

SYLLABUS

FOR

M.Sc. SEMESTER PATTERN IN

BIOTECHNOLOGY

GONDWANA UNIVERSITY

GADCHIROLI

INDIA

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

SEMESTER – I (THEORY)

			MARKS
PAPER - I	BT1-T001	CELL BIOLOGY	80
PAPER - II	BT1-T002	MICROBIOLOGY	80
PAPER - III	BT1-T003	BIOPHYSICAL TECHNIQUES	80
PAPER - IV	BT1-T004	MOLECULAR BIOLOGY	80

PRACTICALS

PRACTICAL - I	BT1-LAB1		80
PRACTICAL - II	BT1-LAB2		80
SEMINAR /	BT1-INT1		25
JOURNAL CLUB /ASSIGNMENTS EACH THORY PAPER			20

SEMESTER – II (THEORY)

			MARKS
PAPER - I	BT2-T005	ENZYMOLGY	80
PAPER - II	BT2-T006	IMMUNOLOGY AND IMMUNOLOGICAL TECHNIQUES	80
PAPER - III	BT2-T007	MOLECULAR BIOLOGY AND BIOINFORMATICS	80
PAPER - IV	BT2-T008	INDUSTRIAL BIOTECHNOLOGY	80

PRACTICALS

PRACTICAL - III	BT2-LAB3		80
PRACTICAL - IV	BT2-LAB4		80
SEMINAR /	BT2-INT2		25
JOURNAL CLUB /ASSIGNMENTS EACH THORY PAPER			20

SEMESTER – III (THEORY)

			MARKS
PAPER - I	BT3-T009	ANIMAL BIOTECHNOLOGY	80
PAPER - II	BT3-T010	PLANT BIOTECHNOLOGY	80
PAPER - III	BT3-T011	GENETIC ENGINEERING	80
PAPER - IV	BT3-T012	APPLIED BIOTECHNOLOGY	80

PRACTICALS

PRACTICAL - I	BT3-LAB5		80
PRACTICAL - II	BT3-LAB6		80
SEMINAR /	BT3-INT3		25
JOURNAL CLUB /ASSIGNMENTS EACH THORY PAPER			20

SEMESTER – IV (THEORY)

			MARKS
PAPER - I	BT4-T013	ENVIRONMENTAL BIOTECHNOLOGY	80
PAPER - II	BT4-T014	APPLIED ENVIRONMENTAL BIOTECHNOLOGY AND ECOLOGY	80
PAPER - III	BT4-T015	ETHICS, PATENTING AND BIO-ENTREPRENEURSHIP	80
PAPER - IV	BT4-T016	RESEARCH METHODOLOGY AND BIOSTATISTICS	80

PRACTICALS AND PROJECT WORK

PRACTICAL - I BT4-LAB7
 PROJECT WORK BT4-
 SEMINAR / BT4-INT1
 JOURNAL CLUB /ASSIGNMENTS EACH THEORY PAPER

80
 100
 25
 20

**APPENDIX A
 MASTER OF SCIENCE (BIOTECHNOLOGY)
 TWO YEAR (FOUR SEMESTERS) DEGREE COURSE**

Sr.No	Semester	Paper	Course code	Title of paper	Teaching scheme			Examination scheme							
					T (hr)	P (hr)	Total Periods /week	Dur. Of paper (Hrs.)		Max. Marks		Min. Pass Marks		Total Marks / Credits	
								T	P	T	P	T	P	T	P
1	I	I	BT1-T001	Cell Biology	4		4	3		75		30		75/4	
2	I	II	BT1-T002	Microbiology	4		4	3		75		30		75/4	
3	I	III	BT1-T003	Biophysical Techniques	4		4	3		75		30		75/4	
4	I	IV	BT1-T004	Molecular Biology	4		4	3		75		30		75/4	
5	I		BT1-LAB1	Laboratory Exercise 1		8	8		8*		90		36		90/4
6	I		BT1-LAB2	Laboratory Exercise 2		8	8		8*		90		36		90/4
7	I		BT1-INT1	Seminar / Journal Club / Assignments	2		2			20			08	20/1	
8				Total	18	16	34			320				320/ 17	180/ 8
9	II	I	BT2-T005	Enzymology	4		4	3		75		30		75/4	
10	II	II	BT2-T006	Immunology and Immunological techniques	4		4	3		75		30		75/4	
11	II	III	BT3-T007	Molecular Biology and Bioinformatics	4		4	3		75		30		75/4	
12	II	IV	BT2-T008	Industrial Biotechnology	4		4	3		75		30		75/4	
13	II		BT2-LAB3	Laboratory Exercise 3		8	8		8*		90		36		90/4
14	II		BT2-LAB4	Laboratory Exercise 4		8	8		8*		90		36		90/4
15	II		BT2-INT2	Seminar / Journal Club / Assignments	2		2			20			08	20/1	
16				Total	18	16	34			320				320/ 17	180/ 8

Sr.No	Semester	Paper	Course code	Title of paper	Teaching scheme			Examination scheme							
					T (hr)	P (hr)	Total Periods /week	Dur. Of paper (Hrs.)		Max. Marks		Min. Pass Marks		Total Marks / Credits	
								T	P	T	P	T	P	T	P
1	III	I	BT3-T009	Animal Biotechnology	4		4	3		75		30		75/4	
2	III	II	BT3-T010	Plant Biotechnology	4		4	3		75		30		75/4	
3	III	III	BT3-T011	Genetic Engineering	4		4	3		75		30		75/4	
4	III	IV	BT3-T012	Applied Biotechnology	4		4	3		75		30		75/4	
5	III		BT3-LAB5	Laboratory Exercise 5		8	8		8*		90		36		90/4
6	III		BT3-LAB6	Laboratory Exercise 6		8	8		8*		90		36		90/4
7	III		BT3-INT3	Seminar / Journal Club / Assignments	2		2			20			08	20/1	
8				Total	18	16	34			320				320/ 17	180/ 8
9	IV	I	BT4-T013	Environmental Biotechnology	4		4	3		75		30		75/4	
10	IV	II	BT4-T014	Applied Environmental Biotechnology and Ecology	4		4	3		75		30		75/4	
11	IV	III	BT4-T015	Ethics, Patenting and Bio-Entrepreneurship	4		4	3		75		30		75/4	
12	IV	IV	BT4-T016	Research Methodology and Biostatistics	4		4	3		75		30		75/4	
13	IV		BT2-LAB7	Laboratory Exercise 7		8	8		8*		90		36		90/4
14	IV		BT4	Project Work		8	8		8*		90		36		90/4
15	IV		BT4-INT4	Seminar / Journal Club / Assignments	2		2			20			08	20/1	
16				Total	18	16	34			320				320/ 17	180/ 8

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, pomato, 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
- D. Gene isolation and purification: general methods (shotgun method for producing gene library, cloning specific genes by hybridization and reverse transcriptase methods, direct selection of a gene)

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, phagemid 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 Therapy and Therapeutic Products

- A. Production of monoclonal antibodies by phage display technique using filamentous phage vectors.
- B. Gene Therapy: somatic and germline, random and targeted gene replacement, *in vivo* and *ex-vivo* gene delivery, retrovirus gene transfer system, advantages and disadvantages of adenovirus, adeno-associated virus, herpes virus vectors, gene correction, replacement/augmentation, editing, regulation and silencing. Gene therapy of human diseases.

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

- A. Plant secondary metabolites: phenylpropanoid pathway, shikimate pathway, alkaloids, industrial enzymes, biodegradable plastics, polyhydroxybutyrate, therapeutic proteins, lysosomal enzymes, oleosin partitioning technology.
- 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

1. Callus propagation, organogenesis.
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.
4. Cell counting and cell viability.
5. Trypsinization of monolayer and subculturing.
6. Preparation of plant tissue culture media.
7. Surface sterilization.
8. Organ culture.
9. Anther culture: production of haploids.
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
14. Agrobacterium culture and selection of transformants.

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
6. Cloning in plasmid/phagemid vectors.
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
12. Production of industrial enzymes and its biochemical assay.
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.
3. A TEXTBOOK OF MICROBIOLOGY, R.C.DUBEY,D.K.MHESHWARY, 2009, S.CHAND
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
11. PLANT PHYSIOLOGY AND BIOCHEMISTRY, S. K. VERMA, 2006, S.CHAND, DELHI
12. CELL, B. LEWIN, 2007, JONES AND BARTLETT PUBLISHER, LONDON.
13. CYTOLOGY, VERMA AND ARGAWAL, 2005, S. CHAND, NEWDELHI
14. TEXT BOOK OF PRACTICAL BOTANY VOL-I AND II, B. P. PANDEY, 2008, S. CHAND, DELHI
15. TEXT BOOK OF BOTANY, S. N. PANDEY AND P. S. TRIVEDI, 2008, VIKAS PUBLICATION HOUSE, DELHI
16. GENETICS, C.B. POWAR, KALYANI PUBLICATION
17. BIOTECHNOLOGY, U. SATYANARAYAN
18. GENE AND GENOME ANALYSIS, RECHARD RICH
19. GENES, C.B. POWAR
20. GENOME BY LEWINS
21. CELL BIOLOGY BY G. KARP
22. ANIMAL BIOTECHNOLOGY BY RANGA
23. CULTURE OF ANIMAL CELLS BY FRESHNEY
24. PLANT BIOTECHNOLOGY AND ITS APPLICATION IN TISSUE CULTURE BY ASHWINI KUMAR