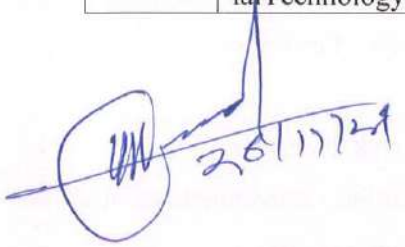
REVISEDSYLLABUSOF

M. Sc.

(MICROBIOLOGY)SEMEST

ER-III

aperNo.	Title of the theorypaper	Marks/Credits	Practical	Marks/Credits
SemesterIII				
Th-IX	EnzymeTechnology	100/04	P-IX	50/02
Th-X	BioprocessEngineering and Technology.	100/04	P-X	50/02
Th-XI	Molecular MicrobialGenetics.	100/04	P-XI	50/02
Th-XII	EnvironmentalMicrobialTechnology	100/04	P-XII	50/02



SEMESTER III

PAPER IX

ENZYME TECHNOLOGY

Marks 100 (04 Credits)

Unit -IExtraction and Purification of Microbial Enzymes (0.8 Credit)

Importance of enzyme purification, different sources of enzymes. Extra cellular and intracellular enzymes. Physical and chemical methods used for cell disintegration. Concentration of the enzyme extract, Enzyme fractionation by precipitation methods, chromatographic methods of enzyme purification- ion exchange chromatography, gel filtration, affinity chromatography and electrophoretic methods of enzyme purification. Enzyme crystallization techniques, Purification table, concept of enzyme units and specific activity. Analysis of purity of enzymes.

Unit II- Enzyme Inhibition and kinetics- (0.8 Credit)

Irreversible and reversible enzyme inhibitions. Competitive, uncompetitive and non-competitive enzyme inhibitions with suitable examples and their kinetic studies.

Allosteric inhibition- Positive and negative cooperativity, sigmoidal kinetics and allosteric enzymes. Models accounting cooperativity – Hill, Adair, MWC and KNF models. Cooperative binding of oxygen to haemoglobin – significance of sigmoidal behavior. Aspartate transcarbamoylase as allosteric enzyme.

Regulation of enzyme activity- Allosteric regulation, feedback regulation and cascade system (Genetic regulation), covalent modification.

UnitIIIImmobilization of enzymes (0.8 Credit)

Principles, parameters, carriers/matrices used for immobilization, techniques of enzyme immobilization, Economic argument for immobilization, Effect of solute partition and diffusion on the kinetic properties of immobilized enzymes.

Analytical therapeutic, environmental and industrial applications of immobilized enzymes. Application of immobilized enzymes in bioconversion processes, Bioreactors using immobilized enzymes. Immobilization of whole cells versus immobilization of enzymes.

Unit IVEnzyme/Protein Engineering (0.8 Credit)

Objectives of Protein Engineering, basic strategy of enzyme engineering. Protein engineering versus enzyme engineering as a biocatalyst. Techniques of Protein Engineering, Chemical modification and Site directed mutagenesis to study the structure- function relationship of industrially important enzymes. Properties of enzymes modified by enzyme engineering. Hybrid enzymes. Examples of Protein Engineering applications- Improvement in stability, catalytic efficiency, selectivity and substrate specificity, purification and biopharmaceutical applications etc.

Unit VClinical Enzymology (0.8 Credit)

Enzymes in clinical diagnostics (Blood Glucose, Blood Urea, Cholesterol, Diagnosis of liver disorders and heart disorders like Myocardial infarction). Enzymes and inborn errors, their use as markers in cancer and other diseases.

Enzyme sensors for clinical purposes-glucose oxidase, urease, cholesterol biosensors. Enzyme immunoassay.

Enzyme therapy – Treatment of genetic deficiency diseases, Enzymes in cancer therapy, Enzyme inhibitors and drug design. ADEPT and GDEPT.

PRACTICAL

PAPER IX

ENZYME TECHNOLOGY

Marks 50 (02 Credits)

1. Microbial production, extraction, purification and confirmation of α- Amylase/ Protease/Lipase/ Invertase/ Urease.
2. Determination of efficiency of enzyme purification by measuring specific activity at various stages viz. Salt precipitation, Dialysis, Electrophoresis etc.
3. Studies on activation and inhibition of extracted enzyme. (Effect of heavy metal ions, chelating agents, activators and inhibitors)
4. Immobilization of cells and enzyme using Sodium alginate/ egg albumin and measurement of enzyme activity of immobilized α- Amylase/ Protease/Lipase/ Invertase/ Urease.
5. Impact of immobilization on enzyme activity in terms of temperature tolerance, Km/ Vmax using various forms of α- Amylase/ Protease/Lipase/ Invertase/ Urease.
6. Determination of molecular weight of enzymes using PAGE technique.
7. Preparation of Urease biosensor and determination of its activity.
8. Determination of blood glucose by glucose oxidase biosensor.

REFERENCES

1. Methods in Enzymology Volume 22- Enzyme purification and related techniques. Edited by William B. Jakoby, Academic Press, New York.
2. Allosteric Enzymes – Kinetic Behaviour, 1982 by B.I. Kurganov, John Wiley and Sons. Inc., New York.
3. Biotechnology Volume 7A – Enzymes in Biotechnology, 1983. Edited by H.J. Rehm and G.Reed, Verlag Chemie.
4. Handbook of Enzyme Biotechnology by Wiseman.
5. Enzyme as Drugs Edited by John S. Holcenberg and Joseph Roberts, John Wiley and Sons. Inc., New York.
6. Methods of Enzymatic Analysis by Hans Ulrich, Bergmeyer, Academic Press
7. Methods in Enzymology by W.A.Wood, Academic Press
8. Advances in Enzymology by Alton Meister, Interscience Publishers.

9. Topics in Enzyme and Fermentation Biotechnology by L.N. Wiseman, John Wiley and Sons. Inc., New York.
10. Fundamentals of Enzymology by Nicholas C. Price and Lewis Stevens, Oxford University Press.
11. Biocatalysts and Enzyme technology by Klaus Buchholz, Volker Kasche, Uwe T. Bornscheuer, Wiley- VCH Verlag GmbH and Co., Germany.
12. Protein Purification techniques Edt. Simon Roe, Oxford University Press.
13. Enzymes- Biochemistry, Biotechnology, Clinical chemistry by Trevor Palmer. East- West Press Edition.

PAPER X

BIOPROCESS ENGINEERING AND TECHNOLOGY

Marks 100/ (04 Credits)

Unit-I: Introduction to Industrial Bioprocess Engineering (0.8 Credits)

Definition of bioprocess engineering, bioprocess engineer, biotechnology and bioprocess engineering, approach of biologist and engineers towards research, regulatory constraints of bioprocess. Batch growth (growth pattern and kinetics in batch culture, environmental factors affecting growth kinetics), Monod's equation, continuous culture, Chemostat and turbitostat (construction and working), mixed culture in nature, industrial utilization of mixed culture.

Unit-II : Bioreactors (0.8 Credits)

Design of basic bioreactor, bioreactor configuration, design features, individual parts, baffles,
impellers, foam separators, spargers, culture vessel, cooling and heating devices, probes for on-line monitoring, computer control of fermentation process, measurement and control of

process. Ideal batch reactor, ideal continuous flow stirred tank reactor, packed bed reactor bubble column reactor, fluidized bed bioreactor, Trickle bed reactor (Their basic construction, working, and distribution of gases).

Unit III: Mass Transfer and Sterilization **(0.8 Credits)**

Transport phenomena in bioprocess system: Gas liquid mass transfer in cellular systems, basic mass transfer concept, Rate of metabolic oxygen utilization, Determination on oxygen transfer rates, determination of Kla, Heat transfer, aeration / agitation and its importance. Sterilization of bioreactors, nutrients, air supply, product and effluents, process variable and control

Unit-**IV: Upstream processes** **(0.8 Credits)**

Inoculum development, formulation of production media, sterilization of media, maintenance of stock culture, scale up of the process from shake flask to industrial level.
, choosing cultivation methods, Modifying batch and continuous reactors, immobilization of cell systems, active and passive immobilization, solid state fermentation process.

Unit-V: Down Stream Process **(0.8 Credits)**

Downstream processes: Introduction, Recovery of particulates filtration, centrifugation, sedimentation, emerging technologies for cell recovery , product isolation , extraction , solvent extraction , aqueous two phase system , sorption , precipitation , reverse osmosis, ultra filtration. Product recovery trains: Commercial enzymes, Intracellular foreign proteins from recombinant E. coli, polysaccharide and biogum recovery, antibiotic, organic acids, ethanol, single cell protein.

PRACTICAL

PAPER P-X

BIOPROCESS ENGINEERING AND TECHNOLOGY

Marks 50 (02 Credits)

1. Isolation of industrially important microorganisms for microbial processes (citric / lactic/ alpha amylase) and improvement of strain for increase yield by mutation.

2. Determination of Thermal Death Point (TDP) and Thermal Death Time (TDT) microorganisms for design of a sterilizer.

3. [A] Determination of growth curve of a supplied microorganism and also determine substrate degradation profile. [B] Compute specific growth rate (m), growth yield (Y1/2) from the above.

4. Extraction of Citric acid / Lactic acid by salt precipitation.

5. Monitoring of dissolved oxygen during aerobic fermentation.

6. Preservation of industrially important bacteria by lyophilization.

7. Product concentration by vacuum concentrator.

8. Cell disruption for endoenzymes by sonication.

REFERENCES:

1. James E .Bailey and David F Ollis, Biochemical Engineering Fundamentals, McGraw Hill Publication.

2. Shuler and FikretKargi, Bioprocess Engineering basic concepts, 2nd edition , Prentice Hall Publication.

3. Stanbury PF, Whitekar, A And Hall SJ, Principles of fermentation Technology, Pergamon Press.

4. Peppler and Perlmen , Microbial Technology, Vol I and II , Academic Press.

5. Cruger and Cruger , Biotechnology : A text Book of Industrial Microbiology.

6. Fermentation- A practical Approach

7.Bioprocess Technology: Fundamentals and Applications, Stockholm KTH.

8. Biochemical Reactors by Atkinson B., Pion Ltd. London

9. Fermentation Biotechnology: Industrail Perspectives by S. Chand and Co.

10. Biotechnology : A text book of Microbiology by Cruger

11.Biotechnology, Vol. 3 Edited by H.J. Rehm and G.Reed Verlag Chemie 1983.

12. Advances in Biochemical Engineering by T.K. Bhosh, A. Fiechter and N. Blakebrough, Springer, Verlag Publications, New York.

13. Bioprocess Engineering Kinetics, Mass Transport, Reactorsand Gene Expressions by Veith, W.F., John Wiley and Sons.

14. Applied Microbiology Series.

15. Industrial Microbiology by L.E. Casida, Wiley Eastern.

16. Bioseperation: Down Stream Processing for Biotechnology by Belter P.A., Cussler E.L. and Hu W.S., John Wiley and Sons, New York.

17. Seperation Processes in Biotechnology by Asenjo J.A., Eds. Marcel dekker, New York.
18. Bioprocess Engineering Priciples by Doran, Academic Press, London.
19. Bioprocess Engineering Principles by Neilsen J. and Villadesen, Plenum Press, New York.
20. Fermentation, Biocatalysis and Bioseperation, Encyclopedia of Bioprocess technology by Chisti Y., Vol. 5, John Wiley and Sons., New York.

PAPER TH-XI

MOLECULAR MICROBIAL GENETICS

Marks 100 (04 credits)

Unit –I Molecular Structure Of Chromosome (0.8 Credits)

DNA: Gene, chromosome, genome, Comparative account of genome organization of prokaryotic, archaea & Eukaryotic cell; C-Value and C-value paradox, Structure of DNA (Primary structure -linear polynucleotide, Secondary structure- double stranded helical structure, Tertiary Structure); Topological properties of DNA; Physical characteristics of DNA (Buoyant density, UV-absorption, denaturation, renaturation and hybridization, Cot curve); Forms of DNA (A, B, C and Z forms)

Prokaryotic DNA replication: Meselson and Stahl experiment, Replication Initiation, replication elongation and termination; Mechanism of rolling Circle replication; Types of DNA polymerases, Post replication process (Methylation of DNA)

Mutation: Mechanism of mutation (Random, and Nonadaptive phenomenon); Types of mutation - Base substitution (Transition and transversion), Frameshift mutation (Deletion, Insertion, inversion); Missense, Silent, Non-sense mutation

Molecular basis of mutation – (i) Spontaneous mutation- DNA polymerase errors, mutation due to recombination, mutation due to tautomerization of nitrogen bases, mutation due to deamination nitrogen bases; (ii) Induced mutations - Chemical mutagens (Base analogue, Nitrous oxide, Hydroxylamine, alkylating agents, and acridine orange); Physical mutagens (Ionizing radiation, non-ionizing radiation

DNA repair: Necessity of DNA repair; Types of repairs - Photoreactivation, Base excision repair, Mismatch repair, Nucleotide excision repair, SOS-Inducible repair

Unit -II MOLECULAR MECHANISM OF GENE EXPRESSION (0.8 Credits)

Mechanism of gene expression: Transfer of Genetic Information (Central Dogma); chromatin remodeling and gene expression (eukaryotes), Exons and Introns (Eukaryotes); Polycistronic RNA (prokaryotes)

Types of RNA- —mRNA, tRNA, rRNA, Small nuclear RNAs(snRNA), and Micro RNAs (miRNAs)

Transcription in Prokaryotes: RNA Polymerase, Upstream, Promoter, downstream region, consensus sequences, Initiation of RNA chains, elongation of RNA chains, termination of RNA chains (Rho dependent & Independent); Transcription inhibitors

RNA processing: Differences in Prokaryotic & Eukaryotic RNA Processing, Processing for t-RNA & r-RNA. Polyadenylation, capping of mRNA, and introns splicing

Genetic code- Discovery, genetic code table, silent features of genetic code, exception to universal genetic code

Prokaryotic translation – Ribosome and ribosome subunits; Activation of tRNA, Initiation, elongation, and termination of protein synthesis

Overview of differences in prokaryotic and Eukaryotic systems of transcription and translation, Inhibitors of protein synthesis; Post/Co translational modification- modifications in primary proteins, role of chaperons.

Unit – IIIRegulation Of Gene Expression (0.8 Credits)

Gene expression: Central dogma of molecular biology, Gene induction and repression; Gene expression product, types of gene regulation (Constitutive and inducive gene regulation) and

Significance gene regulation, and levels of gene regulation (Transcriptional regulation, translational regulation, post transcription/post translation regulation), Gene silencing

Operon: Lac operon, Positive regulation of Lac opera on, Negative regulation of lac operon, Lac mutants

Genetic attenuation (Trp operon) – Positive and negative regulation; Arabinose operon

Unit -IVTransposable Elements and Recombination (0.8 Credits)

Transposable elements – Discovery, General types of transposons, Transposable element of *Zea mays*

Bacterial transposable element – IS element and Complex transposons (Composite transposon, Tn3 transposon, Transposable phages

Mechanism of transposition Conservative and Replicative model

Recombination - Homologous and non-homologous recombination, Gene mapping using bacterial recombination - Co-transformation, Co-transduction, and Mapping by conjugation (Intermittent matting experiment with Hfr cell)

Unit – VGenetics Of Viruses (0.8 Credits)

Viral genome: General Features, Linear and circular viral genome, Hershey and Chase experiment, Viral genome replication and expression (Outline), Significance of reverse transcriptase, Genetic complementation, and S. Benzer experiment

Virulent and temperate bacteriophages: T4 Bacteriophage – Structure, feature of viral genome, Virus multiplication (Lytic); Lambda bacteriophage Structure, feature of viral genome, Virus multiplication (Lysogeny); M13bacteriophage - Structure, genome replication, and significance; phi x 174 bacteriophage Structure, genome replication, and significance

Phage gene regulation: Molecular mechanism of lysogenic regulation in lambda phage

Viral mutants: Rapid lysis mutant, conditional lethal mutant, and host range mutant

PRACTICAL

PAPER - PR-XI

MOLECULAR MICROBIAL GENETICS

Marks 50 (02 Credits)

Isolation and Purification of genomic DNA from E. coli / Bacillus sp.

1. Isolation and purification of bacterial Plasmid
2. Estimation of DNA: UV method, Spectrophotometric confirmation of DNA purity
3. Estimation of DNA: Diphenyl amine Method,
4. Isolation and purification of RNA from yeast
5. Estimation of RNA: Orcinol method.
6. Determination of LD50 value for E. coli using ultraviolet radiations (UV survival pattern of E. coli/yeast)
7. Studies on light and dark repair mechanisms in E. coli/yeast using UV radiations
8. Isolation of antibiotic resistant mutants / auxotrophic mutant. (Replica plate method)
9. Studies on regulation of synthesis of inducible enzyme beta galactosidase in E. coli
10. Studies on gene transfer by conjugation\Transformation in E. coli.

REFERENCES

1. Lewin B. (2013) Gene XI, Pearson Prentice Hall, Pearson Education, Inc., NT, USA
2. Clark, David P. and Nan Pazdernik (2013) Molecular biology, (2e) Academic Press and Elsevier
3. Malacinski GM (2003) Freifelder'S Essentials of Molecular Biology, 4th edn., Jones &Batiett, London
4. David Freifelder (2004) Molecular Biology, Narosa Publishing House.
5. Ulhas Patil, JS Kulkarni, AB Chaudhari and SB Chincholkar (2021) Foundations in Microbiology, (10^{th} ed) NiraliPrakashan, Pune
6. Watson JD, Baker JA, Bell SP, Gann A, Lewin M, Losick R (2004) Molecular Biology of the Gene, Benjamin Cummings- CSHL Press, USA.
7. Berg JM, Tymoczko, JL, Stryer, L (2012) Biochemistry 7th edn. W. H. Freeman &Co.New York.
8. Wink M. (2006) An Introduction to Molecular Biotechnology, Wiley-VCH Verlag Gmbh& Co., Weinheim, Germany
9. Weaver, RF (1999) Molecular Biology, WCB McGraw-Hill Co. Inc., NY (ISBN: 0-697- 14750-9).
10. Nelson DL& Cox MM (2005) Lehninger's Principles of Biochemistry, 4th edn., McMillan Worth Publ. Inc. NY.
11. Russell, PJ (1998) Genetics, 5th edn, Benjamin-Cummings Publ. Co. Inc., NY

12. Klug, WS and Cummings, MR (2003) Concepts of Genetics, 7th edn., Pearson Education Inc.,
13. David Plummer, (2017) An Introduction to Practical Biochemistry | 3rd Edition McGraw Hill

a. *****

PAPER TH-XII

ENVIRONMENTAL MICROBIAL TECHNOLGY

Marks 100 (04 Credits)

Unit – I Environment and Ecosystems (0.8 Credits)

Definitions, biotic and abiotic environment. Interaction between biota and its environment, Environmental segments. Composition and structure of environment. Concept of Habitat, Concept of biosphere, communities and ecosystems. Ecosystem characteristics structure and function. Homeostasis of ecosystem, Food chains, food webs and trophic structures. Ecological pyramids. Ecological Succession

Unit – II Eutrophication **(0.8 Credits)**

Water pollution and its control: Need for water management. Sources of water pollution. Measurement of water pollution, Eutrophication: Definition, causes of eutrophication, and microbial changes in eutrophic bodies of water induced by various inorganic pollutants. Effects of eutrophication on the quality of water environment, factors influencing eutrophication. Qualitative characteristics and properties of eutrophic lakes. Measurement of degree of eutrophication. Algae in eutrophication, algal blooms, their effects and toxicity, coloured waters, red tides, and cultural eutrophication. Physicochemical and biological measures to control eutrophication.

Unit –III Effluent treatment techniques **(0.8 Credits)**

Microbiology of wastewater and solid waste treatment: -Waste-types-solid and liquid waste characterization, physical, chemical, biological, aerobic, anaerobic, primary, secondary and tertiary treatments. Anaerobic processes: Anaerobic digestion, anaerobic filters, and upflow anaerobic sludge. Treatment schemes for effluents of dairy, distillery, tannery, sugar and antibiotic industries (Types, microbes used, types of Effluent Treatment Plants). Bioconversion of Sold Waste and utilization as fertilizer. Bioaccumulation of heavy metal ions from industrial effluents.

Unit – IV Bioremediation of Xenobiotics **(0.8 Credits)**

Definition of recalcitrant/ xenobiotic compounds, their presence in the natural ecosystem, Concept and consequences of biomagnification, Microbiology of degradation of xenobiotics in the environment, ecological considerations, decay behavior, biomagnification and degredative plasmids, hydrocarbons, substituted hydrocarbons, oil pollution, surfactants and pesticides. Genetically Modified Organisms released and its environmental impact assessment and ethical issues.

Unit – V Global environmental problems **(0.8 Credits)**

Concept of sustainable development. Need of sustainable development, Role of Microbial technology for achieving sustainable development, Improving and restoration of Barron/ degraded lands, Renewable energy sources using microorganisms, Biodiversity and its conservation, Ozone depletion, UV-B, greenhouse effect and acid rain, their impact and biotechnological approaches for management.

PRACTICAL

PAPER P-XII

ENVIRONMENTAL MICROBIAL TECHNOLOGY

Marks 50 (02 Credits)

1. Physical analysis of sewage / industrial effluent by measuring total solids, total dissolved solids and total suspended solids.
2. Determination of indices of pollution by measuring BOD / COD of different effluents.
3. Bacterial reduction of nitrate from ground waters.
4. Isolation and purification of degradative plasmid of microbes growing in polluted environments.
5. Recovery of toxic metal ions of an industrial effluent by immobilized cells.
6. Utilization of microbial consortium for the treatment of solid waste [Municipal Solid Waste].
7. Biotransformation of toxic chromium (+6) into non-toxic (+3) by Pseudomonas species.
8. Tests for the microbial degradation precuts of aromatic hydrocarbons / aromatic compounds.
9. Reduction of distillery spent wash (or any other industrial effluent) BOD by bacterial cultures.
10. Microbial dye decolorization / adsorption.

REFERENCES:

1. Bioremediation by Baker K.H. and Herson D.S. 1994, McGraw Hill Publications, New York.
2. Waste Water Engineering- Treatment, Disposal and Re-use by Metcalf and Eddy, Tata McGraw Hill, New York
3. Pollution: Ecology and Biotreatment by EcEldowney S., Hardman D.J. 1993 Longman Scientific Technical.
4. Environmental Microbiology edited by Ralph Mitchell, John Wiley and Sons., New York.

5. Waste Water Microbiolgy, 2 nd Edition by Bitton.
6. Chemistry and Ecotoxicology of Pollution, Edited by Des. W. Connell, G.J. Miller, Wiley Interscience Publications.
7. Environmental Biotechnology Edited by C.F. Forster and D.A. John Wase, Ellis Horwood Ltd.
8. Advances in Waste water Treatment Technologies 1998 Vol. I and II by R.K. Trivedy, Global Science Publications.
9. Biocatalysis and Biodegradation: Microbial transformations of organic compounds. 2000, by Lawrence P. Wacekett, C. Douglas Hershberger, ASM Publications
10. A Manual of Environmental Microbiolgy 2 nd edition 2001 by Christon J. Hurst(Chief Editor), ASM Publications.
11. Biodegradation and Bioremediation, Academic Press, San Diego.
12. Biotechnology in the sustainable environment, Plenum Press, New York.
13. Basic Principles of Geo Microbiology by A.D. Agate, Pune.

REVISEDSYLLABUSOF

M. Sc.

(MICROBIOLOGY)SEMES

TER-IV

Paper No.	Title of the theorypaper	Marks/Credits	Practical	Marks/Credits
SemesterIV				
Th-XIII	RecombinantDNA Technology	100/04	P-XIII	50/02
Th-XIV	Fermentation Technology	100/04	P-XIV	50/02
Th-XV	Bioinformatics,Microbial GenomicsandProteomics.	100/04	P-XV	50/02
Th-XVI	Pharmaceutical Microbiology	100/04	P-XVI	50/02

SEMESTER IV

PAPER TH - XIII

RECOMBINANT DNA TECHNOLOGY

Marks 100 (04 Credits)

Unit-I. Enzyme And Basic Techniques Used In rDNA Technology (0.8 Credit)

Core technique of rDNA: Restriction-methylation system in bacteria; Discovery of restriction enzymes, Approach of genetic engineering, Significance of rDNA in cloning and genetic engineering, Common steps of core rDNA technology

Enzymes used in rDNA; Restriction endonuclease (Nomenclature); DNA ligase (T4 &E.coli ligase); Reverse transcriptase; Alkaline phosphatase, polynucleotide kinase, Nucleotide transferase, Bal 31 and S1 nuclease, DNA polymerase, RNAse , Ribozymes; Commercial source of enzymes and Kit used in rDNA technology

Basic techniques: Isolation of genomic-DNA from various cell (Human, bacteria, plant fungi); Isolation of plasmid-DNA from bacteria and yeast.

Electrophoretic separation of DNA: Agarose gel electrophoresis, PAGE, Pulse field gel electrophoresis, DISC gel electrophoresis, and Separation of purified DNA from Gel, Southern and Northern Blotting

Methods of detection for nucleic acids- radioactive labeling of nucleic acids and autoradiography; fluorescence detection of nucleic acids; and chemical tagging with biotin or digoxigenin, DNA-probe, RNA-probe.

Unit-IIAdvanced Techniques In rDNA Technology (0.8 CREDIT)

Principle, technique, and applications of - chromosome walking, chromosome jumping, RFLP, RAPD, AFLP, DNA fingerprinting, Chromosome microdissection and micro cloning, Fluorescence in Situ Hybridization (FISH)

Microarray- principle, methodology, advantages, and applications.

DNA sequencing: sequencing-Maxam-Gilbert, Sanger's dideoxy and automated methods of DNA sequencing.

Nucleic acid amplification by Polymerase chain reaction (PCR): Principle and General procedure of PCR, Primer designing, Thermal cycler

Types of PCR – Principle and significance of Inverse PCR, asymmetrical PCR, multiplex PCR, Hot start PCR, Reverse transcriptase RCR (RT-PCR) , Real-time quantitative PCR and immuno PCR.

Unit-IIICloning Vectors (0.8 Credit)

General Properties of Cloning Vectors, Useful Traits for Cloning Vectors, Specific Types of Cloning Vectors

Criteria to select the cloning vector

Cloning Vectors for E. coli: Plasmids Cloning vectors: The nomenclature of plasmid cloning vectors; Properties and significance of pBR322, pUC8; pGEM3Z

Bacteriophage Cloning vectors -: λ bacteriophage, M13 bacteriophage and cosmid

Cloning Vectors for yeast: 2 µm plasmid, Yeast episomal plasmids; YAC vector

Cloning vectors for higher plants: Ti plasmid of Agrobacterium tumefaciens; Limitations of cloning with Agrobacterium plasmids; Ri plasmid, Plant viruses as cloning vectors (Caulimovirus vectors, Geminivirus vectors)

Cloning Vectors for animal: SV 40 plasmid vectors, retrovirus vectors.

Concept, example, and significance of Shuttle vectors

Unit -IVGene Cloning Technique (0.8 Credit)

Isolation of gene of desired interest: Physical and Enzymatic using Restriction endonucleases, modification of cut ends, Chemical synthesis of genes and methods joining the fragments into vectors

Host and rDNA insertion in host Cell: Various types of hosts used in rDNA technology, Ideal features of host Various methods of transformation, Isolation of recombinant clones.

Gene library: Construction of genomic and cDNA libraries: concept of library construction, significance of gene library

Selection and Identification of clones containing recombinant vectors: Selectable and scorable markers, Insertional inactivation, colony hybridization, plaque lift assay, In Vitro translation (Hybrid arrested translation and hybrid release translation). Fluorescence activated cell sorter, Mini and maxi cells.

Screening for protein expression- Reporter gene expression, Phage display, south-western, Immunodiffusion, Radiolabeled antibody test (RIA), ELISA, and western blotting.

Unit -VApplications Of Genetic Engineering (0.8 Credit)

Production of recombinant Insulin, Covid Vaccine production by rDNA technology, Construction of BT cotton plant and transgenic plants; Knockout mice for medical research, CRISPR-CAS and genome editing, DNA forensics; Genomics and precision medicine; Genetically modified foods; Gene therapy; Bioethics in Genetic engineering.

PRACTICAL

PAPER PR - XIII

RECOMBINANT DNA TECHNOLOGY

1. DNA analysis using agarose Gel Electrophoresis.
2. Determination of melting point of DNA
3. Restriction Digestion analysis of DNA.
5. Studies on DNA Ligation
6. Southern blotting /Northern blotting /
7. Western blotting or Immunodiffusion
8. DNA amplification by PCR
9. Gene Cloning: - Cloning of GFP Gene
10. Blue white screening
11. Demonstration RAPD / RFLP/ribotyping analysis/RTPCR

REFERENCES

1. T.A. Brown (2016) Gene Cloning And DNA Analysis- An Introduction (7 ed) Weily Blackwell

2. Dominic W. S. Wong (2018) The ABCs of Gene Cloning, (3e) Springer Publication

3.Clark, David P. and Nan Pazdernik (2013) Molecular biology, (2e) Academic Press and Elsevier

4.Watson JD, Baker JA, Bell SP, Gann A, Lewin M, Losick R (2004) Molecular Biology of the Gene, Benjamin Cummings- CSHL Press, USA.

5.Berg JM, Tymoczko, JL, Stryer, L (2012) Biochemistry 7th edn. W. H. Freeman &Co.New York.

6.Wink M. (2006) An Introduction to Molecular Biotechnology, Wiley-VCH Verlag Gmbh& Co., Weinheim, Germany

7. Weaver, RF (1999) Molecular Biology, WCB McGraw-Hill Co. Inc., NY (ISBN: 0-697- 14750-9).

8.Russell, PJ (1998) Genetics, 5th edn, Benjamin-Cummings Publ. Co. Inc., NY

9.Klug, WS and Cummings, MR (2003) Concepts of Genetics, 7th edn., Pearson Education Inc.,

10.Alexander J. Ninfa, David P. Ballou, Marilee Benore (2009) Fundamental Laboratory Approaches for Biochemistry and Biotechnology Fitzgerald Science Press, Maryland

PAPER XVI

PHARMACEUTICAL MICROBIOLOGY

MARKS: - 100/ (04 Credits)

Unit I: Principles of Antimicrobial chemotherapy. (0.8 Credit)

Introduction and selection of antimicrobial agents Concept of Bioassay, therapeutic index, MIC and LD50. Penetrating defenses, as cellular permeability barriers, Cellular transport system and drug diffusion.

Definition and classification of antibiotics, with respect to their mechanism of action, Antibacterial spectrum, Structural activity and relationship (SAR), acquisition of drug resistance, pharmacokinetics and adverse drug effect β- Lactum(Penicillin, Amoxicillin, cefuroxime), aminoglycosides (Streptomycin, Gentamicin), Tetracyclines (Tetracyclin, doxicyclin) , Macrolides (Erythromycin, Azethreomycin), Peptide antibiotics (Bacitracin, polymixin,), Sulphonamides (sulfamethoxazole), co-trimoxazole and quinolones (ciprofloxacin) Chloramphenicol, trimethoprim.

Unit II: Molecular aspects of Antimicrobial Chemotherapy. (0.8 Credit)

Definition, classification, Mechanism of action and examples of chemical disinfectants, antiseptic and preservatives. Definition, classification, Mechanism of action and examples of antiviral (Acyclovir, zidovudine), Antifungal (amphotericin B, Fluconazole) and Antitumor (Bleomycin, ductinomycin) antibiotics. Drug delivery system in gene therapy. Approaches and safety considerations associated with gene therapy. Immunological problems associated to gene therapy. Pre-requisites and candidate diseases for human gene therapy. Drug carrier, Macromolecular, cellular, and synthetic Viral and non viral mediated gene delivery. Introduction, concept and types of drug targeting, cellular level events of drug targeting, targeting ligands, blood cell receptors for endogenous compounds/ ligands, carrier and vesicular system for targeting, specialized liposomes for cellular drug targeting.

Unit III: Microbial Production and spoilage of Pharmaceutical Products.(0.8 Credit) Manufacturing procedure and in-process control of Pharmaceutical products: Bacterial and Viral vaccine, sterile injectables, Solid dosage forms, liquid orals and Ointments New Vaccine production: DNA vaccines, synthetic, peptide vaccines, multivalent subunit vaccines, edible vaccines and their trials. Microbial production and

applications of therapeutic / diagnostic enzymes: Asparaginase, Streptokinase, beta lactamases Microbial production contamination and spoilage of Pharmaceutical products (sterile injectables, ophthalmic preparations and implements) and their sterilization Applications of Biosensors in pharmaceutical industries.

Unit IV: Regulatory Practices and Policies in Pharmaceutical Industries. (0.8 Credit)

FDA, Govt. regulatory practices and polices. Concept of R & D and Financing R and D, Quality control and market planning. Significance of IP, BP and USP.

Reimbursement of drugs, Biological and legislative aspects. Rational drug design (Quantitative structure activity relation QSAR of drug) and computational aspect of drug design. Screening and utilization of bioactive phytochemicals. Patenting of drugs and Biological products.

Unit V: Quality Assurance and Validation. (0.8 Credit)

Regulatory aspects of QC, QA, and QM. GMP , GLP and CMP in Pharma Industry. ISO, WHO, USFDA certification. Microbial Limit test of Pharma products. Sterility testing , pyrogen testing and LAL test of Sterile Pharma products. Sterilization- heat, D-value, Zvalue and survival curve, radioactive, gaseous and filtration. Chemical and biological indicators. Designing layout for microbiology laboratory.

PRACTICALS

PAPER XVI: PHARMACEUTICAL MICROBIOLOGY

MARKS: 50 (02 Credits)

1. Spectrophotometeric/ Microbiological methods for the determination of Griseofulvin.
2. Microbial production and Bioassay of Penicillin.
3. Bioassay of Chloramphenicol/Streptomycin by plate assay method or turbitometric assay methods.
4. Screening, Production and assay of therapeutic enzymes: Glucose Oxidase/Asperginase/beta lactamase.
5. Treatment of bacterial cells with cetrimide, phenol, and detection of Leaky substances such as amino acids, nucleic acids as cytoplasmic membrane damaging substances.

6. Determination of MIC and LD50 of Ampicillin / Streptomycin.

7. Sterility testing by using B. sterothermophilus/ B. subtilis.

8. Testing for microbial contamination. Microbial loads from syrups, suspensions, creams, and other preparations, Determination of D-value and Z-value for heat sterilization in pharmaceuticals.

9. Determination of antimicrobial activity of chemical compounds (like phenol, resorcinol and formaldehydes) Comparison with standard products.

REFERENCES

1. Pharmaceutical Microbiology- Edited by W. B. Hugo & A.R. Russel Sixth Edition. Blackwell Scientific Publications.

2. Lippincott's illustrative Reviews: Pharmacology Edition: 02 Maryjnycck by Lippincott's review Publisher Pheladelphia 1997.

3. Principles of medicinal chemistry Vol. 1 by Kadam S.S., Mahadik K.R., Bothra K.G. Edition: 18, Nirali Publication.

4. Pharmacognosy by Gokhle S.D., KoKateC.K.. Edition: 18, Nirali Publication.

5. Biotechnology – Expanding Horizon by B.D. Singh ., First Edition, Kalyani Publication, Delhi.

6. Analytical Microbiology- Edited by Fredrick Kavanagh volume I &II. Academic Press New York.

7. Pharmaceutical Biotechnology by S. P. Vyas & V.K. Dixit. CBS publishers & distributors, New Delhi.

8. Quniolinone antimicrobial agents- Edited by David C. Hooper, John S. Wolfson. ASM Washington DC.

9. Quality control in the Pharmaceutical industry - Edited by Murray S. Cooper Vol. 2, Academic Press New York.

10. Biotechnology- Edited by H.J. Rhem& Reed, vol 4 VCH publications, Federal Republic of Germany.

11. Good manufacturing practices for Pharmaceuticals. By Sydney H. Willing, Murray M. Tuckerman, Willam S. Hitchings IV. Second edition Mercel Dekker NC New York.

12. Advances in Applied Biotechnology series Vol.10, Biopharmaceutical in transition., Industrial Biotechnology Association by Paine Webber,. Gulf Publishing Company Houston.

13. Drug carriers in biology & medicine Edited by Gregory Gregoriadis. Acedemic Press New York.

14. Quality Assurance in Microbiology by Rajesh Bhatia, Rattan Lal Ihhpunjani. CBS publishers & distributors, New Delhi.

PAPER NO. - PXV

BIOINFORMATICS, MICROBIAL GENOMICS AND PROTEOMICS.

100 Marks (Credit – 04)

Unit- I Bioinformatics and its Applications **(0.8 Credit)**

Introduction to Bioinformatics: Introduction and overview of History of Bioinformatics, relationship between molecular evolution and bioinformatics. Structure function relationship, Applications of Bioinformatics

Biological Databases: Types and importance

Nucleotide sequence databases; Primary nucleotide sequence databases- EMBL, GenBank, DDBJ (Sequence file format, sequence submission and retrieval of information). Overview of Secondary nucleotide sequence databases

Protein sequence database – SWISS PROT, TrEMBL, PIR, MIPS

Protein Family database – PFAM, PROSITE, PRINTS, BLOCKS, eMOTIF

Protein Structure database – PDB, SCOP, CATH

Unit – II Whole Genome Analysis **(0.8Credit)**

Human genome project, uses and application, Genome information and special features, coding sequences, (CDS), Untranslated regions (UTR'S), Expressed sequence Tags (EST). Approach to gene identification, Gene Prediction- Importance and Methods.

Genomic and cDNA library, BacterialArtificial Libraries, Shotgun Libraries and sequencing, Conventional sequencing (Sanger,Maxam and Gilbert method), Automated sequencing.

Unit – III Sequence Analysis **(0.8 Credit)**

Sequence Alignment, Algorithms; uses and applications, Local and Global sequence alignment, Pairwise alignment:

Scoring Matrix – PAM, BLOSUM,

Dynamic programming – Needleman – Wunsch, Smith- waterman

Heuristic Methods- FASTA, BLAST for protein and nucleic acid.

Multiple Sequence Alignment;ClustalW ,PROFILE,Hidden Markov Models (HMMs)

Annotation of Gene, Open reading frames (ORF),

Phylogenetic tree construction methods

Unit- IV DNA – Microarray **(0.8 Credit)**

Concept of expression analysis, SAGE, DNA micro array, Spotted arrays, Oligonucleotide arrays, Designing the experiment, Two– colour micro array experiments, Computational analysis of microarray data.

Printing of oligonucleotide and PCR products on glass slides, nitrocellulose paper. Whole genome analysis for global patterns of gene expression using fluorescent labeledcDNA or end labeled RNA probes, analysis of SNP Using DNA chips.

Overview of tools for microarray analysis:-xCluster, MADAM,

Advantage, disadvantageand application of DNA microarray.

Unit- V Proteomics **(0.8 Credit)**

Definition, Protein sequence information, composition and properties, physicochemical properties based on sequence, database, Two dimensional separation of total cellular protein, isolation and sequencing, Analysis individual protein spot by Mass spectroscopy (MALDI- TOF), Electro Spray Ionization (ESI), Tandem mass spectroscopy (MS/MS) tryptic digestion and peptide Mass finger printing(PMF), 3D structure prediction methods; Homology, ab initio, Advantage, disadvantage and application of protein microarray.

PRACTICAL

PAPER- P-XV

BIOINFORMATICS, MICROBIAL GENOMICS AND PROTEOMICS.

Marks 50 (02 Credits)

Use of Internet /software for sequence analysis of nucleotides and proteins. 1. Studies of public domain databases for nucleic acid and protein sequences. 2. Determination of protein structure (PDB) by using RASMOL, CN -3D software 3. Genome sequence analysis by using BLAST algorithm 4. Protein sequence analysis by using BLAST algorithm

REFERENCES

1. Bioinformatics. 1998 by Baxevanis

2. Bioinformatics 2000 by Higgins and Taylor OUP.

3. Nucleic acid Research 2001. Jan. Genome database issue.

4. The Internet and the new Biology: Tools for Genomics and Molecular Research by Peruski, Jr. and Peruske (ASM) 1997.

5. Functional Genomics. A Practical Approach Edited by Stephen P Hunt and Rick Liveey (OUP) 2000.

6. DNA microarrays: A practical approach edited by Mark Schena (OUP)

7. Bioinformatics - A Practical Guide to the Analysis of Genes and Proteins. 2nd Edition by Baxevanis.

8. Bioinformatics: Sequence, structure and Data Bank: A Practical Approach by Higgis.

9. Bioinformatics - from Genomes to drug. 2 volumes by Lenganer.

10. Bioinformatics Methods and Protocols - Misener.

PAPER XVI

PHARMACEUTICAL MICROBIOLOGY

Marks 100 (04 Credits)

Unit I: Antibiotics Vitamins, and enzymes (0.8 Credit)

Antimicrobial chemotherapy: Brief History of Chemotherapy; General Properties of Antimicrobial Agents (Selective Toxicity, Spectrum of Activity, Modes of Action, Kinds of Side Effects, The Resistance of Microorganisms; Determining Microbial Sensitivities to Antimicrobial Agents

Concept of Bioassay, The Disk Diffusion Method, The Dilution Method, Antibiotic assay (Indian pharmacopeia); Therapeutic index, MIC, MBC, MFC and LD50; Serum Killing Power, Automated Methods; Attributes of an Ideal Antimicrobial Agent

Structure, Mode of action, pharmacokinetics, and resistance of –

β- Lactum (Penicillin, Amoxicillin,cefuroxime), aminoglycosides (Streptomycin, Gentamicin), Tetracyclines (Tetracyclin,doxicyclin), Macrolides (Erythromycin, Azethreomycin), Peptide antibiotics (Bacitracin, polymixin,), Sulphonamides (sulfamethoxazole), co-trimoxazole and quinolones; Antiviral (Acyclovir, zidovudine), Antifungal (amphotericin B, Fluconazole) and Antitumor antibiotics. (Bleomycin, dactinomycin)

Vitamin:Mode of action, microbial production, pharmacokinetics, and significance of –Riboflavin, Cyanocobalamin.

Growth promotion test; Vitamin assay as per Indian pharmacopoeia

Enzymes: Therapeutic / diagnostic use of enzymes: Asparaginase, Streptokinase

Unit II Aspects of large-scale Vaccine manufacturing (0.8 Credit)

General aspects of immunization: Objectives of a vaccine/immunization program; Disease severity; Vaccine effectiveness; Safety; Public perceptions; Cost; Longevity of immunity; Immunization of special risk groups

Types of vaccine: Live vaccines, Killed and component vaccines (Toxoid vaccines; Bacterial cell component vaccines, Conjugate vaccines, Viral subunit vaccines); DNA vaccines

Vaccine manufacturing- The seed lot system

Bacterial vaccine: Production of the bacteria and the cellular components of bacterial vaccines; Fermentation; Processing of bacterial harvests

Viral vaccine: Production of the viruses and the components of viral vaccines; Growth of viruses; Processing of viral harvests

Blending, Filling, and drying of vaccine

Quality control in vaccine production - In process control; Final product control, Assays, Safety tests, Tests of general application

Immune sera - Preparation and Quality control.

Unit III: Microbial control aspects in pharmaceutical Industry (0.8 Credit)

Microbial contamination, spoilage, and preservation of medicines; Need to protect medicines against microbial spoilage, Products, and materials vulnerable to spoilage, Sources and control of microbial contamination, Sources and types of contaminating organisms, Factors influencing the growth of spoilage organisms, Control of contamination and spoilage during manufacture, Selection and use of preservatives, Preservative interactions with formulation components and containers

Definition, classification, Mechanism of action and examples of chemical disinfectants, antiseptic and preservatives, Preservative efficacy tests, Disinfectant evaluation (Rideal–Walker and Chick–Martin tests, Kelsey–Sykes test); Aseptic conditions, Environmental monitoring, Biosafety levels, and biosafety cabinets

Non-sterile products:Indian pharmacopeia specifications for the microbiological quality of major categories of pharmaceutical products; Methods of counting of microorganisms in pharmaceutical products; Microbial Limit test

Unit IV: Sterilization procedures and sterility assurance (0.8 Credit)

Sterilization parameters - D value and Z value and F value

Definition, classification, Mechanism of action of - Heat sterilization, Gaseous sterilization, Radiation sterilization, Filtration sterilization, High-level disinfection, Ultrahigh pressure, High-intensity light pulses, Ultrasonication, Gas plasma.

Practical utility of sterilization process in pharma industry; Validation of a sterilization process - Process indicators (Chemical and biological indicators), Testing filtration efficacy, Limitations of sterilization methods

QA of sterile products - Sterility testing, pyrogen testing and LAL test

Unit V: Quality Aspects and Regulatory Policies in Pharmaceutical Industries. (0.8 Credit)

Regulatory aspects of QC, QA, and QM. GMP, GLP and CMP, CGMP in Pharma Industry. ISO, WHO, USFDA certification, of Pharma products.

Designing layout for microbiology laboratory, Autoclave validation, HEPA efficiency testing

FDA, Govt. regulatory practices and policies; Significance of pharmacopoeia, (IP, BP and USP), Pharmaceutical audit, Concept of R & D, Reimbursement of drugs, Rational drug design (Quantitative structure activity relation QSAR of drug) and computational aspect of drug design.

Patenting of drugs and biological products

PRACTICAL

PAPER XVI

PHARMACEUTICAL MICROBIOLOGY

Marks 50 (02 Credits)

1. Sterility testing as per IP
2. Microbiological assay of Chloramphenicol/Streptomycin as per IP
3. Microbiological assay of vitamin
4. Screening, Production, and assay of therapeutic enzymes: Glucose Oxidase/Asperginase/beta lactamase.
5. Evaluation of disinfectant (RW test/ Chick martin/ Kelsey–Sykes test)
6. Determination of MIC and MBC of Ampicillin / Streptomycin. **OR** Determination of MIC and MFC of Amphotericin
7. Determine sterilization efficiency using biological indicators
8. Microbial limit test
9. Determination of D-value and Z-value for heat sterilization in pharmaceuticals.
10. Determination of efficacy of preservative
11. Environmental monitoring of pharmaceutical preparation sections

REFERENCES:

1. Hugo and Russell' Pharmaceutical Microbiology- Edited by Stephen P. Denyer, Norman Hodges, Sean P. Gorman, Brendan F. Gilmore Eighth Edition. Blackwell Scientific Publications (2011)
2. Aulton's Pharmaceutics Edited by Michael E. Aulton and Kevin M. G. Taylor; Elsevier (2018)

3. Lippincott's illustrative Reviews: Pharmacology Edition: 02 Maryjnycck by Lippincott's review Publisher Pheladelphia 1997.
4. Principles of medicinal chemistry Vol. I by Kadam S.S., Mahadik K.R., Bothra K.G. Edition: 18, Nirali Publication.
5. Pharmacognosy by Gokhle S.D., KoKateC.K.. Edition: 18, Nirali Publication.
6. Biotechnology – Expanding Horizon by B.D. Singh ., First Edition, Kalyani Publication, Delhi.
7. Analytical Microbiology- Edited by Fredrick Kavanagh volume I &II. Academic Press New York.
8. Pharmaceutical Biotechnology by S. P. Vyas & V.K. Dixit. CBS publishers & distributors, New Delhi.
9. Quniolinone antimicrobial agents- Edited by David C. Hooper, John S. Wolfson. ASM Washington DC. 9. Quality control in the pharmaceutical industry - Edited by Murray S. Cooper Vol. 2, Academic Press New York.
10. Biotechnology- Edited by H.J. Rhem& Reed, vol 4 VCH publications, Federal Republic of Germany. 11. Good manufacturing practices for Pharmaceuticals. By Sydney H. Willing, Murray M. Tuckerman, Willam S. Hitchings IV. Second edition Mercel Dekker NC New York.
11. Advances in Applied Biotechnology series Vol.10, Biopharmaceutical in transition., Industrial Biotechnology Association by Paine Webber, Gulf Publishing Company Houston.
12. Drug carriers in biology & medicine Edited by Gregory Gregoriadis. Acedemic Press New York.
13. Quality Assurance in Microbiology by Rajesh Bhatia, Rattan Lal Ihhpunjani. CBS publishers & distributors, New Delhi.

SERVICECOURSE-I

AppliedAgriculturalMicrobiology

MARKS:- 100(04 Credits)

Unit-I **(0.8Credit)**

Introduction to biofertilizers, Biofertilization processes - Decomposition of organic matterandsoilfertilityandvermicomposting.Mechanismofphosphatesolubilizationandphosphat e mobilization. Nitrogen fixation - Free living and symbiotic nitrogen fixation. Ectoand endomycorrhizae and their importance in agriculture. Biotechnological application innitrogenfixation.

Unit-II **(0.8Credit)**

Microorganisms as biofertilizers: Biofertilizers and symbiotic associations; Rhizobium - taxonomy, physiology, host-*Rhizobium* interaction, mass cultivation; Associative and nonsymbioticassociation-*Azospirillum,Azotobacter*,Cyanobacteria(NostocandAnabaena)Mycorrhiza and actinorrhiza in plant nutrition and stress tolerance; Interaction of mycorrhizawith*Rhizobium*and*Pseudomonas;*Commercialproductionofbiofertilizers,formulati onsandBISspecifications;theirapplicationsand limitations forIndianagriculture.

Unit-III **(0.8Credit)**

Nitrogenous Biofertilizers - Isolation and purification of Azospirillum and Azotobacter,massmultiplicationofAzospirillumandAzotobacter,formulationofinoculumofAzo spirillum and Azotobacter, application of inoculants of Azospirillum and Azotobacter.Isolation and purification of Rhizobium, mass multiplication and inoculum production ofRhizobium,Methods of applicationofRhizobiuminoculants.

Unit-IV **(0.8Credit)**

Microorganismsasbiopesticides: Microbiologyofplantsurfaces;Principlesandmechanismof

biologicalcontrol;biocontrolagentsforinsectpestandweedcontrol.Commercial production of biopesticides with reference to *Bacillus thuringiensis*; integratedpestmanagement; Theirapplications andlimitations for Indianagriculture.

Unit-V **(0.8Credit)**

PlantPathology

Mode of entry of pathogens, disease symptoms, Brief account of algal disease, fungaldisease,bacterial disease, viral disease, diseases caused by mycoplasmas and nematodeSpecially - brown spot of rice, black stem rust of wheat, stem rot of jute, rice disease byTungo virus, grey blight of tea, red rot of sugarcane, TMV, Blast of rice, leaf blight of potato,Powderymildew of cucurbit)-dissemination and control measurement.

ReferenceBooks:

Bagyaraj,D.J.andA.Manjunath.1990.Mycorrhizalsymbiosisandplantgrowth,Univ.ofAgricultural Sciences,Bangalore,India.

Purohit,S.S.,P.R.KothariandS.K.Mathur,1993.BasicandAgriculturalBiotechnology,Agro BotanicalPub.India.

SubbaRao,N.S.1988.Biologicalnitrogenfixation:recentdevelopments,MohanPrimlaniforOxfordand IBHPub.Co.(P)Ltd., India.

SubbaRao,N.S.,G.S.VenkataramanandS.Kannaiyan1993.Biologicalnitrogenfixation,ICARPub.,NewDelhi.

Somani, L.L., S.C. Bhandari, K.K. Vyas and S.N. Saxena. 1990. Biofertilizers,ScientificPublishers- Jodhpur.

Tilak,K.V.B.1991.BacterialBiofertilizers,ICARPub.,NewDelhi.

AgriosG.N.1997.PlantPathology.AcademicPress,SanDiego.

CookR.J.&BakerK.F.1983.TheNatureandpracticeofBiologicalControlofPlant Pathogens. AmerecaPhytopathologicalSocietyPress,St.Paul,MN.

ForsterC.F.&JohnDA2000.EnvironmentalBiotechnology.EllisHorwoodLtd.Publication.

ChristonJ.H.2001.AManualofEnvironmentalMicrobiology.ASMPublications.

Rao,N.S.S.1999.SoilMicrobiology.Oxford&IBHPublishingCo.,NewDelhi.

Thenatureandpropertiesofsoil.Authors-HarrybuckmanandNyleC.brady.

IntroductiontosoilMicrobiologyInternationals.Authors-MartinAlexander.

Service Course - IIAppliedMedicalMicrobiology

MARKS:- 100(04 Credits)

HAEMATOLOGY **(02Credits)**

1. Methodsofcollectionofblood.
2. Preparationandlabelingofanticoagulantbulbs.
3. Preparationofvariousstainsolutions.
4. Preparationofbloodsmearsandstainingthemusingdifferentstains.
5. Hemoglobinestimation-differentmethods.
6. RBCcount
7. WBCcountbymanualmethods.
8. Platelet count
9. EstimationofE.S.R.
10. P.C.V.
11. Calculatingabsolutevalues.
12. Studyof peripheralblood smear indifferent typesof anaema.
13. Reticulocyte count.
14. Testforsickling.
15. Osmoticfragilitytest.
16. Detectionoffoetalhaemoglobin.
17. Haemoglobinelectrophoresis.
18. DifferentialW.B.C.countandbuffycoatpreparation.

19. StudyofP.B.S.indifferenttypesofleukemia.

20. Cytochemicalstainsforleukemias.

21. Bleedingand clottingtime.

22. Prothrombintime.

23. Partialthromboplastintimewith Kaolin.

24. Thromboplastingenerationtime.

25. Routine,nakedeyeandmicroscopicexaminationofstoolandstudyofparasiticovaandcystsinthestool.

26. Routinephysical,chemicalandmicroscopicexaminationof urine.

27. Demonstrationofnormalandabnormalfindingsinpleural,pericardial,ascitic,cerebrospinalfluid and semen.

28. The use and maintenance of the following centrifuge, colorimeter, chemical balance,haematocrit,varioustypesofpipettes, urinometer, microhaematocritcentrifuge.

29. L.E.cellpreparation.Studyofparasitesintheblood.

30. Studyofparasistesintheblood.

TRANSFUSIONOLOGY: (02Credits)

1. Determinationof bloodgroup by bothtube andslide methods.

2. Sourcesoferrorsingroupdetermination—theirelimination.

3. Titrationofbloodgroupantibodies in serum.

4. Coomb'stest.

5. Majorandminorcrossmatching(compatibilitytest),

6. Investigations of transfusion reactions.

7. Tests to detect diseases that can be transmitted through blood transfusion (VDRL test,testsforHbsAg,HIVusingdifferentmethods).

8.Collectionandstorageofblood.

REFERENCES:

1. ClinicalChemistryinDiagnosisandTreatment.-ZiwaJ.F.PPeter,MayneP.D.

2. PracticalClinicalBiochemistry–VerleyPublications,W.H.Heinemann

3. A Biologist Guide to principle & Techniques of Practical Biochemistry :- William &Wilson,Edward Arnold

4. LynchMedicalLaboratoryTechnology–RephaleD.B,W.BSaunders.

5. PracticalBiochemistry–Plummer

6. TextBookofBiochemistry–Ramkrishanan,Prasman&Rajan

7. MedicalBiochemistry–A.CDeb

8. MedicalBiochemistry-M.N.Chatterjee,Shinde

9. MedicalBiochemistry-Das

10. ClinicalLaboratoryMethods –john D.Bener

11. ManualofHistopathologicalTechniques&theirDiagnosticapplication–JohnDBancroft,Hay C.Cook,Churchill Levingston

12. ClinicalDiagnosisbyLaboratoryExaminationJohnAKokmer.

13. TextBookofPathologyVol.I&II–N.C.Dey

14. ClinicalLaboratoryDiagnosis–LevinsonSA,MacFateR.D.

15. ClinicalLab.Methods&DiagnosisVol.I&II–AlexC,SLGarelt.

16. ClinicalLab.Methods–JohnDBenger,PlilipG.Achermann,GelsaonToro

17. HandbookofHistopathologicalTechnique–C.F.A.Culling.

18. Histopathological&HistologicalTechnique–J.A.Kierman.

19. ANewshortTextBookofMicrobial&ParasiticInfections–B.I.Duerden,T.M.S.Reid, J.M.Jewsbury,D.C.Turk.

20. DistrictLaboratoryPracticeinTropicalCountriesPart–1&2–MonicaCheesbrough.CambridgeLow-PriceEdn.

21. MedicalLaboratoryTechnologyVol.I,II&III–K.L.Mukherjee.

22. MedicalLaboratoryTechnology–
Pror.C.R.Maiti,NewCentralBookAgencyPvtLtd.Kolkata.

23. MedicalParasitology–
RajeshKaryakarte,A.S.Damle.Books&AlliedPvt.LtdKolkata.

24. TextBook ofBacteriology –NCDay&T. K.Day

25. Parasitology–K.D.Chatterjee.

26. TextBookofMicrobiology–Chakarbourty.

Dean
Faculty of Science & Technology
Dr. Babasaheb Ambedkar Marathwada
University, Aurangabad

Chairman BOS
Microbiology