ANNEXURE - I KVR GOVT. COLLEGE FOR WOMEN (AUTONOMOUS), KURNOOL Re-Accredited by NAAC with Grade "A"

(w. e. f. 2020-2021)

DEPARTMENT OF BIOTECHNOLOGY THIRD YEAR – V SEMESTER SYLLABUS PAPER V- MOLECULAR BIOLOGY

Total Hours : 48 Hrs

Credits : 4

COURSE OBJECTIVES :

1. This paper aims to provide students with an extensive understanding of the basic concepts of molecular biology.

2. The course comprises of the structural and functional aspects of basic biomolecules such as DNA, RNA and protein and the mechanisms of DNA replication, transcription, translation and gene regulation.

3. The course facilitates the students to have a strong understanding of the molecular basis of life and the underlying genetic principles.

LEARNING OUTCOME :

1. The outcome of this paper is that the student will have the basic knowledge on the macromolecules that store, transmit and execute the genetic information in a living system and the molecular mechanism of the flow of information in the living system.

2. This theoretical knowledge will help the students to learn basics of genetic engineering and rDNA technology that makes the basis of modern biotechnological research and industry.

Unit I : Introduction to molecular biology

No. of Hours : 9

Structure and functions of DNA- Watson and Crick model of DNA, Chargaff's Rule, Types of DNA (A,B,C,D and Z DNA), Physical, chemical and spectroscopic properties of DNA, Structure and functions of RNA, Types of RNA : m-RNA, t-RNA, r-RNA, Polycistronic and monocistronic RNA

Concepts of genetic material - Experiments to prove DNA as genetic material(Griffith Experiment, Hershey- Chase Experiment), RNA as genetic material.

Unit II: DNA Replication

Enzymology of replication(DNA polymerase I, Pol II, and III, helicase, topoisomerase, single strand binding proteins, DNA melting proteins, primase). Proof of semiconservative replication – Meselson and Stahl experiment, Replication origins, initiation, elongation, and termination. Rolling circle replication. Inhibitors of DNA replication.

DNA damage and repair: causes and types of DNA damage – Gene mutations, Spontaneous mutations, Induced mutations.

Mechanism of DNA repair: Photoreactivation, Base excision repair, Nucleotide excision repair, mismatch repair, Recombination repair.

Unit III : Transcription

Enzymatic synthesis of RNA, Basic features of transcription, structure of prokaryotic RNA polymerase(core enzyme and holo enzyme, sigma factor), concept of promoter (Pribnow box, - 10 and -35 sequences), Four steps of transcription (promoter binding and activation, RNA chain initiation, chain elongation, termination and release) in prokaryotes and eukaryotes. Reverse transcription.

Unit IV : Genetic code and Protein synthesis

Genetic code, Features of genetic code, Splicing, Post transcriptional modification, Wobble hypothesis, Initiation, Elongation and Termination of proteins in prokaryotes and eukaryotes, Post translational modification, Inhibitors of Protein synthesis.

Unit V : Gene Expression and Regulation

No. of Hours : 9

No. of Hours : 10

Regulation of gene expression, Clustered genes and the operon concept- Negative and Positive control of the Lac operon, Trp operon.

Regulation of gene expression in eukaryotes- Conserved mechanism of regulation, Eukaryotic activators, Combinatorial control, Transcriptional repressors, Gene silencing.

BOOKS RECOMMENDED :

- Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
- De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology.VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
- Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.

No. of Hours : 10

 Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.

ONLINE READING MATERIAL ;

- 1. https://www.easybiologyclass.com/molecular-biology-online-tutorials-lecture-notes-study-materials/
- 2.<u>https://ocw.mit.edu/courses/biology/7-01sc-fundamentals-of-biology-fall-2011/molecular-biology/</u>
- 3. <u>https://www.edx.org/learn/molecular-biology</u>
- 4. <u>https://dc.uwm.edu/cgi/viewcontent.cgi?article=1009&context=biosci_facbooks_bergtrom</u>

PRACTICAL SYLLABUS

Total Hours : 24 Hrs

Credits : 2

PAPER V- MOLECULAR BIOLOGY

- 1. Effect of UV radiations on the growth of microorganisms.
- 2. Isolation of genomic DNA from E.coli.
- 3. Isolation of plasmid DNA from bacteria.
- 4. Isolation of DNA from sheep liver.
- 5. Isolation of DNA from plant leaves (Rice or Tobacco or any other plant)
- 6. Determination of absorption maxima of DNA and RNA and their quantification.
- 7. Quantitative estimation of RNA.
- 8. Quantitative estimation of DNA.
- 9. Separation of DNA by Agarose Gel Electrophoresis.
- 10. Purity analysis of the nucleic acid

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DEPARTMENT OF BIOTECHNOLOGY THIRD YEAR – V SEMESTER SYLLABUS PAPER VI- RECOMBINANT DNA TECHNOLOGY

COURSE OBJECTIVES

1. The objective of the course is to familiarize the students with the basic concepts in Genetic Engineering.

2.To acquaint the students to versatile tools and techniques employed in Genetic Engineering

3.To appraise them about applications of recombinant DNA technology.

LEARNING OUTCOME:

1. The students will have knowledge of tools and strategies used in Genetic Engineering.

2. The students shall understand applications of recombinant DNA technology and apply the knowledge in problem solving and in practice

Total Hours : 48 Hrs

Unit I : Outlines of Genetic Engineering

Restriction and modification: Classification and Nomenclature of restriction endonucleases. Enzymes used in molecular cloning : Polymerases, Ligases, Phosphatases, Kinases, Telomerases and nucleases. Cohesive end ligation, Blunt end ligation.

Unit II : Cloning vector

General features of a vector, Types of vectors : Cloning vectors- Plasmid- pBR 322, Bacteriophage - Lambda phage (Insertional and Replacement vectors), Cosmids. Expression Vectors, Shuttle vectors.

Unit III : Screening methods

Selection of transformed cells - Insertional inactivation, Colony hybridization, Blue white screening. Blotting techniques- Southern, Northern, Western blotting, Restriction mapping, RFLP, RAPD.

Unit IV : Methods of gene transfer in prokaryotes and eukaryotesNo. of Hours : 9(i) Physical methods-Microinjection, Microprojectile bombardment, Electroporation

No. of Hours : 10

No. of Hours : 9

No. of Hours : 10

Credits : 4

(ii) Chemical methods : CaCl2 method, Poly Ethylene Glycol method ,Lipofection

(iii)Biological methods-Agrobacterium mediated transformation, Retroviral infection.

Unit V : Methods of gene sequencing

No. of Hours : 10

Maxam - Gilbert's and Sanger's dideoxy chain termination methods, Automated DNA sequencing, Construction and Advantages of genomic and cDNA libraries, Principle and applications of Polymerase chain reaction, Types of PCR – RT PCR, Nested PCR and DNA fingerprinting.

BOOKS RECOMMENDED :

1. Principles of Gene Manipulation by S.B. Primrose, RM Twyman and RW Old (6thEdition) 2. Principles of Gene Manipulation and Genomics SEVENTH EDITION S.B. Primrose and

R.M. Twyman

3. Biotechnology by BD Singh

4. Recombinant DNA: A Short Course by JD Watson, J. Tooze and DT Kurtz.

5. From Genes to Genomes: Concepts and Applications of DNA Technology by JW Dale and M Schantz

6. Molecular Biotechnology: Principles & Applications of Recombinant DNA Glick BR and Pasternak JJ

ONLINE READING MATERIAL

1. <u>https://ocw.mit.edu/courses/biology/7-01sc-fundamentals-of-biology-fall-2011/resource-index/</u>

- 2. <u>https://microbenotes.com/recombinant-dna-technology-steps-applications-and-limitations/</u>
- 3. https://byjus.com/biology/recombinant-dna-technology/

PRACTICAL SYLLABUS

Total Hours : 24 Hrs

- 1. Problems in genetic engineering.
- 2. Transformation in bacteria using plasmid.
- 3. Restriction digestion of DNA and its electrophoretic separation.
- 4. Ligation of DNA molecules and their testing using electrophoresis.
- 5. Activity of DNAase and RNAase on DNA and RNA.
- 6. Isolation of plasmid DNA.
- 7. PCR as diagnostic tool

Credits : 2

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DEPARTMENT OF BIOTECHNOLOGY III B.Sc – VI SEMESTER SYLLABUS PAPER VII B- BIOENERGETICS AND INTERMEDIARY METABOLISM

Total Hours : 48 Hrs

Credits: 4

COURSE OBJECTIVES :

1. This paper aims to provide students with an extensive understanding of the reactions involved in the breaking down and building up of biomolecules.

2. The course affords students opportunity to appreciate the relevance/ applications of biochemistry in our daily activities.

3. The course describes all reactions concerned with the storage, generation of metabolic energy required for the biosynthesis of low molecular weight compounds & energy storage compounds.

LEARNING OUTCOME :

1. The students will attain inter- disciplinary knowledge and understanding of biochemistry, structure and function of biological molecules

2. The students will be able to explain some of the molecular events that occur during normal and abnormal biomolecular activities.

Unit I : Bioenergetics

No. of Hours : 9

Laws of thermodynamics, equilibrium constant, coupled reactions, phosphorylation potential, phosphoryl group transfers, Redox reactions, standard redox potentials and Nernst equation. Energy transformations in the living system, Free energy concept, Exergonic and Endergonic reactions, High energy compounds, Phosphate group transfer potential, Substrate level phosphorylation

Unit II : Carbohydrate metabolism

Concept of Anabolism and Catabolism, Glycolytic pathway, Energy yield, Citric Acid Cycle, Energy yield, Glycogenolysis, Glycogenesis, Gluconeogenesis, Pentose Phosphate pathway, Glyoxylate cycle and its importance.

Unit III: Lipid metabolism

Catabolism of fatty acids(β - oxidation), Ketogenesis, denovo synthesis of fatty acids, elongation of fatty acids in mitochondrial microsomes, Biosynthesis of triacyl glycerol and Cholesterol.

Unit IV : Aminoacid and nucleic acid metabolism No. of Hours : 10

Degradation of proteins - Deamination, Transamination and Decarboxylation, Urea Cycle and regulation, Transport of Ammonia, Ketogenic and Glucogenic aminoacids, Inborn errors of amino acid metabolism, Biosynthesis and degradation of purine and pyrimidine nucleotides.

Unit V : Biological oxidation

Enzymes in biological oxidation, Redox potential, Mitochondrial Electron transport chain and its inhibitors, Structure of ATPase complex, Chemi Osmotic theory, Oxidative phosphorylation and its inhibitors.

BOOKS RECOMMENDED :

1.Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning

2.Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone

3.Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman

4.Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company

ONLINE READING MATERIAL

Functions Biomolecules URL--1. of Chapter on Structures and http://nsdl.niscair.res.in/handle/123456789/59

2. Chapter Enzymes Microbial Physiology Biochemistry on in and URLhttp://nsdl.niscair.res.in/handle/123456789/392

No. of Hours : 10

No. of Hours : 9

PRACTICAL SYLLABUS

PAPER VII B – BIOENERGETICS AND INTERMEDIARY METABOLISM

- 1. Estimation of glucose by DNS method.
- 2. Estimation of glucose by Benedict's titrimetric method.
- 3. Estimation of total carbohydrates by Anthrone method.
- 4. Estimation of blood glucose.

Total Hours : 24 Hrs

- 5. Estimation of protein by Biuret method.
- 6. Estimation of protein by Lowry method
- 7. Estimation of amino acid by Ninhydrin method.
- 8. Estimation of bilirubin (conjugated and unconjugated) in serum.
- 9. Assay of salivary amylase.
- 10. Isolation of cholesterol from egg yolk and its estimation

Credits : 2

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DEPARTMENT OF BIOTECHNOLOGY

III B.Sc – VI SEMESTER SYLLABUS

PAPER VIII B1- PLANT AND ANIMAL BIOTECHNOLOGY

Total Hours : 48 Hrs

Credits : 4

COURSE OBJECTIVES :

1. To accomplish these goals, biotechnologists develop products to protect animals and crops from disease and help farmers identify the best animals and seeds to use in selective breeding programs

2. Use of scientific tools and techniques, including genetic engineering, molecular markers, molecular diagnostics, vaccines, and tissue culture, to modify plants and animals.

3. To supply farmers with tools to increase the yield of plant and animal products, while lowering the costs of production.

LEARNING OUTCOME :

The students will

1. become familiar with sterile techniques, media preparation, DNA extraction methods, gene isolation and nucleotide sequence analysis

2. acquaint with principles, technical requirement, scientific and commercial applications in Plant Biotechnology

3. Be able to describe the structure of animal genes and genomes.

4. Be able to describe how genes are expressed and what regulatory mechanisms contribute to control of gene expression.

UNIT I: Plant cell and tissue culture

Introduction to Plant cell and tissue culture laboratory facilities, sterilization methods in tissue culture, Tissue culture media (composition and preparation), Growth Hormones, Cellular totipotency, Callus and suspension cultures-applications.

UNIT II: Tissue and micro-propagation

Protoplast culture, Somatic hybridization, Cybrids, Somatic embryogenesis, Artificial seeds, Haploid and Triploid production-applications, , Virus free plants, Micro-propagation.

UNIT III: Animal cell and tissue culture No. of Hours: 10

Introduction to Animal cell and tissue culture laboratory facilities, Animal culture media, Growth factors, Cell lines, Characters of cells in culture: Contact inhibition, anchorage dependence, Cell – Cell communication, Cell senescence.

UNIT IV: In Vitro Fertilization and Embryogenesis No. of Hours : 10

Fertilization of sperm and oocytes, Cleavage- Morula, Blastulation & Gastrulation.

IVF – Infertility in male and female: causes, diagnosis and management; Sperm banks, frozen embryos, IVF and embryo transfer technique.

UNIT V: Plant & Animal Biotechnology- applications Concept of Gene Therapy, Application of transgenic animals, Applications of transgenic plants in Indianagriculture, Biofertilizers- Rhizobium, Azolla, Phosphate Solubilizing Bacteria, Mycorrhizae and Biopesticides- Bacillus thuringenisis, Trichoderma, Baculovirus

BOOKS RECOMMENDED :

1. Plant Tissue Culture and its Biotechnological Applications By W. Barz, E. Reinhard, M.H. Zenk

- 2. Plant Tissue Culture By Akio Fujiwara
- 3. Frontiers of Plant Tissue Culture By Trevor A. Thorpe
- 4. In vitro Haploid Production in Higher Plants by S. Mohan Jain, S.K. Sopory, R.E. Veilleux
- 5. Plant Tissue Culture : Theory and Practice By S.S. Bhojwani and A. Razdan

No. of Hours : 10

No. of Hours : 9

6. Plant Cell, Tissue and Organ Culture, Applied and Fundamental Aspects By Y.P.S. Bajaj and

A. Reinhard

7. Strategies in Transgenic Animal Sciences - By Glemn M.M. and James M. Robl ASM

8. Practical Biotechnology – Methods and Protocols - By S. janarthanan and S. Vincent

(Universities Press)

9. Animal Cells as Bioreactors - By Terence Gartoright, Cambridge Univ Press

Web Links for Additional information:

- 1. https://nptel.ac.in/courses
- 2. http://illl.du.ac.in/
- 3. http://epgp.inflibnet.ac.in
- 4. https://www.vlab.co.in/
- 5. https://praxilabs.com/
- 6. <u>https://vlab.amrita.edu/index.php</u>
- 7. https://sites.dartmouth.edu/teachremote/remote-lab-activities-and-experiences

PRACTICAL SYLLABUS

Total Hours : 24 Hrs

Credits : 2

PAPER VIII B1- PLANT AND ANIMAL BIOTECHNOLOGY

- 1. Plant Culture Media
- 2. Multiple shoot induction
- 3. Rhizogenesis Rooting of shoot explants
- 4. Callus induction.
- 5. Suspension culture.
- 6. Determination of seed viability.
- 7. Animal culture media
- 8. Cell count by Hemocytometer.
- 9. Measurement of cellsize.
- 10. Microphotography.

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DEPARTMENT OF BIOTECHNOLOGY THIRD YEAR – VI SEMESTER SYLLABUS PAPER VIII B2- ENVIRONMENTAL AND INDUSTRIAL BIOTECHNOLOGY Total Hours : 60 Hrs Credits : 4

COURSE OBJECTIVES :

1. Introduce the student to different fields of biotechnology for the sustainable development of environment.

2.Emphasize the knowledge of the different types of biotechnological processes that exist in the field of environmental applications.

3.Introduce the wide range of professional activities linked to biotechnological knowledge and provide the foundations of intimate interrelation between the scientific field and the human society.

LEARNING OUTCOME :

1. Describe the scientific bases that are applied by environmental biotechnology.

2. Describe the properties of microorganisms with potential application in the field of environmental biotechnology.

3. To know the role of microorganisms as biotechnological agents.

4. Study bioreactors for environmental application.

Unit I : Energy resources

Renewable and non – renewable resources of energy, Conventional fuels and their environmental impact, Production of biofuels – biodiesel and biohydrogen.

Unit II: Waste Management

BOD, COD, Eutrophication. Microbial treatment of waste water (Sewage and industrial effluents) – aerobic and anaerobic methods, Solid waste management, Genetically engineered microbes in treatment of waste water

No. of Hours : 9

Unit III : Bioremediation

Bioremediation – concepts and types (in-situ and ex-situ), Bioremediation of toxic metal ionsbiosorption and bioaccumulation, Microbial bioremediation of pesticides and xenobiotic compounds, Phytoremediation – concepts and applications. Pseudomonas putida – super bug

Unit IV : Microbial Fermentation

Introduction to industrial biotechnology, Primary and secondary metabolic products of microorganisms, Screening, isolation and preservation of microorganisms, Strain improvement, Preservation of microorganisms, Fermenter design, Submerged and solid state fermentation

Unit V : Microbial technology products and applicationNo. of Hours : 9Microbial production of Organic acids (Citric acid), Enzymes(Amylase), antibiotics (Penicillin),

Vitamins (Vit.B12), Dairy products (Yoghurt and Cheese) and Bioethanol.

BOOKS RECOMMENDED :

- 1. Text Book of Biotechnology By H.K. Das (Wiley Publications)
- 2. Biotechnology -By H.J. Rehm and G. Reed. VIH Publications, Germany
- 3. Biogas Technology By b.T. Nijaguna
- 4. Biotechnology By K. Trehan
- 5. Industrial Microbiology By L.E. Casida
- 6. Food Microbiology By M.R. Adams and M.O. Moss
- 7. Introduction to Biotechnology By P.K. Gupta
- 8. Bioprocess Engineering By Shuler (Pearson Education)

ONLINE READING MATERIAL :

- 1.http://www.brainkart.com/subject/Environmental-Biotechnology_242/
- 2.https://www.elsevier.com/books/environmental-biotechnology/vallero/978-0-12-407776-8
- 3.http://brteam.ir/phocadownload/environmental%20biotechnology.pdf
- 4.http://library.um.edu.mo/ebooks/b28045907.pdf

No. of Hours : 10

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PRACTICAL SYLLABUS

Total Hours : 24 Hrs

Credits : 2

PAPER VIII B2 – ENVIRONMENTAL AND INDUSTRIAL BIOTECHNOLOGY

1. Isolation of industrially important microorganisms from soil.

2. Isolation of amylase producing organisms from soil.

3. Production of α amylase form Bacillus spp. by shake flask culture

4. Production of alcohol or wine

5. Estimation of alcohol by colorimetric method

6.Citric acid production by submerge fermentation

7. Estimation of citric acid by titrimetry

8. Estimation of Dissolved oxygen in water samples

9. Isolation of microbes from industrial effluents

10. Quality testing of milk by MBRT

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DEPARTMENT OF BIOTECHNOLOGY

THIRD YEAR – VI SEMESTER SYLLABUS

PAPER VIII B3- BIOINFORMATICS, BIOSTATISTICS, BIOETHICS, BIOSAFETY AND IPR

Total Hours : 60 Hrs

COURSE OBJECTIVES :

1. To create awareness about broader global ethical issues in healthcare

2. To familiarise students with the issue of religious diversity in healthcare, particularly at the end of life

3. To build up information resources, prepare database on biotechnology and to develop relevant information handling tools and techniques.

LEARNING OUTCOME :

The students will be able to

1. synthesise information to discuss the key technological developments that enabled modern genomic and proteomic studies.

2. describe advanced genomics and proteomics technologies and the ways in which their data are stored.

3. use bioinformatics techniques to query examples of genomic and proteomic databases to analyse cell biology

Unit I : Bioinformatics and Biostatistics

Introduction, Branches of Bioinformatics, Branches of Bioinformatics, Aim and Research Areas of Bioinformatics, Biological databases- nucleotide and protein sequence databases, biological data analysis and application, sequence data bases, NCBI – tools, databases and retrieval tools. Sequence analysis tools – EMBL, PDB, DDBJ, PIR, SWISS PROT, ENSEMBLE, Mean, Median, Mode, Standard Deviation.

Unit II: Genomics, Proteomics and Sequence alignmentNo. of Hours : 9

Genomics, Proteomics, Concept of alignment, Multiple sequence alignment, Local and global alignment BLAST, FASTA Algorithms, Phylogenetic Analysis, Genome Annotation: Pattern and repeat finding, Gene identification tools.

Credits : 5

Unit III : Bioethics

Bioethics – Introduction, Principles, Theories [Utilitarianism and deontology], Informed consent, Patient autonomy, Patient confidentiality, Paternalism and liberty; Applications of bioethical principles – Euthanasia, Abortion, determination of death biologically, IVF, stem cell technology; health ethics, Professional ethics.

Unit IV : Biosafety

Definition, historic evolution, Codes and guidelines, Universal Principles, Role of Institutional Biosafety committee. Review committee on genetic manipulations. Biosafety assessment for biotech foods and related products - LMO,GMO.

Unit V : INTELLECTUAL PROPERTY RIGHTS

Types of Intellectual property rights - patent, trademarks, copyright, design registration, trade secret, geographical indicators, plant variety protection.

Patents- objectives, rights, procedure of obtaining and working of patents, infringement. Copyrights - works protected under copyright law, rights, transfer of copyright.

Trademarks - protection of good will.

Geographical indications – International position, multilateral treaties, national level, Indian position.

International organizations – World Trade Organization (WTO), Trade-Related Aspects of Intellectual Property Rights (TRIPS), General Agreement on Tariffs and Trade (GATT).

BOOKS RECOMMENDED :

1. Bioinformatics and Bioprogramming in C - By L.N. Chavali

- 2. Introduction to Bioinformatics By V. Kothekar
- 3. Introduction to Bioinformatics By Arthur M. Lesk
- 4. Biosafety and Bioethics" by Rajmohan Joshi
- 5. Bioethics and Biosafety in Biotechnology" by V Sree Krishna

6. Biotechnology, IPRs and Biodiversity - By M.B. Rao and Manjula Guru (Pearson Education)

7. Text Book of Biotechnology- By H.K. Das (Wiley Publications)

ONLINE READING MATERIAL

- 1. <u>http://www.freebookcentre.net/Biology/BioInformatics-Books.html</u>
- 2. <u>https://www.who.int/csr/resources/publications/biosafety/Biosafety7.pdf</u>
- 3. <u>https://ncdc.gov.in/WriteReadData/I892s/File608.pdf</u>

No. of Hours : 10

No. of Hours : 10

PRACTICAL SYLLABUS

Total Hours : 24 Hrs Credits : 2 PAPER VIII B3- BIOINFORMATICS,BIOSTATISTICS BIOETHICS, BIOSAFETY AND IPR

- 1. Nucleic acid databases
- 2. Protein databases
- 3. Sequence alignment using BLAST
- 4. Retrieval of information from nucleotide databases
- 5. Genome analysis

6. Project work -

Case studies in :

- 1. Euthanasia
- 2. Death & Dignity.
- 3. A defense of Abortion.
- 4. Ethical dilemma's.
- 5. IVF
- 6. Stem cell Cultures
- 7. Prenatal diagnosis of genetic disorders.
- 8. Pedigree analysis in disease conditions, risk calculations.
- 9. Sequence alignment comparative study
- 10. Phylogenetic tree construction