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॥ अंतरी पेटवू ज्ञानज्योत ॥



**North Maharashtra University,
Jalgaon.**

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

MICROBIOLOGY.

(Sem.III & IV)

W.E.From June, 2003

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NORTH MAHARASHTRA UNIVERSITY, JALGAON.

CORRECTIONS.

M.Sc. (Part-II) Microbiology.

(Sem.-III)

MB-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

MB-302 : Applied & Environmental Microbiology.

No.	Chapter	Number of periods.
1.	Food Microbiology	25 (5 + 15 + 5)
2.	Agromicrobiology	10
3.	Environmental Microbiology.	15

MB-303 : Microbial Fermentation Technology.

Sr. No.	Chapter	Number of periods allotted.
1.	Bioengineering aspects.	10
2.	Industrial strains.	06
3.	Classical Fermentation.	20
4.	Novel biotechnological advances / applications.	14

P.T.O.

(Sem.-IV)

MB-401 : Pharmaceutical Microbiology.

Sr. No.	Chapter	Number of periods allotted
1.	Antibiotics & Synthetic antimicrobial agents.	12
2.	Microbial production & spoilage of Pharmaceutical products.	15
3.	Regulatory practices and applications in pharmaceuticals.	10
4.	Quality assurance & validation.	13

MB-402 : Immunology.

Sr. No.	Chapter	Number of periods allotted
1.	Introduction to immune system.	04
2.	Cells involved in Immune responses.	03
3.	Nature of antigen and antibody.	04
4.	Generation of diversity in immune system.	05
5.	Humoral and cell mediated immune responses.	10
6.	Major histocompatibility Complex Genes & products.	05
7.	Development, Regulation and evolution of immune system.	10
8.	Immune responses in diseases	06
9.	Immunization.	03

MB-403 : Genetic Engineering.

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	03

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

(W.E.From June, 2003)

Semester - III

MB - 301: Molecular Biology

MB - 302: Applied and Environmental Microbiology

MB - 303: Microbial Fermentation Technology

MB - 304: Laboratory Course - I

MB - 305: Laboratory Course - II

Semester - IV

MB - 401: Pharmaceutical Microbiology

MB - 402: Immunology

MB - 403: Genetic Engineering

MB - 404: Laboratory Course - I

MB - 405: Laboratory Course - II (Project Dissertation)

(Each theory course to be completed in 50 lectures of 60 min. duration each)

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

(W.E. From June, 2003)

MB - 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 & di-meric 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, inhibitors 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 lambda, 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, inhibitors of protein synthesis.
- Protein Targeting: Synthesis of exported proteins on membrane bound ribosomes, signal hypothesis, signal recognition particle and its role, chaperon proteins, targeting of lysosomal proteins, protein destruction.

References:

1. Genes VII. Lewin (Oxford University Press) 2000
 2. Molecular cell biology (W.H.Freeman) by Lodish, Berk, Zippursky.
- Biochemistry:
Microbiological quality control of food products and microbiological standards
Methods of sampling and investigation
Preparation of dilutions

D

General viable count

Detection and enumeration of indicator bacteria

Detection and enumeration of pathogenic and toxigenic organisms

Microbiological examination of specific foods

Meat and meat products; Fruits and vegetables;

Milk and milk products; Bakery foods and Ice-cream

- Food mycotoxins affecting human nutrition and health-sources, toxicity, symptoms, prevention, methods of detection and detoxification

Agro-microbiology

- Symbiotic and asymbiotic nitrogen fixation
- Enzymes of nitrogenase complex
- Organization, expression and regulation of nif genes
- Transfer of nif genes to other organisms

Environmental microbiology

- Bioreclamation of salt affected soils
- Bioremediation of alkaline soils
- Biodegradation of pesticides
- Biopesticides in integrated pest management
- Effluent treatment schemes for dairy, distillery, tannery, sugar & antibiotic industries
- Solid wastes - sources and managements (composting, vermiculture and methane production)
- Geomicrobiology - microbial leaching/beneficiation of minerals

References

1. Adams M. R. & Moss M. O. (1995) Food Microbiology Royal Society of chemistry Publ., Cambridge.
2. Baker K.H. & Herson, D.S. (1994) Bioremediation, Mc Graw Hill Inc., New York
3. Frazier W.C. & Westhoff, D. C. (1995) Food Microbiology (4th edn.), Tata McGraw-Hill Inc., New York.
4. Harrigan, W.F., M.E. McCane (1994) Laboratory Methods in Food and Dairy Microbiology.
5. Hobbs B.C. Roberts D. (1993) Food poisoning and food hygiene. Edward Arnold, London.
6. J. Postgate, Edward Arnold, (1987) Nitrogen Fixation (2nd edn.) London.
7. N.N. Potter, Food science (3rd edn.), CBS Publications, New Delhi
8. Norris, J.R. & Pettipher, G.L. (1987) Essays in agricultural and food microbiology, John Wiley Sons, Singapore
9. T.D. Biswas & S.K. Mukharjee, (1997) Textbooks of soil sciences (2nd edn.), Tata McGraw-Hill Publication Co. Ltd., New Delhi.

MB - 303: Microbial Fermentation Technology

Bioengineering aspects

- Design, construction, parts and preparation of typical fermentation vessel
- Alternative fermentation vessel designs: Stirred tank, Air lift, fluidized bed, Fed batch.
- Scale up
- Instrumentation and control systems
- Aeration and agitation, Oxygen, mass and heat transfer kinetics
- Foam and antifoam agents

Industrial strains

- Strategies for screening and improvement
- Maintenance containment of recombinant organisms

Classical Fermentation

- Industrial production of biochemicals, their metabolic pathways and metabolic control mechanisms.

Amino acids: Glutamic acid

Antibiotics: β -lactam antibiotics (Cephalosporin C)

Microbial polysaccharides: Xanthan gum

Nucleotide fermentation : IMP and GMP

Organic acid : Citric acid

Vitamins: Vit B₁₂

Novel biotechnological advances/applications

- Steroid Biotransformation
- Bio-fuel technology : Ethanol production and bio-fuel cells
- SCP from carbohydrate (*Saccharomyces* and *Spirulina*)
- Microbial insecticides: BT
- Microbial siderophore production
- Biofertilizers: N₂ fixers, PSM and mycorrhizae

References

1. Bullock, J. and Kristainsen, B. (1987) Basic Biotechnology. Academic Press, London.
2. Malik, V.S. and Padma Sridhar (1992) Industrial Biotechnology. Oxford & IBH Publ. Co., New Delhi.
3. Rehm, H.J., Reed, G., Puhler, A and Stadler, P. (1997) A multivolume Comprehensive Treatise: Biotechnology, VCH, Weinheim, Germany.
4. Moo-Young, Murray (1987) Comprehensive Treatise to Biotechnology . Pergamon Press, London.
5. Reed, G. (19) Industrial Microbiology. CBS Publishers, New Delhi
6. BIOTOL Biotechnological Innovations in Chemical synthesis. Butterworth - Heinemann publishers.
7. Rehm, H.J, and Reed, G. (1987) Biotechnology: a Comprehensive Treatise. 2nd edn., Volume 3, Verlag Chemie, Weinheim, Germany.
8. El-Mansi, E.M.T. and Bryce, C.F.A. (1999) Fermentation Microbiology and Biotechnology. Taylor and Francis Ltd., London.
9. Peppier, H.J. and Perlman, D. (1987) Microbial Technology, 3rd edn., volume 1 and 2, Academic Press, London.

MB-304: Laboratory Course – I

- Isolation of DNA From *E. coli* / liver
 - Estimation of DNA by diphenylamine reaction
 - Isolation of RNA from yeast / liver
 - Estimation of RNA by orcinol method
 - Determination T_m of DNA
 - Isolation and Characterization of plasmid DNA
 - Agarose gel electrophoresis of DNA
 - Regulation of *lac* operon
 - Peptide analysis by PAGE/SDS-PAGE.
 - Detection of aflatoxin in food
 - Estimation of N,P, moisture and pH from compost and soil.
 - Estimation of bacterial and mould count in sweet meat
 - Isolation of pesticide/organochlorine degrading micro organisms
- (Any 10 experiments from first 13 experiments, D= Demonstration only)

References

1. Mackie & McCrtney Practical Medical Microbiology (13th Ed), J.G.Collee, J.P.Duguid, A.G.Fraser, B.P.Marimion, Churchill Livingstone International Student Ed.
2. A Handbook of Practical & Clinical Immunology, Vol. 1 & 2 (IInd 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, J. Jayraman, Wiley Eastern Limited.

MB-305 Laboratory Course – II

- Bioreactor handling and working of different probes, 3L and 10L-scale-operation.
- Citric acid fermentation:
 - Qualitative demonstration of citric acid production by $CaCO_3$ dissolution
 - Estimation of titrable acidity
 - Estimation of residual sugar
 - Recovery of product
- Riboflavin production
 - TLC and bioassay
- Antibiotic production
 - Bioassay
 - Residual sugar
 - Quantitative estimation
- Biotransformation of steroid/antibiotics
 - Substrate preparation methods (Organic solvents/Cyclodextrin) for biotransformation of steroids/antibiotics
 - Quantitative estimation
- Qualitative and Quantitative determination of microbial siderophores
- Biofertilizer production & bioefficacy
- Microbial production of EPS and its viscosity measurement.
- Determination of kinetics of ethanol production
- *Spirulina* cultivation and protein estimation

MB – 401: Pharmaceutical Microbiology

Antibiotics and synthetic antimicrobial agents

- Antibiotics and synthetic antimicrobial agents
- (Aminoglycosides, β -lactams, tetracyclines, ansamycins, macrolid antibiotics)
- Antifungal antibiotics, antitumor substances
- Peptide antibiotics, Chloramphenicol, Sulphonamides and Quinolinone antimicrobial agents

Microbial production and spoilage of pharmaceutical products

Microbial contamination and spoilage of pharmaceutical products (sterile injectibles, non injectibles, ophthalmic preparations and implants) and their sterilization

- Manufacturing procedures and in process control of pharmaceuticals
- Other pharmaceuticals produced by microbial fermentations (streptokinase, streptodornase)

Regulatory practices and applications in pharmaceuticals

Financing R&D capital and market outlook. IP, BP, USP.

- Government regulatory practices and policies, FDA perspective.
- Reimbursement of drugs and biologicals, legislative perspective.
- Rational drug design.
- Macromolecular, cellular and synthetic drug carriers.

Quality assurance and validation

- Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in pharmaceutical industry.
- Regulatory aspects of quality control.
- Quality assurance and quality management in pharmaceuticals ISO, WHO and US certification.
- Sterilization control and sterility testing (heat sterilization, D value, z value, survival curve, Radiation, gaseous and filter sterilization)
- Chemical and biological indicators.
- Design and layout of sterile product manufacturing unit.
- (Designing of Microbiology laboratory)
- Safety in microbiology laboratory.

References

1. Pharmaceutical Microbiology - Ed. by W.B.Hugo & A.D.Russell , 6th edin. Blackwell scientific Publications.
2. Analytical Microbiology -Edt by Frederick Kavanagh Vol I & II, Academic Press New York.
3. Quinolinone antimicrobial agents- Edt. by David C. Hooper, John S. Wolfson, ASM Washington DC.
4. Quality Control in the Pharmaceutical Industry Edt. By Muray S. Coopewr Vol. 2, Academic Press New York.
5. Biotechnology – Edt. By H J. Rehm & G. Reed, Vol. 4 VCH Publications, Federal Republic of Germany
6. Pharmaceutical Biotechnology by S. P. Vyas and V. K. Dixit, CBS Publishers, New Delhi
7. Good Manufacturing Practices for Pharmaceuticals second edn., by Sydney H. Willing, Murray M. Tuckerman, William S. Hitchings IV. Mercel Dekker, NC New York
8. Advances in Applied Biotechnology Series Vol 10, Biopharmaceuticals in transition. Industrial Biotechnology Association by Paine Webber. Gulf Publishing Company Houston.
9. Drug Carriers in biology & Medicine Edt. by Gregory Gregoriadis, Academic Press New York.
10. Quality Assurance in Microbiology by Rajesh Bhatia, Rattan lal Ihhpunjani. CBS Publishers & Distributors, New Delhi.

MB – 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
- Radio immunoassay
- 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 (immunoprophylaxis)
- 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. Stites, D.P., Stobo, J.D., Fudenberg, H.H. and Wells, J.V. (1984) *Lange Medical Publications*, Los Altos., California.

MB – 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 & their 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 inhibit
- ors, abiotic stress, long shelf life of fruits & flowers.
- Advances in molecular genetics of β -lactum and aminoglycoside antibiotics biosynthesis.
- Scope and applications in medicine, agriculture and industry.
- Gene therapy, vector engineering, gene delivery, gene replacement, augmentation, gene editing.

References

1. *Recombinant DNA*: J.D. Watson, N.H. Hopkins, J.W. Roberts, J.A. Steltz & A. M. Weiner, W.H. Freeman & Co.
2. *Molecular Biology of Gene*: The Benjamin Cummins Publ. Co.
3. *Biochemistry*: L Stryers, W.H. Freeman & Co.
4. *Molecular Cloning: A laboratory manual* : J. Sambrook E.F. Fritsch & T. Maniatis, Cold Spring Harbor lab. Press.
5. *Molecular Biotechnology*: S.B. Primrose, Black Well Scientific Publishes.
6. *Methods in Enzymology Vol. 152: Guide to Molecular Cloning Techniques*, Academic Press.
7. *DNA Cloning : A practical approach*: D.M. Glover & B.D. Hames, IRL Press.
8. *Principles of Genetics*: Gardner, Simmons & Snustad, Viley Eastern.

MB - 404: Laboratory Course - I

- Bacterial culture & antibiotic selection media & preparation of competent Cells.
- Restriction digestion of DNA and separation by agarose gel electrophoresis.
- Transformation of *E.Coli* by heat shock / CaCl_2 method.
- Preparation of *Agrobacterium* culture and *Agrobacterim* medicated root / tumour induction in vitro.
- Amplification of DNA by polymerase chain reaction (PCR) (D)
- Demonstration of Southern blotting technique (D) Use of ELISA technique.
- Determination of blood group
- Widal test and its significance.
- Complement fixation test
- Radio-immuno assay (RIA) of hormones (D)
- Sterility testing by *Bacillus stearothermophilus*
- Treatment of bacterial cells with cetrimide, phenol and detection of leaky Substances such as potassium, amino acids, purines, pyrimidines and pentoses due to cytoplasmic membrane damage.
- Bioassay of chloramphenicol by plate assay method or turbidometric assay method.

References

1. An Introduction to Practical Biochemistry, D.T.Plummer(1992) Tata McGraw Hill Publisher, New-Delhi.
2. Varley's Practical Clinical Biochemistry, (6th edition, 1988), Ed. by A.H.Gowenlock, Heinemann Professional Publishing Co., UK.
3. Experiments In Microbiology, Plant pathology, Tissue Culture and Mushroom Cultivation, (2nd edition, 1996), K.R.Aneja, Wishwa Prakashan (New Age International (P) Ltd.).
4. Molecular Cloning: A laboratory manual: J Sambrook, E.F. Fritsch & T Maniatis, Cold Spring Harbor Lab. Press, New York.

MB – 405 : Laboratory Course II (Project Dissertation)