SYLLABUS

FOR

M.Sc. SEMESTER PATTERN IN

BIOTECHNOLOGY

GONDWANA UNIVERSITY

GADCHIROLI

INDIA
# SYLLABUS
FOR
M.Sc. SEMESTER PATTERN IN BIOTECHNOLOGY SUBJECT, GONDWANA UNIVERSITY
GADCHIROLI (M.S.) INDIA

## SEMESTER – I (THEORY)

<table>
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JOURNAL CLUB / ASSIGNMENTS EACH THEORY PAPER: 20

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SEMINAR / ASSIGNMENTS EACH THEORY PAPER: 25

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JOURNAL CLUB / ASSIGNMENTS EACH THEORY PAPER: 20
# PRACTICALS AND PROJECT WORK

### PRACTICAL - I
- BT4-LAB7
- 80

### PROJECT WORK
- BT4-
- 100

### SEMINAR /
- BT4-INT1
- 25

### JOURNAL CLUB / ASSIGNMENTS EACH THEORY PAPER
- 20

## APPENDIX A

### MASTER OF SCIENCE (BIOTECHNOLOGY)

### TWO YEAR (FOUR SEMESTERS) DEGREE COURSE

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Note: T= Theory; P= Practical/lab, * = If required, for two days.

Minimum marks for passing 32 out of 80 in each Theory paper

Minimum marks for passing 40 out of 100 in each Practical/lab and Project work and minimum of 08 out of 20 in the internal (journal club/assignment) examination of that semester.

Minimum marks for passing 10 out of 25 in seminar
APPENDIX B

MASTER OF SCIENCE (BIOTECHNOLOGY)

TWO YEAR (FOUR SEMESTERS) DEGREE COURSE

A) Pattern of Question Paper

1. Four units in each paper.
2. One question on each unit.
3. Fifth question on all units.
4. Maximum marks of each paper 80
5. Projects shall be evaluated by internal and external examiners. 50% marks of project shall be given by internal and external examiners each.
6. Duration of question paper is 3 hours.
7. Practical/lab examination of 80 marks. Distribution of marks shall be 40 internal and 40 external. Internal practical/lab of 20 marks.

General Instructions/Directions.

Each paper is supposed to cover minimum 60 clock hours of teaching and 240 clock hours per semester for all the four papers.

Each Question paper shall have five questions with equal marks/credits.

There will be four long questions one question from each unit. A long question can be subdivided into two short questions.

Fifth question shall comprise of four very short question one question of each unit.

There shall be internal choice from each unit.

Practical examination shall be of minimum 12 hours and may spread over two days.

There shall be at least one major and two minor experiments in the practical examination

Minimum passing marks are per the marks/credit annexure.

Every student shall be required to participate in educational/industrial tour atleast once during PG course.
M. Sc. Biotechnology Semester III

Paper I - Animal Biotechnology

Unit 1 Introduction to Animal Cell Culture
   A. Animal Cell Culture: Equipments and materials for animal cell culture technology. Various systems of tissue culture, advantages and limitations.
   B. Culture media: natural media, synthetic media, balanced salt solutions.
   C. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium, role of CO₂, serum and supplements.
   D. Characteristics of cells in culture: contact inhibition, anchorage dependence, cell-cell communication.

Unit 2 Methods of Animal Cell and Tissue Culture
   A. Isolation of animal cell material: various methods of separation of cell types, advantages and limitations.
   B. Primary Culture: behavior of cells, properties, utility, explant culture; suspension culture.
   C. Established cell line cultures: definition of cell lines, maintenance and management; cryopreservation, germplasm conservation, cell adaptation.
   D. Three dimensional cultures

Unit 3 Scaling up of animal cell culture
   A. Apoptosis: measurement of cell death. apoptosis (death domain, role of cytochrome C)
   B. Cell synchronization and cell manipulation
   C. Cell transformation, Cell cloning
   D. Tissue engineering: design and engineering of tissue, tissue modeling.
   E. Stem cell cultures, embryonic stem cells and their applications

Unit 4 Application of Animal Tissue Culture
   A. Mass production of biologically important compounds (eg. vaccines), cytotoxicity and diagnostic tests.
   B. Manipulation of reproduction in animals: artificial insemination, embryo transfer (multiple ovulation, multiple ovulation with embryo transfer)
   C. In vitro fertilization technology: embryo cloning and embryonic stem cell. embryo transfer in human.
   D. Application of animal cell culture: transgenic animals- mice, large animals, xenotransplantation, use of transgenic animals in disease interruption.
M. Sc. Biotechnology Semester III

Paper II- Plant Biotechnology

Unit 1 Introduction to Plant Tissue Culture
A. Brief introduction to conventional plant breeding
B. Introduction to cell and tissue culture technique.
C. Tissue culture media (composition and preparation)
D. Role of growth hormone in plant tissue culture (auxins, cytokinins)
E. Callus and suspension cultures: initiation and maintenance of callus and suspension cultures; single cell clones.

Unit 2 Techniques of Plant Tissue Culture
A. Organogenesis, embryogenesis; transfer and establishment of whole plants in soil.
B. Shoot tip culture: rapid clonal propagation and production of virus free plants.
C. Embryo culture and embryo rescue.
D. Hybrid plants: protoplast isolation, culture and fusion.
E. Selection of hybrid cells and regeneration of hybrid plants, symmetric and asymmetric hybrid, cybrid.
F. Production of haploid plants: anther and pollen cultures for production of haploid plants.

Unit 3 Plant transformation technology
A. Basis of tumor formation, hairy root.
B. General features of Ti and Ri plasmids.
C. Mechanism of DNA transfer, role of virulence genes, use of Ti and Ri as vectors, binary vectors.
D. Methods of nuclear transformation, biological and physical transformation methods.
E. Chloroplast transformation.

Unit 4 Application of Plant Tissue Culture
A. Applications of plant transformation for productivity and performance
B. Herbicide resistance - phosphinothricine glyphosate, sulfonyl urea.
C. Insect resistance-Bt genes.
D. Virus resistance, coat protein mediated nucleocapsid gene.
E. Fungal resistance, disease resistance, nematode resistance.
F. Improvement of crop yield and quality - Long shelf life of fruits and flowers.
G. Male sterile lines.
H. Transgenic plants as a food- golden rice, tomato, sugarcane, sweet corn.
M. Sc. Biotechnology Semester III

Paper III Genetic Engineering

Unit 1 Introduction to Genetic Engineering and Gene Selection
A. Isolation of DNA from the source (plant, animal, microbes)
B. DNA manipulation enzymes: nucleases (exonucleases and endonucleases), ligases, polymerases and topoisomerases.
C. Restriction enzymes and their types, restriction modification system, DNA modification enzymes

Unit 2 Cloning Vectors and rDNA Preparation
A. Cloning vectors: Plasmids as vectors, general characteristics of plasmids, bacterial vector plasmids, yeast vector plasmids, yeast artificial chromosomes. Viral vectors (lambda, M13). Cosmid vectors, phagmid vectors.
B. Insertion of DNA and ligation: Berg's terminal transferase method (dA:dT joints); Boyer-Cohen-Chang experiment (cohesive ends), Butt joints (T4 DNA ligase); current ligation techniques (blunt-end ligation, complementary end ligation) linkers, adaptors, homopolymer tailing.

Unit 3 Molecular Probe and DNA Sequencing
A. Gene libraries and molecular probes: Molecular probes for detecting nucleic acids and proteins. Genomic DNA library, cDNA library.
B. Nucleic acid hybridization (Southern, northern). Antibody probes (western blotting, immunoprecipitation and south-western screening).
C. DNA sequencing: Sanger-Coulson dideoxynucleotide method, Maxam-Gilbert chemical cleavage method, automated DNA sequencing.

Unit 4 Insertion of Foreign DNA into Host Cells
A. Transformation: DNA uptake by bacterial cells.
B. Transfection: Chemical and physical methods, Viral vectors. Polyethylene glycol, DEAE-dextran, calcium phosphate coprecipitation, dimethyl sulfoxide, liposomes, microinjection, macroinjection, electroporation, biolistics, somatic cell fusion, viral vectors (single- and two-strain packaging).
C. Gene transfer by pronuclear microinjection
M. Sc. Biotechnology Semester III

Paper IV Applied Biotechnology

Unit 1 Gene Amplification and Expression
A. Salient features of expression vectors.
B. Expression of foreign gene: expression of eukaryotic genes in bacteria, expression of foreign genes in yeast, insect and mammalian cells.
C. Processing of recombinant proteins: refolding and stabilization.
D. Protein engineering- addition of disulphide bond, changing amino acids, modification of metal cofactors, changing protease activity, active site modification.
E. Amplification of DNA: Polymerase chain reaction

Unit 2 Gene Theory and Therapeutic Products
A. Production of monoclonal bodies by phage display technique using filamentous phage vectors.

Unit 3 Production of Commercial Products by GMOs
A. Role of rDNA technology in production of alcohol
B. Role of rDNA technology in production of vitamins- (ascorbic acid, vitamin B12)
C. Role of rDNA technology in production of vaccine- (vaccinia viral vaccine, polio vaccine)
D. Role of rDNA technology in production of hormone- (insulin, oxytocin)
E. Role of rDNA technology in production of antibiotics- (streptomycin, penicillin)

Unit 4 Plant secondary metabolites and Nanobiotechnology
B. Green house technology: principle and application
C. Concept of nanobiotechnology and application of nanobiotechnology in medicine.
M. Sc. Biotechnology Semester III

Practical-V (ANIMAL AND PLANT BIOTECHNOLOGY)

Compulsory Practical
2. Development of primary cell lines/maintenance of established cell lines.
3. Plant protoplast isolation, fusion and protoplast culture.

Optional Practical
1. Preparation of animal cell culture media.
2. Initiation of primary culture from Chick embryo.
3. Preparation of single cell suspension from spleen / liver / thymus.
5. Trypsinization of monolayer and subculturing.
6. Preparation of plant tissue culture media.
7. Surface sterilization.
8. Organ culture.
10. Micropropagation of banana, citrus, papaya, Sugarcane etc.
11. Embryo culture of different plant species.
12. Effect of various growth hormones on cell divisions and cell proliferation.
13. Cytological examination of regenerated plants.

Practical VI (GENETIC ENGINEERING AND APPLIED BIOTECHNOLOGY)

Compulsory Practical
1. Recombinant DNA technology: in vitro DNA ligation and transformation of E. coli.
2. Isolation of polyA + RNA.
3. Demonstration of technique of PCR.

Optional Practical
1. Recombinant DNA technology: characterization of transformants.
2. Cell transformation by viruses.
3. Northern blotting.
4. Isolation of Lambda phage DNA.
5. Construction of restriction map of plasmid DNA.
7. Gene expression in E coli and analysis of gene product.
8. Demonstration of technique of RT-PCR.
9. Replica plating technique.
10. Induction of beta-galactosidase in strains of E. coli (I+ and I-).
11. Production of polyhydroxybutyrate (PHB) and its analysis.
13. Production of rDNA by ligation method.
14. Extraction of DNA from plant source.
Note: In addition to the 3 compulsory practicals, at least 6 optional practicals from each section must be conducted within the semester.

TEXT BOOKS & REFERENCES FOR THEORY AND PRACTICALS:

1. TEXT BOOK OF BIOTECHNOLOGY, R.C.DUBEY, 2009, S.CHAND, DELHI
2. INFRASTRUCTURE AND OF CELLS, BUTTERWORTH, HEINEMANM, 2004, OPEN UNIVERSITY PUBL.
4. PLANT PHYSIOLOGY AND BIOCHEMISTRY, S.K.SINGH,SEEMA SRIWASTAVA, 2009, CAMPUS BOOKS INTERNATIONAL
5. EXPERIMENTS IN MICROBIOLOGY, PLANT, PATHOLOGY AND BIOTECHNOLOGY, K.R. ANEJA, 2003, NEW AGE INT.PVT.LTD
6. CELL BIOLOGY GENETICS MOLE BIOLOGY EVOLUTION AND ECOLOGY, P. S. VERMA, 2005, S. CHAND
7. BIOTECHNOLOGY (E.H.), B. D. SINGH, 2008, KALYANI PUBLICATION
8. CELL AND MOLECULAR BIOLOGY GERALD KARP, 2007. JOHN WILLEY AND SON PVT. LTD.
9. CELL BIOLOGY, C.B. POWAR, 2005, HIMALAYA PUBLISHING HOUSE.
10. CELL BIOLOGY, VARMA AND AGRAWAL, 2005, S. CHAND, DELHI
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