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| **M.Sc. in Microbiology** | **(**FOURTH **SEMESTER)** |
| **COURSE CODE: MMB 401** | **COURSE TYPE: CCC** |
| **COURSE TITLE: MYCOLOGY AND PHYCOLOGY** | |
| **CREDIT: 07**<br>THEORY: 05 PRACTICAL:02 | **HOURS: 135**<br>THEORY: 90 PRACTICAL: 45 |
| **MARKS:100**<br>THEORY: 70 CCA: 30 **PRACTICAL: 33** | |
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| **UNIT1 16 Hours** | Introduction of algae: Occurrence and distribution, thallus structure, characteristics, nutrition, classification and reproduction,Ecological significance |
| **UNIT-2 16 Hours** | Occurrence and distribution, somatic structure, hyphal growth, nutrition, heterothallism, sex hormones in fungi, physiological specialization in fungi, fungi and ecosystem; saprophytic parasitic, mutualistic and symbiotic relationship with plants and animals. Classification of fungi. Reproduction in fungi: asexual, sexual and parasexual |
| **UNIT-3 16 Hours** | Study of the different classes with reference to occurrence, somatic structure and life cycle and economic importance representing the following genera: Acrasiomycetes (*Dictyosteluim*), Myxomycetes (Endosporus and exosporus), Chytridiomycetes (*Neocallimastrix*), Oomycetes (*Phytopthora*), Zygomycetes (*Rhizopus*), Ascomycotina (Hemiascomycetes- *Saccharomyces*, Plectomycetes - *Penicillium*Pyrenomycetes – *Xylaria*, Discomycetes- *Peziza*), Basidiomycotina (Hymenomycetes*Agaricus*, Teliomycetes - *Puccinia*), Deuteromycetes (*Alternaria* |
| **UNIT-4 22 Hours** | Algae as pollution indicators, eutrophication agent and role in bioremediation, algae in global warming and environmental sustainability,cyanobacteria and selected microalgae in agriculture- biofertilizer and algalization, importance of algae in production of algal pigments, biofuels, hydrogen production, important bioactive molecule |
| **UNIT-5 20 Hours** | Lichens: ascolichens, basidiolichens, deuterolichens, Mycorrhiza: ecto-, endo-, ectendo-, VAM, Fungi as insect symbionts, fungi as biocontrol agents, attack of fungi on other microorganisms, potential application in Agriculture, environment, industry, food. Role of fungi in Biodeterioration of wood, paper, textile. Myxotoxins, quorum sensing in fungi |

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| **LABORATORY WORK (MMB411)** | 1. Setting of Winogradsky's column<br>2. Estimation of soil composition by sedimentation method<br>3. Enumeration of soil microorganisms (bacteria), actinomycetes, fungi) by standard platecount<br>4. Estimation of soil microbial activity by CO2 evolution<br>5. Isolation of cellulose decomposing microbes and estimation of cellulose activity<br>6. Estimation of ammonifiers, nitrifiers and denitrifiers in soil by MPN METHOD<br>7. Isolation and culturing of Rhizobium sp from root nodules and Azospirillum from grasses<br>8. Biological enrichment isolation of Rhizobium from soil by Leonard Jar experiment<br>9. Nodulation testing by tube/jar method<br>10. Solubilizatgion of rock phosphate by microorganisms and estimation<br>11. Testing for mineral leaching by Thiobacillussp<br>12. Assessment for sulphate reducing bacteria<br>13. Observation and assessment of soil algae/algal biofertilizers.<br>14. Estimation of N2 fixation (Micro Kjedhasl method/GC method) |
| **SUGGESTED READINGS** | 1. Alexopoulos, C.J. and C.W. Mims 1979. Introduction to Mycology (3rd Ed.)Wiley Eastern Ltd., New Del<br>2. Charlile M. & Watkinson S.C. The Fungi, Publisher: Academic Press.<br>3. E.Moore –Landeekeer: Fundamentals of the fungi, Publisher: Prentice Hall.<br>4. L. Barsanti, Paolo Gualtieri: Algae: anatomy, biochemistry, and biotechnology<br>5. AyhanDemirbas, M. FatihDemirbas: Algae Energy: Algae as a New Source ofBiodiesel (2010)<br>1. Linda E. Graham, James Graham, James M. Graham: Algae (2009)<br>8. Burnett J.H., Publisher: Edward, Arnold Crane Russak: Fundamentals of Mycology |

| M.Sc. in Microbiology | (FOURTH SEMESTER) |
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| **COURSE CODE:MMB 402** | **COURSE TYPE: CCC** |
| **COURSE TITLE: FOOD AND DAIRY MICROBIOLOGY** | |
| **CREDIT: 7**<br>**THEORY: 5 PRACTICAL: 2** | **HOURS: 135**<br>**THEORY: 90 PRACTICAL: 45** |
| **MARKS: 100**<br>**THEORY: 70 CCA:30** | **PRACTICAL:33** |
| **OBJECTIVE: The main purpose of this paper is to make aware and develop the knowledge of the students in the field of Food microbiology, Dairy microbiology and other fermented packed and canned food that is the part of our daily life.** | |
| **UNIT-1 (15 Hrs)** | Microbiology of food items; Fermented food, bakery products, cereals, and milk products. |
| **UNIT-2 (20 Hrs)** | Microbial spoilage of food products - cereals, fruits, vegetables, meat, fish, and dairy products |
| **UNIT-3 (15 Hrs)** | Microbiological examination of milk and milk products, source of their contamination and control Starter cultures |
| **UNIT-4 (20 Hrs)** | Principles of food preservation.preservation methods – pasteurization,, canning, low temperature storage Chemical preservatives and their uses.<br>Mushroom cultivation technology and single cell protein |
| **UNIT-5 (15 Hrs)** | Microbiological legal standards of selected food and milk products.<br>Food poisoning and microbial toxins produced in food items and dairy products |
| **COURSE CODE: MMB 411 LABORATORY WORK** | 1. Microbiological examination of fresh and canned foods and mushrooms<br>2. Microbiological examination of milk and milk products<br>3. Microbiological quality testing dof milk (MBRT test)<br>4. Isolation and cultivation of anaerobic microbes from rumen, and termites<br>5. Isolation and observation for phillospheremicroflore<br>6. Isolation and observation for rhizosphere microflore<br>7. Observation for mycorrhizae<br>8. Effect of pesticides on microbial activity |

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| | 9. Estimation of BOD<br>10. Testing for microbial sanitary quality of water (coliform test )<br>11. Isolation and analysis of mycotoxins<br>12. Isolation and observationof air microsflora |
| **SUGGESTED READINGS** | 1. *Food Microbiology by Frazier*<br>2. *Microbial Ecology – A conceptual approach by Lynch and Poole*<br>3. *Basic food microsbiologoy (Abridged edition) by George J. Banwart*<br>4. *Waste water microbiology by Bitton, G.*<br>5. *Waster water treatment – Biological and chemical process by Henze, M.*<br>6. *Soil Microbiology by Alexander Martin*<br>7. *Soil Microorganisms and Plant growth by NS SubbaRAo*<br>8. *Laboratory experiments in microbiology by Gopal Reddy et al* |

| M.Sc. in Microbiology | (FOURTH SEMESTER) |
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| **COURSE CODE: MMB 403** | **COURSE TYPE: CCC** |
| **COURSE TITLE:PRODUCTION OF MICROBIAL BIOMASS** | |
| **CREDIT: 7**<br>**THEORY: 5 PRACTICAL: 2** | **HOURS: 135**<br>**THEORY: 90 PRACTICAL: 45** |
| **MARKS: 100**<br>**THEORY: 70 CCA:30** | **PRACTICAL: 34** |
| **OBJECTIVE: The objective of this paper is to develop knowledge of our students to solve the problems of food through Microbial biomass as alternative food for huge population.** | |
| **UNIT-1 (15 Hrs)** | Microbial cells as products for commercial use; Selection and Improvement of Strains for biomass production; Characteristics of Single-Cell Biomass: Composition; Nutritional Value and Toxicological Status. Formulation of medium Composition for Biomass Production; Types of fermentation system fir Biomass |
| **UNIT-2 (20 Hrs)** | Single cell protein: microorganisms used; raw material used as substrate; condition for growth and production; nutritive value and uses of SCP. Baker's yeast; Production of probiotic biomass; and mold cultures. |
| **UNIT-3 (15 Hrs)** | Mushroom production: cultivation of different types of mushroom; edible mushroom; diseases of mushrooms therapeutic value of an edible mushroom; production of pectin and microbial conversion of woody biomass |
| **UNIT-4 (20 Hrs)** | Microbial inoculants- Selection and establishment of nitrogen fixing bacteria. Production of Rhizobium, Azotobacter, Azospirilla, cyanobacteria and other nitrogen fixing bacterial cultures. Quality control of bio inoculants; Phosphate solubilizing bacteria; mycorrhiza; plant growth promoting rhizobacteria (PGPR); Biocontrol microbial inoculants.. |
| **UNIT-5 (15 Hrs)** | Cyanobacterial and algal fuels; Fine chemicals (restriction enzymes etc) and nutraceuticals from algae; UV absorbing pigments Industrial products from macro algae - seaweed biotechnology; Bioweapons and Bioshields |

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| **COURSE CODE: MMB 413** | 1. Isolation of cyanobacteria<br>2. Mass cultivation of cyanobacteria<br>3. Isolation of nitrogen fixing bacteria<br>4. Mass cultivation of nitrogen fixer<br>5. Seed inoculation<br>6. Germination and analysis of plant growth |
| **SUGGESTED READINGS** | **1.** Robert A Andersen. 2005. *Algal Culturing Techniques.* Academic Press.<br>2. L. M. Prescott, J. P. Harley and D. A. Klein. Microbiology-, McGraw Hill<br>3. N. J. Pelczar, S. Chand, R. Krieg. Microbiology- Tata McGraw Hill<br>4. Casida, Industrial microbiology-, L.E. New age international Ltd, Publishers. New Delhi:<br>5. Frazier, Food microbiology. W.C. Tata McGraw Hill.<br>6. Carr NG & Whitton BA. 1982. The Biology of Cyanobacteria. Blackwell.<br>7. Bergerson F J. 1980. Methods for Evaluating Biological Nitrogen Fixation. John Wiley & Sons |

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| **M.Sc. in Microbiology** | **(**FOURTH **SEMESTER)** |
| **COURSE CODE: MMBD01** | **COURSE TYPE: ECC/CB** |
| **COURSE TITLE: ETHANOBOTANY & PHARMACEUTICAL BIOTECHNOLOGY** | |
| **CREDIT: 06**<br>THEORY: 06 PRACTICAL: 00 | **HOURS: 90**<br>THEORY: 90 |
| **MARKS: 100**<br>THEORY: 70 CCA: 30 | |

Ethnobotany is the study of how people of a particular culture and region make of use of indigenous plants, while Pharmaceutical Biotechnology is the science that covers all technologies required for the production, manufacturing and registration of biological drugs. Advances in recombinant genetics facilitate the routine cloning of genes and the creation of genetically modified organisms that can be used in industrial production.

The objectives of this course are 1) to make the students well conversant with different molecules that exert a pharmacological action in the body and how the specific action is generated. 2) To impart knowledge how to identify and design drugs that could be potentially useful in the identification of the candidate drugs, which have efficacy in cell culture or animal models.

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| **UNIT-1 19 Hours** | Herbal and naturally derived Products.Formulation development aspects - Delivery aspects for herbal and naturally derived medicinal products (Herbal extracts, crud extracts, incorporation of product performance enhancers, etc.). Product stabilization aspects with consideration of ICH guideline. - Regulatory considerations with consideration of global regulatory guidelines. |
| **UNIT-2 17 Hours** | Industrial aspects: Stability studies of biotechnology derived products, Effects of various environmental /processing on the stability of the formulation and techniques for stabilization of the product against the same regulatory requirement related to stability testing with emphasis on matrixing bracketing techniques, Climatic zones. |
| **UNIT-3 15 Hours** | Concepts for protein engineering. Isolation and purification of proteins, Stability and activity based approaches of protein engineering, Chemical and Physical Considerations in Protein and Peptide Stability, Different methods for protein engineering, Site directed mutagenesis, gene shuffling, and direct evolution. |
| **UNIT-4 21 Hours** | Concept of biotech process validation, Cell lines culture process validation and characterization, Purification process for viral clearance, validation of recovery, Purification, Cleaning, Filtration, Issues of DNA vaccines and plasmid DNA vaccines Analytical methods in protein formulation: concentration, size, purity, surface charge, identity, structure/sequence, shape, activity. Novel methods for enzyme and vaccine production. |

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| **UNIT-5 17 Hours** | Protein formulation: Different strategies used in the formulation of DNA and proteins, Analytical and biophysical parameters of proteins and DNA in pre-formulation, Liposomes, Neon-spears, Neon-particulate system, Pegilation, Biological Activity, Biophysical Characterization Techniques, Forced degradation studies of protein. |
| **SUGGESTED READINGS** | 1. *Chemical Biology: A practical course, Herbert Waldmann, Petra Janning, Wiley-VCH.*<br>2. *DaanCrommelin, Robert D Sindelar, (2002) Pharmaceutical Biotechnology", Tailor and Francis Publications, New York.*<br>3. *Drug Delivery and Targeting, A.M. Hillery, A.W. Lloyd and J. Swarbrick, Harwood Academic Publisher.*<br>4. *Handbook of Biodegradable Polymers (Drug Targeting and Delivery), A.J. Domb, J. Kost and D.M. Wiseman, Dunitz Martin Ltd.*<br>5. *Heinrich Klefenz, (2002) Industrial Pharmaceutical Biotechnology", WILEY-VCH Publication, Germany.*<br>6. *Jay P Rho, Stan G Louie, (2003) Hand book of Pharmaceutical Biotechnology" Pharmaceutical products press, New York.*<br>7. *Tim JohnsonCRC(1998) Ethnobotany Desk Reference CRC Press.* |

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| **M.Sc. in Microbiology** | **(**FOURTH **SEMESTER)** |
| **COURSE CODE: MMBD02** | **COURSE TYPE: ECC/CB** |
| **COURSE TITLE: PLANT PATHOLOGY** | |
| **CREDIT: 06**<br>THEORY: 06 PRACTICAL: 00 | **HOURS: 90**<br>THEORY: 90 |
| **MARKS: 100**<br>THEORY: 70 CCA: 30 | |
| Plant Pathology is the science of plant health, including plant diseases, what causes plant diseases, the effects on the environment, and how to improve and manage plant health. During the study of this course, students will understand the nature of plant disease epidemics and how to manage them. The main objective of this course are; 1) Introduce students to the basic principles and concepts of plant pathology. 2) Introduce and illustrate the major groups of organisms that cause plant diseases. | |
| **UNIT-1 18 Hours** | Historical and developmental aspects of plant pathology. Mode of infection and role of enzymes and toxins in plant disease. Defense mechanisms of plants against infection: Preexisting structural and chemical defense, induced structural and chemical defense, hypersensitive reaction, the role of phytoalexins and other phenolic compounds. |
| **UNIT-2 18 Hours** | Management of plant diseases: Cultural, chemical, biological, biopesticides, breeding for resistant varieties, plant quarantine,integrated pest management. Post-harvest pathology: Fungal deterioration of food commodities, mycotoxins and health hazards, control measures. |
| **UNIT-3 13 Hours** | Molecular plant pathology: Molecular aspects of host pathogen interactions - PR proteins, degradation of phytoalexins, systemic resistance mechanism; application of molecular biology to plant disease control - transgenic approach for crop protection, engineering chemicals that elicit defense response to plants. |
| **UNIT-4 19 Hours** | Study of plant diseases caused by fungi, bacteria, viruses, nematodes and mycoplasma like organisms: Wart disease of potato, blight of colocasia, downy mildew of cucurbits, stem gall of coriander, peach leaf curl, ergot of bajra, smut of sugarcane, Karnal bunt of wheat, linseed rust, Tikka disease of groundnut, red rot of sugarcane. |
| **UNIT-5 15 Hours** | Panama disease (*Fusarium*wilt) of banana, bacterial blight of rice, leaf curl of tomato, yellow vein mosaic of Bhindi, mosaic of sugarcane, potato spindle tuber mosaic, ear cockles of wheat, grassy shoot of sugarcane, phylloidy of sesamum, Citrus greening. |

**SUGGESTED READINGS**


1. *Agrios GN (2005) Plant Pathology, 5th Edition.*
2. *Edward K. Wanger, Martinez Hewiett, David Bloom and David Camerini (2007) Basic Virology by 3rd edition, Blackwell Publishing,*
3. *Buchanan B, Gruissem G and Jones R (2000) Biochemistry and Molecular Biology of Plants", American Society of Plant Physiologists, USA.*
2. *Dickinson M, (2003) Molecular Plant Pathology, Bios Scientific Publishers, London.*
3. *Experiments in Microbiology, plant Pathology, tissue culture and mushroom production technology, K. R. Aneja, New Age international (p) Ltd. New Delhi.*
4. *Mathew's Plant Virology by Roger Hull (2001) Academic Press, NY.*
5. *M. Dickinson (2003)Molecular plant pathology by BIOS Scientific Publishers, London.*
6. *Strange RN, (2003) Plant resistance mechanisms (SAR, ISR) Introduction to Plant Pathology, John Wiley & Sons, USA.*
4. *Roger Hull (2002)Plant Virology 4th edition, Academic press,*
5. *Alan J. Cann (2001) Principles of Molecular Virology by 3rd edition, Elsevier Academic Press,*
7. *Williamson VM, Kumar A (2006) Nematode resistance in plants: the battle underground. Trends in Genetics 22: 396-403.*

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| **M.Sc. in Microbiology** | **(**FOURTH **SEMESTER)** |
| **COURSE CODE: MMB D03** | **COURSE TYPE: ECC/CB** |
| **COURSE TITLE: BIO-NANOTECHNOLOGY** | |
| **CREDIT: 06**<br>THEORY: 06 PRACTICAL: 00 | **HOURS: 90**<br>THEORY: 90 PRACTICAL: 00 |
| **MARKS:100**<br>THEORY: 70 CCA: 30 | |
| Bionanotechnology refer to the intersection of nanotechnology and biology. Given that the subject is one that has only emerged very recently, Bionanotechnology and Nanobiotechnology serve as blanket terms of various related technologies. The main objectives of this course are; 1) To understand the basic physics of the behavior of molecules and molecular interactions. 2) To understand the experimental techniques used to characterize bio-nano systems. | |
| **UNIT1 16 Hours** | Introduction to Nano-Biotechnology; Nanotechnology definition and concepts; Cellular. Nanostructures; Nanoprocess; Biomolecular motors; Criteria for suitability of nanostructures for biological applications. Nanostructures for diagnostics and biosensors; Nanopartcles for diagnostics and imaging; Nanodevices for sensor development. |
| **UNIT-2 16 Hours** | Molecular nanotechnology; Nanopowders and nanomaterials: Sol-gels and their use, Use of natural nanoparticles, Nanobiometrics, Lipids as nano-bricks, Proteins as nanomolecules, DNA in nanotechnology, Present and future of nanotechnlogy applications in Molecular biology and Medicine. |
| **UNIT-3 16 Hours** | Basic characterization techniques; Electron microscopy; Atomic force microscopy; Photon correlation sepectroscopy, Thin films; Colloidal nanostructures; Nanovesicles; Nanospheres; Nanocapsules. Nanostructures for drug delivery, concepts, targeting, routes of delivery and advantage. Implications for Drug Delivery – Polymeric Nanoparticles as Drug Carriers and Controlled. |
| **UNIT-4 22 Hours** | **Nanocarriers for Drug Delivery:** Nanoscale Devices for Drug Discovery - Application of Nano-biotechnology in drug Delivery- Needs and Requirements – Carriers – Solid Lipid Nanoparticles as Drug Carriers. **Nanosensors:** Chemical and Molecular Sensors – Displacement and Motion Sensors – Force Nanosensors – Pressure Sensing – Thermal Nanosensors – Electric and Magnetic Sensing – Cellular Bioscanning – Non-invasive Neuroelectric Monitoring – Macrosensing – Acoustic Macrosensing – Electric and Magnetic Macrosensing – Neural Macrosensing. |

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| **UNIT-5 20 Hours** | **Nanotechnology and the Cell**. Cell Motility: Nano Motors and Cellular Navigation Chemotaxis - Transmembrane Signalling and Related Protein. Nanoscale Artificial Platforms: Lipids in Self-assembly Structures. **Nano-Medicine:** Bio-Pharmaceuticals – Implantable Materials – Implantable Devices – Surgical Aids – Diagnostic Tools – Genetic Testing – Imaging – Nanoparticles Probe – Case Analysis – 1) Resiprocytes – Mechanical Artificial Red Cells – 2) Using DNA as a construction medium. **Nanotechnology for Cancer Diagnostics and Treatment.** Nanotechnology for Imaging and Detection. |
| **SUGGESTED READINGS** | 1. *Bionanotechnology: Lessons from Nature Author: David S. Goodsell Publisher:*<br>2. *David S. Goodsell, (2004) Bionanotechnology: Lessons from Nature, 1st Edition, Wiley-Liss,*<br>3. *Neelina H. Malsch, (2005) Biomedical Nanotechnology, 1st Edition, CRC Press,*<br>4. *Niemeyer C.M. and Mirkin C.A, (2003) Introduction to Nanobiotechnology, Wiley VCH publishers*<br>5. *Sandra J. Rosenthal, David W. Wright (2005) Nanobiotechnology Protocols. Humana Press Inc. 999 Riverview Drive, Suite, 208, Totowa, New Jersery.*<br>6. *Pethig and Smith(2013) Introductory Bioelectronics, Wiley.*<br>7. *C.M. Niemeyer and C.A. Mirkin(2005) Nanobiotechnology Concepts, Applications and Perspectives (Edt) Wiley-VCH.* |

| M.Sc. in Microbiology | (FOURTH SEMESTER) |
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| **COURSE CODE: MMB D04** | **COURSE TYPE: ECC/CB** |
| **COURSE TITLE: SOIL MICROBIOLOGY** | |
| **CREDIT: 6**<br>**THEORY: 6** | **HOURS: 90**<br>**THEORY: 90 PRACTICAL:** |
| **MARKS: 100**<br>**THEORY: 70 CCA:30PRACTICAL: 00** | |
| **OBJECTIVE: Soil is the most common and important habitat for all forms of microbial life. The main purpose of this paper is to inculcate the knowledge about the soil, soil properties and interaction of microbial population in soil.** | |
| **UNIT-1 (15 Hrs)** | The soil as habitat for microorganisms: general description of soil, soil structure,differences among soils and factors of ecological significanceSoil Microorganisms: Distribution, abundance, methods of estimation, biomassmeasurement, environmental factors, activity and functions of soil bacteria, fungi, algae,protozoa, blue green algae and soil fertilityMicrobial diversity in soil and its significance |
| **UNIT-2 (20 Hrs)** | Organic matter decomposition both native and added organic matter and factors governing the decompositionDegradation of carbonaceous materials in soil – cellulose, hemicellulose and lignindecomposition, factors governing the decomposition and biochemistry of decompositionMineralization of nitrogenous organic matter – microbes involved and factors influencingthe processes, Soil humus formation |
| **UNIT-3 (15 Hrs)** | Nitrification –Microbes involved, factors influencing nitrification, nitrifying bacteria andbiochemical mechanism. Denitrification – microbes involved, factors influencing andthe mechanism of denitrification and nitrate pollution. |
| **UNIT-4 (20 Hrs)** | Nitrogen fixation – Asymbiotic and symbiotic nitrogen fixation, microorganisms involved, biochemistry and genetics of nitrogen fixation, measurement of nitrogen fixation, ecological and economic importance of nitrogen fixation |

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| **UNIT-5 (20Hrs)** | Microbial transformation of phosphorus in soil Microbial transformationofsulfur in soil Microbial transformationof iron in soilBiofertilizedrs – bacterial fertilizers and production of rhizobial inoculants and bluegreen algae, quality control tesrts |
| **SUGGESTED READINGS** | *1. Soil Microbiology by Alexander Martin*<br>*2. Microbial ecology, Fundamentals and Applications Ed. Benjamin-Cummings*<br>*3. Soil Biotechnology by JM Iynch*<br>*4. Microbial Ecology: Organisms, Habitats, Activities by Stolp, H.*<br>*5. Soil Microbiology and Biochemistry by Paul E. and PE Clank*<br>*6. Microbial Ecology: Principles, Methods and Applications by Lavin, Seidler, Rogul*<br>*7. Biological Nitrigen Fixation by Quispel*<br>*8. Soil Microorganisms and Plant Growth by N.S,.SubbaRao.*<br>*9. Laboratory experiments in microbiology by Gopal Reddy et al* |