

FACULTY OF LIFE SCIENCES

SYLLABI

FOR

CBCS SYSTEM

M.Sc. (Hons.) Biotechnology Second Year

(3rd and 4th Semester)

(Session: 2018-19)



MATA GUJRI COLLEGE

FATEHGARH SAHIB-140406, PUNJAB



M.Sc. (Hons.) Biotechnology Second Year

(3rd and 4th Semester)

Subjects and Distribution of Marks

(Academic Session 2018-2019)

Semester III

Paper code No.	Paper No.	C/E	Name of paper	Credit per week	Internal Marks	Marks External Marks	Total Marks
MBT(C7)-301	Paper XI	C7	Enzymology & Enzyme Technology	4	30	70	100
MBT(C8)-302	Paper XII	C8	Genetic Engineering	4	30	70	100
MBT(C9)-303	Paper XIII	C9	Research Methodology	3	25	50	75
MBT(E5)-304	Paper XIV	E V	Opt I Plant Physiology Opt II Ecological Principles	3	25	50	75
MBT(E6)-305	Paper XV	EVI	Opt I Bioinformatics Opt II Solid and Hazardous waste management	3	25	50	75
MBT(Lab)-306	LC 7	Lab.Course7Pertaining to theory paper XI & XII		3	--	100	100
MBT(Lab)-307	LC 8	Lab.Course8 Pertaining to theory paper XIII		2	--	35	35
MBT(Lab)-308	LC 9	Lab.Course9 Pertaining to theory paper XIV & XV		2	--	70	70
MBT(lab)-309	STS 1	Seminar presentation of summer training		1		25	25
MBT(RP1)-310	RP1	Research project		5		25	25
						Grades A,B,C,D	
Total				30	135	545	680

Semester - IV

Paper No.	code	Paper No.	C/E	Name of paper	Credit per week	Internal Marks	Marks External Marks	Total Marks
MBT(C10)-401		Paper XVI	C 10	Bioprocess engineering	3	30	70	100
MBT(C11)-402		Paper XVII	C11	Commercial Biotechnology	3	25	50	75
MBT(C12)-403		Paper XVIII	C12	Tissue & cell culture technology	3	25	50	75
MBT (Lab)-404		LC-10		Lab Course- 10 Pertaining to paper XVI	1	--	50	50
MBT (Lab)-405		LC-11		Lab Course-11 Pertaining to paper XVII and XVIII	2		70	70
MBT(RP2)-406		RP 2		Research Project	15		100	100
						Grades A, B, C, D		
MBT(T2)- 407				Industrial/Institute Training Report (4-6 weeks)***	3		25	25
						Grades A, B, C, D		
Total					30	80	415	495

Paper XI – MBT (C7)-301 Enzymology & Enzyme Technology

Course Objective:

1. To make the students conversant with structure and mechanism of enzymes
2. To make the student acquire sound knowledge of kinetics and enzyme inhibitions
3. To acquaint the student with concepts of enzyme production purification and applications.

Lectures to be Delivered 60

M. Marks : 70

Time allowed: 3 Hrs

Pass Marks : 35%

INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE

The question paper will consist of three sections. Section A and B (Consist of unit I and II of the syllabus, respectively) will have four questions each from respective units and candidates are required to attempt two questions each from section A and B. Each question in section A and B shall carry 12 marks. Section C will consist of 11 short answer type questions covering entire syllabus and the candidates are required to attempt all questions. Each question in section C will carry 2 marks

UNIT-I

Introduction to enzymes: Introduction and properties of enzyme, classification of enzymes, enzyme activity, units of enzyme activity, specific activity, cofactors, coenzymes and prosthetic group, role of coenzymes, turnover number.

Enzymes specificity- Types of specificity, lock and key hypothesis, induced fit hypothesis,

Mechanism of enzyme catalysis: Enzyme structure, Factors responsible for catalytic efficiency of enzymes (proximity and orientation effects, acid base catalysis, distortion, covalent catalysis, pH, temperature). Mechanism of action of lysozyme and chymotrypsin. Monomeric, Oligomeric and multienzyme complexes (pyruvate dehydrogenase), isozymes

Kinetics of enzyme catalyzed reactions: One substrate reactions, Michaelis-Menten equations, modification of Michaelis-Menten equations (Briggs Haldane, Lineweaver-Burk plot, Eadie Hofstee plot), two substrate reactions, King and Altman, method of deriving steady-state velocity equations, random ordered, Threol and Chance, and Ping-pong mechanisms.

Allosteric enzyme: Characteristics of allosteric enzymes, cooperatively, model for allosteric regulation (KNF and MWC model)

Enzyme Inhibition: Concept of enzyme inhibition, types of enzyme inhibition.

UNIT-II

Industrial Enzyme production: Microbial sources of enzymes, criteria for the selection of microbes for the enzyme production, Microbial production of amylase and cellulase.

Enzyme purification- Strategies of purification of enzymes (primary and secondary purification), molecular weight determination and characterization of enzymes.

Immobilized enzymes: Methods of enzyme immobilization (ionic bonding, adsorption, covalent bonding, microencapsulation and gel entrapment). Kinetics of immobilized enzymes. Co immobilization

Enzyme engineering: Principle and applications of enzyme engineering, artificial enzymes.

Biocatalysts in organic solvents: Enzyme reactions in biphasic liquid systems, stabilization of enzymes in biphasic aqueous-organic systems, Equilibrium and enzyme kinetics in two phase system.

Application of enzymes: Enzyme Biosensors, theory and application of enzyme electrodes, application of enzyme in food industry (amylase, protease and lipase). Application of enzyme in diagnosis (liver and heart) and treatment of disease (enzyme therapy).

Books Recommended:

1. Structural and Mechanistic Enzym. By: Christo I. Christov.
2. Fundamentals of Enzyme Kinetics By: Athel Cornish-Bowden.
3. Enzyme Kinetics and Mechanism. By: Paul F. Cook, Published:
4. Athel Cornish-Bowden Fundamentals of Enzyme Kinetics. Portland Press
5. Enzyme Kinetics, Cambridge Press Shultz, A.R. ..
6. Understanding Enzymes, 4th ed. Prentice Hall/Ellis Horwood, England. Trevor, P.
7. Enzymology Labfax, Bios Scientific Publisher, Academic Press, U.K. Engel, P.C.
8. Fundamentals of Enzymology, 3rd ed., Oxford University Press. Price, N.C. and Strevens, L

Lab Course LC7- MBT (Lab)-306 Pertaining to Enzymology & Enzyme Technology

Practical Time 3 Hrs/Week

M. Marks : 50

Time allowed for Examination: 5 Hrs.

Pass Marks : 35%

INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (12.5 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (25 Marks). Section C will contain, practical note Book Evaluation and Viva Voce (12.5 Marks).

List of Practicals

1. Estimation of enzyme activity and specific activity of amylase/cellulase enzyme.
2. Determination of enzyme activity in presence of activators/ inhibitors.
3. Determination of optimum pH and temperature for the activity of enzyme.
4. Determination of K_m & V_{max} for the amylase/cellulase enzyme.

5. Determination of Competitive, non-competitive inhibitions process in enzyme kinetics.
6. Production and purification of amylase/cellulase enzyme.
7. Determination of molecular weight of purified protein by Polyacrylamide gel electrophoresis.
Immobilization of amylase/cellulase enzyme for the saccharification of
8. substrate.

Paper XII – MBT(C8) 302 Genetic Engineering

Course Objective:

1. To make the students conversant with tools and techniques of recombinant DNA technology
2. To make the student acquire sound knowledge of DNA libraries and cloning aspect in organisms
3. To acquaint the student with application of RDT in industry and agriculture

Lectures to be Delivered 60

M. Marks : 70

Time allowed: 3 Hrs

Pass Marks : 35%

INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE

The question paper will consist of three sections. Section A and B (Consist of unit I and II of the syllabus, respectively) will have four questions each from respective units and candidates are required to attempt two questions each from section A and B. Each question in section A and B shall carry 12 marks. Section C will consist of 11 short answer type questions covering entire syllabus and the candidates are required to attempt all questions. Each question in section C will carry 2 marks.

Unit-I

Introduction to basic tools: DNA cutting and modifying enzymes (restriction enzymes, alkaline phosphatase, polynucleotide kinase, DNA ligase, endonucleases, exonucleases).

Techniques of Cloning: PCR: Basic, Real Time PCR, Chemical synthesis of DNA: Adaptors, linkers and Homo-polymer tailing for in-vitro ligation.

Cloning & Transformation techniques: Plasmids, phages, cosmids, phasmids, their salient features and host-range. Chemical, physical and biological strategies of transformation.

DNA libraries: Genomic & cDNA libraries: construction and applications.

Recombinant Selection and identification: Direct and indirect methods: Antibiotic resistant marker selection, X-gal IPTG selection, reporter genes, South-Western screening, North-western screening.

Unit-II

Cloning in Prokaryotes: Cloning in model organism: E.coli (vectors and strategies).

Cloning in Eukaryotes: Cloning in Yeast and mammalian cells (vectors and strategies).

Gene Expression in recombinants: Principles of maximizing gene expression, Expression vectors, their salient features and host range: His-tag & GST tag.

Nucleic acid Sequencing I: Principle, procedure and application: NG Sequencing , pyrosequencing , Illumina (Solexa) sequencing, Single molecule real time (SMRT) sequencing.

Applications of rDNA Technology: Recombinant medicinal products; Vaccines and Nucleic acid therapeutics , Agricultural applications: Bt cotton and Flavr Savr Tomato.

Books Recommended:

1. Principles of Gene Manipulations by R.W. Old and S.B. Primrose Blackwell Scientific Publication.
2. Fundamentals of Genetic Engineering (Vol. 12) by R.H. Rehm and G. Reed Verlag Press, NY.
3. Treatics Genetic Engineering by P.J. Barrwiley, NY.
4. Molecular Cloning by J. Sambrook, E.F. Fritsch and T. Maniatis Cold Spring Harbor, NY.
5. Gene Cloning by T.A. Brown, Van Nosterland and Teinhold, NY.
6. Recombinant DNA Principles and Methodologies by J. Greene and V.B. Rao, Marcel Dekkel Inc., NY.
7. Genetic Engineering by R. Williamson (Vol. 1, 2, 3 and 4) Academic Press, NY.
8. An Introduction to Genetic Engineering by Desmond S. T. Nicholl Cambridge University Press.
9. Genetic Engineering by Anil Kumar, Neha Garg , Nova Publishers.

Lab Course LC7- MBT(Lab) 306 Pertaining to Genetic Engineering

Practical Time 3 Hrs/Week

M. Marks : 50

Time allowed for Examination: 5 Hrs.

Pass Marks : 35%

INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (12.5 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (25 Marks). Section C will contain, practical note Book Evaluation and Viva Voce (12.5 Marks).

List of Practicals:

1. Isolation of plasmid DNA from *E. coli* cells.
2. Restriction digestion of plasmid DNA.
3. Determination of Molecular weight of DNA by agarose gel electrophoresis.
4. Determine the transformation efficiency of *E. coli* cells by chemical method.
5. Selection of transformants in *E.coli* by X gal/ ampicilin markers.
6. Amplification and evaluation of DNA with Polymerase Chain Reaction (PCR).
7. Isolation and analysis of m-RNA from eukaryotic cells.

Paper XIII – MBT(C9)303 Research Methodology

Course Objective:

1. To make the students familiar with tools and techniques of research.
2. To create a sound knowledge for the data collection and interpretations.
3. To give details to the student for the use of tools and techniques in research.

Lectures to be Delivered 60

M. Marks : 70

Time allowed: 3 Hrs

Pass Marks : 35%

INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE

The question paper will consist of three sections. Section A and B (Consist of unit I and II of the syllabus, respectively) will have four questions each from respective units and candidates are required to attempt two questions each from section A and B. Each question in section A and B shall carry 12 marks. Section C will consist of 11 short answer type questions covering entire syllabus and the candidates are required to attempt all questions. Each question in section C will carry 2 marks.

Unit-I

Foundations of Research: Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory, Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable Research Process

Problem Identification & Formulation– Research Question – Investigation Question – Measurement Issues – formation of Hypothesis.

Research Design: Concept and Importance in Research, Features of a good research design, Exploratory Research Design, concept, types and uses, Descriptive Research Designs: concept, types and uses Experimental Design: Concept of Independent & Dependent variables

Qualitative and Quantitative Research: Qualitative research, Quantitative research, Concept of measurement, causality, generalization, replication, merging the two approaches

Unit-II

Sampling: Introduction to Sample selection, Determining size of the sample– Practical considerations in sampling and sample size

Interpretation of Data and Paper Writing: Layout of a Research Paper, Search for Journals, Impact factor of Journals, When and where to publish, Ethical issues related to publishing, Plagiarism and Self-Plagiarism.

Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline

Use of tools /techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like MS Office, Software for detection of Plagiarism.

Books Recommended:

1. Research Methodology: Methods and Techniques by C.R.kothari
2. Research Methodology by Ranjit kumar
3. Research Methodology by J.A.Khan
4. Research Methodology And Statistical Techniques By Santosh Gupta
5. Research Methodology: Concepts and Cases By Deepak Chawla & Neena Sodhi

Lab Course LC8- MBT(Lab) 307 Pertaining to Research methodology

Practical Time 2 Hrs/Week

M. Marks : 35

Time allowed for Examination: 5 Hrs.

Pass Marks : 35%

INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (8.5 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (18 Marks) Section C will contain, practical note Book Evaluation and Viva Voce (8.5 Marks).

List of Practicals:

1. Search of sites for literature survey including national and international.
2. Determination of impact factor of a journal.
3. How to write an abstract for a research paper.
4. Reference writing in the project report.
5. Checking of plagiarism using various softwares.
6. How to write a review article.
7. How to write and submit a research paper for journals.
8. Selection of journal for the submission of journal.

Paper XIV – MBT (E5)304 (Option I) Plant Physiology

Course Objective:

1. To make the student familiar with the structure of plant organs and their functioning.
2. To acquaint the student for the role of nutrients in plant growth, Metabolic pathways that act as backbone for plant survival
3. To make the student familiar about the stress physiology in plants
4. Biotechnology based synthesis of secondary metabolites

Lectures to be Delivered 30

M. Marks : 50

Time allowed: 3 Hrs

Pass Marks : 35%

INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE

The question paper will consist of three sections. Section A and B (Consist of unit I and II of the syllabus, respectively) will have four questions each from respective units and candidates are required to attempt two questions each from section A and B. Each question in section A and B shall carry 10 marks. Section C will consist of 10 short answer type questions covering entire syllabus and the candidates are required to attempt all questions. Each question in section C will carry 1 mark.

Unit-I

Photosynthesis: Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO₂ fixation-C₃, C₄ and CAM pathways.

Respiration and photorespiration: Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway.

Nitrogen metabolism: Nitrate and ammonium assimilation; amino acid biosynthesis.

Plant hormones: Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action.

Unit-II

Sensory photobiology: Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks

Solute transport and photoassimilate translocation – uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.

Secondary metabolites - Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.

Stress physiology – Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.

Books Recommended:

1. Plant Physiology edited by Hans Mohr, Peter Schopfer
 2. Modern Plant Physiology By Rajiv Kumar Sinha
 3. Plant Physiology By Narendra Gupta
 4. Plant Physiological Ecology: By Hans Lambers , By (author) F. Stuart Chapin , By Thijs L. Pons
 5. Plant Physiology : The Structure of Plants Explained:By (author) Edwin Oxlade , Edited by Dr. Graham Lawler
 6. Plant Physiology : International Edition:By (author) Lincoln Taiz , By Eduardo Zeiger
 7. Plant Behaviour and Intelligence:By Anthony Trewavas
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Lab Course LC9- MBT (Lab) 308 (Option I) Plant Physiology

Practical Time 2 Hrs/Week

M. Marks : 35

Time allowed for Examination: 5

Pass Marks : 35%

Hrs.

INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (8.5 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (18Marks). Section C will contain, practical note Book Evaluation and Viva Voce (8.5 Marks).

Practicals

1. Study the structure of living shoot apices by dissection method.
- 2 Determination of the Ascorbic Acid Content in Cabbage.
- 3 To study the apical dominance in plant using auxin and/or a cytokinin growth regulator.
- 4 Determination of seed germination test by paper method.
- 5 Preparation of stained mounts of anatomy of monocot and dicot's root, stem & leaf.
- 6 Demonstration of plasmolysis by *Tradescantia* leaf peel.
- 7 Demonstration of opening & closing of stomata
- 8 Demonstration of guttation on leaf tips of grass and garden nasturtium.
- 9 Effect of Abiotic stress on plant growth.

Paper XIV Option-II MBT (E 5) 304 – ECOLOGICAL PRINCIPLES

Course Objective:

1. To make the student familiar with the environment, Population and community ecology.
2. To acquaint the student for the role of ecosystem and applied ecology.

Lectures to be Delivered 30

M. Marks : 50

Time allowed: 3 Hrs

Pass Marks : 35%

INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE

The question paper will consist of three sections. Section A and B (Consist of unit I and II of the syllabus, respectively) will have four questions each from respective units and candidates are required to attempt two questions each from section A and B. Each question in section A and B shall carry 10 marks. Section C will consist of 10 short answer type questions covering entire syllabus and the candidates are required to attempt all questions. Each question in section C will carry 1 mark.

Unit-I

The Environment: Physical environment; biotic environment; biotic and abiotic interactions.

Habitat and niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.

Population and community ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.

Species interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.

Unit-II

Ecological succession: Types; mechanisms; changes involved in succession; concept of climax.

Ecosystem: Structure and function; energy flow and mineral cycling (CNP); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic .

Biogeography and Applied ecology: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India. Environmental pollution; biodiversity-status, monitoring and documentation; major drivers of biodiversity

change.

Conservation biology: Principles of conservation, Indian case studies on conservation/management strategy .

Books Recommended:

1. Ecology: Principles and Applications J. L. Chapman, M. J. Reiss Cambridge University Press, 1999 - Nature
2. Ecological Principles of Agriculture Paperback– Dec 28 1999 by Laura Powers (Author), Robert McSorley (Author)
3. Advanced Ecological Theory: Principles and Applications Editor(s): Jacqueline McGlade
4. Population Ecology: First Principles Second Edition John H. Vandermeer & Deborah E. Goldberg
5. Ecological Engineering: Principles and Practice Patrick Kangas by CRC Press

Lab Course LC9- MBT (Lab) 308 – Ecological Principles

Practical Time 2 Hrs/Week

M. Marks : 35

Time allowed for Examination: 5 Hrs.

Pass Marks : 35%

INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (8.5 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (18 Marks) Section C will contain, practical note Book Evaluation and Viva Voce (8.5 Marks).

List of Practical:

1. Physical and chemical characteristics of soil.
2. Assessing influence of light, temperature and moisture on plant germination and growth.
3. Assessment of density, frequency and abundance of plants/animal in a community using various techniques i.e. transect, quadrat etc.
4. Determination of population density in natural or hypothetical community by quadrat method.
5. Biochemical transformation of carbon compounds by isolation of cellulose decomposer.
6. Principles of GIS and RS technology.
7. Study of aquatic ecosystem.
8. Report on a visit to national park or a Diversity park.

Paper XV –MBT (E6) 305 Option I Bioinformatics

Course Objective:

1. To make the student familiar with the fundamentals of computer and Bioinformatics.
2. To become familiar with Sequence Analysis and Phylogenetic Trees & their construction

Lectures to be Delivered 30

M. Marks : 50

Time allowed: 3 Hrs

Pass Marks : 35%

INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE

The question paper will consist of three sections. Section A and B (Consist of unit I and II of the syllabus, respectively) will have four questions each from respective units and candidates are required to attempt two questions each from section A and B. Each question in section A and B shall carry 10 marks. Section C will consist of 10 short answer type questions covering entire syllabus and the candidates are required to attempt all questions. Each question in section C will carry 1 mark.

Unit-I

Bioinformatics: Introduction, its goals and Applications, Role of Computers in Bioinformatics.

Biological Databases: Characteristics and Classification of Databases- Primary (INSDC), secondary (PROSITE), Composite (UNIPROT) and Specialised Databases (REBASE).

Sequence Analysis: Introduction, methods of sequence analysis, Local and Global alignment; Dot plot & Dynamic Programming

Unit-II

Heuristic methods: algorithm and versions of FASTA& BLAST. Scoring matrices: PAM & BLOSSUM.

Multiple Sequence Alignment: Methods and Applications of multiple seq. alignment.

Phylogenetic Trees & their construction: Branches. Nodes, Clade, Taxa, OUT, Rooted and Unrooted tree. Forms of Tree representation: Phylogram, Cladogram, Dendrogram. Methods used for construction and evaluation of phylogenetic trees.

Books Recommended:

1. Essential Bioinformatics by Jin Xiong, Cambridge University Press.
2. Bioinformatics : Sequence and Genome Analysis by David W. Mount , CSHL Press
3. Bioinformatics: Concepts, Skills and applications by R. C. Rastogi, CBS publishers.
4. Bioinformatics by David R. Westhead, John Howard Parish, Richard M. Twyman, BIOS.
5. Bioinformatics: A Practical Guide to analysis of Genes and Genomes by

- Andreas D. Baxevanis and b. F. Francis Ouellette. John Wiley & Sons.
6. Tomita M & Nishioka T. Metabolomics: The Frontier of Systems biology. Springer Verlag.
 7. James FK & Keith WR. Computer Networking: A Top-Down Approach Featuring the Internet. Prentice Hall.

Lab Course LC9-MBT(lab)308 Pertaining to Bioinformatics

Practical Time 2 Hrs/Week

M. Marks : 35

Time allowed for Examination: 5 Hrs.

Pass Marks : 35%

INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (8.5 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (18 Marks). Section C will contain, practical note Book Evaluation and Viva Voce (8.5 Marks).

List of Practicals:

1. Flat file format of GENBANK
2. Describe databases that can be used to access text information about human diseases.
3. Compare the use of Entrez and ExPasy to retrieve information about a protein sequence.
4. Perform pairwise alignments of the proteins using PAM 30, Pam 70 and PAM 250 matrices.
5. Compare sequence and taxonomy information from BLAST, PSI-BLAST, PHI-BLAST
6. Creation of molecules and calculation of energy minimization, torsion angles, band distance, bond angle, Ramachandran plot.
7. Molecular modeling of given protein structure (3D) database using various software.

Paper XV- MBT (E6)305 Option II Solid and Hazardous waste management

Course Objective:

1. To make the student familiar with the processing technology for Solid and Hazardous materials.
2. To become recognizable with Hazardous waste management system

Lectures to be Delivered **30**

M. Marks : 50

Time allowed: **3 Hrs**

Pass Marks : 35%

INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE

The question paper will consist of three sections. Section A and B (Consist of unit I and II of the syllabus, respectively) will have four questions each from respective units and candidates are required to attempt two questions each from section A and B. Each question in section A and B shall carry 10 marks. Section C will consist of 10 short answer type questions covering entire syllabus and the candidates are required to attempt all questions. Each question in section C will carry 1 mark.

Unit-I

Introduction: Types, sources and characteristics of solid wastes. Solid waste generation, handling and storage. Collection of solid wastes- Collection services, types of collection system and their analysis, transfer and transport.

Processing Techniques- Shredding and pulverizing, baling, component separation, incineration, gasification and pyrolysis.

Disposal: Dumping, land filling- site selection, leachate contamination, land filling methods, treatments of leachates, land farming and deep well injection.

Unit-II

Materials recovery system: Processing of recyclable materials, metals recovery from solid wastes. Recovery of thermal conversion products: Recovery of clean liquid and gaseous fuels from organic wastes.

Reusable Energy sources: Recovery of energy from conversion products: energy from wood wastes, animal waste, Biogas plant.

Hazardous Waste Management: Definition and classification of Hazardous Waste, Characteristics and Transportation of Biological, chemical and radioactive waste, treatment, storage and disposal.

Books Recommended:

1. Environmental Hazards-Smith, Keith
2. Environmental Hazards-Iqbal, M, Srivastava, A.S. and Siddiqui, T.Q.
3. Basic Environmental Technology-Nathanson, J.A.

Lab Course LC 9- MBT (Lab) 308 Option II Solid and Hazardous waste management

Practical Time 2Hrs/Week

M. Marks : 35

Time allowed for Examination: 5 Hrs

Pass Marks : 35%

INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (8.5 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (18 Marks) Section C will contain, practical note Book Evaluation and Viva Voce (8.5 Marks).

List of Practicals

1. To determine the heavy metals in the industrial waste.
2. To evaluate the organic carbon content in waste.
3. Demonstration for preparation of vermicompost from domestic waste.
4. To determine the surfactant content in waste.
5. To estimate the amount of chlorides in sewage.
6. To determine the weight of solids in the sludge.
7. Estimation of the loss of ignition of waste.
8. Demonstration of biogas production from waste.
9. Technique for laboratory waste management.

**M.Sc. (Hons.) Biotechnology Second Year
(4th Semester)**

Paper XVI MBT (C10)-401 Bioprocess Engineering

Course Objective:

1. This course enables students to understand the concept of sterilization, bioreactors and mass transfer and their equipment design.
2. This course enables students to understand Up stream and down stream processing in the bioprocess technology
3. This course facilitates students to acquire the knowledge about scale up and bioprocess economics.

Lectures to be Delivered 45

M. Marks : 70

Time allowed: 3 Hrs

Marks : 35%

INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE

The question paper will consist of three sections. Section A and B (Consist of unit I and II of the syllabus, respectively) will have four questions each from respective units and candidates are required to attempt two questions each from section A and B. Each question in section A and B shall carry 12 marks. Section C will consist of 11 short answer type questions covering entire syllabus and the candidates are required to attempt all questions. Each question in section C will carry 2 marks.

Unit-I

Introduction: Bioprocess & Bioprocess engineering, biochemical engineering. Upstream and down stream processing (USP and DSP).

Sterilization principles and practices: Media sterilization, kinetics of medium sterilization, thermal death time (TDT), D, Z and F value, batch and continuous sterilization systems, filter sterilization of air and media.

Bioreactors: Construction of Bioreactor, Types (STR, bubble column, airlift, packed bed fluidized. Cyllindro-conical, cyclone column), valves and steam traps, sterilization of bioreactors.

Aeration and agitation: The structural components of the bioreactors involved in aeration and agitation and their design; mass transfer coefficient (KLa), determination of KLa, factors affecting KLa value in bioprocess.

Bioprocess control and monitoring systems: Sensors (inline, on line, off line), Methods of measuring process variables (temperature, flow rate, pressure, biomass, dissolved oxygen, oxygen in air, stirring, pH), neural networking

Unit-II

Fermentation Broth Rheology: Viscosity, Rheological Properties of Fermentation Broths, Factors affecting broth viscosity

Down stream processing (DSP): Methods of cell separation from fermentation medium (foam separation, flocculation, filtration and centrifugation) Cell disruption (physical and chemical methods).

Recovery/purification of bioproducts: Solid-liquid extraction, dialysis, liquid-liquid extraction, Principle and application of chromatographic techniques (paper, TLC, ion exchange, molecular sieve, affinity, hydrophobic, high performance liquid chromatography, gas liquid chromatography), distillation and drying.

Scale up and bioprocess modeling: Optimization and scale up of bioprocesses. Introduction to Bioprocess modeling.

Bioprocess economics: Economic analysis of projects, project selection, R & D planning for projects; Techno-economic parameters for commercial evaluation of bioprocesses; Capital cost; Direct and indirect manufacturing costs.

Books Recommended:

1. Bioprocess Engineering by Michael L. Shuler and Fikret Kargi. Pearson Education London UK
2. Bioprocess Engineering Principles by Pauline M. Doran. Academic Press San Diego California
3. Biochemical Engineering by A. Aiba, A.E. Humphery and N.F. Mkili University of Tokyo.
4. Biotechnology Vol : 1, 2 and 7 by Moo Young, Pergamoon Press, NY.
5. Comprehensive Biotechnology Vol. 2 by Moo Young, Pergamnon Press, NY.
6. Fundamentals of Biotechnology by P. Prave, F. Eaus, W. Sitting and D.A. Sukatech, ECH Weinheim.
7. Biochemical Engineering Fundamentals by J.E. Bailey and D.F. Ollis, McGraw Hill Co., NY.
8. Methods in Industrial Microbiology by B. Sikyata, Ellis Horwood Ltd., London.
9. Principles of Fermentation Technology by P.F. Stanbury and A. Whitaker, Pergamnon Press, NY.
10. Principles of Microbial and Cell Cultivation by S.J. Pirt. Black Well Scientific Publications, London.

Lab Course LC 10 MBT (Lab)-404 Bioprocess Engineering

Practical Time 3 Hrs/Week

M. Marks : 50

Time allowed for Examination: 5

Pass Marks : 35%

Hrs.

INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (12.5 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (25 Marks) Section C will contain, practical note Book Evaluation and Viva Voce (12.5 Marks).

List of Practical:

1. Introduction to laboratory scale bioreactor and its fabrication.
2. Determination of thermal death time of culture and evaluation of sterilization techniques.
3. Evaluation of cell disruption technique for extraction of intracellular components in Bacteria.
4. Evaluation of effectiveness of biomass harvesting techniques in down stream processing (DSP).
5. Precipitation of protein by ammonium sulfate and Acetone.
6. Purification of protein by HPLC
7. Determination of Molecular weight of protein by electrophoresis
8. Determination of aeration capacity of fermentor (KLa)
9. Scale up Bioreactor.

Paper XVII – MBT(C11)-402 Commercial Biotechnology

Course Objective:

1. This course enables students to understand the concept of Intellectual property rights, patent and Good Safety practices.
2. This course enables students to understand the concept of Tools and techniques of TQM and ISO.

Lectures to be Delivered 45

M. Marks : 50

Time allowed: 3 Hrs

Pass Marks : 35%

INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE

The question paper will consist of three sections. Section A and B (Consist of unit I and II of the syllabus, respectively) will have four questions each from respective units and candidates are required to attempt two questions each from section A and B. Each question in section A and B shall carry 10 marks. Section C will consist of 10 short answer type questions covering entire syllabus and the candidates are required to attempt all questions. Each question in section C will carry 1 mark.

Unit-I

Intellectual property rights: Intellectual property, types and related Indian legislations, International conventions (TRIPs, Paris convention, Budapest treaty, UPOV).

Patents: A Patentability criteria, subject matter, types of patents and patents claims.

Patenting system: Patentability of biological processes and products in India, US and Europe .

Good Safety practices: GLP Standards, Lab contaminants GMPs. The Cartagena protocol on biosafety.

Unit-II

Total quality management: Introduction, concept, role and its importance; Cost of quality, competitive bench market and quality delivery market.

Tools and techniques of TQM: Techniques for analyzing quality process, statistical process control, problem solving tools.

International Organization for Standardization (ISO): About the organization and its functioning. Members, various revisions and requirements for ISO 9000 & 14000.

Commercial Biotechnology :Concept of a Project and setting up a small scale enterprise. Project identification and project formulation. Legal requirements for establishment of a unit.

Books Recommended:

1. Total quality in research and development by Greg McLaughlin .
2. Guide to Total Quality Management by Ralph early.
3. Total Quality Management by Shailendra Nigam , Excel Books India.

4. Total Quality Management by Sundara Raju - Tata McGraw-Hill Education.
5. Quality Control and Total Quality Management, Jain P L Jain - Tata McGraw-Hill Education
6. Guide to Quality Management systems for the food industry by R. Early, Blackie Academic, NY.
7. Intellectual Property Rights on Biotechnology by K.C.Singh, BCIL, New Delhi,.
8. Intellectual Property Rights :Patent Laws in India, By G.V.Rao, SSDN Publishers,

Lab Course LC11- MBT(Lab)-405 Commercial Biotechnology

Practical Time 3 Hrs/Week

M. Marks : 35

Time allowed for Examination: 5 Hrs.

Pass Marks : 35%

INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE

The Final practical paper will consist of three sections A, B and C. Section A will contain write up (7.5 Marks) from the list of practical pertaining to lab course. Section B will contain practical to perform in examination (20 Marks) Section C will contain, practical note Book Evaluation and Viva Voce (7.5 Marks).

List of Practical:

1. Use of MS- Office software to sketch a company profile.
2. Emulation of Simon`s Model of decision making for a fictitious concern.
3. An over view of ISO 9000 family of Quality Management Standards.
4. A brief about ISO 9000 certified Indian companies.
5. An overview of ISO 14000 family of Environment Management Standards.
6. A brief about ISO 14000 certified Indian companies.
7. Identification of the TQM related problems in an organization and possible solution.
8. Preparation of a project report.
9. Procedure to file a Patent.
10. Brief Introduction to PPE (Personal protective equipments)in lab.

Paper XVIII – MBT (C12) 403- Tissue and Cell Culture Technology

Course Objective:

1. This course facilitates students to understand the concept of plant cell and tissue culture techniques.
2. This course enables students to understand the concept of Tools and techniques of for animal cell culture for the production of transgenic animals

Lectures to be Delivered 45

M. Marks : 50

Time allowed: 3 Hrs

Pass Marks : 35%

INSTRUCTIONS FOR THE PAPER SETTER/CANDIDATE

The question paper will consist of three sections. Section A and B (Consist of unit I and II of the syllabus, respectively) will have four questions each from respective units and candidates are required to attempt two questions each from section A and B. Each question in section A and B shall carry 10 marks. Section C will consist of 10 short answer type questions covering entire syllabus and the candidates are required to attempt all questions. Each question in section C will carry 1 mark.

Unit-I

Plant Tissue culture: Introduction, Laboratory set up, Plant growth regulators, their physiological functions.

Cell Culture: Culture media, Sterilization techniques, Callus and Suspension culture.

Culture Techniques: Somatic Embryogenesis, Organogenesis, Micro propagation, Anther culture, Somatic cell hybridization

Gene Transfer in plants: Agrobacterium mediated, Direct gene transfer methods in plants, Vectors for production of transgenic plants.

Crop improvement and Plant Bioreactor: Applications of plant tissue culture, virus free plant production, modification of starch, oil and seed protein quality. Introduction to Plant bioreactors.

Unit-II

Animal cell culture: History, culture media composition- serum and serum free media.

Sterilization techniques: Culture media, glassware and laboratory, Safety considerations in ATC lab.

Culture Establishment, maintenance and preservation: Initiation and establishment of cell culture - primary culture techniques, large scale culture of cell lines, Culture of tumor cells. Somatic cell fusion, selection, properties of cell hybrids.

Transgenic Animals: Methods of transfection in animals and their applications.

Application ATC: IVF- humans and cattle. Stem cells- basics, embryonic

