JAYA COLLEGE OF ARTS AND SCIENCE,

THIRUNINRAVUR-602024.

DEPARTMENT OF BIOTECHNOLOGY

M.Sc. BIOTECHNOLOGY

REVISED SYLLABUS (w.e.f. 2012-2013)

PROGRAMME OBJECTIVE

PO1	Postgraduate students will be able to demonstrate and apply their knowledge of Cell biology, Biochemistry, Microbiology and Molecular Biology to solve the problem related to the field of biotechnology.
PO2	Students will be able to demonstrate and apply the principles of bioprocess engineering in the design and analysis
PO3	Gain fundamental knowledge in animal and Plant Biotechnology and their application.
PO4	Students will be able to understand various facts of molecular procedures and basics of genomics, proteomics and metabolomics that could be employed in early diagnosis and prognosis of human diseases
PO5	Students will be able to gain hands on training in Molecular Techniques. This experience could enable them to begin a carrier in industry that engages in genetic engineering as well as in research laboratories

PROGRAMME OUTCOME

PO1	The M.Sc program of Biotechnology of Jaya College of Arts and Sciences, Thiruninravur was started in the year 2002
PO2	The program provides intensive and in-depth knowledge of Biotechnology
PO3	This program makes the students to acquire knowledge on critical thinking skills and experience in projects
PO4	They are trained to handle equipments with understanding standard operating procedure and safety aspects.
PO5	The students are trained to take up wide variety of roles like Researchers and academicians

COURSE STRUCTURE:

FIRST SEMESTER

S. No	Course Components	Name of the Course	Semester	Inst. Hours	Credits	Exam hrs	Max. Marks	
							CIA	External
1	Core Paper-1	Biochemistry	I	3	3	3	25	75
2	Core Paper-2	Molecular genetics	I	3	3	3	25	75
3	Core Paper-3	Molecular Cell Biology	I	3	3	3	25	75
4	Core Paper-4 Practical-I	Practical-I (a) Biochemistry (b) Molecular Genetics (c) Molecular Cell Biology	I	15	10	6	40	60
5	Paper-5 *Elective	Bioinstrumentation	I	2	2	3	25	75
6	Paper-6 *Elective	Biostatistics	I	2	2	3	25	75
7	Paper-7 *Elective	Enzymology	I	2	2	3	25	75
8	Soft Skill-I		I	2	2	3	40	60
Total credits:25								

SECOND SEMESTER

S. No	Course Components	Name of the Course	Semester	Inst. Hours	Credits	Exam hrs	Max. Marks	
							CIA	External
9	Core Paper-8	Microbiology	II	3	3	3	25	75
10	Core Paper-9	Plant and Animal Biotechnology	II	3	3	3	25	75
11	Core Paper-10	Genetic Engineering	II	3	3	3	25	75
12	Core Paper-11 Practical-II	Practical-I (a) Microbiology (b) Plant and Animal Biotechnology (c) Genetic Engineering	II	15	10	6	40	60
13	Paper-12*Elective	Tissue Engineering	II	2	2	3	25	75
14	Paper-13 *Elective	Pharmaceutical Biotechnology	II	2	2	3	25	75
15	Paper-14 *Elective	Environmental Biotechnology	II	2	2	3	25	75
16	Soft Skill-II		II	2	2	3	40	60
Total credits:25								

THIRD SEMESTER

S. No	Course Components	Name of the Course	Semester	Inst. Hours	Credits	Exam hrs	Max. Marks	
							CIA	External
17	Core Paper-15	Bioinformatics	III	3	3	3	25	75
18	Core Paper-16	Immunology	III	3	3	3	25	75
19	Core Paper-17	Bioprocess Technology	III	3	3	3	25	75
20	Core Paper-18 Practical-III	Practical-I (a) Bioinformatics (b) Immunology (c) Bioprocess Technology	III	15	10	6	40	60
21	Paper-19*Elective	Nano Biotechnology	III	2	2	3	25	75
22	Paper-20 *Elective	Molecular Developmental Biology	III	2	2	3	25	75
23	Extra disciplinary elective	Any Elective offered by other Depts	III	2	2	3	25	75
24	Soft Skill-III		III	2	2	3	40	60
25	**Internship	Internship in industries or Research Laboratories related to Biotechnology Field	III	-	2	-	-	100

26	Elective offered to other Dept	Principles of gene manipulation technology	III	2	3	3	25	75
Total credits:28								

FOURTH SEMESTER

S. No	**Course Components**	**Name of the Course**	**Semester**	**Inst. Hours**	**Credits**	**Exam hrs**	**Max. Marks**	
							CIA	**External**
27	Core Paper-21	Research Methodology	IV	4	3	3	25	75
28	Paper-22*Elective	Stem Cell Biology	IV	2	2	3	25	75
29	Paper-23*Elective	Bioethics, Human Rights and Social Issues	IV	2	2	3	25	75
30	Core Paper-24	Dissertation	IV	20	15		60	240 (40 – work book,150 dissertation+ 50 viva)
31	Soft Skill-IV		IV	2	2	3	40	60
Total credits:22/24*								

SEMESTER I
BIOCHEMISTRY

Course Code: MDK1A

Course Objective

- Demonstrate knowledge and understanding of the molecular machinery of living cells
- Using basic laboratory skill and apparatus to obtained data
- Implement and experimental protocol and adapt them to plan and carry out simple investigation
- Build on their knowledge and understanding in tackling more advanced and specialized course
- More widely to pursue independent self direct and critical learning

Course Outcome

Biochemistry	
CO1	Students should be able to gain fundamental knowledge in biochemistry
CO2	Knowledge of biochemical principles with specific emphasis on different metabolic pathways and regulations
CO3	Identify and demonstrate Bioenergetics and biological oxidation
CO4	Understand the molecular basics of aminoacids and protein
CO5	To know about the nucleic acids like purine and pyrimidines and to know the pathways

Syllabus

Unit-1

pH, pK – acid, base – biological buffer system – Water- Principles of thermodynamics. Carbohydrates: Nomenclature, classification, structure, chemical and physical properties of carbohydrates. Metabolisms: glycogenesis, glycogenolysis, gluconeogenesis, pentose phosphate pathway.

Unit-2

Lipids: Nomenclature, classification, structure, chemical and physical properties of fatty acids. Metabolisms: biosynthesis of fatty acids,

triglycerols, phospholipids, glycol lipids. Cholesterol biosynthesis, bile acids and salt formation. Eicosanoids, sphingolipids and steroid hormones.

Unit- 3

Bioenergetics and Biological oxidation: Electron transport chain, oxidative phosphorylation, glycolysis, citric acid cycle, cori's cycle, glyoxalate pathway. Oxidation of fatty acids- mitochondrial and peroxisomal ßoxidation, á and ù oxidation, oxidation of unsaturated and odd chain fatty acids, ketone bodies. Photosynthesis, urea cycle, hormonal regulation of fatty acids and carbohydrates metabolisms.

Unit – 4

Amino acids and Protein: Nomenclature, Classification, structure, chemical and physical properties of amino acids and proteins. Metabolisms: Biosynthesis of amino acids. Degradation of proteins, nitrogen metabolisms and carbon skeleton of amino acids. Over all in born error metabolisms.

Unit- 5

Nucleic acids: Nomenclature, Classification, structure, chemical and physical properties of purine and pyrimidines. In de novo and salvage synthesis of purines, pyrimidine bases, nucleosides and nucleotides. Catabolism of purine and pyrimidine bases. Synthetic analogues of nitrogenous bases.

MOLECULAR GENETICS

Course Code: MDK1B

Course Objective

- Basic principles of molecular genetics of prokaryotic and eukaryotic organisms
- Gain higher level thinking skills that is necessary for scientist
- This course suit exits about basic science and its application
- To identify important outstanding problems in molecular genetics
- To acquire a broad understanding of current molecular genetics and genomics

Course Outcome

Molecular Genetics	
CO1	Students can understand about the genes and chromosomes and complexity of eukaryotic genome
CO2	Gain knowledge about replication of DNA, DNA regulation, Gene expression and regulation in prokaryotes and eukaryotes
CO3	Helps to know about the DNA repair mechanisms and chromosomal abnormalities
CO4	Enable the students to know about the discovery and early experiments of Mc Clintock in maize
CO5	Can aquire knowledge in mutation, migration and random fenetic drift

Syllabus

Unit – 1

Genes and chromosomes, Colinearity of Genes and Proteins, Genetic code, Identification of DNA as the genetic material. The complexity of eukaryotic genome (introns, exons, repetitive DNA sequence, gene duplication and pseudogenes).

Unit – 2

Replication of DNA, DNA repair, Gene expression and regulation in prokaryotes and eukaryotes. Mutation: Spontaneous and virus induced mutation, Radiation induced mutation – Ionizing radiation, UV radiation.

Unit – 3

DNA repair mechanisms, (photoreactivation, excision, SOS, recombination and heat shock responses), xerodermapigmentosum, chemically induced mutation – Base analogs Nitrous acid, Acridines, Alkylating and hydroxylating agents. Chromosomal Abnormalities, Recombination - models.

Unit – 4

Discovery – early experiments of McClintock in maize – Insertion sequences in prokaryotes – complex transposons (ex. Tn3, Tn5, Tn9 and Tn10) – Mechanisms, control consequences and application of transposition by simple and complex elements.

Unit – 5

Allele frequencies and genotype frequencies, systems of mating, inbreeding, genetics and evolution – mutation and migration, random genetic drift.

MOLECULAR CELL BIOLOGY

Course Code: MDK1C

Course Objective

- Students will understand the structure and purpose of basic components of prokaryotic and eukaryotic cell
- Students will understand the cellular components underlying mitotic division
- Students will apply their knowledge on cell biology
- Students will understand the relationship between cell level phenomena

Course Outcome

Molecular Cell Biology	
CO 1	To learn about the structural organization of cell organelles
CO 2	Make the students to understand the principle, working mechanism of microscopy and microtome
CO 3	Gain fundamental knowledge on organization of eukaryotic DNA
CO 4	sensitize the students about molecular basis of eukaryotic cell cycle
CO 5	Students will be able to understand the structure and function of microtubules and microfilaments

Syllabus

Unit – 1

The molecules of a cell; Organelles of the eukaryotic cell and its functions; Biomembranes - structural organization, transport across membrane (Passive, Active and Bulk transport); Cell-Cell adhesion- Cell junctions (Tight junctions, gap junctions, desmosomes, adherens); Extra cellular matrix (ECM)- components and role of ECM in growth.

Unit – 2

Microscopy- Bright field, Phase contrast, fluorescence; Electron (TEM, SEM and Tunneling SEM), Histochemistry – Microtomy, Fixation, embedding, sectioning and staining of tissues. Hybridization-FISH; Flow cytometry; Cell fractionation.

Unit – 3

Organization of Eukaryotic DNA in to chromosomes; DNA replication – mechanism; Transcription- basic mechanism in prokaryotes and eukaryotes; Post and co-transcriptional modifications; Translation in prokaryotes and eukaryotes; Post translational modifications; Protein sorting and secretion; Protein folding and degradation.

Unit – 4

Molecular basis of eukaryotic cell cycle, Regulation and cell cycle check points; Programmed cell death (Apoptosis); Cell-Cell signaling-signaling molecules, types of signaling, signal transduction pathways (GPCR-cAMP, IP_3, RTK, MAP Kinase, JAK-STAT, Wnt Pathway); Cancer-multistage cancer development, carcinogens, oncogenes and proto-oncogenes, tumor suppressor genes-Rb, p53.

Unit – 5

Microfilaments – Actin structure, Dynamics of actin assembly, Myosin and molecular motors. Intermediate filaments- types and functions. Microtubules- structure and dynamics, kinesin and dynein powered motors, focal adhesion points, microvilli and pseudopodial extensions.

PRACTICAL -I

(A) Biochemistry - Practical

1. Basic calculations in Biochemistry - Normality, Molarity, Molality percent solutions (v/v, w/v).
2. Calibration of pH meter
3. Transition interval of commonly used pH indicators
4. Preparation of biological buffer - phosphate buffer
5. Extraction of Proteins from biological materials
6. Protein separation methods:-Ammonium sulphate Precipitation,
7. Membrane Dialysis ,
8. SDS PAGE
9. Urea-SDS PAGE for separation of low molecular weight proteins
10. Estimation of Proteins by Lowry's method
11. Estimation of Proteins by Biuret method
12. Estimation of Proteins by Bradford method
13. Estimation of RNA by orcinol method
14. Estimation of DNA by diphenylamine method
15. Estimation of Carbohydrate by Anthrone method
16. Purity check of DNA & RNA by UV Spectrophotometry - A260/280
17. Separation of amino acids by Paper Chromatography
18. Separation of sugars by Paper Chromatography
19. Separation of amino acids by Thin layer chromatography
20. Separation of sugars by Thin layer chromatography
21. Thermal Denaturation of DNA and UV absorption studies

Demo Experiments

1. Gel permeation chromatography,
2. Affinity chromatography,
3. Ion–exchange chromatography
4. Western blotting

(B) Molecular Genetics - Practical

1. Isolation of DNA from bacteria
2. Isolation of DNA from plants
3. Isolation of DNA from animal tissue
4. Isolation of DNA from blood
5. Plasmid DNA isolation.
6. Agarose gel electrophoresis of DNA
7. Transfer of DNA from gel – Southern Blotting
8. Isolation of RNA
9. Glyoxal denatured Agarose gel electrophoresis of RNA
10. Formaldehyde denatured Agarose gel electrophoresis of RNA
11. Urea denatured Agarose gel electrophoresis of RNA
12. Transfer of RNA from gel – Northern Blotting
13. Restriction digestion of DNA
14. Radiation induced genetic damage assessment (Root meristem of ***Allium cepa***).
15. Chemical induced genetic damage assessment (Root meristem of ***Allium cepa***).
16. Preparation of metaphase chromosomes form blood
17. G-banding and karyotyping.

(C) Molecular Cell Biology - Practical

1. Introduction to Microtome and types
2. Microtomy - Fixation of tissue
3. Microtomy – Embedding
4. Microtomy - Sectioning of tissue
5. H & E Staining of tissues
6. Histochemical staining to localize proteins
7. Histochemical staining to localize carbohydrates
8. Histochemical staining to localize lipids.
9. Subcellular fractionation and marker enzyme detection (mitochondria).
10. Giant chromosome studies in Chironomous larvae.
11. Meiotic study in flower buds and cockroach or grasshopper.
12. Preparation of tissue culture medium and membrane filtration;
13. preparation of single cell suspension from spleen and thymus;
14. Cell counting and cell viability;
15. Macrophage monolayer from PEC and measurement of phagocytic activity;
16. Trypsinization of monolayer and subculturing; Cryopreservation and thawing;
17. Role of serum in cell culture;
18. Preparation of metaphase chromosomes from animal cells;
19. Isolation of mRNA, genomic DNA;
20. MTT assay for cell viability and growth; Cell fusion with PEG.
21. Embryonic development and stem cells (Serpulid polychaete, Hydroides elegans/ chick/ frog).

BIOINSTRUMENTATION

Course Code: MDKAA

Course Objective

- Students will be able to demonstrate an understanding of physics and engineering in biosensor electrodes
- Understanding of biomedical instruments, principles in aspects of device
- Science associated with a measurement of a biological variable such as pressure, temperature etc.
- Understanding of measuring of the biological parameters
- Students will get knowledge in instrument handling

Course Outcome

Bioinstrumentation	
CO1	Students will have clear view on principle and application of light and electron microscopy
CO2	To have elaborate knowledge on centrifugation and chromatography
CO3	Gain knowledge on theory and application of electrophoresis amd blotting techniques
CO4	To have insight on various techniques of spectroscopy
CO5	To apply the knowledge of Radioisotopic techniques, autoradiography and RIA

Syllabus

Unit-1

Microscopic Techniques: Principles and Applications of Light, Phase Contrast, Fluorescence Microscopy, Scanning and Transmission Electron Microscopy, Scanning Tunneling Microscopy, Atomic Force Miscroscopy, Confocal Microscopy, Cytophotometry and Flow Cytometry, patch clamping.

Unit-2

Centrifugation: Preparative and Analytical Centrifuges, Sedimentation analysis RCF, Density Gradient Centrifugation. Chromatography Techniques: Theory and Application of Paper Chromatography, TLC, Gel Filtration Chromatography, Ion Exchange Chromatography, Affinity Chromatography, GLC, HPLC, FPLC.

Unit-3

Electrophoretic Techniques: Theory and Application of PAGE, Agarose Gel Electrophoresis – 2DE, Iso-electric Focusing, Immuno diffusion, Immuno Electrophoresis , ELISA , RIA , Southern , Northern and Western Blotting. PCR, Real time PCR, DNA/RNA Sequencing, Microarray (DNA, Proteins).

Unit-4

Spectroscopic Techniques: Theory and Application of UV and Visible Spectroscopy, Fluorescence Spectroscopy, MS, NMR, ESR, Atomic Absorption Spectroscopy, X- ray Spectroscopy, LASAR, Raman Spectroscopy, MALDI -MS.

Unit-5

Radio-isotopic Techniques: Introduction to Radioisotopes and their Biological Applications, Radioactive Decay – Types and Measurement , Principles and Applications of GM Counter, Solid and Liquid Scintillation Counter, Autoradiography, RIA, Radiation Dosimetry .

ENZYMOLOGY

Course Code: MDKAC

Course Objective

- Understanding the theory of enzyme kinetics
- Understanding the mechanism of enzyme catalysis
- Understanding the mechanism of enzyme regulation in the cell
- It provides information about the diverse range of reactions
- Understand the predict the metabolism of all living things

Course Outcome

Enzymology	
CO1	Enable students be aware of classification, nomenclature and properties of enzymes
CO2	Understand the kinetics of catalyzed reaction and concept of Michaelis- Menten.
CO3	Acquire knowledge on enzyme catalysis with its mechanism
CO4	Students have knowledge on multi enzymes system
CO5	To acquaint understanding on mechanism of enzyme regulation

Syllabus

Unit 1

Introduction to enzymes, Classification, nomenclature and general properties like effects of pH, substrate and temperature on enzyme catalysed reactions. Extraction Isolation and purification of enzymes by precipitation, centrifugation, chromatography and electrophoresis methods.

Unit 2

Kinetics of catalysed reaction : Single substrate reactions, bi-substrate reactions, concept of Michaelis - Menten, Briggs Haldane relationship, Determination and significance of kinetic constants, Limitations of Michaelis-Menten Kinetics, line weaver Burk plot, Hanes wolf equation , Eadie Hoofstee equation ,Inhibition of enzyme activity.

Unit 3

Enzyme catalysis : enzyme specificity and the concept of active site, determination of active site. Stereo specificity of enzymes. Mechanism of catalysis: Proximity and orientation effects, general acid-base catalysis, concerted acid - base catalysis, nucleophilic and electrophilic attacks, catalysis by distortion, metal ion catalysis.

Unit 4

Theories on mechanism of catalysis -Mechanism of enzymes action: mechanism of action of lysozyme, chymotrypsin, carboxypeptidase and DNA polymerase. Multi enzymes system, Mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthetase complex.

Unit 5

Coenzyme action. Enzyme regulation: General mechanisms of enzyme regulation, Allosteric enzymes, sigmoidal kinetics and their physiological significance, Symmetric and sequential modes for action of allosteric enzymes. Reversible and irreversible covalent modification of enzymes, Immobilized enzymes and their industrial applications.Clinical and industrial applications of enzymes, Enzyme Engineering.

SECOND SEMESTER

MICROBIOLOGY

Course Code: MDK2A

Course Objective

- Students will be able to identify common infectious agents and the disease
- To evaluate methods used to identify infectious agents in the clinical microbiology lab
- Students will be able to recognize and diagnosis of microbial infections
- Students will be able to assess treatment strategies
- Students can perform antibacterial assays

Course Outcome

Microbiology	
CO 1	Students gain knowledge on taxonomy and systematic identification of microorganisms
CO 2	Ability to perform gram, acid-fast, nuclear, capsule, flagella and other special staining method
CO 3	Perceive details about size, shape, composition and structure of eukaryotic cells
CO 4	Students learn about Host- parasite relationship ships, pathogenic mechanisms, lab- diagnosis and treatment
CO 5	Aware on microorganism role on production of food, pharmaceuticals, biofertilizers and biopesticide

Syllabus

Unit-1

Microbial Taxonomy, systematics, identification: Taxonomical hierarchyspecies- type strains: culture collections; binomial nomenclature; system of classification- phenetic, numerical taxonomy. General characteristics used in classification- five kingdom, six kingdom and eight kingdom systems. Classification of microbes using DNA analysis, proteins, rRNA analysis and phylogeny.

Unit-2

Staining methods – Gram, Acid fast, Metachromatic granules, nuclear staining, capsule, silver impregnation, Flagella and other special staining methods. Sterilization and disinfection methods and their quality control. Size, shape, composition and structure of prokaryotic (bacteria, actinomycetes, archaea and blue green algae).

Unit -3

Size, shape, composition and structure of eukaryotic cells (algae, fungi and protozoans). Nutritional requirements for growth. Growth media and pure culture techniques. Symbiosis, Mutualism, Parasitism, Commensalism and endophyte. Structure of virus and prions. Measurement of growth and enumeration of cells – Techniques of pure culture.

Unit -4

Introduction to Medical parasitology – classification, host-parasite relationships, pathogenic mechanisms, transmission life cycle, lab diagnosis, treatment etc. for the following: Protozoa – *Entamoeba*, Aerobic and Anaerobic amoebae causing human diseases. Toxoplasma, cryptosporidium and other protozoan parasites causing infections in man. *Leishmania, Trypanasoma, Giardia, Trichomonas, Balantidium.*

Unit – 5:

Role of microorganisms in food production (SCP) dairy and non-dairy products. Fuel (ethanol), pharmaceuticals (antibiotics), biofertilizers (BGA), biopesticides (*Bacillus thuringenesis*), biopolymers, biosurfactants, vitamin B12, protease, glutamic acid. Secondary metabolites. Biogas production, biocomposting and biotransformation.

PLANT AND ANIMAL BIOTECHNOLOGY

Course Code: MDK2B

Course Objective

- Fundamental knowledge will be gained from plant and animal biotechnology
- Some of the basic techniques are micro propagation and plant molecular diagnostics
- Students will learn all the sterile techniques and media preparation
- Laboratory teaching will be provide to get hands on training
- To know about the animal health diagnosis and treatment

Course Outcome

Plant And Animal Biotechnology	
CO1	This course presents the application of plants in Biotechnology, to make the student to understand usage of plant products and exploitation of them in biotechnology
CO2	To know about the plant transformation techniques for the development of new genetic traits
CO3	To aware on the animal health, diseases and diagnosis using hybridoma techniques
CO4	Gaining knowledge about the tissue culture, cryopreservation methods and micromanipulation techniques
CO5	Students understand about the crop development, callus culture, animal tissue culture, animal products and production and improvement of them

Syllabus

Unit-1

Introduction of plant tissue culture, composition of media, Micropropagation, organogenesis, somatic embryogenesis, haploid and triploid production, protoplast isolation and fusion, hybrid and cybrid, synthetic seed production, secondary metabolic production.

Unit-2

Plant Transformation — Direct transformation by electroporation and particle gun bombardment - Agrobacterium, Ti plasmid vector. Theory and techniques for the development of new genetic traits, conferring resistance to biotic and abiotic. Plant engineering towards development of enriched food products, plant growth regulators.

Unit – 3

Animal health – disease diagnosis, hybridoma technique, monoclonal antibodies, application of probes for disease diagnosis of existing and emerging animal diseases. Prophylaxis - Vaccines, Oral vaccines – DNA Vaccines in animal disease. Cell culture: primary and established culture; organ culture; tissue culture;

Unit – 4

Disaggregation of tissue and primary culture; cell separation, Slide and coverslip cultures, flask culture, test tube culture techniques, cell synchronization, cryopreservation. Scaling up of animal cell culture, cell line and cloning – micromanipulation and cloning, somatic cell cloning. Karyotyping; measuring parameters for growth, measurement of cell death, apoptosis and its determination, cytotoxicity assays.

Unit – 5

Nuclear magnetic resonance methods of monitoring cell metabolism culturing animal cells in fluidised bed reactors- GPI- Anchored fusion proteins- harvesting GPI- anchored proteins from CHO cells- Hematopoietic cells for cellular and gene therapy. Transgenic animals: Production and application; transgenic animals in livestock improvement, transgenic animals as model for human diseases.

GENETIC ENGINEERING

Course Code: MDK2C

Course Objective

- To illustrate creative use of modern tools
- To illustrate techniques for manipulation and analysis of genomic sequences
- To understand about the recombinant DNA techniques
- To know about the biological research
- To know about the new combination of heritable genetic material

Course Outcome

Genetic Engineering	
CO1	Students have a detail understanding on gene cloning and recombinant DNA technology
CO2	To describe different types of gene cloning vectors such as E.coli vectors, lamda bacteriophage vectors, phasemid and phagemid
CO3	Students have insight on molecular genetics and expression of eukaryotic vectors
CO4	Learning the process of nucleic acid hybridization techniques, types of probes and its construction
CO5	Detailed note on technique like DNA microarray, chromosome walking and jumping

Syllabus

Unit – 1

Gene cloning – Genetic engineering tools – Nucleic acid manipulating enzymes. Promoters, Selectable markers and reporters used in rDNA technology. Restriction digestion, Ligation, Transformation, Selection of Recombinants. Construction of gene libraries.

Unit – 2

E.Coli vectors - pBR322 and its derivatives; Cloning vectors for gram negative bacteria - ColE1, p15A, R1, IncPa, pSC101; Lambda bacteriophage vectors, filamentous phages, Cosmids, Phasmids, Phagemids. Cloning in gram-positive bacteria (*Bacillus subtilis*)

Unit – 3

Cloning in yeast *Saccharomyces cerevisae* – Life cycle and types of vectors; Eukaryotic vectors – SV40 (molecular genetics and expression); Specialized cloning vector for cDNA; Synthesis of specific RNA in vitro; Vectors for cloning promoters and terminators; vectors with adjustable copy number.

Unit – 4

Nucleic acid hybridization techniques; Molecular probes (Types of probes and its construction); probe labeling – Nick translation, End labeling and Random primer labeling. Polymerase chain reaction and its variants; DNA fingerprinting; DNA sequencing first generation sequencing methods (Maxam and Gilbert sequencing, Sanger's Dideoxy sequencing, Pyrosequencing, PCR based sequencing and hybridization sequencing).Second generation sequencing methods.

Unit – 5

Site directed mutagenesis; DNA microarray; chromosome walking and jumping. Molecular techniques in prenatal diagnosis gene therapy, Pharmaceutical products (Vaccine, Humulin, etc), Crop improvement – pesticide resistance, herbicide resistance, transgenic animals and GM foods.

PRACTICAL-II

Paper – 11 - Practical II

(A) Microbiology-Practical

1. Sterilization of glassware using dry heat- hot air oven
2. Sterilization of media using moist heat – autoclave
3. Filter sterilization
4. Liquid media preparation – nutrient broth
5. Solid media preparation – SDA plates
6. Preparation of Agar slants
7. Streak plate method
8. Pour plate method
9. Spread plate method
10. Serial dilution agar plate method
11. Isolation of microbes from soil
12. Isolation of microbes from water
13. Isolation of microbes from air
14. Isolation of microbes from plant surface.
15. Isolation of pure culture of *E.coli*
16. Isolation of pure culture of *Aspergillus niger*
17. Isolation of pure culture of Streptomyces.
18. Preparation of bacterial smear and fixation
19. Gram staining and morphological characterization of microbes.
20. Negative staining of bacteria
21. Determination of growth curve of bacteria – *E.coli*
22. IMViC test of enteric bacteria.

(B) Plant and Animal Biotechnology - Practical

1. Plant tissue culture media preparation
2. Plant tissue culture sterilization techniques.
3. Generation of Callus from leaf
4. Generation of Callus from root

5. Generation of Callus from bud
6. Generation of Callus from shoot apex
7. Maintenance of callus culture.
8. Cell suspension culture
9. Anther culture
10. Pollen culture
11. Embryo culture.
12. Isolation of plant protoplast
13. Culture of plant protoplast.
14. Protoplast viability test.
15. Localization of nucleus using nuclear stain.
16. Agrobacterium culture maintenance and isolation of plasmid DNA.
17. Mass culture of Chlorella /Spirulina
18. Introduction to Animal Cell culture: Procedure for handling cells and medium.
19. Cleaning and sterilization of glassware and plastic tissue culture flasks
20. Preparation of tissue culture media
21. Preparation of sera for animal cell culture
22. Preparation of single cell suspension from chicken liver (Primary cell culture).
23. Trypsinization of established cell culture.
24. Cell counting and viability - staining of cells **a)** Vital Staining (Trypan blue, Erythrosin B) **b)** Giemsa staining.
25. MTT Assay

(C) Genetic Engineering - Practical

1. Preparation of plasmid DNA by alkaline lysis method.
2. Agarose gel electrophoresis
3. Silver staining of gels
4. Methylene blue DNA staining
5. Elution of DNA from agarose gel.
6. Restriction enzyme digestion.
7. Restriction mapping of plasmid DNA.
8. Ligation.
9. Competent cell preparation
10. Transformation and selection of recombinants.
11. Cloning of fragments in PBR322
12. Insertional inactivation/Blue white screening
13. RAPD
14. RFLP
15. Amplification of DNA - PCR
16. Determination of molecular weight of DNA.

TISSUE ENGINEERING

Course Code: MDKAD

Course Objective

- To focus on strategies to repair, replace and regenerate various tissues and organs
- To solve major clinical problems
- To gain insight in to topical issues including stem cells
- To learn characterization of biomaterials and nonmaterial
- To focus and improve damage tissue or whole organs

Course Outcome

Tissue Engineering	
CO1	Students will have a clear idea about the basic biology of tissue engineering
CO2	Learning the process by invitro control of tissue development and organs
CO3	To know about the organotypic and histotypic models of engineered tissues and biomaterials in tissue engineering
CO4	Students have insight on bioartificial pancreas, red blood cell substitutes and renal replacement devices
CO5	Understanding the role of tissue engineering and its application

Syllabus

Unit – 1

Basic biology of tissue engineering: The basis of growth and differentiation morphogenesis and tissue engineering.

Unit – 2

In vitro control of tissue development-Growth factors-Tissue engineering bioreactors-Tissue assembly in microgravity-In vitro synthesis of Tissue and organs.

Unit – 3

Organotypic and histotypic models of engineered tissues-Biomaterials in tissue engineering-Approaches to transplanting engineered cells and tissue engineering.

Unit –4

Bioartificial pancreas- Hepatassist liver support system – Heamatopoietic system: Red blood cell substitutes - Renal replacement devices; Musculo-skeletal system.

Unit – 5

Structural tissue engineering - Bone regeneration through cellular engineering-Brain implants - Neural stem cells - Periodontal applications-Artificial Womb.

ENVIRONMENTAL BIOTECHNOLOGY

Course Code: MDKAG

Course Objective

- To make known the great biodiversity existing in the microbial world
- To know the functions and types of bioreactors
- It makes student to understand about the aerobic and aneroboic treatment process
- Students can learn about sewage and waste water treatment process
- To know about the quality, evaluation and monitoring , remediation and contaminated environments

Course Outcome

Environmental Biotechnology	
CO 1	Students understand the concept for deriving biofilm kinetics
CO 2	To describe the different types of reactors with effluent recycle
CO 3	To gain knowledge on denitrification, waste water and drinking water treatment systems
CO 4	Students learn detoxification of hazardous chemicals and biodegradation of contaminants
CO 5	Elaborate on strategies for evaluating bioremediation and sewage and waste treatment control and remediation

Syllabus

Unit – 1

Biofilm Kinetics: Completely mixed biofilm reactor-Soluble microbial products and inert biomass-Special-case biofilm solution. Reactor types - batch reactor - continuous-flow stirred-tank reactor with effluent recycle.

Unit – 2

Plug-flow reactor - plug-flow reactor with effluent recycles-Reactors with recycle of settled cells - Using alternate rate models - Linking stoichiometric equations to mass balance equations - Engineering design of reactors - Reactors in series.

Unit – 3

Denitrification: Physiology of denitrifying bacteria-Tertiary denitrification-One-sludge denitrification - Waste water treatment systems - Anaerobic & Aerobic - Drinking-water treatment: Anaerobic treatment by methanogenesis - uses for methanogenic treatment-Reactor configurations - Special factors for the design of anaerobic sludge digesters.

Unit – 4

Detoxification of Hazardous chemicals: Factors causing molecular recalcitrance - Synthetic organic chemical classes - Energy metabolism versus co-metabolism - Electron donor versus electron acceptor Minimum substrate concentration (S_{min}) Biodegradation of problem environmental contaminants.

Unit – 5

Bioremediation: Engineering strategies for bioremediation - Evaluation bioremediation - Sewage and waste treatment - Pollution monitoring, control and remediation (Petroleum Industry, Paper Industry, chemical industry etc.) Biomass from the wastes.

THIRD SEMESTER

BIOINFORMATICS

Course Code: MDK3A

Course Objective

- Students studying bioinformatics shall be able to apply knowledge and principles and concepts of biology and computer science
- They can effectively use the existing software to extract information from large database
- Gain the ability to perform phylogenetic analysis
- They can have better understanding of the intersection of life and information sciences

Course Outcome

Bioinformatics	
CO1	Students could gain knowledge in Bioinformatics-an overview, definition and history information networks-internet in scope of bioinformation
CO2	To gain knowledge on biological databases: NCBI, EMBL, PIR,SWISS-prot, Pubmed
CO3	Helps to learn about analysis of three dimensional structures of proteins and primary and secondayu databases
CO4	Elaborate on biomolecular sequences on genebank, fasta, msf, nbrf- pir etc
CO5	Understanding the basic concepts of scoring matrix PAM and BLOOSUM series and also usage of different software for analysing biological data

Syllabus

Unit-1

Bioinformatics data – nucleic acid sequence, protein sequence, protein structure, genomic, proteomic and metabolomic information, Bioinformatics databases – types, design, file formats, access tools with examples, Bioinformatics tools and Resources – free online tools, downloadable free tools, software packages, internet, Bioinformatics books and Journals, Bioinformatics web-portals.

Unit-2

Sequence alignment basics, match, mismatch, similarity, scoring an alignment, gap penalty, protein vs DNA alignments, Dot-matrix alignment, Pairwise alignment – global and local alignment algorithms, Multiple sequence alignment-progressive alignment and Iterative alignment algorithms, consensus sequence, patterns and profiles, Database searching: Pairwise alignment based rigorous algorithm (Smith and Waterman) and Heuristic algorithms (FASTA and Blast). Multiple sequence alignment based database searching – PSI- Blast, PAM and Blosum matrices.

Unit-3

Bioinformatics for genome sequencing, EST Clustering and analyses, Finding genes in prokaryotic and eukaryotic genomes, Regulatory sequence analysis, Bioinformatics for Genome maps and markers, Bioinformatics for understanding Genome variation, Protein structure prediction and classification, Bioinformatics in support of Proteomic research

Unit-4

Molecular visualization tools – Rasmol, Chime and Spdb viewer – Structure analysis tools – VAST and DALI, Structural biology - Homology modeling, Bioinformatics for micro array designing and transcriptional profiling, Bioinformatics for metabolic reconstruction, Bioinformatics for phylogenetic analysis.

Unit-5

Medical application of Bioinformatics – disease genes, Drug Discovery – History – Steps in drug discovery – Target Identification – Target Validation – QSAR – Lead Identification – Preclinical pharmacology and toxicology – ADME – Drug designing – Rational drug design – Computer aided drug design – Ligand based approach – Target based approach.

IMMUNOLOGY

Course Code: MDK3B

Course Objective

- The course aims to provide an adequate knowledge about the functioning of the immune system
- To analyze the mechanism of immune response against infectious agent
- To describe the reactions between antigen and antibody with the production of monoclonal antibody
- To provide an adequate knowledge on various effects, mechanisms in immunity
- To provide an overall knowledge on various immune techniques for detection of antigen

Course Outcome

Immunology	
CO1	Helps to get an adequate knowledge about the functioning of immune system
CO2	Students can analyze the mechanism at the base of the immune response against different infectious agents and against tumors
CO3	To provide an overall comprehension about the causes and the pathogenesis of the main alterations of the immune response and knowledge about vaccines and immunotherapy
CO4	Acquire knowledge on the immune response to explain the alterations and functions
CO5	To acquire a correct terminology and applications of immunotechniques

Syllabus

Unit-1

Histroy and overview of the immune system. Types of immunity - innate, acquired, passive and active, self *vs* nonself discrimination. Physiology of immune response: HI and CMI specificity and memory. Cells and organs of the immune system – Lymphoid tissue, origin and development. Hematopoiesis, differentiation of lymphocytes.

Unit-2

Lymphocyte-sub-populations of mouse and man. T and B cells, APC cells, lymphokines, Phagocytic cells, macrophage, dendritic cells, K and NK Cells. Nature and biology of antigens, epitopes, haptens, adjuvents. Immunoglobulins- structure, distribution and function, Isotypic, Allotypic and Idiotypic variants, generation of antibody diversity.

Unit-3

Antigen antibody reactions. Monoclonal antibody production and its applications. Types of vaccine and vaccination schedule. Role of MHC antigens in immune responses, Structure and function of class I and class II MHC molecules. MHC antigens in transplantation and HLA tissue typing.

Unit-4

Effector mechanisms in immunity - macrophage activation, cell mediated cytotoxicity, cytotoxicity assay. Hypersensitivity reactions and types. The complement system, mode of activation, classical and alternate pathway, biological functions of C proteins.

Unit-5

Immunotechniques- precipitation, Single and double immuno diffusion, Immuno fluorescence, RIA and ELISA, FACS, Western blot, Agglutination tests – Direct and Indirect, Widal's test, VDRL test. Purification of antibodies, Quantitation of immunoglobulin by RID, EID and nephelometry.

BIOPROCESS TECHNOLOGY

Course Code: MDK3L

Course Objective

- This course introduces the knowledge of fermentation process and their applications
- Exemplify different types of bioreactors and production of bioproducts
- Introduce the knowledge on cell disruption and flocculation method
- Generate conditional knowledge on sedimentation and extraction
- Describe the principles and operation of various dryer formulation method

Course Outcome

Bioprocess Technology	
CO1	This course contains the development of bioprocess in an interdisciplinary perspective and basic engineering calculations applied in biological processes
CO2	Able to understand and explain the definition of bioprocess techniques and fermentation process
CO3	To gain knowledge about the term byproducts and bioseparation by different methods
CO4	Able to analyse the filtration ,principle, conventional, sedimentation and liquid-liquid extraction
CO5	Makes the students to understand the development of bioprocess engineering in educational world and industry to support a biobased economy

Syllabus

Unit – 1

Aerobic and anaerobic fermentation processes and their application in the field of biotechnology industry. Solid substrate, slurry fermentation and its application. Microbial cell culture. Whole cell immobilization.

Unit – 2

Types of bioreactors: Submerged reactors, surface reactors, mechanically agitated reactors, non-mechanically agitated reactors. Design of fermentors – body construction. Production of citric acid, penicillin and insulin.

Unit – 3

Introduction to bioproducts and bioseparation. Primary recovery process: Cell disruption methods. Cell lysis and Flocculation: Osmotic and mechanical methods of lysis. Flocculation by electrolysis; polymorphic flocculation.

Unit – 4

Filtration: Principles, Conventional, Crossflow filtration. Sedimentation: Principles, Sedimentation coefficients. Extraction Principles, Liquid – liquid extraction, aqueous two phase extraction, supercritical fluid extraction.

Unit – 5

Membrane separation – ultrafiltration, precipitation methods: liquid-liquid extraction, aqueous two phase extraction. Drying –Principles and operation of vacuum dryer, shelf dryer, rotary dryer, freezer and spray dryer.
Formulation methods.

PRACTICAL-III

(a) Bioinformatics-practical

1. Sequence retrieval from Genbank
2. Sequence retrieval from Uniprot.
3. Sequence identity search- Sequence similarity search using BLAST
4. Sequence similarity search using FASTA
5. Sequence similarity search using PSI BLAST
6. Sequence similarity search using PHI- BLAST.
7. Prediction of signal sequence using SignalP online tool
8. Pattern Search (Domains & Motifs) using Pfam
9. ORF gene Search - Genscan
10. Sequence translation using ExPASy translate tool
11. Characterization of retrieved protein sequence by Prot Param tool.
12. Pair-wise global sequence alignment using EBI-EMBOSS Needleman Wunsch tool
13. Pair-wise local sequence alignment using EBI-EMBOSS Smith Waterman tool
14. Multiple sequence alignment using EBI-CLUSTALW2.
15. PHYLOGENY- Phylogenetic tree using PHYLIP.
16. Prediction of secondary protein structure using GOR (Garnier Osguthorpe-Robson) server.
17. Prediction of tertiary protein structure using SWISS-MODEL Server18. Validation of the predicted structure using PROCHECK server
19. Molecular visualization of proteins using RASMOL.
20. Docking of small molecule with protein structure using Hex software.
21. Docking of two proteins using Patch Dock (Protein-Protein docking) tool.
22. Retrieval of *E.Coli* glycolytic pathway from KEGG.

(b) Immunology - practical

1. Identification of various immune cells from human peripheral blood.
2. Lymphocyte separation and identification
3. Determination of lymphocyte viability by trypan blue method
4. WBC counting
5. Preparation of serum and plasma
6. Electrophoretic profile of human serum in native PAGE
7. Preparation of cellular antigen – human RBC
8. Preparation of antigen-adjuvent mixture for production of polyclonal antibody
9. Isolation of IgG molecule from serum
10. Immunodiagnostics: CRP
11. Immunodiagnostics: ASO
12. Immunodiagnostics: Widal
13. Immunodiagnostics: RF
14. Immunodiagnostics: Blood grouping and typing
15. Immunodiagnostics: hCG
16. ELISA
17. Radial Immunodiffusion
18. Ouchterlony Immunodiffusion
19. Immuno electrophoresis
20. Rocket electrophoresis
21. Counter current immune electrophoresis.
22. Bioassays for cytokines
23. Radio immunoassays (Demonstration)

(c) Bioprocess Technology - Practical

1. Parts and design of fermenter
2. Solid state fermentation
3. Submerged fermentation
4. Foaming and antifoaming agents
5. Media preparation and sterilization
6. Isolation of industrially important microorganisms for microbial processes.
7. Conservation of Bacteria by Lyophilization.
8. Production and estimation of protease
9. Production and estimation of amylase.
10. Production of wine using grapes
11. Production of penicillin
12. Determination of penicillin activity
13. Citric acid production
14. Use of alginate for cell immobilization.
15. Media standardization (C:N ratio) for maximum biomass production of an industrially important microorganism.
16. Cell disruption (Sonication)
17. Aqueous Two Phase Extraction of enzymes.

MOLECULAR DEVELOPMENTAL BIOLOGY

Course Code: MDKAJ

Course Objective

- To develop the skill of observing developing organisms
- TO know about the developmental stages of all the organs
- To learn about the Different pathways
- To analyze about the different phases of cell cycle
- To know clearly about the cellular mechanisms that regulate cell death and apoptosis

Course Outcome

Molecular Developmental Biology	
CO1	Helps to understand about different developmental stages and the mechanism like instructive and permissive interactions and the signaling pathway
CO2	To gain knowledge about the fertilization process, types, mechanism and molecular recognition of egg and sperm
CO3	To acquire knowledge about the cleavage and gastrulation in gastrulation in xenopus, click and mammals
CO4	To gain comprehensive knowledge about the vertebrate development like formation of neural tube and eye development
CO5	Students can gain knowledge about the development disorders and drosophila maternal effect genes

Syllabus

Unit – 1

Gamete cells: Dynamics of the Sperm and Egg, Spermatogenesis, Oogenesis, Sperm and oocyte maturation, Instructive and permissive interactions, competence, epithelial- mesenchymal interactions. Important signaling pathways in vertebrate development.

Unit – 2

Fertilization: Fate Maps, Nieuwkoop center, molecular role of organizer, Types of fertilization, Molecular recognition of egg and sperm, fusion and prevention of polyspermy, rearrangement of egg cytoplasm and activation of egg.

Unit – 3

Cleavage and gastrulation: Cleavage in Xenopus, Chick and mammals, Regulation of cleavage cycle. Morphogenetic movements, Gastrulation in Xenopus, chick and mammals.

Unit – 4

Vertebrate Development: Formation of the neural tube, mechanism of vertebrate eye development, myogenesis, and hematopoiesis.

Unit – 5

Drosophila Maternal effect genes, induction at single cell level differentiation of photoreceptors in ommatidia. Developmental disorders – Spina bifida, Anenecephaly, and craniorachischis, Cyclopia, Thanotrophic dysplasia.

LIFE STYLE-DISEASE AND PREVENTION

Course Code: MENBB

Course Objective

- This course aims to implement the importance of individual general healthcare system
- To provide depth knowledge on the dietary management of hypertension
- Enhance their knowledge on different types of cancer with treatment
- Inculcate the depth understanding on age related diseases
- Describe on causes, symptoms, preventive aspects on treatment of gall stone

Course Outcome

Life Style-Disease And Prevention	
CO1	Students can understand the causes on consequence of obesity
CO2	They can have a depth knowledge on hypertension and its dietary management
CO3	Students can know about diagnosis and treatment of different types of cancer
CO4	Awareness on several age related diseases such as dementia osteoporosis and osteoarthritis
CO5	They gain knowledge on causes and prevention of gall stone and ulcer

Syllabus

UNIT-1

Obesity – Prevalence- causes, Consequences (Symptoms-coronary heart disease and type2 diabetes mellitus-lifestyle and dietary management of obesity

UNIT-2

Hypertension-blood pressure-normal level of blood pressure, dietary management of hypertension, stroke and chronic renal failure due to

hypertension-kidney stone-causes, types, symptoms and treatment(only lethotrophy), dietary management for prevention of kidney stone

UNIT-3

Cancer-types of cancer, aetiology of breast cancer, diagnosis (self examination, Mammography) and treatment (radiation, chemotherapy, surgery). Cervical cancer-causes types of cervical cancer, symptoms, diagnosis and treatment (radiation, chemotherapy, surgery) Cigarette smoking and symptoms, diagnosis and treatment (chemotherapy)

UNIT-4

Aging factors influencing aging. Age related diseases –dementia, osteoporosis. Osteoarthritis- causes, sign and symptoms, preventive measures of aging with special reference to antioxidants

UNIT-5

Gallstone- causes, factor, aetiology of gall stone, type of gall stone, symptoms, preventive aspects of gall stone. Drug therapy- ursodeoxy cholic acid, surgical treatment and dietary management. Ulcer-Causes and prevention

FOURTH SEMESTER

RESEARCH METHODOLOGY

Course Code: MDK4A

Course Objective

- Understands some basic concepts of research and its methodology
- Identify appropriate research topics
- Preparation of project proposal
- Organize and conduct research in more appropriate manner
- Write a research report, thesis and proposal

Course Outcome

Research Methodology	
CO 1	Students can acquire knowledge about the research methodology like objective, types, research approaches and importance
CO 2	Students can able to write the research report (thesis and publications)
CO 3	Students have depth knowledge about analysis of variance components (ANOVA) for fixed effect model and factorial design
CO 4	Students will gain knowledge in spread sheet tool, applications, features and functions
CO 5	Students acquire knowledge on creating presentation, customizing presentation and showing presentation

Syllabus

Unit-1

Research Methodology - An Introduction: Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Importance of knowing how research is done, Research Process, Criteria of good research. Defining the Research Problem; Research Design; Sampling Design; Methods of Data Collection; Processing and Analysis of Data; Sampling Fundamentals; Testing of Hypothesis.

Unit-2

Writing the Research Report (Thesis and publications): Components of research report - Title, Authors, Addresses, Abstract, Keywords, Introduction, Materials and Methods, Results, Discussion, Summary, Acknowledgements and Bibliography.

Unit-3

Analysis of Variance components (ANOVA) for fixed effect model; Total, treatment and error of squares, Degrees of freedom, Confidence interval; ANOVA for random effects model, Estimation of variance components, Model adequacy checking. Two factor Factorial Design, Basic definitions and principles, main effect and interaction, response surface and contour plots, General arrangement for a two factor factorial design; .

Unit 4

Spreadsheet Tool: Introduction to spreadsheet application, features and functions, Using formulas and functions, Data storing, Features for Statistical data analysis, Generating charts/ graph and other features.

Unit-5

Tools used may be Microsoft Excel, Open office or similar tool. Presentation Tool: Introduction to presentation tool, features and functions, Creating presentation, Customizing presentation, Showing presentation. Tools used may be Microsoft Power Point, Open Office or similar tool. Web Search: Introduction to Internet, Use of Internet and WWW, Using search engine like Google, Yahoo etc, and Using advanced search techniques.

STEM CELL BIOLOGY

Course Code: MDKAK

Course Objective

- This course aims to learn fundamental process of human embryology
- To know about human embryology and developmental biology
- To learn about the progression of pluripotent stem cells through different phases of development
- To know about molecular mechanisms and cell biology
- To learn about the research and application of stem cells science and human health

Course Outcome

Stem Cell Biology	
CO1	To get clear idea about the stem cell niche, specification and drosophila germ line stem cells
CO2	To know about the stem cell niche, specification and drosophila germ line stem cell.
CO3	To acquire knowledge about characteristics of stem cell, cell cycle, Ras/Rat pathway, P13k cell signaling , P53 check points in cell cycle control
CO4	To gain knowledge about chromatin modification and transcriptional regulation
CO5	Students acquire knowledge in therapeutic applications of embryonic stem cells and ethics in human stem cell research

Syllabus

Unit – 1

Stem cells - Definition, Characterization, Pluripotency, Self renewal and differentiation.

Unit – 2

Stem cell niche, Niche specification - Drosophila germ line stem cells. Adult stem cell from amniotic fluid, cord blood and tooth primordial.

Unit – 3

Characteristics of stem cell- cell cycle, Ras/Raf pathway, pI3K cell signaling, p53 check points, Role of LIF pathway in cell cycle control.

Unit – 4

Chromatin modification and transcriptional regulation, chromatin modifying factors, Chromosomal inactivation.

Unit – 5

Therapeutic applications of Embryonic stem cells, Bone marrow stem cells, Adipose derived stem cells and Hematopoietic stem cells in Heart regeneration and neural defects. Ethics in human stem cell research.

BIOETHICS, HUMAN RIGHTS AND SOCIAL ISSUES

Course Code: MDKAL

Course Objective

- This course aims to study about ethics, human rights and social issues
- Evaluate multiple perspective concerning bioethical issues and recognize different value system may lead to different ethical decision
- To asses complex bioethical issues and the processes used to build resolution
- To identify the reason advancement in this areas have influenced current bioethical issues

Course Outcome

Bioethics, Human Rights And Social Issues	
CO1	Students acquire knowledge about historical development of human rights relation- international and national instruments
CO2	To gain knowledge about European convention for human right, UDHR, civil, political rights and article of Indian constitution
CO3	To know about human relations, political relations, ethnic, human rights and communal relations
CO4	To have insights on assignment, case study, Term paper etc
CO5	To gain knowledge on the impact of gene cloning and bioethics and about genetically modified organisms

Syllabus

Unit – 1

Introduction: Historical development of Human Rights and Human Relations – International and National. International Instruments: United Nation Commission for Human Rights.

Unit – 2

European Convention for Human Rights, UDHR, Civil and Political Rights National Instruments: National and State Instruments: Development of Human Rights – Article 21 of Indian Constitution.

Unit – 3

Human Relations: Political relations, Ethnic and Communal relations, Socio-cultural relations, Organization relation etc., and related Human Rights. Economics of Human Rights and Relations – Adam Smith's thoughts on moral sentiments.

Unit – 4

Student's Activity: Assignment/Case study/Term paper etc.,

Unit – 5

Impact of gene cloning and Bioethics. Intellectual Property Rights (IPR) and patents, biosafety, containment facilities for Genetic Engineering experiments, Regulations on field experiments and release of GMO's (Genetically Modified Organisms), labeling of GM (Genetically Modified) Foods.