: - Properties, applications and manufacture of agar, agarose and carrageenan. Alginate- general uses and applications of alginate microcapsules for transplantation of cells (like Islets of Langerhans).	
Unit 2: Marine pharmacology- Bioactive natural products (anti-bacterial, anti-fungal, anti-viral, anti-inflammatory, anti-tumour, anti-parasitic and anthelminthic) from macroalgae, marine bacteria, dinoflagellates, coelenterates (corals), bryozoans, sponges, and tunicates.	**10 Days**
Unit 3: Eicosanoids and related compounds from Marine Algae. Biological uses of Omega-3 polyunsaturated fatty acids and production of DHA and EPA from microalgae.	**6 days**
Unit 4: Biotechnoligical application of commercially important enzymes from marine microorganisms & Extremozymes from Extremophiles. Global CO2 levels and reduction by ocean farming.	**4 days**
Unit 5: Applications of chitosan in separation and purification of metals. Molecular biology and applications of green mussel adhesive protein.	**5 days**
5-8 days left for CIA Tests, Quizzes, Seminars, Case Presentations, etc.	

501505–BIODIVERSITY, ECOLOGY AND EVOLUTION (Core – 3 credits)

COURSE DEPICTION

Program: **M.Sc. BIOTECHNOLOGY**	Semester :
Course Title: Major Elective **: Biodiversity, Ecology & Evolution (501505)**	Class Time:
Name of Course Teacher	**Dr.M.Ramesh**
Mobile: **+ 91 9442318200**	Email : **mrbiotech.alu@gmail.com**

Course Brief:

Biodiversity is the variety of all species on earth (plants, animals, micro-organisms, and their genes). The study of biodiversity is an emerging area of biology that is of growing importance in the public and political spheres. The main objective of this basic elective course is that the students at Post Graduate level should understand the fundamentals of biodiversity, evolutionary and ecological concepts and principles in an ecological context with particular reference to plant biodiversity, its dynamics, values, and different types of conservation methods and various theories of evolution. For students, it is very important to understand the importance of biodiversity and evolution. The course is a prerequisite for specialized biological programs and most relevant to those focusing on evolution and ecology. Understanding the diversity of plants and animals, their origin and evolution and ensuring their conservation through biotechnological approaches is not only of academic interest but is also crucial to ensuring the sustainable development of our society. Unlike most of the other courses, students electing this course with basic interest in ecology and biodiversity will know how to assess

biodiversity of our country (especially plant biodiversity) with different methodologies and they will be able to conduct a critical analysis of measures to manage biodiversity. Ecology is the study of the relationships between living organisms, including humans, and their physical environment. Study of ecology provides information about the benefits of ecosystems and how we can use Earth's resources in ways that leave the environment healthy for future generations. Students mastering biodiversity aspect acquire multidisciplinary training designed to begin research in the area of biodiversity and its conservation in particular plant conservation. Evolution is change in the heritable characteristics of biological populations over successive generations and gives rise to biodiversity at every level of biological organization, including the levels of species, individual organisms, and molecules. Overall the course provides a comprehensive introduction to all areas of ecology, evolution, and biodiversity. Students studying this course will learn about how this diversity emerged, as plants, animals, and microbes become adapted to the environment and to each other. Biodiversity Ecology and Evolution course will provide not only the basic knowledge on ecology, evolution and biodiversity of life, but also help them to improve their society life.

Text Books:

1. An advanced Text Book of Biodiversity (2004) K.V.Krishnamoorthy, Oxford &IBH, New Delhi.

2. Biodiversity and Conservation (2004). Joshi PC and Namitha Joshi, APH Publishing Company, New Delhi.

3. Evolution (1975) Savage, Amerind Publishing Company Ltd, New Delhi.

Reference Books:

1. Biodiversity and Conservation (2001) Melchias Oxford and IBH Publishing Company Pvt. Ltd., New Delhi

2. Fundamentals of Ecology (1971) E P Odom B Saunders &co, Philadelphia, USA.

Course Objectives:

To make the students to:

I. Understand the principles and concepts about the evolution of biodiversity on earth.
II. Understand the origin and evolution of biotic community.
III. Familiarize with the biotic and abiotic component concepts, principles and conservation of Red listed plants
IV. Acquaint students with sustainable use of plant genetic resources
V. Understand the significance of nature using scientific methods.

Course Outcomes:

On successful completion of Biodiversity, Ecology & Evolution course, students should be able to:

i. Learn the fundamental principles and concepts of evolutionary theory and ecology and they can use this knowledge to explore the evolution of biodiversity on earth

ii. Understand how scientific hypotheses, experiments and comparisons are used to investigate ecological and evolutionary processes
iii. Interpret ecological and social phenomena from a biodiversity point of view
iv. Gain a general understanding of the importance, application, and practice of biodiversity
v. Apply the knowledge to our daily life to solve various environmental problems.
vi. Familiar with the different groups of organisms, including when they evolved on earth and how they are related to each another. Students will also learn basic ecological theory and can use these principles in understanding and proposing solutions to the major environmental problems facing the biosphere
vii. Describe evolutionary and ecological patterns & processes related to the survival, diversity, relationships, distribution, abundance and interactions of organisms, their populations and environments.

Course Outline: Major Elective: Biodiversity, Ecology & Evolution (3 Credits)

i.	Concepts, types ,values and uses of biodiversity
ii	Measures of biodiversity
iii	Vegetation types and hotspot biodiversity areas of India
iv	Red Listed plants and RED Data Book, Threatened plants and animals
v	Role of biotechnology in reintroducing economically important plants
vi	Sustainable uses of plant genetic resources. *In situ* and *ex situ* methods.
vii	Molecular markers and their application in plant conservation
viii	Biotic and Abiotic components of Ecosystem
ix	Food chain, Food web, and energy flow. Trophic levels and ecological pyramids
x	Biogeochemical cycles.
xi	Lamarckism, Neo ï Lamarckism, Darwinism, Neo-Darwinism and De Vries theory of mutation
xii	Molecular evolution and theory of natural selection
xiii	Genetic basis of evolution.

Additional books for Reading and Referencing

Author (s)	Title
John Marynard Smith	The Theory of Evolution (1993), Canto.
Mark Ridley	Evolution (2004) Wiley-Blackwell.

Course Schedule: Major Elective: Biodiversity, Ecology & Evolution (3 Credits)

Syllabus	Schedule
Unit 1: Introduction to Biodiversity, Different types of Biodiversity and Concepts. Values and uses of Biodiversity (food, genes, biocontrol agents, natural products and medicines). Measures of biodiversity (alpha, beta and gamma).	**8 Days**
Unit 2: Vegetation types of India. Hotspot biodiversity areas in India, Red Listed plants and RED Data Book, Threatened plants and animals of India. Role of biotechnology in reintroducing commercially and economically important plants to wild.	**11 Days**
Unit 3: Conservation biodiversity, Sustainable uses of plant genetic resources and biotechnology assisted plant conservation - *In situ* and *ex situ* methods. Molecular markers and their application in plant conservation.	**10days**
Unit 4: Concept and dynamics of ecosystem, Components of Ecosystem-Biotic and Abiotic, Food chain, Food web, and energy flow. Trophic levels and ecological pyramids. Biogeochemical cycles.	**8 days**
Unit 5: Theories of Evolution (Lamarckism, Neo ï Lamarckism, Darwinism, Neo-Darwinism and De Vries theory of mutation), Molecular evolution. Theory of natural selection. Gene pool and gene frequencies. Mechanism of Isolation. Genetic basis of evolution. .	**7 days**
8 days assigned for CIA Tests, Quizzes, Seminars, etc.	

501506–IPR, BIOSAFETY AND BIOETHICS (Core – 3 credits)

COURSE DEPICTION

Program: **M.Sc. BIOTECHNOLOGY**	Semester : **III (2015-16)**
Course Title: Major Elective: **IPR, Biosafety and Bioethics (501510)**	Class Time:**10-11:M** **11-12: Wednesday** & **Friday**
Name of Course Teacher	**Dr. M. Ramesh**
Mobile: **+91 9442318200**	Email : **mrbiotech.alu@gmail.com**

Course Brief:

IPR, Biosafety and Bioethics is one of the interesting general elective courses designed for the aspiring students to understand the rules and regulations governing various types of IPR. This elective course is an advance level course and students must have an understanding of introductory undergraduate level course such as chemistry, biology, microbiology, plant and animal biology and molecular biology. Overall the course explain the basic concepts of Intellectual Property Rights, Biosafety, Bioethics and their relevance for science and technology and develop basic understanding of national and international IPR regime. During the last two decades, considerable number of advances has been made in application of biotechnology for the benefit of human being in field of agriculture, medicine, and industrial production. In order to approve those new technologies, intellectual property i.e. legally enforceable rights resulting from intellectual activity in the industrial and scientific fields is very important. In this course, safety concerns and ethical issues on application of biotechnology will be discussed under the current issues associated with the benefits and risk concerns on biotechnology. Biotechnology students suppose to understand the basic concepts of patent rights and follow the regulatory framework important for the product safety and benefit for the society. Thorough understanding of this course will creates awareness on the patenting of biotechnological processes and products and makes students aware about the regulation of bioethics and the biosafety rules and understands the laws governing biotechnology and related field at national and international level. The course also helps them to gain knowledge about precautions (for example basic and Good Laboratory Practices (GLP), Standard Operating Procedures (SOP) necessary during biotechnological work and to understand the ethical perspective of handling potentially harmful biomaterials. In this course, safety concerns and ethical issues on application of biotechnology will be discussed under the current issues associated with the benefits and risk concerns on biotechnology.

Text Books:

1. Patents (2003), N.Subbaram, Pharma Book Syndicate, Hyderabad.
2. Bioethics and Biosafety in Biotechnology (2007), V.Sree Krishna, New Age International (P) Limited Publishers. ISBN (13): 978-81-224-2248-1
3. Molecular Biotechnology: Principles and Applications of Recombinant DNA (2010), 4th Edition, Glick, B.R., and Pasternack, J.J., ASM Press, Washington, DC.

Reference Books:

1. Introduction to Plant Biotechnology (2001), 3rd Edition, H.S.Chawla, Oxford & IBH Publishing Co. Pvt. Ltd.
2. Bioethics and Biosafety (2008) M.K.Sateesh, I.K.International Pvt. Ltd, New Delhi, India.
3. Intellectual Property Rights (2008) Prabuddha Ganguly, Tata McGraw Hill Publishing

Company, India. ISBN: 9780070077171 9. http://www.patentoffice.com/index.php

Course Objectives:

To make the students to:

i. Be aware / understand the laws governing patents, trade secrets, copy rights and trademarks with special emphasis to biotechnology at national and international level
ii. Familiarize with various criteria of patents
iii. Sort out the requirements of patent and trade secret
iv. Get acquainted with principles of biosafety and gain knowledge about basic and advanced laboratory practices and safety precautions followed during biotechnological work
v. Understand the ethical perspective of handling biomaterials including transgenic plants and animals
vi. Be aware of the general guidelines for research in microorganisms, animals and plants
vii. Follow Good Laboratory Practices during practicalôs and dissertation works
viii. Gain Ethical, Legal and Social Implications of Human Genome Project.

Course Outcomes:

On successful completion of IPR elective course, students should be able to:

i. Understand the concepts, criteria, and importance of IPR.
ii. Analyze the basic principles and legal framework of intellectual property rights and its application to biotechnology.
iii. Understood the basic issues of IPR Biosafety and Bioethics. It is expected that they will be more confidant to practice and implement all these policies in their future endeavor.
iv. Create awareness on the Biosafety, Bioethics and patenting of biotechnological processes and products.
v. Define biosafety and bioethics in the context of modern biotechnology, demonstrate good laboratory procedures and practices, describe the standard operating procedures for biotechnology research
vi. Follow Biosafety practices in appropriate Biosafety labs

Course Outline: Major Elective: IPR, Biosafety and Bioethics (3 Credits)

i.	Role of international agencies such as GATT, WTO and WIPO and National agencies - RCGM, GEAC and IBSC.
ii	Salient features of physical and intellectual Property, tangible and intangible property.
iii	Different types of IPR - Patents, Trade mark, Trade secret, Copy right and

	Geographical Indications and their requirement
iv	Biotechnological examples of patent, trade mark, trade secret, and copy right
v	Rules governing patents
vi	Case studies on Basmati rice, Turmeric, and Neem patents
vii	Indian Patent Act 1970 and amendments
viii	Levels of Biosafety.
ix	Guidelines for rDNA research activities in microbes, plants and animals.
x	Assessment of risks associated with GMO.
xi	Bioethics and animal rights
xii	General issues related to the release of transgenic plants, animals and microorganisms.
xiii	Embryonic stem cell cloning and its ethics
xiv	ELSI of Human Genome Project.

Additional books for Reading and Referencing

Author (s)	**Title**
Department of Biotechnology, Ministry of Science & Technology, Government of India, New Delhi.	Recombinant DNA safety guidelines (January 1990)
Department of Biotechnology, Ministry of Science & Technology, Government of India, New Delhi.	Revised guidelines for research in Transgenic plants (August 1998)
Deepa Goel and Shomini Parashar,	IPR, Biosafety and Bioethics (2013), 1st Edition, Pearson Education, India

Course Schedule: Major Elective: IPR, Biosafety and Bioethics (3 Credits)

Syllabus	**Schedule**
Unit 1: Introduction. Definitions. General Agreement on Trade and Tariff (GATT) and World Trade Organizations. Establishment and functions of GATT, WTO and WIPO. WTO Guidelines and Summits. Physical and Intellectual Property. Tangible and Intangible property. Roles of IBSC, RCGM and GEAC.	**10 Days**

Unit 2: TRIPS. Different types of intellectual property rights (IPR) - Patents, Trade mark, Trade secret, Copy right and Geographical Indications. Requirement of patentability. Compulsory licences.Biotechnological examples of patent, trademark, trade secret, copy right. Traditional Knowledge.	**11 Days**
Unit 3: Patent application. Rules governing patents. Patent related cases. Licensing - Flavr SavrÊ tomato as a model case. Biopiracy and case studies on patents (Basmati rice, Turmeric, and Neem). Indian Patent Act, 1970 and recent amendments.	**9 days**
Unit 4: Biosafety-Introduction. Different levels of Biosafety. Guidelines for rDNA research activities. General guidelines for research in transgenic plants, Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP). Containments- Types. Basic Laboratory and Maximum Containment Laboratory. Biological weapons. The Cartagena Biosafety protocol (CAB).Assessment of risks associated with GMO.	**8 days**
Unit 5: Bioethics-Introduction. Animal Rights. General issues related to environmental release of transgenic plants, animals and microorganisms. Ethical issues related to research in embryonic stem cell cloning. Ethical, Legal and Social Implications (ELSI) of Human Genome Project. .	**7 days**
8 days assigned for CIA Tests, Quizzes, Seminars, etc.	

501507–GENOMICS AND PROTEOMICS (Core – 3 credits)

Program: M. Sc. (Biotechnology)	**Semester: III**
Course Title: GENOMICS AND PROTEOMICS	**Timings: (M, Th & F)**
Course Teacher	**Dr. K. Balamurugan**
Contact email	**bsuryar@yahoo.com**

COURSE BRIEF:

The subject Genomics and Proteomics deals with the combination of Genomics and Proteomics to study the complex nature of life. It provides a molecular level analysis of biological molecules such as nucleic acids and proteins. This subject provides a clear picture of the molecular mechanisms that takes place inside the multicellular host system.

TEXT AND REFRENCE BOOKS:

1. Introducing proteomics (2011) Josip lovric. John Wiley Publication

2. Expression Genetics: accelerated and High Throughput Methods (1999). Edited by M. McClelland and A. Pardee, Eaton Publishing, MA.
3. Principles of proteomics (2013). R. M Twyman. Taylor and Francis publishers.
4. Microbial Functional Genomics (2004). J. Zhou, D.K. Thomson, Y. Xu and J.M. Tiedje, Wiley Liss.
5. Reviews and articles from Journals such as Nature, Science, PNAS(USA), Nucleic Acids Research, Trends and Current Opinion Series.
6. Principles of Gene Manipulation and Genomics (2013) Sandy B. Primrose, Richard Twyman ï Blackwell Publishing
7. An Introduction to Genetic Engineering 3rd Edition DesmondS. T. Nicholl CambridgeUniversity Press
8. Molecular Biotechnology: Principles and Applications of Recombinant DNA 4th Edition Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten ASM Press
9. Post-translational modifications in host cells during bacterial infection, D. Ribert, P. Cossart, FEBS letters, 2010.

COURSE OBJECTIVES

I. To provide a brief introduction about human genome project and other genome projects, a precise note on the transcript analysis techniques such as DNA chip and microarray for gene screening, DGE (Differential gene expression) RNA sequencing and Real-Time PCR.
II. To provide good knowledge on microbial functional genomics of bacterial pathogens and environmentally significant microbes, using animal models such as *C. elegans*, mice and techniques such as gene knockout, cell culture.
III. To provide basic knowledge of system biology which includes proteomics and different techniques or approaches involved. It explains the protocols in sample preparation, extraction, solubilisation of different proteins for proteomic analysis and the challenges associated with the analysis like sample pre fractionation, liquid phase IEF, molecular weight cut off, IgG depletion.
IV. To explain the principle and working methodology of the proteome techniques such as 2-D electrophoresis, 2-D NMR, Mass spectrometry, LC-MS, DIGE, gel free mass spectrometry with their merits and demerits.
V. To introduce the interactomics to the students to gain the knowledge on advanced techniques for example co-immunoprecipitation, protein microarray and computational tools of protein - protein interactions.

COURSE OUTLINE:

The subject content includes interdisciplinary concepts that provide a wide berth to serve students from various fields such as Botany, Zoology, Biochemistry, Microbiology, Veterinary Science, Biotechnology, Nanotechnology, Molecular Biology, Structural Biology, Bioinformatics and Bioengineering. The understanding of basic biology is important to comprehend the use of advanced technology to aid the analysis of biomolecules.

The subject has been divided into five units from basic concepts to use of advanced technology in analyzing the building blocks of life (DNA ,RNA and Proteins,).

Unit – 1: This unit describes human genome project and explains the transcriptome analysis, expression analysis tools such as DGE (Differential gene expression) RNA sequencing and Real-Time PCR. This will give them knowledge on how to analyse the expressed gene.

Unit – 2: This unit covers microbial functional genomic analysis of bacterial pathogens and significant microbes to analyse the normal and abnormal state of the cells. This chapter also consists of pathogenesis related transcriptome analysis techniques.

Unit – 3: This unit deals with the techniques of transcriptome analysis and provides the protocols for sample preparation, sample pre fractionation, liquid phase IEF, molecular weight cut off, IgG depletion.

Unit – 4: In this unit, protein analytical tools such as 2-D electrophoresis, 2-D NMR, Mass spectrometry, LC-MS, DIGE, gel free mass spectrometry with their merits and demerits are described. It also constitutes of quantitative proteomic techniques which are necessary for analysing the expression level of the protein.

Unit – 5: This unit focuses on the techniques of interactomics which deals with the study of proteinï protein interactions. It also provides the latest informations about Post Translational modifications associated with the expressed proteins. Furthermore, easy way of analysing the expression of a protein with reporter gene and GFP is described. The unit provides in depth knowledge about the interacting nature of the proteins that will pave the way for understanding the systems biology in future.

COURSE OUTCOME

Each unit is designed to accommodate students from multiple disciplines; therefore the students are expected to understand the basics concepts of Genomics & Proteomics and its involvement in biological processes that can be utilized as a parameter for the analysis of biological expression.

The student also will study in depth the expression analysis of a protein. The student will be equipped with knowledge of various proteomic techniques required to measure the expression level of proteins which could be used in future. The understanding of interactomics with analysing the expression of protein with reporter gene and GFP can equip the student for future career perspective.

APPLICATION FOR FUTURE CAREER:

The subject provides an overall understanding of the basic concepts in Genomics & Proteomics as well as interactomics that will help the student in easily accessing the methodology required for analysing the protein expression during future studies. The subject also equips the student to analyze the questions posed with respect to genes/proteins and their functions during competitive examination or interview.

COURSE SCHEDULE

Syllabus	Schedule
UNIT-1 Brief introduction to Human and other genome projects. Transcript analysis: DNA chips and microarray gene screen technology, RNA sequencing, Differential gene expression, Real-Time PCR	**15 Days**
UNIT-2 Microbial Functional genomics- Functional Genomic analysis of bacterial pathogens and environmentally significant microorganisms. Studies on human microbial pathogens using model animals (Mice and C. elegans) Transgenic animals and gene knockout techniques, cell culture based techniques. virus-induces cell transformation, pathogen-induced diseases in animals, cell-cell fusion in both normal and abnormal cells.	**15 Days**
UNIT-3 Introduction to system biology approach- Proteome and Proteomics- Need for proteomic approach- promises of proteomics- Extraction and solubilisation of proteins from cytoplasm, membrane, extracellular, subcellular organelles and biological fluids. Challenges associated with low- and high- abundant proteins- sample pre-fractionation techniques- Liquid phase IEF, Molecular Weight Cut Off and IgG deoletion.	**15 Days**

UNIT-4 protein analysis: Protein micro array. Analysis of protein by 2-D gel electrophoresis, 2-D NMR and Mass spectroscopy: LC-MS, quantitative Proteomics- gel- based quantitative proteomic techniques. Applications of gel based and gel-free quantitative proteomic techniques.	**15 Days**
UNIT-5 Interactomics- Yeast Two Hybrid- Immuno precipitation- Protein microarrays- Computational tools for Protein-protein interactions- Pros and cons using various interactomics techniques. Differential display proteomics Protein engineering; Protein chips; experimental and computational methods, databases. Functional characterisation of proteins, Use of reporter gene GFP to visualize proteins in live-culture; Clinical and biomedical application of proteomics. Post translational modifications in proteins. Reversible and Irreversible PTMôs- techniques for characterisation of PTMôs- gel electrophoresis and staining procedures for PTM identification- Identification- and quantisation of PTMôs by MS. Public protein databases and interfaces for PTMôs- challenges in PTMôs for proteomics and bioinformatics.	**15 Days**
~10 days for CIA tests, Quizzes, Seminars, Interactive sessions, Hands on Training sessions, etc.,	

501508–PHARMACOGENOMICS (Core – 3 credits)

Program: M. Sc. (Biotechnology)	**Semester: I**
Course Title: Pharmacogenomics	**Timings: 12-1 PM (M, Th & F)**
Course Teacher	**Dr. K. Balamurugan**
Contact email	**bsuryar@yahoo.com**

COURSE BRIEF:

Pharmacogenomics is the study which analyses the response of genetic makeup of an individual against a particular drug. The main aim of pharmacogenomics is to optimise personalized drug therapy with relevance to the patientôs genotype. This could ensure maximum efficiency of the drug with minimum side effects. The paper has all the basic and necessary tools required for understanding the pharmacogenomics related developments in the future. Computer

aided drug designing and analysis of latest data on human transcriptomics play a critical role in pharmacogenomics.

TEXT AND REFERENCE BOOKS:

Molecular Modelling, Principles and Applications, IInd Edition, A.R. Leach, 2001, Prentice Hall

2. Pharmocogenomics and Proteomic enabling the practice of personalized medicine, Steven H. Y. Wong, 2006, American Association for Clinical Chemistry

3. Pharmocogenomics applications to patient care ACCP, 2004, American College of Clinical Pharmacy

4. Drug Discovery Research- New frontiers in the Post- Genomic Era (2007), by Ziwei Huang, Wiley- Interscience.

5. Guidebook on Molecular Modeling in Drug Design (1996), Edited by N. Claude Cohen Academic Press.

COURSE OBJECTIVES:

I. To understand the basic concept and tools used in computational analysis
II. To learn the principle and application of docking and to use it to design the 3D structure of ligands binding to molecules
III. To explore the applications in the field of pharmacy (Toxicity analysis, drug development, etc.)
IV. To equip the students with necessary hands on skill which will help them to pursue a career in this field

COURSE OUTLINE:

The subject content includes interdisciplinary concepts that provide a wide berth to serve students from various fields such as Botany, Zoology, Biochemistry, Microbiology, Veterinary Science, Biotechnology, Nanotechnology, Molecular Biology, Structural Biology, Bioinformatics and Bioengineering. The understanding of basic biology along with basic knowledge in computer operation is important to comprehend the use of advanced technology to aid the analysis of pharmacogenomics.

The subject has been divided into five units covering basic concepts to computer tools used for applications in the field of Pharmacy and to provide a better idea of the concept dealt.

Unit 1 deals with concepts of computational chemistry. The Born-Oppenheimer approximations are the assumption that the movement of nuclei and electrons in a molecule can be separated. In pharmacogenomics, it has been applied to the field of drug delivery. The Hartreeï Fockmethod helps in the approximation for the determination of the wave function and the energy of a quantum many-body system in a stationary state. Molecular orbital theory is a method to determine the molecular structure in which electrons are supposed to move under the influence of nuclei in the whole molecule.

Unit 2 deals with Docking and drug design strategies. Docking is the identification of the low-energy binding modes of a small molecule, or ligand, within the active site of a macromolecule, or receptor, whose structure is known. A compound that interacts strongly with, or binds, a receptor associated with a disease may inhibit its function and thus act as a drug. By this way, new drugs can be discovered and its efficiency can be increased by combining with other compounds which can enhance this activity. 3D database will allow to formulate substructure, superstructure or similarity queries in 3 dimensions. Scoring functions are mathematical tools used to assess the binding efficacy of two molecules. Quantitative structure activity relationship (QSAR) models are regression or classification models used in chemical and biological sciences, by relating a set of predictor variables to response variables.

Unit 3 deals with clinical applications of pharmacogenetics. Pharmacogenetics and pharmacogenomics studies on HIV infection is highly essential for finding the genetic polymorphisms affecting the activity and/or the expression of key drug-metabolizing enzymes and membrane drug transporters. This unit also provide the mechanism underlying the inter-individual variations in drug exposure and response to a new therapy which could aid in efficacy and toxicity among different individuals even at standard doses.

Unit 4 deals with studying the genetic variations to predict efficacy of toxicity. Finding the genetic variations especially the genetic polymorphism leads to the development of targeted therapeutics by locating the defected or altered gene that is responsible for drug metabolising enzymes or transporters. Analysing the genetic polymorphism will aid to predict the changes in ADMET properties of a drug and to virtual screening of the drug metabolites.

Unit 5 deals with curated databases in pharmacogenomics. Learning to utilise the pharmacogenomics related curated databases provides one to access all the information regarding the polymorphic change that took place, drug administered, altered drug-metabolizing enzymes/membrane drug transporters to ensure make use of the available knowledge into drug development. Studying the pharmacogenomics facts is necessary to design personalized medicine

by analysing the metabolism status and an individual's response to a particular drug and therapeutic modality.

COURSE OUTCOME:

Pharmacogenomics helps the students to understand better about personalised medical care which is of high relevance in this period of modern medicine, as it can give maximum efficiency, minimal dose and almost negligible side effects. The paper will help the candidate to equip himself in pharmaceutical and medical industry.

APPLICATION FOR FUTURE CAREER:

Pharmacogenomics will allow the candidate to have better placement opportunities in the field of medicine and pharmacy. Molecular Docking is an advanced technique for which knowledge on pharmacogenomics help to assess future drug related findings. Learning and imbibing the techniques will allow the candidate to find a better placement in the highly competitive world.

COURSE SCHEDULE:

Syllabus	**Schedule**
UNIT-1 Computational Chemistry: Concepts of computational chemistry, Born-Oppenheimer approximations, Application of Hartree-Fock equations to molecular systems, approximate Molecular orbital theories, semi-emperical methods	**15 days**
UNIT-2 Docking and Drug Design: DOCK algorithm, Discovery and design of new drugs, computer representation of molecules, 3D database searching, scoring functions, Pharmacophore keys, Structure-based De Novo Ligand design, Quantitative Structure Activity Relationship QSAR, Combinatorial libraries	**15 days**
UNIT-3 Clinical Applications of Pharmacogenetics/Pharmacogenomics in HIV, Pharmacogenomic based therapeutic applications	**15 days**
UNIT-4 Genetics effects to predict efficay of toxicity, ADMET, Virtual screening, Combinatorial library designing	**15 days**
UNIT-5 Pharmocogenomics related curated Databases.	**15 days**

Pharmacogenomics and the Future of Pharmaceuticals	
~10 days for CIA tests, Quizzes, Seminars, Interactive sessions, Hands on Training sessions, etc.,	

501509–GENE SILENCING TECHNOLOGIES (Core – 3 credits)

Program: M. Sc. (Biotechnology)	**Semester: II**
Course Title: GENE SILENCING TECHNOLOGIES	**Timings: (M, Th & F)**
Course Teacher	**Dr. K. Balamurugan**
Contact email	**bsuryar@yahoo.com**

COURSE BRIEF:

Gene silencing is a process of preventing/blocking (switching off) the expression of a particular gene, which will help to analyze the ñspecific roleò played by that particular gene in a biological system. The method will reduce the expression of the gene by approximately 70%, without eliminating the gene sequence. The main objective of this paper is to study and analyze the specific genes which are essential for lifespan, disease resistance, drug delivery, etc.

TEXT AND REFRENCE BOOKS:

1. RNA Interference in Practice: Principles, Basics, and Methods for Gene Silencing in *C. elegans*, Drosophila and Mammals (2005) by Ute Schepers.

2. RNAi: A Guide to Gene Silencing (2003) by Gregory J. Hannon

3. Additional information can be obtained from World Wide Web resources

4. Molecular Biology of the Gene (2008) by Watson, Baker, Bell, Gann, Levine, Losick. Sixth Edition, Pearson International Edition.

5. RNA Methodologies (2010) by Robert E. Farrell JR. Fourth Edition, Academic Press.

6. Molecular Cloning (2012) by Green and Sambrook. Fourth Edition. Volume 1 & 2, Cold Spring Harbor Laboratory Press.

7. Lewinôs Genes XI (2014) by Krebs, Goldstein, Kilpatrick. Jones & BartlettIndia Pvt.Ltd., New Delhi.

COURSE OBJECTIVES:

I. To understand the basic concept and principle of gene silencing

II. To know the molecular tools involved, their specific functions and applications in gene silencing

III. To study the process of gene silencing in the simple model host, *C. elegans,* Drosophila and plants

IV. To extrapolate the gene silencing technique to mice and other cellular system

V. To understand the applications of gene silencing which will be of high relevance in future healthcare biotechnology

COURSE OUTLINE:

The subject content includes interdisciplinary concepts that provide a wide berth to serve students from various fields such as Botany, Zoology, Biochemistry, Microbiology, Veterinary Science, Biotechnology, Nanotechnology, Molecular Biology, Structural Biology, Bioinformatics and Bioengineering. Understanding of basic molecular biology is important to comprehend the use of advanced gene silencing technology to aid the analysis of biomolecules.

The subject has been divided into five units from basic concepts, tools involved, models used and use of advanced technology.

Unit 1 deals with the tools that are required to carry out gene silencing. The coding sequence (sense strand) will be paired complimentarily to an antisense strand (DNA or RNA) which will block the expression of particular gene thereby silencing the same. This unit provided information on major tools which are involved in Gene silencing events. For example, (1). PTGS (Post Transcriptional Gene Silencing) which is characterized by the blocking of target mRNAs using small interfering RNAs. Itôs a conserved technique which is identified in plants, animals and fungi. (2) siRNA (Small interfering RNAs), which are small fragments of double stranded RNA which can bind to the mRNAs thereby promoting the degradation of the latter. This results in prevention of translation of the particular coding sequence, thereby silencing of the gene. Similarly, shRNA, miRNA, DICER and RISC are being explained in this unit.

Unit 2 deals with RNA interference techniques in the model nematode *Caenorhabditis elegans.* The soil dwelling nematodes are the most ideal laboratory animals to conduct RNAi studies. The dsRNA can be directly injected using a microinjector or it can be incorporated into a plasmid DNA which will express the dsRNA. Interestingly, the nematodes can be simply soaked

in a solution containing dsRNA which will induce silencing. Another method which can be used is by feeding the worms to *E. coli* expressing the dsRNA..

Unit 3 deals with RNAi in plants and Drosophila. In plants, RNAi has been applied in many areas ranging from increased crop production, incorporating drought resistance and also protection from weeds, mites or other harmful agents thereby leading to the production of disease free, stress resistant, high yielding plants. In Drosophila, injecting the dsRNA into the cells can be done to silence the target genes. The effect persists throughout development, and can be observed in adults in low percentage.

Unit 4 deals with RNAi in mammals. In the case of mice, short hairpin (sh) RNAs expressed from transgenic vectors are used. Body-wide or cell type-specific gene silencing in mice can be done by control of shRNA expression through Cre recombinase or doxycycline. For reproducible expression of shRNAs, vectors are placed into the Rosa26 locus of ES cells by recombinase-mediated cassette exchange and transmitted through the germ line of chimeric mice. The site specific insertion of single copy shRNA vectors allows to expedite and reproducible production of knockdown mice and provides a simple approach to assess gene function in vivo.

Unit 5 deals with the applications of RNAi. One of the major advantages is to analyze the functions of multiple genes inside the biological system in a short time. It can be used in drug screening and development studies. It is more advantageous than gene knockout studies. In cancer therapy, RNAi can be used to silence the genes in cancer cells, which is of potential interest to scientific world. RNAi can also be applied in microarray techniques where individual cell clusters can be infected with specific shRNA which will silence our gene of interest. More applications can be seen in the era of modern medicine where patient specific treatment strategies are preferred.

COURSE OUTCOME:

The paper carries necessary information about gene silencing, tools and process involved. Moreover, the paper deals in detail about the different models used to carry out gene silencing. The paper enables the students to have a clear idea about the whole process involved and they can be well versed in the technique.

APPLICATION FOR FUTURE CAREER:

The paper will allow the students to equip themselves in the field of modern medicine where personalized treatment is preferred. The new era of pharmacological companies are also focusing on site specific effects of the drugs involved, which could be tested using gene silencing

studies in model organisms. Therefore, having a clear knowledge in this area will provide state of the art technology knowledge to the students in the field of modern medicine.

COURSE SCHEDULE:

Syllabus	Schedule
UNIT-1 Antisense tools: Introduction of Antisense Oligos, Antisense RNA, PTGS, siRNA, dsRNA, shRNA and miRNA. DICER, RISC and RdRPs	**15 days**
UNIT-2 RNA-interference in Caenorhabditis elegans: Introduction, application of RNAi in C. elegans, Generation of dsRNA, various methods of introducing RNAi into C. elegans, Genome-wide RNAi Based Screen for Genes Important in Cell Division, RNAi Database for C. elegans	**15 days**
UNIT-3 RNAi in Plants and Drosophila: Introduction, application of RNAi in plants and Drosophila, Methods of introducing RNAi into Plants, Drosophila and Drosophila cell lines	**15 days**
UNIT-4 RNAi in Mammals: Introduction, siRNA synthesis and modifications, Tuschl rules, Delivery of siRNAs: Transient and Stable transfections of siRNA into mammalian cell lines, shRNA-synthesis and cloning in vector with promoters; viral mediated delivery of shRNA, inducible RNAi cassettes	**15 days**
UNIT-5 Applications of RNAi in Mice, Generation of Transgenic and Knock-out mice with RNAi, RNAi in Gene therapy, RNAi in Microarray, High-Throughput screening with RNAi, RNAi in immunology	**15 days**
~10 days for CIA tests, Quizzes, Seminars, Interactive sessions, Hands on Training sessions, etc.,	

Grading system for the course:

This course will be graded as follows:

Evaluation Criteria	Percentage Value
Assignments/Quiz/Seminars, Daily participation/ Projects, etc.,	10
Continuous Internal Assessment(s)	15
Final Examination	75
TOTAL	**100%**

GENERAL INSTRUCTIONS

Attendance: It is expected that every student will be in class for lectures. Attendance records will be kept and used to determine each personôs qualification to sit for the final examination. In case of illness or other unavoidable cause of absence, the student must communicate as soon as possible with any of the faculty, indicating the reason for the absence.

Academic Integrity: Violations of academic integrity, including dishonesty in assignments, examinations, or other academic performances are strictly prohibited. You are not allowed to make copies of another personôs work and submit it as your own; that is plagiarism. All cases of academic dishonesty will be reported to the Department Head/University Authorities for appropriate sanctions in accordance with the guidelines for handling studentsô misconduct as practiced in Academic Institutions.

Philosophy: Students are expected to meet expected course goals and apply knowledge through real-life situations. Biotechnology related courses are heavily embedded with multicellular events and system Biology. A variety of teaching techniques such as group discussions, lecture, lab, and independent study will be used to integrate process skills such as decision making, problem solving, and critical thinking. Laboratory experiences are most essential to the course and provide students with opportunity to plan, organize and implement learning activities, applying principles, learning processes, and practice desired skills and behavior. Students will engage in activities, experiences, and assessments that deal with applying, synthesizing and evaluating knowledge and skills.

Academic Dishonesty: It means students knowingly presenting another person's ideas, findings or work as one's own by copying or reproducing them without due acknowledgement of the source, with intent to deceive the faculty into believing that the content is original to the student. Academic honesty is a fundamental part of learning and teaching and a core value of the Biotechnology Department of the Alagappa University. The University takes the view that all academic dishonesty is unacceptable and this policy aims to uphold the standards of ethics and integrity embodied in the student culture and expected of all students. Finally, students at the Department of Biotechnology, Alagappa University are expected to be honest and forthright in their academic endeavors.

Code of Conduct in Lecture Rooms: Students should turn off their cell phones during lectures.

Students are prohibited from engaging in other activities (such as texting, watching videos, etc.)

during lectures. Food and drinks are not permitted in the classroom.

Submission of Assignments: The assignments for the students will be of different catagories, namely, Open Assignments, Course based assignments, Web-based data base assignments or

future perspective based assignments. Students usually face challenges with the coursework and assignments in any of the subject. They find it tough to complete the assignment on given point in time. Students can submit online Assignments in simple word file or as powerpoint slides using several submission types. Faculty can provide you choice for the kind of online submissions they want students to use. Students may also have the option to resubmit assignments if your instructor allows. Students are encouraged to discuss their concern with the faculty about the assignment through email or after regular class hour.

501510 HUMAN MOLECULAR GENETICS (Major elective – 3 credits)

COURSE DEPICTION

Program: **M.Sc.**	Semester :
Course Title: **Human Molecular Genetics**	Class Time:
Name of Course Teacher	**Prof. S. Karutha Pandian**
Mobile: +91 9442318144	Email: **sk_pandian@rediffmail.com**

Course Brief

The science of genetics deals with the study of inheritance in individuals/populations and the molecular mechanisms of the genes that control growth, development, and appearance of an organism. Genetics is commonly divided into classical, molecular, and population genetics from simple prokaryotic to complex eukaryotic system.

The principle aim of this course is to provide the students with the clear understanding of structure, organization and function of human chromosomes. This course also focuses on the better understanding about linkage, crossing over and other chromosomal abnormalities such as autosomal inheritance and sex-linked inheritance. This course also provides the glimpse about the disorders/diseases resulting from genetic defects, gene polymorphism, metabolic defects and different molecular tools to identify these disorders.

Text Books:

1. Pastemak, An Introduction to Molecular Human Genetics, 2nd Edition, Fritzgarald, 2005.
2. Mange and Mange, Basic Human Genetics, 2nd Edition, Sinauer Assoc, 1999.

Reference Books:

1. Lewis, Human Genetics, 7th Edition, WCB & McGraw, 2007.
2. Vogel and Motulsky, Human Genetics, 3rd Edition, Springer Verlag, 1997.

Course Objectives:

The objectives of the course is to make the students

1. Understand the basic concepts of chromosomal structure, its organization and the functions of various genes involved in human genome.
2. Know about genetic disorders behind the gene abnormalities.
3. Understand the principles of various techniques used to identify the genetic disorders

Course Outcomes:

On successful completion of Human molecular genetics, students will be able to:

i.	Acquire knowledge on inheritance and pedigree mapping of various genes on human genome
ii.	Understand the chromosomal aberrations, inherited genetic disorders and mutation assisted genetic disorders
iii.	Understand the applications of Human molecular genetics in drug design and forensic science

Course outline:

1. Basic concepts Human Chromosomes: Structure and Chemical nature
2. Chromosome aberrations and abnormalities
3. Pedigree analysis of monogenic traits Complications to the basic pedigree patterns
4. Complications to the basic pedigree patterns
5. Polygenic inheritance of discontinuous (dichotomous) traits
6. Detection of genetic defects, Gene polymorphism, Metabolic and genetic disorders
7. Molecular methods and hybridization based assays
8. DNA Testing
9. Proteome tools in human disease diagnosis
10. Identification of diseased gene/locus and Chromosome analysis

More books for Reading and Referencing:

Author (s)	**Title**
Tom Strachan and Andrew Read	Human Molecular Genetics
Gustavo Maroni	Molecular and Genetic Analysis of Human Traits
Scott Hawley and Catherine Mori	The Human Genome

Course Schedule: 501510 HUMAN MOLECULAR GENETICS (major elective – 3 credits)

Syllabus	**Schedule**
Unit 1: Human Chromosomes: Structure and Chemical nature, Heterochromatin and euchromatin, Linkage and crossing over,	**10 Days**

Chromosome aberrations and abnormalities, Autosomal inheritance- dominant, recessive; Sex-linked inheritance- X-linked recessive, dominant; Yï linked; Sex-limited and sex-influenced traits; Mitochondrial inheritance; MIM number, Pedigrees- gathering family history; Pedigree symbols; Construction of pedigrees; Presentation of molecular genetic data in pedigrees; Pedigree analysis of monogenic traits Complications to the basic pedigree patterns I: Non-penetrance, variable expressivity, pleiotropy, onset, dominance problem; Anticipation;Compound heterozygosity.	
Unit 2: Complications to the basic pedigree patterns II: Genomic imprinting and uniparental disomy; Spontaneous mutations; Mosaicism and chimerism; Male lethality; X-inactivation; Consanguinity and its effects in the pedigree pattern; Allele frequency in population; Complex traits-polygenic and multifactorial: Approaches to analysis of complex traits- ónature vs nurtureô; Role of family and shared environment; Monozygotic and dizygotic twins and adoption studies; Polygenic inheritance of continuous (quantitative) traits, normal growth charts, Dysmorphology; Polygenic inheritance of discontinuous (dichotomous) traits ï threshold model, liability and recurrence risk; Genetic susceptibility in complex traits; Alcoholism, cardiovascular disease, diabetes mellitus, obesity & epilepsy; Estimation of genetic components of multifactorial traits: empiric risk; Heritability; Coefficient of relationship; Application of Bayesôtheorem.	**8 Days**
Unit 3: Detection of genetic defects, Gene polymorphism, Metabolic and genetic disorders, Phenylketoneurea, Duchene Muscular Dystrophy, Sickle cell anemia, ß-Thalassemia, retinoblastoma, cystic fibrosis, Alzheimerôs disease, diabetes, X-linked CGD, Mitochondrial syndromes, management of genetic disorders.	**7 Days**
Unit 4:DNA Fingerprinting, Prenatal molecular diagnostics-CVS and amniocentesis, pre-implantation test-Medico, legal, social, ethical and legal aspects of molecular diagnostics, Paternity dispute-Personal identification and identity of descent by molecular methods, Human disease gene detection-SNP detection, hybridization based assays (Allele specific probes), polymerization based assays (Allele specific nucleotide incorporation, allele-specific PCR), Ligand based assay (Allele specific oligonucleotide ligation).	**6 Days**
Unit 5:DNA Testing-Direct testing-Screening for unknown mutations, detection of known mutations, Indirect testing-gene tracking, Mutational screening, loss of function and gain of function, Molecular Pathology-from genes to disease and from disease to genes, Epigenetics, Comparative genomics for human disease identification-Proteome tools in human disease diagnosis, Identification of diseased gene/locus, Chromosome analysis, karyotyping and chromosome banding, molecular cytogenetics, Nucleic acid hybridization assays, FISH, Fiber FISH, m-FISH	**8 Days**

5 days left for CIA Tests and Seminars

501511–INHERITANCE BIOLOGY (Core – 3 credits)

COURSE DEPICTION

Program: **M.Sc.**	Semester :
Course Title: **Inheritance Biology**	Class Time:
Name of Course Teacher	**Dr. S. Karutha Pandian**
Mobile: **+91 9442318144**	Email : **sk_pandian@rediffmail.com**

Course Brief

Inheritance Biology mainly deals with the study of hereditary biology that attempts to provide an in depth knowledge about the mechanism of gene transfer from parents to offsprings. Through this course, students will be able to understand the fundamental concepts from Mendelian inheritance to extra chromosomal inheritance. Inheritance Biology is one of the most important aspects of the Biotechnology, as it provides the in-depth knowledge on the principles and mechanisms behind the hereditary biology. Since, both cloning and other high-throughput processes can be done only with strong prowess in various aspects (Gene transfer techniques such as Transformation, Transfection, Transduction, various Recombination techniques) involving in the Inheritance Biology, this course will directly benefit students to get placed in various biotech R &D research laboratories. In addition, this course will also provide the glimpse about human genetics such as Pedigree analysis, LOD Score analysis, and various genetic disorders. As a whole, this course will shed more lights on the basic concepts of hereditary biology.

Text Books:

1. Essential genetics: A genomic perspective. 6th edition (2014) by Hartl DL, Library of congress, USA.
2. Concepts of Genetics. 10th edition (2012) by Klug WS, Cummings MR, Spencer CA and Palladino MA, Pearson Education, Inc., San Francisco.

Reference Books:

1. Lewinôs Genes XI. 1st Indian Edition (2014) by Krebs JE, Goldstein ES and Kilpatrick ST, Jones and Bartlett India Pvt. Ltd., New Delhi.
2. Molecular Biology of the Gene. 6th edition (2008) by Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R, Pearson Education, Inc., San Francisco.

Course Objectives:

The objectives of the course is to make the students

1. Understand the basic concepts of Mendelian principles of inheritance and concept of genes.
2. Comprehend the genome mapping methods and recombination.
3. Comprehend the extra chromosomal inheritance and microbial methods of genetic transfers.
4. Demonstrate the mutation, its types and detection and its genetic implications.
5. Fathom the human genetics and quantitative genetics.

Course Outcomes:

On successful completion of Inheritance Biology course, students will be able to:

i.	Acquire knowledge on the fundamentals of Mendelian genetics that includes how the inherited characters are transferred from one generation to other generation.
ii.	Understand to analyze and locate the locus of the gene through gene mapping and recombination.
iii.	Comprehend the extra chromosomal inheritance and the importance of maternal inheritance and the microbial methods of gene transfer.
iv.	Fathom how the mutations take place, its causative agents, types &detection and the genetic implication due to mutation and chromosomal number alteration
v.	Understand the inheritance pattern in human & the genetic disorders in humans

Course outline:

1. Basic concepts of Mendelian and non-Mendelian inheritance of genes.
2. Genome mapping methods
3. Recombination and its types
4. Extra chromosomal inheritance ï Chloroplast and Mitochondrial inheritance
5. Natural gene transfer methods involved in microbes.
6. Mapping genes by interrupted mating
7. Structure analysis of genes
8. Mutation ï its types and detection - mutant types
9. Structural and numerical alteration in chromosomes and its implications
10. Inheritance pattern in human and the genetic disorders occurs in humans

More books for Reading and Referencing:

Author (s)	**Title**
Snyder L, Peters JE, Henkin TM and Champness W	Molecular Genetics of Bacteria
Griffiths AJF, Gelbart WM, Lewontin RC and Miller JH	Modern Genetic Analysis
Daniel L. Hartl, Elizabeth W. Jones	Genetics: Principles and Analysis
Robert J. Brooker	Genetics Analysis and Principles
Joseph Felsenstein	Theoretical evolutionary genetics
D. peter Snustad, Michael J. Simmons	Principles of Genetics
Sally A. Moody	Principles of Developmental genetics
Anthony J.F. Griffiths, Susan R. Wessler,	An Introduction to Genetic Analysis

Richard C. Lewontin, William M. Gelbart, David T. Suzuki and Jeffrey H. Miller	
Corinne A. Michels	Genetic Techniques for Biological Research A case study approach

Course Schedule: Core- 501511–Inheritance Biology (Core – 3 credits)

Syllabus	Schedule
UNIT-1 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.	**10 Days**
UNIT-2 Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants. Recombination: Homologous and non-homologous recombination, including transposition, site-specific recombination.	**8 Days**
UNIT-3 Extra chromosomal inheritance: Inheritance of mitochondrial and chloroplast genes, maternal inheritance. Microbial genetics: Methods of genetic transfers ï transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes.	**7 Days**
UNIT-4 Mutation: Types, causes and detection, mutant types ï lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis. Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications.	**6 Days**
UNIT-5 Human genetics: Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders. Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping.	**8 Days**
5 days left for CIA Tests and Seminars	

501601–HEALTHCARE BIOTECHNOLOGY (Core – 3 credits)

COURSE DEPICTION

Program: M. Sc (Biotechnology)	**Semester: I**
Course Title: Healthcare Biotechnology	**Timings: 12-1 PM (M, Th & F)**
Course Teacher	**Dr. K. Balamurugan**
Contact email	**bsuryar@yahoo.com**

Course Brief:

The Healthcare Biotechnology, which includes Genetics, Clinical diagnostic systems and innovative therapies, constitutes the latest research area leading to generation of many biotechnological industries on an international level.In the last decades, the use of biotech in medicine has led to a series of important developments in several fields. This subject is designed for the students intending to develop their careers in scientific-research institutions, clinical and diagnostic laboratories, analytical services, pharmacological and pharmaceutical companies, etc. Specifically, the human healthcare, biotechnology is enabling the development and manufacturing of therapies for a number of rare diseases with a genetic origin. Students will be provided with basic information associated with human diseases due to genetic abnormalities and pathogen induced changes in the field of Healthcare biotechnology. Research and experimental design will be highlighted as students develop and conduct industry appropriate investigations

Text and Reference books:

1. Microbiology, (2005), Sixth edition by L.M. Prescott, J.P. Harley and D.A. Klein, McGraw Hill, Boston.

2. Molecular Microbiology ï Diagnostic Principles and Practice, (2004), D.H. Persing, ASM Press, Washington, USA.

3. Genetics ï A Molecular Approach, 2nd Edition (2006) by Peter J. Russel

4. Laboratory Manual for Analytical Biochemistry and Separation techniques (2009). P. Palanivelu, Madurai Kamaraj University.

5. Kuby Immunology 4th Edition by Thomas J. Kindt, Richard A. Goldsby and Barbara A. Osborne. W.H.Freeman and Company

6. From Genes to Genomes ï Concepts and Applications of DNA technology. 3rd Edition (2012) by Jeremy W Dale, Malcolm Von Schantz and Nick Plant.

7. Genetic modification of plants: Methods and Applications (2009) Edwin B. Herman, (Ed.), USA: Agritech Consultants, Inc.

8. Biotechnology, Academic cell update (2012) by David P. Clark, Nanette J. Pazdernik, Academic Press.

9. Essential genetics: A genomic perspective. 6th edition (2014) by Hartl DL, Library of congress, USA.

Course Objective:

I. To provide basic concepts on Molecular genetics and the dynamic nature of modern genetics, chromosomal abnormalities and related inherited diseases.

II. To provide basic idea on testing how to detect and diagnose genetic conditions in human population.

III. To impart knowledge on human infectious diseases and their causative agents. Furthermore, prevention, control and cure of those diseases by vaccination, chemotherapeutic agents and other alternate strategies (quorum sensing inhibition)

IV. To provide insight on innovative medicines as well as many diagnostic and agricultural products made by applying modern biotechnology, their development and manufacturing processes.

V. To provide basic knowledge on cancer, its types, causative agents and its several modern therapeutic strategies.

Course Outline:

Unit-1: This kind of study will make students understand the basic concept of DNA's structure and function**.** The effect of DNA on scientific and medical progress has been enormous. This unit will enlighten students in identifying human genes that trigger major inherited diseases. In fact, the identification of these genes and their subsequent analysis in terms of therapeutics has ultimately influenced science and will continue to do so in future.

Unit-2: This is detection techniques based unit which will provide students about use of several diagnostics techniques in detail. A diagnosis of a genetic disorder can be made anytime during life, from before birth to old age, depending on when the symptoms of the condition appear and the availability for testing. A genetic diagnosis can also suggest whether other family members may be affected by or at risk of a specific disorder. While many genetic diseases are still incurable, understanding what causes them is the first step to successfully treating them, and hopefully a cure. In doing so may pave the pathway to formulate brand new drugs to treat these diseases.

Unit-3: Several pathogen like bacteria, fungi, viruses and parasites use to establish an infection in a susceptible host. This unit will provide important concepts about host immunity to selected infectious diseases caused by the pathogens and will impart important knowledge about pathogen strategies and pathways to cause a disease. Although both innate immunity and adaptive immunity responses to pathogen and provides critical defense to human, they still cause death of million each year. However, wide spread use of vaccines and drug therapy has drastically reduced mortality from infectious diseases. This unit will impart several targets to design a future drug or new vaccine.

Unit-4: Application of healthcare biotechnology will provide knowledge on how to diagnose an infectious disease and cure that by referring several diagnostic products or a vaccine that consists of, or has been produced in living organisms and may be manufactured by combining DNA sequences that would not naturally occur together (recombinant DNA). Today, the majority of innovative medicines like antibiotics, insulin, growth hormones, interferonŝ etc and as well as

many diagnostic products are made by applying modern biotechnology in their development and manufacturing processes and led to a series of important developments in several fields. About 50% of all new drugs and therapies in development for the foreseeable future will originate from biotechnology, and the proportion is growing in the most innovative treatments such as vaccines, monoclonal antibodies for the treatment of cancer and inflammatory diseases/infectious diseases, cell therapy, gene therapy and regenerative medicine.

This unit also provides a brief account on the Biotechnology technique, DNA fingerprinting, which has revolutionized the criminal investigations, and is an incredibly important tool for identifying the guilty, as well as liberating the innocent. DNA testing can also identify siblings, grandparents, aunts, uncles, and more. This type of testing plays an important role in legal proceedings, particularly in immigration or child custody cases; DNA testing can be used to confirm the pedigree.

Unit-5:

This unit will impart important knowledge about most dreadful disease called cancer. Cancer is the name given to a collection of related diseases. This unit provides information about three main drivers of Cancer, proto-oncogenes, tumor suppressor genes and DNA repair genes, genetic changes of given genes will cause the cancer. This unit will cover about many treatment options for cancer, the primary ones include surgery, chemotherapy, radiation therapy, hormonal therapy, targeted therapy and palliative care.

Course Outcome:

This course will provide basic knowledge and research developments at the interface of molecular biology and genetic engineering with special reference to human health care. This course provide students with an interdisciplinary understanding of the fundamental scientific principles, analysis techniques, and research design methodologies that are required for both practice and advanced study in the field of health care biological sciences. This course is expected to impart fundamental knowledge and human health care updates necessary for successful careers in industrial or academic roles.

Future Career Opportunities: This program will be attractive to students interested in moving directly into industry or the public sector, or continuing on to a Ph.D. program in biological science. On successful completion of the course, the candidate can take up jobs in industry as Scientific Officer (Quality Assurance/ Quality Control), biological Science Project Manager, able to run the genetic diagnostic lab and also in academics as Junior Research Fellow in the National

Laboratories, Assistant Professor in the Department of biological Science in various Universities in India and abroad.

Course Schedule:

Syllabus	Schedule
UNIT I: DNA as genetic material: DNA structure, central dogma. Genome structure and function - Chromosome theory, Chromosome number, Abnormalities of chromosome number- ploidy. Concept of gene, Mutation, Mutagens-physical, chemical and biological agents. Inherited diseases	15 days
UNIT 2: Diagnosis of inherited diseases- Karyotyping, DNA based diagnosis-PCR, protein and enzyme markers. Prenatal diagnosis of genetic diseases - Amniocentesis, Chorionic villus sampling, Fetoscopy, Percutaneous umbilical cord blood sampling. Population screening, carrier detection and genetic counseling, consanguinity in human population.	15 days
UNIT 3: Infectious diseases: causative agents- Bacteria, virus, fungi, parasites; disease transmission. Prophylactic measures- General hygiene, Vaccines- principle, types- inactivated, attenuated, toxoid, subunit, conjugate.Control of microorganisms - antibiotics and chemotherapeutic agents, proper usage of antibiotic. Alternate strategies to control infection- quorum sensing inhibition	15 days
UNIT 4: Application of biotechnology in healthcare: Diagnosis of infectious diseases, Production of therapeutic products- antibiotics, insulin, growth hormones, TPA, alpha interferon, Hepatitis B vaccine and Factor VIII, Forensic application- DNA Profiling, Paternity dispute, AgricultureGenetically modified foods, Medicine-Gene therapy.	15 days
UNIT 5: Cancer- Benign and malignant, Hallmarks of cancer, Grades and stages of cancer, Causative agents- Physical, chemical and biological, therapeutic strategies- Chemotherapy, radiotherapy, stem cell therapy	15 days
~10 days for CIA tests, Quizzes, Seminars, Interactive sessions, Hands on Training sessions, etc.,	

501602–ENVIRONMENTAL BIOTECHNOLOGY (Core – 3 credits)

Program: M. Sc (Biotechnology)	**Semester: II**
Course Title: Environmental Biotechnology	**Timings:**
Course Teacher	**Dr. S. Karutha Pandian** **Dr. K. Balamurugan** **Dr. A. Veera Ravi** **Dr. M. Ramesh** **Dr. K. Pandima Devi**

Course Brief:

The theme Environmental biotechnology is historic and also eminently modern. Although, the microbiological treatment technologies developed at the beginning of the 20th century, such as filtration techniques, pollution control measures, and waste water treatment, bioremediation remain the mainstays today. In recent years, new technologies are constantly introduced on bioremediation and air pollution control and solid waste management that address very contemporary problems such as detoxification, detoxification of hazardous chemicals,

environmental biomonitoring and microbial genetic engineering for bioremediation of air, water, and soil. This course aims to provide in-depth knowledge on the environmental issues, ways to control them for the sustainable development through biotechnological approaches.

Text and Reference books:

1. R.K. Trivedi, ñHandbook of Environmental Laws, Rules, Guidelines, Compliances and Standardsò, Vol. I and II, Enviro Media.

2. Wastewater Engineering ï Treatment, Disposal and Reuse, Metcalf and Eddy. Inc. Tata McGraw Hill, New Delhi. 1991

3. Biotechnology for Wastewater Treatment. P Nicholas Cheremisinoff. Prentice Hall Of India. 2001.

4. Biotechnological Methods of Pollution Control. S A Abbasi and E Ramaswami. Universities Press 1999.

5. Environmental Biotechnology, Concepts and Applications. Hans-Joachin Jordening and Josef Winter. Winter-VCH. 2005

6. Biology of wastewater Treatment. N F Gray. Mc Graw Hill. 2004.

7. Environmental Biotechnology by S. K. Agarwal

8. Biodegradation & Bioremediation (1999), Martin Alexander, Academic press.

Course Objective:

- **i.** To provide basic concepts on environmental biotechnology and its components.
- **ii.** To provide basic idea on environmental ethics and policies.
- **iii.** To provide awareness of emerging concerns such as water, Air, Soil and Thermal pollutions
- **iv.** To explain advanced skills in understanding engineered bioremediation
- **v.** To appreciate ethical and social issues associated with environmental issues and applications for alleviating the environmental concerns.
- **vi.** To impart knowledge on biotechnological techniques required for clean environment.

Prerequisites

Prior knowledge in environmental biotechnology, microbiology or biochemical engineering is recommended but not required.

Course Goal

To obtain a working knowledge of the principles, techniques and current applications of biotechnology to environmental quality evaluation, monitoring, remediation of contaminated environments and energy production.

Course Outcome:

On successful completion of the course the students will be able to:

- Explain the importance of environmental protection, diversity in environmental systems, processes and biotechnology
- Understand and explain the importance of molecular approaches and control measures to protect environmental insults.
- Understand existing and emerging technologies that are important in the area of environmental biotechnology in controlling various types of pollution and hazardous materials;
- Explore the biotechnological solutions to address environmental issues including ethical problems associated with environment, pollution management, microbial technology for mining, waste water treatment, renewable energy and bioremediation, and solid waste management;
- Understand and develop specific case-studies for targetting key areas of environmental Biotechnology;
- Undertake a range of practical approaches relevant to environmental biotechnology and
- Bioremediation for clean environment and be able to record, report and discuss data

Course Schedule:

Syllabus	Schedule
UNIT I: Basic concepts of Environment and Environmental components. Status, Scope and Role of Biotechnology in Environmental protection. Environment protection Act: Environmental laws, Environmental policies, Environmental ethics - need for public awareness	15 days
UNIT 2: Environmental pollution and its types: Definition ï causes, effects, control measures and Biotechnological methods for management of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Noise pollution (e) Thermal pollution (f) Nuclear hazards.	15 days
UNIT 3: Sewage and waste water treatment and solid waste management, chemical measure of water pollution, conventional biological treatment. Recent approaches to biological waste water treatment, composting process and techniques, use of composted materials	15 days
UNIT 4: Concept of bioremediation (*in-situ*, *ex-situ*, intrinsic & engineered bioremediation). Bioremediation of toxic metal ions- biosorption and bioaccumulation	15 days

principles. Concepts of phytoremediation. Microbial leaching mechanism. Mining: use of microbial technology for mining.	
UNIT 5: Bioremediation- Biotechnology for clean environment. Bioindicators and biosensors for detection of pollution. Biotechnology for Hazardous Waste Management, Persistent organic pollutants, Xenobiotics, Biological Detoxification of PAH, Biotechniques for Air Pollution Control. Solid Waste Management-Bio-toilets.	15 days
~10 days for CIA tests, Quizzes, Seminars, Interactive sessions, Hands on Training sessions, etc.,	

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