CMS COLLEGE OF SCIENCE AND COMMERCE

(AUTONOMOUS)

Chinnavedampatti, Coimbatore - 641 049

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DEPARTMENT OF BIOTECHNOLOGY

II Year M.Sc., Biotechnology

CURRICULUM, SCHEME OF EXAMINATION AND SYLLABI (CBCS)

(2011)

(FOR THE STUDENTS ADMITTED DURING THE ACADEMIC YEAR 2010)

DEPARTMENT OF BIOTECHNOLOGY

M.Sc., Biotechnology

REGULATIONS

INTRODUCTION

BIOTECHNOLOGY

Any technology application that uses biological systems, living organisms or derivatives thereof, to make or modify product and processes for specific use

OBJECTIVES

On successful completion of the course, students will thoroughly understand what is Biotechnology, various Biotechnological processes, fundamental techniques in Biotechnology, as well as key applications of Biotechnology in various fields, such as Medical Biotechnology, Pharmaceutical Biotechnology, Animal Biotechnology, Plant Biotechnology, Immunotechnology, Genetic Engineering and Recombinant DNA Technology, Microbial Biotechnology, Bioprocess Technology, Fermentation Technology, Genomics & Proteomics, Molecular Biology, IPR, IPP and Patenting of live forms, Germplasm preservation & Cloning of animals, and Nanobiotechnology. Students will also be acquainted with recent trends, developments, and advancements in Biotechnological research

ELIGIBILITY

B.Sc. Degree in Biology/ Biochemistry, or B.Sc. Degree in Chemistry (with Ancillary in any Life Science subject), B.Sc. in Biotechnology/ Polymer Chemistry/ Microbiology/ Zoology/ Botany/ Plant science/ Plant Biotechnology/ Industrial Chemistry/ Applied Microbiology/ Medical Microbiology/ Human Genetics/ Medical Genetics/ Molecular Biology/ Genetics Technology/ Environmental Science/ Environmental Biotechnology/ Genetic Engineering/ Bioinformatics/ Plant Biology and Biotechnology/ Animal Cell and Biotechnology/ Biological Techniques and Specimen Preparation/ B.Sc. Agriculture/ B.F.S./ B.Pharm/ B.E./ B.Tech., M.B.B.S and B.V.Sc.

DURATION OF PG COURSE

The course shall extend over a period of two years comprising of four semesters, with two semesters per year. There shall not be less than ninety instructional days during each semester. Examination shall be conducted at the end of each semester for the respective subject

DISTRIBUTION OF THE MARKS AND CREDITS UNDER CBCS

PART	SUBJECT@	No of Papers	Marks @	Credits
I	Core Subjects and core practicals $	17	1700	68
II	Elective Subjects	4	400	16
III	Project	1	150	6
	Total		**2250**	**90**

Note: I

@ Includes 25/40 % continuous assessment marks for theory and practical subjects respectively

$ In core subjects both theory and practicals are included wherever applicable

The following parameters are considered throughout study period

- **i)** Regularity of Attendance
- **ii)** Active participation in classes/Camps/Games (College/District//University)
- **iii)** Exemplary awards/certificates/prizes
- **iv)** Other Social Components (Blood Camp, Fine Arts, etc)

Note: II

The Credit points, Lecture Hours, Marks are not linked

Annexure No.UEC5
BOS.DT:05-08-2011

CMS COLLEGE OF SCIENCE AND COMMERCE
COIMBATORE – 641 049
(AUTONOMOUS)
M.Sc., BIOTECHNOLOGY DEGREE COURSE
SCHEME OF EXAMINATION - CBCS PATTERN
(FOR STUDENTS ADMITTED DURING THE ACADEMIC YEAR 2010)

Semester	Part	Subj. Code	Subject Title	Inst. Hrs per week	Examination Details				Credits
					Duration in Hours.	CIA Marks	End Semester Examination Marks	Total Marks	
I	I		Cell & Molecular Biology	5	3	25	75	100	4
	II		Biochemistry	5	3	25	75	100	4
	III		Microbiology	5	3	25	75	100	4
	IV		Research Methodology	5	3	25	75	100	4
	EI		Elective I	5	3	25	75	100	4
	PI		Practical – I: Cellbiology, Biochemistry and Microbiology	5	6	40	60	100	4
			Total	**30**				**600**	**24**
II	V		Microbial Biotechnology	5	3	25	75	100	**4**
	VI		Genetic Engineering	5	3	25	75	100	4
	VII		Immunology & Immunotechnology	5	3	25	75	100	4
	VIII		Bioprocess Technology	5	3	25	75	100	4
	EII		Elective II	5	3	25	75	100	4
	PII		Practical- II: Microbial Biotechnology, Bioprocess Technology and Immunotechnology	5	6	40	60	100	4
			Total	**30**				**600**	**24**
III	IX		Plant Biotechnology	5	3	25	75	100	4
	X		Animal Biotechnology	5	3	25	75	100	4
	XI		Genomics & Proteomics	5	3	25	75	100	4
	XII		Bioethics, Biosafety, Quality Management & IPR	5	3	25	75	100	4
	EIII		Elective III	5	3	25	75	100	4
	PIII		Practical- III: rDNA Technology, Plant and Animal cell culture	5	6	40	60	100	4
			Total	**30**				**600**	**24**
IV	XIII		Environmental Biotechnology	5	3	25	75	100	4
	PIV		Practical – IV: Environmental Biotechnology	5	6	40	60	100	4
	EIV		Elective IV	5	3	25	75	100	4
	Project		Project *****	-	-	-	-	150 *****	6
			Total	**15**				**450**	**18**
			Grand Total					**2250**	**90**

P = Practical subject, E = Elective subject

ELECTIVES OFFERED
(Students should choose one of the electives in each group)

Elective I (Semester I)
Food Biotechnology
Medical Biotechnology
Human Physiology

Elective II (Semester II)
Pharmaceutical Biotechnology
Plant Physiology
Conservation Biology

Elective III (Semester III)
Bionanotechnology
Molecular Diagnostics
Molecular modeling & computer aided drug design

Elective IV (Semester IV)
Bioinformatics
Enzyme Technology
Developmental & Evolutionary Biology

Each paper carries an internal component
There is a pass minimum for an external component
Theory: Internal assessment: 25 marks; External component: 75 marks
Practical: Internal assessment: 40 marks; External component: 60 marks
***** Project: 3 Reviews + Dissertation: 120 marks; Final Viva voce: 30 marks

***** The project report is the bonafide work carried out by the candidate under the guidance of a faculty authenticated and countersigned by the HOD. This project work must be presented and defended by the candidate in the department attended by all faculties and reviewed by external examiner. Candidate who has presented the work as 'Not qualified as per CBCS' must resubmit the project again in the ensuing academic year.

COMPONENTS OF INTERNAL ASSESSMENT*
Theory: Two tests in each semester (one Internal Test and one Model Test). Marks from both Tests will be taken: Total 15 marks (5 marks Internal Test and 10 marks Model Test)
Either Two Assignments – 10 marks *OR* one assignment and One Seminar – 10 marks
Practical: Marks should be awarded to each practical by the course teacher and the average of the best ten practicals be taken for 40 marks.
Project: 120 marks should be awarded as internal assessment marks (90 marks for three monthly reviews conducted by the project guide and the HOD, 30 marks for Dissertation)

***** Retest for internal examination to be conducted for genuine cases as per the recommendations of class in charge, subject in charge. The final decision to be made by the HOD.

Semester III

COURSE: M.Sc., Biotechnology

SUBJECT TITLE: PLANT BIOTECHNOLOGY

Total teaching hours/week: 5

SUBJECT DESCRIPTION:
The course deals with the study of various culturing techniques of plant cells and its applications. It also gives emphasis on Gene transferring methods.

Goals:
To enable the students to learn various culturing techniques of plant cells, Gene transferring mechanisms and production of transgenic plants.

Objectives:
On successful completion of the course the students will be aware of

- Various in vitro culture techniques
- Preservation of plant cells
- Gene transferring mechanisms
- Transgenic plants

CONTENTS:

UNIT I
Genome organization in plants: Nuclear genome, chloroplast genome, mitochondrial genome and CMS, Gene regulation in plants (transcriptional, post transcriptional and translational level). Protein targeting to chloroplast and mitochondria, heat shock proteins, seed storage proteins.

UNIT II
Molecular markers: RFLP and RAPD markers, STS, micro satellites, SCAR (Sequence characterized Amplified Regions), SSCP (Single Stranded Conformational Polymorphism), AFLP, molecular marker assisted selection, Plant secondary metabolites and metabolic engineering.

UNIT III
An overview of Conventional plant breeding methods. Cell and tissue culture in plants: Tissue culture media (Composition and Preparation), Micropropagation, Suspension and Single cell culture, Somaclonal variation, Somatic embryogenesis and Artificial seed production, Embryo culture, hairy root culture, Protoplast isolation and culture, Somatic hybridization; Cybrids and Haploid plants.

UNIT IV:
Plant transformation technology: *Agrobacterium tumifaciens* and crown gall tumors, Features of Ti and Ri plasmid, Mechanism of t-DNA transfer to plants, Ti and Ri plasmid as vectors, Plant reporter genes, Methods of gene transfer in plants, Plant viral vectors and agro infection, Vector – less or direct DNA transfer, Symbiotic nitrogen fixation in plants, Genetic improvement of biofertilizers, Tagging and Cloning of plant genes.

UNIT V

Application of plant transformation for productivity and performance: Engineering plants for herbicide resistance, insect resistance. virus resistance, disease resistance, nematode resistance, abiotic stress tolerance, long shelf life of fruits and flowers and for cytoplasmic male sterility, Production of plant bodies in plants and Edible vaccines. Issues related to GM crops.

REFERENCES:

TEXT BOOKS:

1. **An Introduction to genetic engineering in plants-** Mantel. S.H, Mathews, J.A, Mickee, R.A. (1985). Blackwell Scientific Publishers, London.
2. **Plant cell culture, A practical approach,** 2nd Ed - R.A. Dixon and R.A. Gonzales, (1994). Oxford University Press, Oxford
3. **Plant Molecular Biology**- Grierson and Convey, (1984). Blackie and Son Ltd, New York.

REFERENCE BOOKS:

1. **Plant Molecular Genetics** - Monica. A. Hughes, (1999). Pearson Education Ltd, England
2. **Plant Biotechnology** - Mantell and Smith, (1983). Cambridge University Press,Newyork.
3. **Introduction to plant biotechnology**- H.S Chawla, 2nd edition (2002.)oxford and IBA publishing company Ltd, New Delhi,

Semester III

COURSE: M.Sc., Biotechnology

SUBJECT TITLE: ANIMAL BIOTECHNOLOGY

Total teaching hours/week: 5

SUBJECT DESCRIPTION:

The course deals with the study of embryology, various culturing techniques of animal cells and its applications. It also gives emphasis on Gene transferring methods, cloning of animals, Generation of transgenic animals and applications.

GOALS:

To enable students to learn various animal cell culture techniques, gene transferring mechanisms and production of transgenic animals.

OBJECTIVES:

On successful completion of the course, the students will be aware of

i) Various *in vitro* culture techniques
ii) Preservation of animal cells
iii) Gene transferring mechanisms
iv) Transgenics & cloning

CONTENTS:

UNIT I
Animal cell culture: Preparation of culture media; Role of carbon dioxide, serum & growth factors in cell culture, Serum and protein free defined media. Types of animal cell culture: Primary cell culture, organ culture, primary explant culture, monolayer culture, suspension culture, feeder layer, establishment of cell lines.

UNIT II
Biology of cells in culture-cell adhesion, cell proliferation, differentiation, measurement of cell growth and death, cytotoxicity assays, cell separation, Cryopreservation, MLR and tissue typing, tissue engineering, stem cell research, production of native and recombinant proteins in animal cells.

UNIT III
Gene transfer in Animal cells: Physical, chemical and biological methods, applications of animal cell culture, hybridoma technology and monoclonal antibody production, gene targeting, Gene silencing and Gene knockout.

UNIT IV
Gametogenesis in mammals: Spermatogenesis and oogenesis, molecular events during Fertilization, early mammalian development: Cleavage in mammals, gastrulation in mammals and fate map construction. Conventional methods of improvement of animal live stock:

Artificial insemination, multiple ovulation and embryo transfer (MOET), *in vitro* fertilization (oocyte recovery, *In vitro* maturation, embryo culture, parthenogenesis and chromosomal imprinting), embryo biopsy and embryo sexing, embryo splitting and embryo cloning (Nuclear transfer and embryonic stem cells).

UNIT V

Transgenic animals: Production and applications of transgenic animals, Transgenic mouse: human mouse, oncomouse, Alzheimer's mouse, knockout mouse, human hemoglobin from pigs, animal Bioreactors, building a better animal: improving the quality, increasing disease resistance, environmental replacements, cloning of animals,: Dolly and the transgenic clones, Ethical issues in animal biotechnology.

REFERENCE:

TEXT BOOKS:

1. **Culture of Animal cells: A Manual of basic Techniques**, R. Ian Freshney, (2003) A John Wiley & Sons Inc publications, NY.
2. **Developmental Biology**- 7th Edition, Scott F. Gilbert (2003) Sinaver Associates Inc Publishers, Sunderland, Massachusetts, USA.
3. **DNA Technology- The Awesome Skill**, 2nd Edition, I. Edward Alcamo (2001) IAP Harcourt, Academic Press, San Diego, USA.

REFERENCE BOOKS:

1. **Animal Biotechnology: Recent concepts & Developments**, P. Ramadass (2008), MJP Publishers, Chennai.
2. **Animal Cell Biotechnology- Methods and Protocols**, Ed. Nigel Jenkins, (1999), Humana Press, New Jersey.
3. **Molecular Biotechnology: Principles and applications of Recombinant DNA**- Bernard R. Glick & Jack. J.Pasternak, (2002) Panima Publishing Corporation, New Delhi.
4. **Animal Cell Culture**- 3rd Edition- John R.W.Masters (2000) Oxford University Press, Oxford.
5. **Developmental Biology**, R.M.Twyman (2003), Viva Books Pvt Ltd, New Delhi.
6. **Recombinant DNA**- Second Edition- James D. Watson, Michael Gilman, Jan Witkowski & Mark Zoller (1992), Scientific American Books, New York.
7. **Molecular Biotechnology**-Second Edition, S.B. Primrose (2001) Panima Publishing Corporation, New Delhi.

Semester III

COURSE: M.Sc., Biotechnology

SUBJECT TITLE: GENOMICS & PROTEOMICS

Total teaching hours/week: 5

Subject description:
This paper deals with genome map, comparative genomics, structural genomics, functional genomics, protein structure prediction and function and various tools for analysis of proteins.

Goals:
To make the students to familiar with genome map, comparative genomics, structural and functional genomics and proteomics-extensively used in drug discovery, and in learning various tools for analysis of proteins.

Objectives:
To understand the genome architecture and extracting information like gene function, gene regulation, protein evolution and targets for drug designing.

CONTENTS:

UNIT I:
Genomics:
Introduction to Genomics: Genome sizes, Number of genes. Genome overview at the level of chromosomes: Structural, functional and regulatory properties of chromosomes of prokaryotic and eukaryotic cells: Nature of DNA, Copy numbers in cells, functional elements, regulatory elements and arrangement of genes in genome.
Genome topology: Chromatin, super coiling and packaging.
Genome organization: Genome organization in prokaryotic and eukaryotic systems: Operon concept, globins, immunoglobulins gene families, chromosome banding, chromosome purification, chromosome number, characteristics of autosomes, sex chromosomes and mitochondrial chromosomes.

UNIT II:
Genome analysis:
i. Chromosome analysis:
Basic strategy for genetic analysis in human: Linkage mapping, physical mapping, genetic mapping and restriction mapping.
Cytogenetics and Pseudogenetics: ISCN system of nomenclature of chromosomes. In situ hybridization (ISH), Fluorescence in situ hybridization (FISH), high resolution FISH, chromosome painting, chromosome microdissection.

UNIT III:
ii. DNA Analysis:
a. Small scale DNA sequencing: Ladder sequencing, fluorescence DNA sequencing, automated fluorescence DNA sequencing. Accuracy of automated fluorescent DNA sequencing. Phylogenetic analysis.
b. Larger scale DNA sequencing: Shot-gun method, walking primer method, genomic walking method, transposon mediated sequencing method and Human genome project (HGP).

Finding genes and mutations: Gene annotation, Single nucleotide polymorphisms (SNPs) and SNP detection methods. Bioinformatics tools for genomics and genome comparison. Functional Genomics: ESTs, SAGE and Microarray technology. Transcriptome analysis: SAGE and Microarray analysis.
Genomics Tools: NCBI Map viewer, SNP, ORF finder, BLAST, Phylip and Locus link.

UNIT IV:
Proteomics:
Introduction to proteomics: Proteome and proteomics, methods of proteome separation and identification: Proteome extraction, precipitation, filtration, dialysis, chromatographic separation, determination of criteria of purity, protein concentration and crystallization.
Determination of proteomes by spectrophotometric methods, Overview of determination of levels of organizations of proteomes and sequencing.

UNIT V:
Analytical proteomics: Sample preparation and processing, Proteome analysis techniques: 2D PAGE, CE, HPLC, LC-MS, Spectroscopy: NMR, MS and MALDI-TOF (Matrix Assisted Laser Desorption Ionization – Test Of Fly).
Protein Microarrays and Protein Biochips: SELDI, Aptamers.
3D structural analysis: X-ray crystallography/X-ray diffraction analysis.
Proteomics tools – Downloading of protein databank file of a protein from PDB, ExPASy, KEGG, WIT and organism specific databases.

REFERENCES:

Text Books:

1. **Bioinformatics - Methods and Applications, Genomics , Proteomics & Drug discovery** -S C Rastogi, Namita Mendiratta & Parag Rastogi. Printice Hall of India private limited, New Delhi.
2. **Principles of Genome analysis and genomics** - S B Primrose and Twyman (2003) Third Edition, Blackwell publishing.
3. **Bioinformatics - Sequence and Genome analysis**- David W Mount (2005), CBS publishers and distributors.
4. **Bioinformatics - A practical guide to the analysis of genes and proteins**- Andreas D Baxevanis & B F Francis Ouellette (2002), A John Wiley and Sons, INC., Publications.
5. **Genomics – The science and technology behind the human genome project** – Charles R. Cantor

Reference Books:

1. **Proteomics**- From protein sequence to function - S R Pennington & M J Dunn (2002), Viva Books Pvt. Ltd.
2. **Genes VII** - Lewin B (2000), Oxford University Press, UK.
3. **Essential Bioinformatics** - Jin Xiong (2006), Cambridge University Press.
4. **Recent advances in Bioinformatics** - Irfan A Khan & Atiya Khunum(2003), Ukaaz Publications.
5. **Introduction to Proteomics** – Principles and applications by Nawin Mishra
6. **Proteomics in practice** – Reiner Westermeier and Tom Naven

Semester III

COURSE: M.Sc., BIOTECHNOLOGY

SUBJECT TITLE: BIOETHICS, BIOSAFETY, QUALITY MANAGEMENT & INTELLECTUAL PROPERTY RIGHTS

Total teaching hours/week: 5

Subject description
This paper presents the basics of bioethics, biosafety, quality management & IPR.

Goals
To provide information on the bioethics of genetic engineering & transgenics.

Objectives
On successful completion of the course the students should have:

1. Understood the basics of TQM, bioethics
2. Learnt the concepts of IPR

CONTENTS:

UNIT I
Bioethics in genetic engineering & transgenics- Ethics of genetically modified microbes, bioethics in animal and plant genetic engineering, ethics in genetically modified food, ethical issues in human biotechnology, stem cell research, gene therapy and biowarfare.

UNIT II
Biosafety guidelines in India & international level, biosafety levels for microbes, plants & animals, risk assessment & management of lab & industrial research, risk assessment of biotechnological products, physical & biological containment, field trials with genetically modified plants, planned introduction of genetically engineered microbes.

UNIT III
Concepts in TQM: Tools and techniques of TQM – Requirements for supplementing TQM- steps for supplementing TQM- Questionare- assessment through Questionare- mission statement- benefits of TQM- check list for implementing TQM- Case study.

UNIT IV
Protection of intellectual property rights- protection of biotechnological inventions, patents- patenting of genes, plants, animals, microbes and transgenic organisms, trade secrets, copyright, World Intellectual Property Rights organization (WIPO).

UNIT V
IPR for plant breeding-plant variety protection in India, plant breeder's rights, farmer's rights, protection & implementation of plant varieties, farmer's rights act, national gene fund, biodiversity bill of India, benefits of PBR, mechanism involved in terminator technology, technology for pure lines & hybrid seed protection, traitor technology.

TEXT BOOKS:

1. **Intellectual Property Rights**, Radhakrishnan R. and Balasubramanian, S. Excel Books, I ed., 2008.
2. **Handbook of Indian Patent Law and Practice**, Subbaram N. R.,S. Viswanathan (Printers and Publishers) Pvt. Ltd., 1998.

REFERENCE BOOKS

1. **Bioethics and Biosafety in Biotechnology**, Sree Krishna, V, New Age Internationsl Publishers, 2007
2. **Technology Transfer**, Goel Cohen, Sage Publications, 2004.
3. **Twelve management skills for success**- Ram Narain, Viva books private limited, Chennai.
4. **Across functional perspectives of TQM**. Rao, Carr, Dambolena & Kopp. John Wiley& sons, Newyork.
5. **Ehics in engineering**, Martin. M.W. and Schinzinger.R. III Edition, Tata McGraw-Hill, New Delhi. 2003.
6. **Biosafety issues related to transgenic crops, DBT guidelines**, Biotech Consortium India Limited, New Delhi.

Semester III

COURSE: M.Sc., BIOTECHNOLOGY

SUBJECT TITLE: ELECTIVE PAPER III: NANOBIOTECHNOLOGY

Total teaching hours/week: 5

SUBJECT DESCRIPTION:
This paper presents the basics of molecular biology of bionano compounds and molecules, characterization of Bionanos as applied to Drug designing, Drug discovery, Molecular modeling, Molecular docking, High throughput screening and applications of Nanotechnology.

GOALS:
This paper is introduced to impart advanced training to the students with post graduate qualification in Biotechnology to understand the new concept of Nanotechnology applied to the area of Biotechnology and to acquire requisite skills for the design and development of High throughput screening and assay methods leading to the novel drug discovery and designing

OBJECTIVES:
On successful completion of the course the students will be aware of:

1. The basics of characterization of bionano compounds and molecules.
2. The concepts of Drug development.
3. The modern trends in Nano level application of biochemical and biomedical sciences.

CONTENTS:

UNIT I
The Quest for Bionanotechnology: Historical perspectives, Nanotechnology & Bionanotechnology, Nanoimages in Bionanotechnology, Opportunities, Challenges & growth potential of Bionanotechnology; Key features of Nano-size, Significance of Nano domain: limitations of micron size, nanosize vs macrosize particle behaviour, advantages of scaling-down, Nano drug delivery: conventional, targeted & delivery profile, Molecular modeling and Docking studies; Bionanomachines in action.

UNIT II
Structural principles of Bionanotechnology: Natural Bionanomachinery & Strategy for the construction of Nanomachines, The raw materials: Biomolecular structure & stability (forces, bonds & interactions), Protein folding: structure of globular proteins, Role of chaperonones in folding, self assembly: Role of symmetry and quasi symmetry, Self organization, Molecular Recognition: Crane principles & atomicity limits, Flexibility of biomolecules.

UNIT III
Functional principles of Bionanotechnology: Information driven nanoassembly, Energetics, Chemical transformation, Regulation of protein activity: allosteric interactions and covalent modifications, Biomaterials: filaments & fibrils, elastic proteins, adhesives & its applications, Biomolecular motors: ATP synthase , flagellar motors & rotary motors, Traffic

across membranes: potassium channels, ABC transporters, Biomolecular sensing: smell, taste and light sensors, mechanosensory receptors, bacterial sensors, Self replication, Machine phase bionanotechnology: Muscle sarcomeres, nerves.

UNIT IV

Applications of Bionanotecnology: Bionanoimaging: Quantum Dots; Ultrasound contrast agents, Magnetic Nanoparticles, Nanoemulsion and coating, Nanobiosensors; Biochips, Biobarriers, Biorobotics; Biobatteries**,** Synthesis of gold, Titania nanostructures and Zinc oxide; Nanopore technology, Nanoarrays, Nano self- assembling systems; DNA computers, Artificial life, Hybrid materials.

UNIT V

Bionanotechnology a panacea? (Remedy for all diseases): Nanostructures and Nanosystems, Nanoparticles, Nanomedicine (overview of computer-aided design, Immunotoxins, Liposomes, Artificial blood, Gene therapy), Invitro diagnostics, Medical applications of Nanoparticles & Nanosystems, Nanovision: The futuristic goals of Bionanotechnology, Case studies: nanotube synthase, nanoscale assembler, nanosurveillance, Ethical considerations.

TEXT BOOKS:

1. **Bionanotechnology** – Lessons from Nature by David S.Goodsell ,Wiley-Liss Publications, New Jersey, 2004.
2. **Bionanotechnolog** by Elisabeth S. Papazoglou & Aravind Parthasarathy, Morgan & Claypool Publishers, 2007.

REFERENCE BOOKS:

1. **Bionanotechnology – Proteins to Nano Devices** edited by V. Renugopalakrishnan and Randolph V. Lewis, Springer press.
2. **Protein Nanotechnology**-Protocols, Instrumentation and applications edited by Tuan Vo-Dinh, Humana Press.
3. **Hand Book of Nanotechnology** edited by Bhushan – Chapter No: 24, Mechanics of Biological Nanotechnology, Springer publications.

Semester III

COURSE: M.Sc., BIOTECHNOLOGY

ELECTIVE PAPER III: MOLECULAR MODELLING & COMPUTER AIDED DRUG DESIGN

Total teaching hours/week: 5

Objectives: To understand the concepts of molecular modeling and computational approaches for drug design.

CONTENTS:

UNIT I
Introduction to the concept of molecular modeling, molecular structure and internal energy, applications of molecular graphics, coordinate systems, potential energy surfaces, discussion of local and global energy minima.

UNIT II
Introduction to computational quantum mechanics: one electron atom, poly electronic atoms and molecules, Hartree Fock equations; calculating molecular properties using ab initio and semi empirical methods

UNIT III
Molecular mechanics: general features of molecular mechanics force field, bond stretching, angle bending, torsional terms, non-bonded interactions; force field parametrisation and transferability; energy minimization: derivative and non-derivative methods, applications of energy minimization.

UNIT IV
Molecular dynamics simulation methods: molecular dynamics using simple models, molecular dynamics with continuous potential, setting up and running a molecular dynamic simulation, constraint dynamics; Monte carlo simulation method: Monte Carlo simulation of molecules.

UNIT V
Macromolecular modeling, design of ligands for known macro molecular target sites, Drugreceptor interaction, classical SAR/QSAR studies and their implications to the 3-D modeler, 2-D and 3-D database searching, pharmacophore identification and novel drug design, molecular docking, Structure-based drug design for all classes of targets. Enzyme Inhibition strategies.

REFERENCES

TEXT BOOKS:

1. **Molecular Modeling: Principles and Applications**, by Andrew R. Leach.
2. **Basic principles and applications** by Hans-x.
3. **Designing bioactive molecules three-dimensional techniques and applications** by Yvonne C. Martin,

4. **Exploring QSAR**, Leo, Albert, Hockma, D.H.– Hansch, Corwin.

REFERENCE BOOKS:

1. **Principles of Bioinformatics**, Pointer Publishers, Jaipur, India, Shanmughavel, P. 2005,
2. **Trends in Bioinformatics**, Pointer Publishers, Jaipur, India. by. Shanmughavel, P. 2006.

Semester III

COURSE: M.Sc., BIOTECHNOLOGY

ELECTIVE PAPER III: MOLECULAR DIAGNOSTICS

Total teaching hours/week: 5

SUBJECT DESCRIPTION: This course deals with the study of different stages of molecular diagnostics, analysis of mutations, applications of electrophoresis in molecular diagnosis, tools used for cytogenetic study and the array technology.

GOALS: To enable the students to become familiar with isolation and purification of nucleic acids and their role in the detection of mutations, diagnosis of diseases by electrophoresis, array technology and cytogenetic tools.

OBJECTIVES: On successful completion of the course the students should have understood:

i) The extraction, purification and storage of nucleic acids.
ii) How to identify genetic variation.
iii) The applications of electrophoresis in disease diagnosis.
iv) The different techniques involved in cytogenetic study.
v) The use of array technology in molecular diagnosis.

CONTENTS:

UNIT I

Introduction to Molecular Diagnosis - Past, present and future. Stages of molecular diagnosis: Selection and processing of samples, Extraction and purification of Nucleic acids, Assessment of Quality and Quantity of Nucleic acids, Storage of nucleic acids, Nucleic acid blotting techniques, polymerase chain reaction, Electrophoretic methods and enzymatic cleavage methods.

UNIT II

Mutation analysis and identification of genetic variation: Single Nucleotide Polymorphisms (SNPs), Allele specific mutation detection by RFLP and PCR. DNA methylation analysis.

UNIT III

Electrophoretic applications in Molecular Diagnosis: Temperature and denaturing gradient gel electrophoresis and Capillary electrophoresis (CE). Proteomics tools: 2D PAGE, MS and MALDI-TOF.

UNIT IV

Cytogenetic tools: Flow cytometry, Fluorescence activated cell sorter (FACS), Fluorescence *in situ* hybridization (FISH), Immunohistochemistry and Laser capture microdissection.

Unit V

Microarray, Nanoarray and Biochips: Basic principles, chip manufacturing, components of microarray analysis and molecular diagnosis of cancer by microarray.

REFERENCE BOOKS:

1. **Molecular Diagnostics for the Clinical Laboratorian** (Second edition) Edited by William. B. Coleman and Gregory. J. Tsongalis (2006) Humana Press, New Jersey, USA.
2. **Molecular Diagnostics** edited by George P. Patrinos and Wilhelm Ansorge (2009) Elsevier Academic Press.
3. **Molecular Biotechnology**, Glick and Pasternak, (1996) Panima Publishing Corporation, New Delhi.
4. **Principles of gene manipulation** - Old, R.W. and Primrose S.B, 6th Ed, (2003), Black well Sci ltd, Germany.

Semester III

COURSE: M.Sc., Biotechnology

SUBJECT TITLE: PRACTICAL III: RECOMBINANT DNA TECHNOLOGY, PLANT & ANIMAL CELL CULTURE.

Total practical hours/week: 5

Subject description:

This course deals with the study of different techniques of Recombinant DNA technology and culturing of plant & animal cells..

Goals:
To learn various techniques of Recombinant DNA Technology and also learn various culturing methods of plant cells & animal cells

Objectives:
After successful completion of the course the students will be aware of

1. Various culture techniques in PTC & ACC
2. Isolation of DNA from various sources
3. PCR, Restriction digestion and Ligation techniques
4. Transformation & conjugation techniques

Contents:
rDNA TECHNOLOGY:

1. Isolation of Genomic DNA from Plant tissue
2. Isolation of Genomic DNA from animal tissue
3. Isolation of Genomic / Plasmid DNA from Bacteria
4. Agarose gel electrophoresis
5. Restriction digestion & Ligation experiments
6. PCR
7. Transformation
8. conjugation

PTC:

9. PTC Laboratory organization & Preparation of medium
10. In vitro germination of seeds
11. Callus induction and differentiation
12. Micropropagation
13. Embryo culture
14. Suspension culture
15. Protoplast isolation and protoplast fusion
16. Artificial seeds production
17. Meristem culture

ACC:

18. Washing, Sterilization Techniques & Membrane filtration
19. Preparation of complete ACC medium & of serum
20. Isolation of peripheral blood monolayer cells
21. Preparation of primary culture from Chicken embryo
22. Cell counting & viability test
23. Cytotoxicity assay

References:

1. **Laboratory Manual for Biochemistry and Molecular Biology** by R. Palanivelu, Madurai Kamaraj University Press, Madurai.
2. **Molecular biology : Principles and Applications**- A Practical Approach edited by Nagarajan, P. and N. Senthil kumar (2002), Sree Narmatha Printers, Coimbatore.
3. **Plant Biotechnology- A Laboratory Manual-** Robert J.Lebowitz, Wm.C.Brown Publishers, England (2005).
4. **Culture of Animal cells: A Manual of basic Techniques**, R. Ian Freshney, (2003) A John Wiley & Sons Inc publications, NY.
5. **Animal Cell Biotechnology- Methods and Protocols**, Ed. Nigel Jenkins, (1999), Humana Press, New Jersey.
6. **Animal Cell Culture**- 3rd Edition- John R.W.Masters (2000) Oxford University Press, Oxford.

SEMESTER IV

COURSE: M.Sc., BIOTECHNOLOGY

SUBJECT TITLE: ENVIRONMENTAL BIOTECHNOLOGY

Total teaching hours/week: 5

Subject description:

To find the solution for environmental problems by biotechnology

GOALS: This course is important from the aspect of industrial biotechnology and will help students who want to take up a career in industries and for research in other areas like development, use and regulation of biological systems for remediation of contaminated environments (land, air, water), and for environment-friendly processes such as green manufacturing technologies and sustainable development.

OBJECTIVES: Students will get an idea about
1) The different types of pollution & it's effects
2) Ecofriendly treatment methods for air, water & soil pollution
3) Bioremediation technology

CONTENTS:

UNIT I
Air pollution & its effects-Acid rain, Green house effect & climate change, Ozone depletion, Biotechniques for air pollution abatement and odour control–bioscrubbers, biobeds, biotrickling filters. Water pollution & its effects-eutrophication, ground water contamination, oil pollution, effects of untreated effluent disposal and physiochemical features of waste water.

UNIT II
Waste water treatment- primary, secondary treatment of effluent-Aerobic process - oxidation ponds, trickling filter, RBC, ASP, FBR , Anaerobic process-UASB, PCR, advanced treatment of waste water, reuse of waste water, Industrial effluent treatment - textile, paper and food industries.

UNIT III
Soil pollution & its effects-biomagnification, effects of pesticides & heavy metals.
Solid waste management-Secure land fill, composting-microbial & vermi composting, thermal process-incineration & pyrolysis, biofuel production from waste-biogas, bioethanol production from waste and novel enzymes production from waste.

UNIT IV
Bioremediation - *In situ* bioremediation-biostimulation, bioaugmentation, bioventing, air sparging, Exsitu bioremediation-land farming, solid ,slurry phase management, Phytoremediation & its types, waste land reclamation, methods of immobilization and role of immobilized cells in bioremediation.

UNIT V

Role of biotechnology in environmental protection, Biosorption & it's mechanism, bioremediation of heavy metals by bacteria, fungi & algae, biodegradation of xenobiotics (Pesticides), Biomining, MEOR-Microbial enhanced oil recovery, production of ecofriendly bioplastics and environmental biosensors.

TEXT BOOKS:

1. **Environmental Biotechnology** (Industrial pollution management)-S.N.Jogdand, Third edition (2010), Himalaya publishing house.
2. **Environmental Pollution and control**- J. Jeffrey Peirce., Ruth F. Weiner and P. Aarne Vesilind, Fourth edition ,(1998), University of Visconsin, Madison.
3. **Wastewater Engineering** – Treatment, Disposal and Reuse. Metcalf and Eddy (2002), Tata Mc Graw Hill, NewDelhi.

REFERENCE BOOKS:

1. **Environmental chemistry** by A.K. De, Fourth edition, (2001) New Age International Ltd, NewDelhi.
2. **Environmental Biotechnology** by Alan H. Scragg (2005) Oxford University Press.
3. **Soils and the environment**- Aland Wild. (1993). Cambridge University Press, New York.

SEMESTER IV

COURSE: M.Sc., BIOTECHNOLOGY

SUBJECT TITLE: PRACTICAL IV: ENVIRONMENTAL BIOTECHNOLOGY

Total practical hours/week: 5

SUBJECT DESCRIPTION:
This course deals with the study of the characterization of effluent and bioremediation

GOALS:
To learn the various techniques in waste water characterization, bioremediation, waste management techniques

OBJECTIVES:
After the successful completion of the course the students will be aware of various techniques in characterization of effluent, bioremediation, ecofriendly waste management.

CONTENTS:

1. Estimation of Dissolved Oxygen
2. Estimation of total hardness
3. Estimation of BOD
4. Estimation of COD
5. Determination of Chloride
6. Estimation of phosphate
7. Estimation of sulphate
8. Isolation of bacteria & fungi from industrial effluent
9. Composting -microbial / Vermi composting
10. Ethanol production from waste
11. Citric acid production from waste
12. Enzyme production (protease/ cellulase) by using waste substrate
13. Bioremediation of industrial effluent
14. Production of antibiotics by using the isolated microbes from effluent
15. Study of polluted leaves

REFERENCES:

1. **Wastewater Engineering – Treatment, Disposal and Reuse**. Metcalf and Eddy, Inc., Tata Mc Graw Hill, NewDelhi.
2. **Microbial Biotechnology** - Glazer et al., (1995.) W.H. Freeman & Co. New York.
3. **Industrial microbiology** - A.H.Patel, (1985) Macmillan Publication, New Delhi.
4. Aditya Books (P) Ltd, New Delhi.

SEMESTER IV

COURSE: M.Sc., BIOTECHNOLOGY

SUBJECT TITLE: ELETIVE PAPER IV: BIOINFORMATICS

Total teaching hours/week: 5

SUBJECT DESCRIPTION:

This paper presents the basics of Bioinformatics, Concepts applied to Structural and functional analysis of genomes and proteomes and Drug discovery**.**

GOALS:
This paper is introduced to impart advanced training to the students with graduate qualification in Biotechnology to carry out characterization of genomes and proteomes leading to the design and development of novel drugs.

OBJECTIVES:
On successful completion of the course the students should have:

1. Understood the Basics of Genomes and Proteomes.
2. Learnt the concepts of structural and functional analysis of Genomes, Proteomes and Transcriptomes.

CONTENTS:

UNIT I:
An Over view of Bioinformatics: Scope, Bioinformatics and internet, useful bioinformatics sites on WWW. Data acquisition – Overview of sequencing of DNA, RNA and proteins, determination of protein structure, Gene and protein expression data, protein interaction data. Introduction to biological databases: Types of databases, biological databases, information retrieval from biological databases, file formats, annotated sequence databases, genome and organism specific databases. Retrieval of biological data - ENTREZ and DBGET/LinkDB, SRS.

UNIT II:
Sequence alignment:
Pair wise sequence alignment, sequence homology vs sequence similarity; sequence similarity vs sequence identity, methods, scoring matrices.
Database Similarity Searching: Heuristic Database searching, BLAST, FASTA, comparison of FASTA and BLAST, database searching with the Smith – Waterman method.

UNIT III:
Multiple Sequence alignment: Scoring function, Exhaustive algorithms, Heuristic algorithms, practical issues.
Profiles and Hidden Markov model: Position specific scoring matrices, profiles, Markov model and Hidden Markov model.
Protein motifs and domain prediction: Identification of Motifs and domain in multiple sequence alignment, protein family databases, motif discovery in Unaligned sequences.

UNIT IV:

Gene and promoter prediction: Gene prediction, categories, Gene prediction in prokaryotes and eukaryotes. Promoter and regulatory element prediction in prokaryotes and eukaryotes.
Molecular Phylogenetics: Gene phylogeny vs Species phylogeny, Phylogenetic tree construction methods and programs- distance based, character based methods.

UNIT V:

Structural Bioinformatics: Protein structure database, Protein structural visualization, comparison and classification, An Overview of protein structure prediction- Secondary (Globular and transmembrane proteins) and Tertiary (homology modeling, threading and fold recogisition, abinito, CASP. RNA structure prediction – Types, Methods of secondary structure prediction, Ab initio approach.
Genomics applications: Genome annotation, Comparative genomics. Functional genomics – Comparision of SAGE and Microarrays.
Proteomics applications: Protein expression analysis and protein-protein interactions.

REFERENCES:

TEXT BOOKS:

1. **Instant Notes Bioinformatics** - D.R. Westhead, J.H. Parish and R.M. Twyman (2002)
2. **Introduction to Bioinformatics**-Attwood. T. K. and Parry Smith. D.J. (2004), Pearson.
3. **Proteomics** – Pennington & Dunn (2002).Viva Books Pub. New Delhi.
4. **Genomes 3**, - T. A. Brown (2002) Garland Science, Taylor & Francis Group, NY & London.
5. **Principles of genome analysis and genomics** - S.B. Primrose and Twyman. (2003) Third Edition, Blackwell Publishing.

REFERENCE BOOKS:

1. **Essential Bioinformatics -** Jin Xiong (2006), Cambridge University Press.
2. **Bioinformatics Sequence and genome Analysis** – David W. Mount, (2005) Second Edition, CBS Publishers & Distributors.
3. **Bioinformatics: a practical guide to the analysis of genes and proteins -** Andrew D.Baxevanis, B.F.Francis Ouellette. Second edition.(2002), John Wiley and Sons, inc.

SEMESTER IV

COURSE: M.Sc., BIOTECHNOLOGY

SUBJECT TITLE: ELECTIVE PAPER IV: ENZYME TECHNOLOGY

Total teaching hours/week: 5

Subject description:

This paper presents the basics of enzyme properties, production, extraction, purification and application of enzymes in different fields.

Goals
This paper is introduced to impart advanced training to the students with post graduate qualification in biotechnology to know about the different types of enzymes, its production and uses.

Objectives
On successful completion of the course the students should have:
1. Understood the basics enzyme technology.
2. Learnt the concepts of immobilization of enzymes and its uses.
3. Learnt the modern trends in production and purification of enzymes.

CONTENTS:

UNIT I
An over view of Enzymology: Properties of enzymes, Classification of enzymes, Structure of enzymes: active site, apoenzyme and holoenzyme. Structure based classification of enzymes - Monomeric enzymes, Oligomeric enzymes and membrane bound enzymes. Mechanism of enzyme action, enzyme substrate complex formation, specificity of enzyme action, factors affecting enzyme activity, inhibitors of enzymes, Enzyme kinetics and nontraditional enzymes

UNIT II
Enzyme Bioprocessing: Upstream Processing of enzymes: Different types of sources for the production of enzymes- enzyme production from bacteria, fungi- production of protease, amylase, cellulase. Extraction of enzyme by physical & chemical methods- sonication, freezing, solid & liquid shear, cold & osmotic shock; alkali, lysozyme, EDTA, detergents. Bioreactors used for enzyme production-CSTR, packed bed and fluidized bed reactor.

UNIT III
Downstream processing of enzymes: Purification of enzymes-concentration by ammonium sulphate precipitation, dialysis, organic solvent, ultra filtration, freeze drying, gel, ion exchange chromatography and criteria of purity – Zymogram, SDS-PAGE, Size-exclusion chromatography, Analytical ultracentrifugation and construction of purification table. HPLC, Preparative HPLC & FPLC. GE- AKTA systems of enzyme purification, Stabilization of enzymes, concentation of enzymes and packaging.

UNIT IV

Immobilization of enzymes: Different methods of immobilization of enzymes-adsorption, covalent binding, cross linking, gel entrapment, fibre entrapment, micro encapsulation, carrier binding, chelation. Effect of immobilization on enzyme activity and applications of immobilized enzymes.

Biosensors: Enzymes as biosensors - Enzyme electrode, colorimetric, potentiometric, amperometric, optical, piezo-electric and immunosensors (Principle only).

UNIT V

Applied Enzymology:

Applications of enzymes in biochemistry, organic chemistry, biotechnology, clinical assays, medicinal use, production of aminoacids, flavouring agents, detoxifying enzymes, and enzyme based detergents. Applications of immobilized enzymes in different fields. Enzymes used in Biotransformation. Applications of enzymes in industries-food, dairy, paper, textile, leather. Applications of enzymes in bioremediation, bioaugmentation, waste water treatment. Safety & regulatory aspects of enzymes.

TEXT BOOKS

1. **Enzymes -Biochemistry, Biotechnology, Clinical chemistry**-Trevor palmer, First edition, East West press Pvt Ltd.
2. **Enzymes biotechnology hand book**- NIIR Board, Asia pacific business press.
3. **Enzyme Technology** – Martin Chaplin (http://www.lsbu.ac.uk/biology/enztech/).

REFERENCE BOOKS

1. **Enzyme biotechnology**-Wiseman, First edition, Ellis Horwood Publishers.
2. **Fundamentals of Enzymology**-Nicholas C. Price, Lewis Stevens, Third edition, Oxford University press.
3. **Enzyme Technology**-Chaplin & Bucke, Cambridge University press.
4. **Fundamentals of Enzymology**-Price & Stevens, Oxford University press.

Semester VI

COURSE: M.Sc., BIOTECHNOLOGY

SUBJECT TITLE: ELECTIVE PAPER IV: DEVELOPMENTAL AND EVOLUTIONARY BIOLOGY

Total teaching hours/week: 5

Subject description:

This paper presents the basic concepts of developmental biology & evolutionary biology

Goals
This paper gives the knowledge about the stages in developmental biology & evolution

Objectives
On successful completion of the course the students should have:
1. Understood the basics of blastulation, gastrulation and organization
2. Learnt the theories of evolution & its significance

CONTENTS:

UNIT I
Scope of embryology, Germplasm, gradient and organizer theory, spermatogenesis, spermiogenesis, oogenesis, types of sperms & ova, omponents of egg, polarity, physiological changes in fertilization, acrosomal & cortical reaction, activation, parthenogenesis & types

UNIT II
Cleavage, blastula & types, planes & patterns of cleavage, factors affecting cleavage, molecular changes in cleavage..
Gastrulation & it's molecular changes, exogastrulation, features of gastrulation, fate map, types of morphogenetic movements.

UNIT III
Metamorphosis of amphibian & insects.
Development of mammal- egg, cleavage, morula, implantation & types, gastrulation, development of primitive streak, organogenesis – development of heart, brain, foetal membranes, placentation , physiology of placenta.

UNIT IV
Emergence of evolutionary thoughts - Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneous mutations Origin of basic biological molecules; Concept of Oparin and Haldane; Experiement of Miller (1953); Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.

UNIT V
The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multi cellular organisms; Major groups of plants and animals; Stages in primate evolution including Homosapiens, molecular clocks, factors

responsible for variation & it's significance, Gene pool, Gene frequency; Hardy-Weinberg Law, migration & genetic drift, speciation.

REFERENCES:

TEXT BOOKS

1. **Animal evolution**, Carter. G. S. 1951, Sedgwick and Jackson , London ,England.
2. **Population biology and evolution**, Sobrig and sobrig , 1981 Addition wiley
3. **Vertebrate history: problems in evolution**, Stahl, V: 1985, Mc GRAW-Hill,New Delhi
4. **Systematic and origin of species**, Mayer, S 1942, University press, Colombia.

REFERENCE BOOKS

1. **Essential developmental biology** – Jonathan Michael Wyndham slack, 2006.Wiley-Blackwell.
2. **Current topics in developmental biology** – Geral P. Schatten, Academic press, 2006.
3. **The origin of animal body plans: a study in evolutionary developmental biology** – 2000. Wallace Arthur, Cambridge university press.
4. **Developmental biology** – Werner A. Muller, 1997, Springer

Semester IV

COURSE: M.Sc., Biotechnology

PROJECT WORK
(Duration: 1st December to 28th February)

Total project hours/week: 15

Rules and regulations to be followed:

1. Project can be carried out at the college premises or at any research institution or renowned industry for a period of three months.
2. Allotment of guides will be done as per the Lot system in the third semester.
3. **For Internal Projects:**

- The concerned guides will maintain attendance. At the end of each month they have to submit a consolidated attendance to the class in charge.
- Requirement of chemicals and glasswares for the project work will be submitted to the HOD with the recommendation from concerned guides on or before 30th of October. Purchase of Highly expensive items (chemicals or imported chemicals or special glasswares) will not be possible.
- Students who are doing their project work at CMS shall submit a weekly report of their research work to their respective guides.

Moreover, they have to submit a monthly report (in MS word format as attachment) to the HOD by email to cmsbiotechdept@gmail.com on or before 30th of each month.

4. For External Projects:

- Students who are doing their project work in external labs shall submit a weekly report of their research work to their guide by letter or email. Moreover, they have to submit a monthly report (in MS word format as attachment) to the HOD by email to cmsbiotechdept@gmail.com on or before 30th of each month.
- At the time of completion of their project work in the month of February, students have to submit original attendance certificate from research lab or Industry to the HOD duly recommended and forwarded by the guides. Based on the recommendations by the guide, attendance will be provided to the students.

5. Dissertation:

- A Common format of the dissertation to be followed by all the students. A template of dissertation will be given to each student by email in the month of January.
- Final copy will be given for printing after the approval by the concerned guide.
- Students have to submit the four copies of the dissertation (One original and three copies neatly bound) at the time of Research paper presentation.

6. Any deviations from above mentioned rules and regulations will not be considered.

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