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॥ अंतरी पेटवू ज्ञानच्योत ॥



**North Maharashtra University,
Jalgaon.**

**Syllabus for
M.Sc. (Part-II)**

BIOTECHNOLOGY.

(Sem.III & IV)

W.E.From June, 2003

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**NORTH MAHARASHTRA UNIVERSITY, JALGAON.
CORRECTIONS.**

M.Sc.(Part-II) Biotechnology.

(Sem.-III)

BT-301 : Molecular Biology.

Chapter.*	1	2	3	4	5	6	7	8	9
Number of periods allotted.	05	02	05	07	07	07	06	06	05

BT-302 : Bioprocess Engi. & Tech.

Chapter.*	1	2	3	4	5	6	7	8	9	10
Number of periods allotted.	01	10	02	05	03	02	12	08	03	04

BT-303 : Plant Biotechnology.

Chapter.**	1	2	3	4	5	6	7	8	9	10	11	12	13
Number of periods allotted.	02	03	03	04	04	04	04	03	05	04	03	07	04

(Sem.-IV)

BT-401 : Ind. & Env. Biotechnology.

Chapter.*	1	2	3	4	5	6	7	8	9
Number of periods allotted.	18	02	03	02	03	04	09	05	04

BT-402 : Immunology.

Chapter.	1	2	3	4	5	6	7	8	9
Number of periods allotted.	04	03	04	05	10	05	10	06	03

BT-403 : Genetic Engi.

Chapter.*	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Number of periods allotted.	04	03	02	04	04	03	03	04	05	04	05	03	02	04

* Represents chapter.

** Number represents chapter.

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**Syllabus Structure for M.Sc. Part-II.
BIOTECHNOLOGY.**

(W.E. From June, 2003)

Semester - III

- BT - 301: Molecular Biology**
- BT - 302: Bioprocess Engineering and Technology**
- BT - 303: Plant Biotechnology**
- BT - 304: Laboratory Course - I**
- BT - 305: Laboratory Course - II**

Semester - IV

- BT - 401: Industrial and Environmental Biotechnology**
- BT - 402: Immunology**
- BT - 403: Genetic Engineering**
- BT - 404: Laboratory Course - I**
- BT - 405: Laboratory Course - II (Project Dissertation)**

(Each theory course to be completed in 60 lectures of 60 min. duration each)

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**Syllabus for M.Sc. Part-II.
BIOTECHNOLOGY.**

(W.E. From June, 2003)

Semester - III

BT 301: Molecular Biology

- DNA structure: Current concept, melting of DNA. DNA replication: general principles, various models of replication, isolation and properties of DNA polymerases, proof reading, continuous and discontinuous synthesis. Asymmetric & dimeric nature of DNA polymerase III, DNA polymerase; exonuclease activity in eukaryotic DNA polymerases.
- Superhelicity in DNA, linking number, topological properties, mechanism of action of topoisomerases.
- Inhibitors of DNA replication DNA damage and repair: types of DNA damage. Repair pathways-methyl-directed mismatch repair, very short patch repair, nucleotide excision repair, base excision repair, recombination, repair, SOS system.
- Transcription: RNA types & functions Initiator and elongator class of tRNA, ribosome binding site on mRNA and corresponding site on rRNA, peptidyl transferase activity of 23S rRNA. Transcription: General principles, basic apparatus, types of RNA polymerase, steps: initiation, elongation and termination, inhibitor of RNA synthesis. Control of transcription by interaction between RNA polymerase and promoter regions, Use of alternate sigma factors, controlled termination: attenuation and antitermination.
- Maturation and processing of RNA methylation, cutting and trimming of rRNA; capping, polyadenylation and splicing of mRNA; Catalytic RNA, group I and group II intron splicing, RNase P.
- Regulation of gene expression: operon concept, catabolite repression, instability of bacterial RNA, positive and negative regulation with example, inducers and corepressors. regulation by attenuation- *his* and *trp* operons;
- Antitermination-N protein and *nut* sites in λ . DNA binding proteins, enhancer sequences and control of transcription heat shock response, stringent response and regulation by small molecules such as ppGpp and cAMP.
- Basic features of the genetic code. Protein synthesis steps, details of initiation, elongation and termination, role of various factors in the above steps, inhibition of protein synthesis.
- Protein Targeting: Synthesis of secreted proteins on membrane bound ribosomes, signal hypothesis, signal recognition particle and its role in protein targeting, targeting of lysosomal proteins, protein destruction.

References

1. Genes VII, Lewin (Oxford University Press) 2000.
2. Molecular cell biology by Lodish, Berk, Zipursky (W.H. Freeman).
3. Fundamentals of Biochemistry. D Voet, J.Voet & C. Prati, John Wiley and Sons, New York 1999.
4. Molecular biology of genes: J Watson, NH Hopkins, J.W. Roberts, J.P. Stertz and A.M. Weiner, Freeman Co. (Latest edition)
5. Biochemistry (IV edition) L. Stryer, W.H. Freeman & co., New York.

BT -302 : Bioprocess Engineering and Technology

- Introduction to Bioprocess Engineering
- Selection of microbial strain: Fundamental criteria for selection, Isolation, Primary, secondary, tertiary and quaternary screening, strain improvement through selection, mutation and genetic engineering, strain maintenance
- Kinetics of microbial growth
- Media for industrial Fermentation: Concepts behind the selection of media, Criteria for selection, Quality of ingredients, Composition of maintenance media, inoculum media, production media
- Media sterilization: Factors governing sterilization, Types of sterilization: Jacket-, In-situ-, Jet-sterilization, Sterility testing and maintenance
- Inoculum preparation : Cascade technique, Concepts behind quality and quantity of inoculum
- Biochemical Engineering Aspects :
Bioreactors: Concept behind design, Types, specialized bioreactors (pulsed, fluidized, photobioreactors, etc.)
Oxygen / CO₂, mass, heat and nutrients transfer
Measurement and control of Bioprocess Parameters: pH, temperature, foam, aeration, agitation, nutrient level, etc.
Automation for Monitoring and Control
Process Scale-up
- Downstream processing : Strategy for recovery, Harvesting of biomass and product : precipitation, filtration, centrifugation, cell disruptions, liquid-liquid extraction, chromatography, membrane process, drying and crystallization
- Quality control and specifications (Trade, ISI and Pharmacopial)
- Solid state fermentations: Introduction, procedure, factors governing, applications (enzymes, organic acids, solid waste treatment), merits and demerits

Reference Books

1. Biochemical Engineering, Aiba, S., Humphery, A.E. and Mills, N.F., Univ. of Tokyo Press, Tokyo.
 2. Biochemical Reactors, Atkinson, B., Pion Ltd, London.
 3. Principles of Fermentation Technology, Stanbury, P.F., and Whitaker, A., Pergamon Press, Oxford.
 4. Microbial Technology (Vol. I and II), Pepler, H.J. and Perman D, Academic Press, New York.
- Comprehensive Biotechnology (Vol. I, II, III and IV), Ed. Young M.M., Pergamon Press, London.

BT- 303: Plant Biotechnology

1. Conventional Plant Breeding
2. Introduction to cell and Tissue Cultured, tissue culture as a technique to produce novel plants and hybrids.
3. incubation Systems- advantages, limitations and applications of each system.
4. Tissue culture media (composition and preparation)
5. Initiation and maintenance of callus and suspension culture; single cell clones.
6. Organogenesis; somatic embryogenesis; transfer and establishment of whole plants in soil.
7. Shoot-tip culture; rapid clonal propagation and production of virus-free plants.
8. Embryo culture and embryo rescue.
9. Protoplast isolation, culture for production of haploid plants and homozygous lines.
10. Anther, pollen and ovary culture for production of haploid plants and homozygous lines.

11. Cryopreservation, slow growth and DNA banking for germ plasm conservation.
12. Plant cells as producers of secondary compounds. Introduction to secondary metabolism, significance of degree of cell differentiation, selection, downstream processing influence of culture conditions on accumulation of secondary metabolites.
13. Immobilization of plant cells: Introduction, characterization of immobilization processes, advantages and disadvantages of immobilization.

Reference Books:

1. Applied and fundamental aspects of plant cell, tissue and organ culture, J.Reinert and Y.P.S.Bajaj, 11th edition. 1992.
2. Plant cell biotechnology, R.Endress, Springer Verlag, 1994.
3. Biotechnology in Agriculture, M.S.Swaminathan, 1992.
4. Secondary Metabolism in Plant Cell Culture, P.Morrist, A.H.Scragg, A Stafford, M.W.Fowles, 1986.
5. Basic and Agriculture Biotechnology, S.S.purohit, P.R.Kothari and S.K.Mathur, Agro-botanical Publ., India 1993.
6. Plant Biotechnology. J.Hammond, P.McGravery and V.Yusibov (Eds.) Springer Verlag, 2000
7. Plant Cell and Tissue Culture for the Production of Food ingredients. T.-I. Fu, G.Singh, and W.R.Curtis (Eds.) Kluwer Academic/Plenum Press. 1999
8. Biotechnology in Crop Improvement, H.S.Chawla International Book Distributing Company. 1998
Practical Application of plant Molecular Biology, R.J.Henry. Chapman and Hall. 1997.

BT-304: Laboratory Course – I

1. Isolation of DNA From E. coli / liver
2. Estimation of DNA by diphenylamine reaction
3. Isolation of RNA from yeast / liver
4. Estimation of RNA by orcinol method
5. Determination Tri of DNA
6. Agarose gel electrophoresis of DNA
7. Regulation of lac operon
8. Isolation of industrially important micro-organisms
9. Determination of thermal death point and thermal death time of micro-organism for design of a steriliser
10. Determination of growth curve of a supplied microorganism and also determine substrate degradation profile.
11. Compute specific growth rate (μ), growth yield ($Y_{x/s}$) from the above
12. Sauer Krant fermentation.

(Any 10 experiments from first 12 experiments, D= Demonstration only)

Reference Books:

1. Mackie & McCroney Practical Medical Microbiology (13th Ed), J.G.Collee, J.P.Duguid, A.G.Fraser, B.P.Marinton, Churchill Livingstone International Student Ed.
2. A Handbook of Practical & Clinical Immunology Vol. 1 & 2 (11th Ed.) Editors-G.P.Talwar & S.K.Gupta, CBS Publishers & Distributors.
3. Methods for Cloning & Analysis of Eukaryotic Genes. Bothwell, Yancopoulos, Alt Jones & Bartlett Publishers, Boston (1990)
4. Laboratory Manual in Biochemistry, I. Jayaraman, Wiley Eastern Limited.

BT-305: Laboratory Course – II

1. Comparative efficacy of sterilization of plant material.
 2. Callus induction and characteristics of callus (*S.khasianum* and *V.radiata*)
 3. Plant regeneration from callus (*S.khasianum*).
 4. Somatic embryogenesis
 5. Isolation of secondary metabolites from callus tissue (*S.khasianum* and *W. somnifera*)
 6. Meristem culture for medicinal plants (*W.somnifera*)
 7. Regeneration of high yielding banana plantlet from rhizome.
 8. Microbial bio-pesticide preparation and evaluation.
 9. Botanical biopesticide preparation & evaluation
 10. Isolation of Phosphate solubilising microbes and determination of bioefficacy
 11. Isolation of Nitrogen fixing microbes and determination of bioefficacy
 12. Isolation of alkaloid /Steroid / flavanoid from suitable source and estimation (quantitative / qualitative) (D)
 13. Separation of plant secondary metabolites by HPTLC (D)
- (Any 10 experiments from the first 12 experiments, D = Demonstration only)

Reference Books:

1. An Introduction to Plant Tissue Culture, Kalyan Kumar De, II Edition, New Central Book Depot, Calcutta, 1995.
2. Plant tissue culture: Techniques and Experiments, R.H.Smith, 1992.
3. Plant Cell & Tissue Culture: A Laboratory Manual, J. Reinert and M.M.Yeoan 1989.
4. Methods in Plant Molecular Biology, M.A.Schuler and R.E.Zielinski, 1989.
5. A Laboratory Manual of Plant Biotechnology, S. S. Purohit, Agro-botanical Publ., India 1995.

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Semester - IV

BT- 401 : Industrial and Environmental Biotechnology

Section A: Industrial Biotechnology

- **Industrially Significant Fermentations :**
 - Alcohol : Ethanol
 - Organic acids : Acetic acid and gluconic acid
 - Solvents : Glycerol, acetone and butanol
 - Antibiotics : Penicillin, Tetracycline, Streptomycin
 - Amino acids : Lysine and glutamic acid
 - Vitamin : Vit. B₁₂ and Vit. B₂
- **Single cell protein :** Types, Nutritional value, and cultivation
- **Applications of industrial enzymes :** Amylase, lipase, protease, papain and penicillin acylase
- **Applications of animal cell culture and concept in Stem cell cultures.**

Section B: Environmental Biotechnology

- **Environmental Pollution :** Basic concepts and types, General introduction to air and soil pollution
- **Water pollution and its control :** Sources, measurement, waste water treatments : physico-chemical and biological processes
- **Microbiology of Waste Water Treatments:**
 - Aerobic Process :** Activated sludge, Oxidation ditches, trickling filter, towers, rotating discs, rotating drums, oxidation ponds
 - Anaerobic processes :** Anaerobic digestion and anaerobic filters, upflow anaerobic sludge blanket reactors
 - Treatment schemes for Waste Waters :** Dairy, Distillery, Tannery, Sugar, Antibiotic industries
- **Biodegradation of recalcitrant Compounds in Environment :** Hydrocarbons, Oils, Synthetic Polymers, Pesticides, Surfactants, Lignin
- **Bioremediation of contaminated / problematic soils and waste lands**

References Books

1. Comprehensive Biotechnology (Vol. I, II and IV), Ed. Young M.M., Pergamon Press, London.
2. Principles of Fermentation Technology, Stanbury, P.F., and Whitaker, A., Pergamon Press, Oxford.
3. Industrial Biotechnology, Malik V.S. and Padma Sridhar, Oxford & IBH Publishing Co Pvt. Ltd., New Delhi, 1992.
4. Microbial Technology (Vol. I and II), Peppler, H.J. and Perlman D. Academic Press, New York.
5. Environmental Chemistry, De, A.K. Wiley Eastern Ltd, New Delhi.
6. Biotechnology and waste water treatment, Fopster
7. Environmental Biology, Agrawal K.C., Agro-Botanical Publishers, India.

BT – 402: IMMUNOLOGY

Introduction to Immune System

- Memory, specificity, diversity, innate and acquired immunity, self vs non-self discrimination.
- Structure and functions of primary and secondary lymphoid organs.

Cells Involved in Immune Responses

- Phagocytic cells and their killing mechanisms
- T and B lymphocytes
- Differentiation of stem cells and idiotypic variations.

Nature of Antigen and Antibody

- Antigen vs Immunogen, Haptens
- Structure and functions of immunoglobulins
- Isotypic, allotypic and idiotypic variations.

Generation of Diversity in Immune System

- Clonal selection theory — concept of antigen specific receptor.
- Organization and expression of immunoglobulin genes: generation of antibody diversity
- T cell receptor diversity.

Humoral and Cell Mediated Immune Responses

- Kinetics of primary and secondary immune responses
- Complement activation and its biological consequences
- Antigen processing and presentation
- Cytokines and costimulatory molecules: Role in immune responses.
- T and B cell interactions.

Major Histocompatibility Complex (MHC) Genes and Products

- Polymorphism of MHC genes
- Role of MHC antigens in immune responses
- MHC antigens in transplantation.

Development, Regulation and Evolution of the Immune System

Measurement of Antigen — Antibody Interaction

- Production of polyclonal and monoclonal antibodies: Principles, techniques and applications.
- Agglutination and precipitation techniques
- Radioimmunoassay
- ELISA
- Immunofluorescence assays: Fluorescence activated cell sorter (FACS) technique.

Immune Responses in Diseases

- Immune responses to infectious diseases: viral, bacterial and protozoal
- Cancer and immune system
- Immunodeficiency disorders
- Autoimmunity.

Immunization

- Active immunization (immune prophylaxis)
- Passive immunization (immunotherapy)
- Role of vaccines in the prevention of diseases.

References

1. Roitt, I.M. (1998) Essentials of Immunology, ELBS, Blackwell Scientific Publishers, London.
2. Kuby, J. (1994) Immunology 2nd edn., W.H. Freeman and Company, New York.
3. Topley and Wilson's (1995) Textbook on Principles of Bacteriology, Virology and immunology, IX edn., (5 volumes) Edward Arnold, London.
4. Barrett, J.T. (1983) Text book of Immunology, Mosby, Missouri.
5. Sites, D.P., Stobo, J.D., Fudenberg, H.H. and Wells, J.V. (1984) Lange Medical Publications, Los Altos., California.

BT- 403 Genetic Engineering

- Genetic engineering concepts, restriction enzymes, their mode of action, modification enzymes, RNA & DNA markers.
- Cloning vectors: Plasmids, Cosmids, phages, artificial chromosomes & phagemids
- Cloning in yeast
- cDNA synthesis and cloning. Genomic & cDNA library construction.
- Restriction mapping of DNA fragments and map construction. Nucleic acid sequencing methods. Automatic DNA sequencing.
- Selection of recombinant DNA, clone characterization, S1 mapping, hybridization and immunological techniques.
- Site directed mutagenesis and its applications.
- PCR and its applications, RFLP, AFLP & RAPD techniques & their applications.
- Feature of Ti & Ri plasmids, basis of tumor formation, mechanism of DNA transfer, role of virulence genes, use of reporter genes, genetic markers.
- Viral vectors & there applications, particle bombardment electroporation, micro injection transformation of monocots, transgene stability & gene silencing, antisense technology.
- Application of plant transformation for productivity & performance, herbicide resistance, Bt genes, protease inhibitors, abiotic stress, long shelf life of fruits & flowers.
- Advances in molecular genetic of β -actin and aminoglycoside antibiotics biosynthesis.
- Scope and applications in medicine, agriculture and industry.
- Gene therapy, vector engineering, gene delivery, gene replacement, argummentation, gene editing.

Reference Books:

- Recombinant DNA: J.D. Watson, N.H. Hopkins, J.W. Roberts, J.A. Steitz & A. M. Weiner, W.H. Freeman & Co.
- Molecular Biology of Gene: The Benjamin Cummings Publ. Co.
- Biochemistry: L. Stryers, W.H. Freeman & Co.
- Molecular Cloning: A laboratory manual : J. Sambrook E.F. Fritsch & T. Maniatis, Cold Spring Harbor lab. Press.
- Molecular Biotechnology: S.B. Primrose, Black Well Scientific Publishes.
- Methods in Enzymology Vol. 152: Guide to Molecular Cloning Techniques. Academic Press.
- DNA Cloning : A practical approach: D.M. Glover & B.D. Hames, IRL Press.
- Principles of Genetics: Gardner. Simmons & Sraustad, Wiley Eastern.

BT-404: Laboratory Course - I

1. Bacterial culture & antibiotic selection media & preparation of competent Cells.
2. Restriction digestion of DNA and separation by agarose gel electrophoresis.
3. Comparative studies of Ethanol production using different substrates.
4. Preparation of Agrobacterium culture and Agrobacterim mediated root / tumour induction in vitro.
5. Amplification of DNA by polymerase chain reaction (PCR) (D)
6. Demonstration of Southern blotting technique (D)
7. Estimation of SGOT/SGPT and its pathological significance.
8. Microbial production of Citric acid using *Aspergillus niger*.
9. Estimation of serum cholesterol and its diagnostic applications.
10. Use of alginate for cell immobilization

11. Use of ELISA technique.
12. Determination of blood group
13. Widal test and its significance.
14. Complement fixation test
15. Radio immuno assay (RIA) of hormones (D)
(Any 10 experiments out of 15 experiments, D = Demonstration only)

Reference Books:

1. An Introduction to Practical Biochemistry, D.T.Plummer(1992) Tata McGraw Hill Publisher, New-Delhi.
2. Experiments In Microbiology, Plant pathology, Tissue Culture and Mushroom Cultivation, (2nd edition, 1996), K.R.Aneja, Vishwa Prakashan, New Age International (P) Ltd
3. Molecular Cloning: A laboratory manual: J Sambrook, E.F. Fritsch & T Maniatis, Cold Spring Harbor Lab. Press, New York.
4. A Handbook of Practical & Clinical immunology, Vol. 1 & 2 (11th Ed.) Editors-G.P.Talwar & S.K.Gupta, CBS Publishers & Distributors.

BT- 405: Laboratory Course – II **Project (Dissertation)**