

nodule formation in leguminous plant with the help of photographs. Slide preparation of crushed nodule to observe nodule forming bacteria. Study of mycorrhizal association through pictures.

UNIT – 2 (5 Weeks)

Evaluation of microbial activity in soil: Study of microbial activity in soil by CO₂ evolution: determination of CO₂ by trapping it in alkali solution and its estimation by titration. Detection of microbes in soil by Dehydrogenase/Urease/Amylase activity: reduction of triphenyl tetrazolium chloride (TTC) by dehydrogenases/ detection of ammonia by phenol red or Nessler's reagent/ detection of amylase using iodine solution

UNIT – 3 (3 Weeks)

Biodegradation of organic matter and Trichoderma as biocontrol agent: Demonstration of steps of organic matter decomposition: composting of plant and food wastes containing organic compounds-lignin, cellulose, hemicellulose, polysaccharides, proteins, lipids, etc. into simple inorganic compounds/elements to be used as soil conditioner. Demonstration of antagonistic activity of *Trichoderma sp.* against different fungi (any 2) using dual culture plate technique.

Essential/recommended readings

1. Benson's Microbiological Applications, Laboratory Manual in General Microbiology by A. Brown and H. Smith. 15th edition. McGraw-Hill Education, USA. 2022.
2. Biopesticides and Bioagents: Novel tools for pest management by M. A. Anwer. 1st edition. Apple Academic Press, USA. 2021.
3. Brock Biology of Microorganisms by M.T. Madigan, J. Aiyer, D. Buckley, W. Sattley and D. Stahl. 16th edition. Pearson, USA. 2021.
4. Microbiology: A Laboratory Manual by J. Cappuccino and C.T. Welsh. 12th edition. Pearson Education, USA. 2020.
5. Soil Microorganisms and plant growth by N.S., Subba Rao. 4th edition. Oxford & IBH Publishing Co. Pvt. Ltd. India. 2020.
6. Prescott's Microbiology by J. M. Willey, K. Sandman and D. Wood. 11th edition. McGraw Hill Higher Education, USA. 2019.
7. Biofertilizers in Agriculture and Forestry by N.S., Subba Rao. 4th edition. Biogreen Publisher, India. 2009.
8. Agricultural Microbiology by G. Rangaswami. and D. J., Bagyarai. 2nd edition, Prentice-Hall of India Private Limited, New Delhi. 2005.
9. Principles and Applications of Soil Microbiology by D.M., Sylvia. J.J., Fuhrmann. P.J. Hartel and D.A., Zuberer. 2nd edition Pearson, Prentice Hall, USA. 2005.
10. Agricultural Biotechnology by S.S., Purohit. 2nd edition. Agrobios Publisher, Jodhpur, India. 2003.

Suggestive readings (if any)

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

GENERIC ELECTIVES (GE-10: MICROBIAL PRODUCTS IN THERAPEUTICS)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course	Department offering the course
		Lecture	Tutorial	Practical/ Practice			
MICROB-GE10: MICROBIAL PRODUCTS IN THERAPEUTICS	4	2	0	2	None	NIL	Microbiology

Learning Objectives

The Learning Objectives of this course are as follows:

- The major objective of this course is to give students an in-depth knowledge of the commercially available microbial products used in the treatment of human diseases and their management.
- Students will be acquainted with the large-scale culturing of microorganisms to produce various metabolites used for therapeutic purposes.
- Students will get an hands-on experience in the production of enzymes by microorganisms and production of fermented foods.
- They will learn to use bioassay for detecting an antibiotic in a sample and they will get familiar with the technique to determine antibiotic sensitivity of any bacterial culture..

Learning outcomes

The Learning Outcomes of this course are as follows:

- The student be able to describe the techniques involved in isolation, screening and mass culturing of microorganisms to produce microbial metabolites at the industrial scale.
- The student would be able to describe the microbial therapeutics used in the management of infectious and non-infectious diseases in humans.
- The student be able to demonstrate and/or describe the extracellular enzyme production by microorganisms and its detection in the broth, and the production of fermented food products involving microorganisms.
- The student would be able to demonstrate the concept of bioassay for the detection of an antibiotic in the sample, and differentiate between antibiotic sensitive and antibiotic resistant bacteria.

- The student be able to collect and analyse data of commercially available therapeutic products and on locally available fermented foods.

SYLLABUS OF MICROB-GE10

UNIT – I (5 Weeks)

Isolation, screening and mass culturing of microorganisms to produce useful metabolites: Sources of industrially important microbes, their isolation and screening (primary and secondary). Fermentation techniques for large scale culturing: batch, fed-batch, continuously stirred tank reactor, solid-state fermentation. Different methods for recovery of microbial products

UNIT – II (5 Weeks)

Microbial therapeutics in the treatment of infectious diseases: Antibiotics: mode of action, uses, and producer organisms of penicillin, streptomycin, tetracycline, cephalosporin, neomycin, erythromycin, augmentin, vancomycin and griseofulvin. Antimicrobial Resistance (AMR) phenomenon. Enzybiotics: Mode of action, uses and producer microorganisms of bacteriocins and lysozyme. Probiotics: Features of effective probiotics, benefits, commonly used probiotic microorganisms (Lactobacillus sp., Bifidobacterium sp., Saccharomyces boulardii). Bacto therapy by microbiota transplant.

UNIT – III (5 Weeks)

Microbial therapeutics in the treatment of non -infectious diseases: Mode of action, uses and producer microorganisms of the following biopharmaceuticals: anti-inflammatory agents (serratopeptidase and collagenase), thrombolytic agents (streptokinase, nattokinase, tissue plasminogen activator), digestive aids (fungal amylase and lipase), anticancer agents (asparaginase, methioninase), vitamins (cyanocobalamin,riboflavin), hormones (insulin and somatostatin). Production of steroid- based pharmaceuticals by microbial transformation: dehydrogenation (cortisol to prednisolone), hydroxylation (progesterone to11 α hydroxyprogesterone).

Practical component –

UNIT – 1 (6 Weeks)

Production of enzymes and fermented foods: Production of amylase from fungi and its detection in the culture broth: medium preparation, sterilization by autoclaving, inoculation, fermentation under specified condition of temperature and product harvesting from the broth by filtration. Production of any fermented product having probiotic bacteria or yeast (sauerkraut /curd / kanji). Estimation of lactic acid produced during curd formation by titration

UNIT – 2 (6 Weeks)

Detection of antibiotics and determination of antibiotic susceptibility: Bioassay to detect the presence of an antibiotic in the broth/ provided samples: spreading an antibiotic sensitive bacterial culture on nutrient agar plates, making wells in the plates and dispensing antibiotic dilutions in the wells. Measuring zone of inhibition following incubation. Determination of the sensitivity of a bacterial culture to antibiotics using Kirby -Bauer disc diffusion method: spreading a bacterial culture

using sterile swab on Mueller -Hinton agar and determination of susceptibility of the bacterial culture to different antibiotic discs

UNIT – 3 (3 Weeks)

Data collection and report preparation: Student research study project: Market survey of commercially available pharmaceutical products of microbial origin. Report preparation of locally fermented food and dairy products. Presentation of main findings.

Essential/recommended readings

1. Industrial Microbiology by A.H. Patel. 2nd edition. Laxmi publication Pvt Ltd/Trinity Press. 2022.
2. Microbiology: A Laboratory Manual by J. Cappuccino and C.T. Welsh. 12th edition. Pearson Education, USA. 2020.
3. Industrial Microbiology by L.E. Casida. 2nd edition. New Age International publisher. 2019.
4. Prescott's Microbiology by J. M. Willey, K. Sandman and D. Wood. 11th edition. McGrawHill Higher Education, USA. 2019.
5. Crueger's Biotechnology: A Textbook of Industrial Microbiology by W. Crueger,
6. A. Crueger and K.R.Aneja. 3rd edition. Medtech Publisher, India. 2017.
7. Principles of Fermentation Technology by P.F. Stanbury, A.Whitaker and S.J. Hall. 3rd edition. Elsevier Science Ltd, Netherlands. 2016.
8. Benson's Microbiological applications: Laboratory manual in general microbiology by A.E. Brown and H. Smith H. 15th edition. McGraw-Hill Education, USA. 2022.
9. Pharmaceutical Biotechnology: Fundamentals and Applications edited by J. Crommelin, R. Sindelar and B Meibohm B. 4th edition. Springer, UK. 2013.
10. Manual of Industrial Microbiology and Biotechnology edited by R.H. Baltz, A.L. Demain, and J.E. Davies. 3rd edition. American Society for Microbiology. 2010.
11. Pharmaceutical Biotechnology: Concepts and Applications by G. Walsh. John Wiley and Sons. 2007.

Suggestive readings (if any)

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.