

Course outcomes of Department of Microbiology

Semester: Semester I

Title of the paper: Microbiology and Biochemistry – I (MIC GC-1)

Class: F.Y.B.Sc.

No. of Credits: 4 (Theory) + 2 (Practical)

Objectives: To understand the basics of microbiology and biochemistry.

Course content (Syllabus in brief):

1. History of Development and Scope of Microbiology
2. Cell organization
3. Bacteriological techniques
4. Microscopy and Principles of staining
5. Growth and nutrition
6. Macromolecules
7. Enzymes

Course level learning outcomes:

1. Students will gain knowledge about the different cell organelles of microorganisms and their detailed functions.
2. Students will also study the growth and control of microbes as well as different bacteriological techniques involved in microbiology.
3. Students will learn about the biomolecules by studying their structures and types.

Suggested reading (Bibliography):

1. Tortora GJ, Funke BR and Case CL. Microbiology: An Introduction. Pearson Education
2. Madigan MT, Martinko JM, Dunlap PV and Clark DP. Brock Biology of Microorganisms. Pearson International Edition
3. Wiley JM, Sherwood LM and Woolverton CJ. Prescott's Microbiology. McGrawHill International
4. Atlas RM. Principles of Microbiology. WM.T.Brown Publishers.
5. Pelczar MJ, Chan ECS and Krieg NR. Microbiology. McGraw Hill Book Company.
6. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. General Microbiology. McMillan
7. Cappucino J and Sherman N. Microbiology: A Laboratory Manual. Pearson Education Limited
8. Salle A.J. Fundamental Principles of Bacteriology. Tata McGraw-Hill Education
9. Modi H.A, Elementary Microbiology Vol I, Fundamentals of Microbiology

10. Nelson DL and Cox MM. Lehninger Principles of Biochemistry. W.H. Freeman and Company.
11. Voet, D. and Voet J.G. Biochemistry. John Wiley and Sons.
12. Conn E and Stump P. Outlines of biochemistry. John Wiley and Sons.

Semester: Semester I

Title of the paper: Introduction and Scope of Microbiology (MIG 101)

Class: F.Y.B.Sc.

No. of Credits: 4

Objectives: To study the basics of different fields in Microbiology

Course content (Syllabus in brief):

1. History of Development of Microbiology
2. Diversity of Microorganisms
3. Microscopy
4. Sterilization
5. Microbes in Human Health & Environment
6. Industrial Microbiology
7. Food and Dairy Microbiology
8. Ecology and Ecosystem
9. Soil Microbiology

Course level learning outcomes:

4. Students will learn about the different fields in microbiology.
5. Students will gain knowledge about the different types of microorganisms and their significance.
6. Students will study different techniques used in microbiology.

Suggested reading (Bibliography):

1. Pelczar MJ, Chan ECS and Krieg NR. Microbiology. McGraw Hill Book Company.
2. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. General Microbiology. McMillan.
3. Tortora GJ, Funke BR and Case CL. Microbiology: An Introduction. Pearson Education
4. Madigan MT, Martinko JM, Dunlap PV and Clark DP. Brock Biology of Microorganisms. Pearson International Edition
5. Cappucino J and Sherman N. Microbiology: A Laboratory Manual. Pearson Education Limited

6. Wiley JM, Sherwood LM and Woolverton CJ. Prescott's Microbiology. McGraw Hill International.
7. Atlas RM. Principles of Microbiology. W.M.T. Brown Publishers.

Semester: Semester II

Title of the paper: Microbiology and Biochemistry – II (MIC GC-2)

Class: F.Y.B.Sc.

No. of Credits: 6 credits = 4 (Theory) + 2 (Practical)

Objectives: To study microbial growth and different biochemical pathways used for the same.

Course content (Syllabus in brief):

1. Nature and Properties of Viruses
2. Microbial Growth and Effect of Environment on Microbial Growth
3. Nutrient uptake and transport
4. Chemoheterotrophic Metabolism – Aerobic respiration
5. Chemoheterotrophic Metabolism - Anaerobic respiration and fermentation
6. Eukaryotic Cell Structure and functions

Course level learning outcomes:

1. Students will study about the growth of different types of microorganisms based on various environmental factors.
2. Students will gain knowledge about the nutrient uptake and transport and the different metabolic pathways involved in their growth.
3. Students will also learn about viruses and eukaryotic cell structure in detail.

Suggested reading (Bibliography):

1. Alberts B, Johnson A, Lewis J, Raff M, Roberts K, Walter P. Molecular Biology of The Cell. Garland science, Taylor and Francis group.
2. Carter J and Saunders V. Virology: Principles and Applications. John Wiley and Sons.
3. Cooper GM and Hausman RE. The Cell: A Molecular Approach. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. De Robertis EDP and De Robertis EMF. Cell and Molecular Biology. Lipincott Williams and Wilkins, Philadelphia.
5. Dimmock NJ, Easton AL and Leppard KN. Introduction to Modern Virology. Blackwell Publishing Ltd.

6. Flint SJ, Enquist LW, Krug RM., Racaniello VR. and Skalka AM. Principles of Virology, Molecular biology, Pathogenesis and Control. ASM press Washington DC.
7. Gottschalk G. Bacterial Metabolism. Springer Verlag
8. Levy JA, Conrat HF and Owens RA. Virology. Prentice Hall publication, New Jersey.
9. Lodish H, Berk A, Kaise C, Krieger M, Scott M, Bretscher A, Ploegh H and Matsudaira P. Molecular cell biology .W. H. Francis and company, New York.
10. Madigan MT and Martinko JM. Brock Biology of Microorganisms. Prentice Hall International Inc.
11. Moat AG and Foster JW. Microbial Physiology. John Wiley and Sons
12. Reddy SR. and Reddy SM. Microbial Physiology. Scientific Publishers India.
13. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. General Microbiology. McMillan Press.
14. Verma PS. and Agarwal PK. Genetics, Molecular biology, Evolution and Ecology. S. Chand.
15. Wagner, E.K. and Hewlett, M.J. Basic Virology. Blackwell Publishing.
16. Willey, J.M., Sherwood, L.M., and Woolverton, C.J. Prescott's Microbiology. McGraw Hill Higher Education.

Semester: Semester II

Title of the paper: Industrial and Food Microbiology (MIG 102)

Class: F.Y.B.Sc.

No. of Credits: 4

Objectives: To study the basics of industrial and food microbiology processes.

Course content (Syllabus in brief):

1. Introduction to Industrial Microbiology
2. Isolation of Industrial Strains and Study of Fermentation Media
3. Microbial fermentation processes
4. Food as a substrate for microbial growth
5. Principles and methods of food preservation and food sanitation
6. Dairy products, Probiotics and Food-borne Diseases

Course level learning outcomes:

1. Students will learn about the different types of fermentation processes, equipments used and microbiological processes involved.
2. Students will gain knowledge of significance and activities of microorganisms in food.

3. Students will gain knowledge about microbiology of milk and fermented products.
4. Students will also know the microbial quality control and quality schemes used in food industries.

Suggested reading (Bibliography):

1. Crueger W and Crueger A. Biotechnology: A textbook of Industrial Microbiology. Panima Publishing Company, New Delhi.
2. Patel AH. Industrial Microbiology. MacMillan India Limited Publishing Company Ltd. New Delhi, India.
3. Tortora GJ, Funke BR and Case CL. Microbiology: An introduction. Pearson Education.
4. Willey JM, Sherwood LM. and Woolverton CJ. Prescott, Harley and Klein's Microbiology. McGraw Hill Higher education.
5. Casida LE. Industrial Microbiology. Wiley Eastern Limited.
6. Stanbury PF, Whitaker A and Hall SJ. Principles of Fermentation Technology. Elsevier Science Ltd.
7. Adams MR and Moss MO. Food Microbiology. New Age International (P) Limited Publishers, New Delhi, India.
8. Banwart JM. Basic Food Microbiology. CBS Publishers and Distributors, Delhi, India.
9. Frazier WC and Westhoff DC. Food Microbiology. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.
10. Jay JM, Loessner MJ and Golden DA. Modern Food Microbiology. CBS Publishers and Distributors, Delhi, India.

Semester: Semester III

Title of the paper: Environmental Microbiology (MIC GC-3)

Class: S.Y.B.Sc.

No. of Credits: 6 credits = 4 (Theory) + 2 (Practical)

Objectives:

1. To study presence of pathogens in drinking water .
2. To study the relationship between microorganisms and geochemistry.

3. To understand the role of microorganisms as agents of environmental change.
4. To use microorganisms as indicators of alteration of an ecosystem.
5. To know and understand the role of microbes in the environment and evaluation of anthropogenic activities on pollution, climate change as well as environmental protection.

Course content (Syllabus in brief):

1. Microorganisms and their Habitats.
2. Microbial Interactions.
3. Waste Management.
4. Microbial Bio-remediation.
5. Water Portability.

Course level learning outcomes:

1. Students will gain knowledge and use the properties of microorganisms, principally bacteria, as bioindicators of contamination and to remedy problems of contamination and other environmental impacts.

Suggested reading (Bibliography):

1. Madigan MT, Martinko JM, Dunlap PV and Clark DP. Brock Biology of Microorganisms. Pearson International Edition.
2. Wiley JM, Sherwood LM and Woolverton CJ. Prescott's Microbiology. McGrawHill Higher Education.
3. Atlas RM and Bartha R. Microbial Ecology; Fundamental and Applications. Benjamin Cummings Science Publishing USA.
4. Maier RM, Pepper IL, and Gerba CP, Environmental Microbiology, Academic Press.
5. Okafor, N. Environmental Microbiology of Aquatic and Waste systems. Springer New York.
6. Singh A, Kuhad, RC and Ward OP. Advances in Applied Bioremediation. Springer –Verlag, Berlin Heidelberg.
7. Barton LL Northup DE. Microbial Ecology, Wiley Blackwell, USA.
8. Campbell RE Microbial Ecology Blackwell Scientific Publication, Oxford England.
9. Coyne MS. Soil Microbiology :An Exploratory Approach. Delmar Thomas Learning.
10. Lynch JM and Hobbie JE. Microorganisms in Action: Concepts and Application in Microbial Ecology. Blackwell Scientific Publication, U.K.
11. Martin A. An Introduction to Soil Microbiology. John Wiley and Sons Inc. New York and London.
12. Subba Rao NS. Soil Microbiology. Oxford and IBH Publishing Co. New Delhi.

Semester: Semester III (S.E.C.)

Title of the paper: Food and Dairy Microbiology (MIC SEC-1)

Class: S.Y.B.Sc.

No. of Credits: 4 credits = 3 (Theory) + 1 (Practical)

Objectives:

1. To study general principles of food microbiology, food preservation, fermented and microbial foods.
2. To study epidemiology of food-borne microorganisms of public health significance and food spoilage microorganisms.
3. To study microbiological examination of foods, microbiological quality Control and quality schemes.

Course content (Syllabus in brief):

1. Food as substrate for microorganisms.
2. Principles and methods of food preservation.
3. Fermented foods.
4. Food borne diseases (causative agents, food involved, symptoms and preventive measures.)
5. Food sanitation and control.

Course level learning outcomes:

1. Students will gain knowledge of significance and activities of microorganisms in food.
2. Students will also study interaction between microorganisms and factors influencing their growth and survival.
3. Students will study use of standard methods and procedure for the microbiological analysis of milk.
4. Students will study the characteristics of food-borne microorganisms and spoilage microorganisms and preventive measures.

Suggested reading (Bibliography):

1. Adams MR and Moss MO. Food Microbiology. New Age International (P) Limited Publishers, New Delhi, India.
2. Davidson PM and Brannen AL. Antimicrobials in Foods. Marcel Dekker, New York.
3. Banwart JM. Basic Food Microbiology. CBS Publishers and Distributors, Delhi, India.
4. Dillion VM and Board RG. Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon.

5. Frazier WC and Westhoff DC. Food Microbiology. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.
6. Gould GW. New Methods of Food Preservation. Blackie Academics and Professional, London.
7. Jay JM, Loessner MJ and Golden DA. Modern Food Microbiology. CBS Publishers and Distributors, Delhi, India.
8. Lund BM, Baird Parker AC, and Gould GM. The Microbiological Safety and Quality of Foods. Vol, 1-2, ASPEN Publication.
9. Gaithersberg MD, Tortora GJ, Funke BR, and Case CL. Microbiology: An Introduction. Pearson Education.

Semester: Semester III

Title of the paper: Molecular Biology (MIC GC-4)

Class: S.Y.B.Sc.

No. of Credits: 6 credits = 4 (Theory) + 2 (Practical)

Objectives: To study in detail the structure of DNA and RNA with elaborate knowledge on the replication of the former and in-depth knowledge on the transcription and translation of the latter.

Course content (Syllabus in brief):

1. Nucleic acids
2. Replication of DNA
3. Transcription
4. Translation

Course level learning outcomes:

1. Students will study the detailed structure of nucleic acids.
2. Students will learn in detail the molecular processes such as replication, transcription and translation.

Suggested reading (Bibliography):

1. Pelczar, M.J., Chan, E.C.S. and Krieg, N.R. Microbiology. McGraw Hill Book Company.
2. Gardner, E.J., Simmons, M.J. and Snustad, D.P. Principles of Genetics. Wiley-India.
2. Stanier, R.Y. General Microbiology. Macmillan Publishers.
3. Wiley, J.M., Sherwood, L.M. and Woolverton, C.J. Prescott's Microbiology. McGraw Hill International.

4. Stryer, L. Biochemistry. W H Freeman and Company.
5. Primrose, S.B., Twyman, R.M. and Old, R.W. Principles of Gene Manipulation. Wiley Blackwell.
6. Nelson, D.L. and Cox, M.M. Lehninger Principles of Biochemistry. W H Freeman.
7. Sambrook, J. and Russell, D. Molecular Cloning: A Laboratory Manual. Cold Spring Harbor Laboratory Press.

Semester: Semester IV (S.E.C.)

Title of the paper: Instrumentation and Biotechniques (MIC SEC-2)

Class: S.Y.B.Sc.

No. of Credits: 4 credits = 3 (Theory) + 1 (Practical)

Objectives: To study different techniques and instruments used in Microbiology.

Course content (Syllabus in brief):

1. Microscopy.
2. pH and Buffers
3. Spectroscopy
4. Chromatography
5. Electrophoresis.
6. Centrifugation.

Course level learning outcomes:

1. Students will learn about the principle, working and applications of commonly used instruments in microbiology.
2. Students will also learn applications of different separation techniques such as electrophoresis, centrifugation, chromatography, etc.
3. Students will be able to handle, calibrate and use the instruments.

Suggested reading (Bibliography):

1. Nelson, D.L. and Cox, M.M. Lehninger Principles of Biochemistry. W H Freeman.

2. Wiley, J.M., Sherwood, L.M. and Woolverton, C.J. Prescott's Microbiology. McGraw Hill International.
3. Karp G. Cell and Molecular Biology: Concepts and Experiments. John Wiley & Sons. Inc.
4. Wilson K and Walker J Principles and Techniques of Biochemistry and Molecular Biology Cambridge University Press.

Semester: Semester V

Title of the paper: Medical Microbiology (MIC 105)

Class: T.Y.B.Sc.

No. of Credits: 6 credits = 4 (Theory) + 2 (Practical)

Objectives: Understand relationship between human host and pathogens and the ability of pathogens to cause disease.

Course content (Syllabus in brief):

1. Normal microflora of the human body and host pathogen interaction
2. Sample collection, transport and diagnosis
3. Bacterial diseases
4. Viral diseases
5. Protozoan diseases
6. Fungal diseases

Course level learning outcomes:

1. Students will be able to correlate disease symptoms with causative agent, isolate and identify pathogens.
2. They will gain knowledge of mechanism of action of antimicrobial drugs and prophylaxis.

Suggested reading (Bibliography):

1. Kanungo R. (Editor) Ananthanarayanan and Paniker's Textbook of Microbiology. University Press.
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. Jawetz, Melnick and Adelberg's Medical Microbiology. McGraw Hill Publication.
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. Mims' Medical Microbiology. Elsevier.
4. Willey JM, Sherwood LM, and Woolverton CJ. Prescott, Harley and Klein's Microbiology. McGraw Hill Higher Education.
5. Madigan MT, Martinko JM, Dunlap PV and Clark DP. Brock Biology of Microorganisms. Pearson International Edition.

Semester: Semester V

Title of the paper: Industrial Microbiology (MIC 106)

Class: T.Y.B.Sc.

No. of Credits: 6 credits = 4 (Theory) + 2 (Practical)

Objectives:

1. To understand importance of industrially significant microorganisms and their metabolites.
2. To understand fermentation processes and product recovery.

Course content (Syllabus in brief):

1. Isolation of industrially important microbial strains and fermentation media.
2. Types of fermentation processes, bio-reactors and measurement of fermentation parameters
3. Down-stream processing
4. Microbial production of industrial products (micro-organisms involved, media, fermentation conditions, downstream processing and uses)

Course level learning outcomes:

1. Students will be able to understand the industrial production of important microbial metabolites and products.
2. Students will gain knowledge of isolation, maintenance and handling of industrially important microbial cultures in laboratory settings.

Suggested reading (Bibliography):

1. Patel A.H. Industrial Microbiology. Macmillan India Limited
2. Okafor N. Modern Industrial Microbiology and Biotechnology. Bios Scientific Publishers Limited. USA.
3. Waites M.J., Morgan N.L., Rockey J.S. and Higton G. Industrial Microbiology: An Introduction. Wiley – Blackwell
4. Glaze A.N. and Nikaido H. Microbial Biotechnology: Fundamentals of Applied Microbiology. W.H. Freeman and Company.
5. Casida LE. Industrial Microbiology. Wiley Eastern Limited.
6. Crueger W and Crueger A. Biotechnology: A textbook of Industrial Microbiology. Panima Publishing Co. New Delhi.
7. Stanbury PF, Whitaker A and Hall SJ. Principles of Fermentation Technology. Elsevier Science Ltd.

Semester: Semester V

Title of the paper: Microbial Genetics (MIC 107)

Class: T.Y.B.Sc.

No. of Credits: 6 credits = 4 (Theory) + 2 (Practical)

Objectives:

1. To understand mechanisms of gene transfer, expression and regulation.
2. To comprehend the types and effects of mutations and recombination.

Course content (Syllabus in brief):

1. Gene expression and regulation
2. Gene transfer mechanisms
3. Transformation
4. Transduction
5. Conjugation
6. Mutations
7. Spontaneous Mutations
8. Types of mutations
9. Induced mutations
10. Molecular recombination and molecular taxonomy

Course level learning outcomes:

Students will gain knowledge of prokaryotic gene transfer mechanisms, mutations and recombination.

Suggested reading (Bibliography):

1. Pelczar, M.J., Chan, E.C.S. and Krieg, N.R. Microbiology. McGraw Hill Book Company.
2. Gardner, E.J., Simmons, M.J. and Snustad, D.P. Principles of Genetics. Wiley-India.
3. Stanier, R.Y. General Microbiology. Macmillan Publishers.
4. Wiley, J.M., Sherwood, L.M. and Woolverton, C.J. Prescott's Microbiology. McGraw Hill International.
5. Stryer, L. Biochemistry. W H Freeman and Company.
6. Primrose, S.B., Twyman, R.M. and Old, R.W. Principles of Gene Manipulation. Wiley-Blackwell.
7. Nelson, D.L. and Cox, M.M. Lehninger Principles of Biochemistry. W H Freeman.
8. Sambrook, J. and Russell, D. Molecular Cloning: A Laboratory Manual. Cold Spring Harbor Laboratory Press.

Semester: Semester V

Title of the paper: Applied Microbiology (MID 101)

Class: T.Y.B.Sc.

No. of Credits: 3 + 1 = 4

Objectives: To study the applications of microorganisms and their components.

Course content (Syllabus in brief):

1. Nutraceuticals
2. Biosensors
3. Bioplastics
4. Applications of Microbes in Biotransformation
5. Immobilisation methods and Applications
6. RNAi
7. Nanotechnology
8. Omics

Course level learning outcomes: Students will be able to apply the knowledge for start-ups in the field of microbiology.

Suggested reading (Bibliography):

1. Ratledge, C and Kristiansen, B. Basic Biotechnology, Cambridge University Press.
2. Demain, A. L and Davies, J. E. Manual of Industrial Microbiology and Biotechnology, ASM Press.
3. Swartz, J. R. Advances in Escherichia coli production of therapeutic proteins. Current Opinion in Biotechnology, 12, 195–201.
4. Prescott, Harley and Klein's Microbiology by Willey JM, Sherwood LM, Woolverton CJ, Mc Graw Hill Publishers.
5. Gupta PK Elements of Biotechnology Rastogi Publications,
6. Glazer AN and Nikaido H Microbial Biotechnology, Cambridge University Press
7. Glick BR, Pasternak JJ, and Patten CL Molecular Biotechnology, ASM Press
8. Stanbury PF, Whitaker A, Hall SJ Principles of Fermentation Technology, Elsevier Science
9. Crueger W, Crueger, A Biotechnology: A text Book of Industrial Microbiology Sinauer associates, Inc.
10. Shukla, RP and Mishra, RS.Nutraceuticals Food Processing Technology: Innovative Scientific Research Hardcover, Bharti Publications.
11. Dubey, RC. A Textbook of Biotechnology, S. Chand & Co. Pvt. Ltd., New Delhi.

Semester: Semester V

Title of the paper: Microbial Physiology (MID 102)

Class: T.Y.B.Sc.

No. of Credits3 (Theory) + 1 (Practical)

Objectives: To understand the energetics and biochemistry of metabolic pathways

Course content (Syllabus in brief):

1. Bioenergetics and Electron transport chain
2. Chemoheterotrophic Carbohydrate Metabolism
3. Chemoheterotrophic Lipid Metabolism
4. Chemoheterotrophic Protein Metabolism
5. Chemolithotrophic and Phototrophic Metabolism

Course level learning outcomes:

1. Students will gain knowledge of energy transfers and biomolecular transformations.
2. Students will comprehend metabolic pathways unique to microorganisms.

Suggested reading (Bibliography):

1. Berg JM, Tymoczko JL and Stryer L. Biochemistry, W.H. Freeman and Company.
2. Pawar and Dagainawala General Microbiology Volume I. Himalaya Publishing House
3. Murray RK, Mayes PA, Granner DK and Rodwell VW. Harper's Biochemistry. Prentiss Hall International Editions.
4. Jayaraman J. Laboratory Manual in Biochemistry. New Age International (P). Ltd. Publishers
5. Plummer David T. An Introduction to Practical Biochemistry. Tata McGraw Hill Publishers
6. Stanier RY, Ingrahm JJ, Wheelis ML and Painter PR. General Microbiology. McMillan Press.
7. Willey JM, Sherwood LM, and Woolverton CJ. Prescott's Microbiology. McGraw Hill Higher Education.
8. Moat AG and Foster JW. Microbial Physiology. John Wiley & Sons
9. Nelson DL and Cox MM. Lehninger Principles of Biochemistry. W.H. Freeman and Company.
10. Voet, D. and Voet J.G. Biochemistry. John Wiley and Sons
11. Conn E and Stumpf P. Outlines of biochemistry. John Wiley and Sons.

Semester: Semester VI

Title of the paper: Immunology (MIC 108)

Class: T.Y.B.Sc.

No. of Credits: 6 credits = 4 (Theory) + 2 (Practical)

Objectives:

1. To study the components of human immune system.
2. To understand human defense mechanisms.

Course content (Syllabus in brief):

1. Introduction of Immunology
2. Immune Cells and Organs
3. Antigens and Antibodies
4. Major Histocompatibility Complex
5. Complement System
6. Generation of Immune Response
7. Immunological Disorders and Tumor Immunity
8. Immunological Techniques
9. Immunohaematology

Course level learning outcomes: Students will gain hands on experience of haematology and immunotechniques.

Suggested reading (Bibliography):

1. Delves P, Martin S, Burton D, Roitt IM. Roitt's Essential Immunology. Wiley-Blackwell Scientific Publication, Oxford.
2. Goldsby RA, Kindt TJ, Osborne BA. Kuby's Immunology. W.H. Freeman and Company, New York.
3. Murphy K, Travers P, Walport M. Janeway's Immunobiology. Garland Science Publishers, New York.
4. Peakman M, and Vergani D. Basic and Clinical Immunology. Churchill Livingstone Publishers, Edinburgh.
5. Richard C and Geiffrey S. Immunology. Wiley Blackwell Publication

Semester: Semester VI

Title of the paper: Agricultural Microbiology (MIC 109)

Class: T.Y.B.Sc.

No. of Credits: 6 credits = 4 (Theory) + 2 (Practical)

Objectives: To understand the plant microbe interactions in the soil and mechanisms involved in improving crop productivity

Course content (Syllabus in brief):

1. Soil as microenvironment
2. Plant Microbe Interaction
3. Plant diseases
4. Bacterial diseases
5. Viral diseases, viroids
6. Fungal diseases
7. Control of plant diseases
8. Beneficial associations
9. Phytostimulation and Bioinsecticides
10. Biofertilizers
11. Genetically Modified Crops

Course level learning outcomes:

1. The students will be able to identify the types of plant diseases affecting crops .
2. They will be able to isolate PGPB and formulate bioinoculant.

Suggested reading (Bibliography):

1. Agrios GN. Plant Pathology. Academic press, San Diego,
2. Singh RS. Plant Diseases Management. Oxford & IBH, New Delhi.
3. Glick BR, Pasternak JJ, and Patten CL Molecular Biotechnology ASM Press
4. Atlas RM and Bartha R. Microbial Ecology: Fundamentals & Applications. Benjamin/Cummings Science Publishing, USA
5. Maier RM, Pepper IL and Gerba CP. Environmental Microbiology. Academic Press
6. Barton LL & Northup DE Microbial Ecology. Wiley Blackwell, USA
7. Campbell RE. Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
8. Coyne MS. Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
9. Altman A Agriculture Biotechnology, Marcel decker Inc.
10. Mahendra K. Rai Hand Book of Microbial Biofertilizers, The Haworth Press, Inc. New York
11. Reddy, S.M. *etal.* Bioinoculants for Sustainable Agriculture and Forestry, Scientific Publishers
12. Saleem F and Shakoori AR. Development of Bioinsecticide, Lap Lambert Academic Publishing.
13. Rangaswamy G. Diseases of crop plants in India
14. Glick B.R. Beneficial Plant Bacterial Interactions, Springer.

Semester: Semester VI

Title of the paper: Genetic Engineering (MIC 110)

Class: T.Y.B.Sc.

No. of Credits: 6 credits = 4 (Theory) + 2 (Practical)

Objectives: To familiarize the students with tools and techniques in genetic engineering.

Course content (Syllabus in brief):

1. Introduction to genetic engineering
2. Tools and strategies:
3. DNA modifying enzymes and their applications:
4. Cloning and Expression vectors:
5. Methods in molecular cloning
6. DNA, RNA and Protein Analysis
7. DNA amplification and DNA sequencing
8. Transformation, Transduction and Screening
9. Applications of recombinant DNA technology
10. Products of rDNA technology:

Course level learning outcomes: Students will be able to handle microorganisms for isolation and amplification of DNA and transform host cells.

Suggested reading (Bibliography):

1. Sambrook J and Russell D. Molecular Cloning: A Laboratory Manual. Cold Spring Harbor Laboratory Press.
2. Freifelder D. Microbial Genetics. Jones and Bartlett Publishers.
3. Gardner EJ, Simmons MJ, Snustad DP. Principles of Genetics. Wiley India.
4. Stryer L. Biochemistry. W H Freeman and Company.
5. Krebs JE, Goldstein ES, Kilpatrick ST. Lewin's Genes. Jones and Bartlett Publishers.
6. Glick BR, Pasternak JJ, and Patten CL. Molecular Biotechnology ASM Press.

7. Dubey RC, A Textbook of Biotechnology. S. Chand & Co. Ltd.
8. Mathur SK, Purohit SS, Biotechnology. Fundamentals and Applications. Agro Botanica.
9. Brown TA. Gene Cloning and DNA Analysis: An Introduction. Wiley Publication.

Semester: Semester VI

Title of the paper: Cell Biology (MID 104)

Class: T.Y.B.Sc.

No. of Credits: 4 credits = 3 (Theory) + 1 (Practical)

Objectives: To study the types and functioning of different organelles and mechanisms in eukaryotic and prokaryotic cells .

Course content (Syllabus in brief):

1. Cell to cell interactions.
2. Protein Sorting and Transport
3. Cell Signalling
4. Cell Cycle
5. Development of cancer, causes and types

Course level learning outcomes: Students will gain knowledge of functioning of different part of cells and understand differences between normal and diseased cells.

Suggested reading (Bibliography):

1. Hardin J, Bertoni G and Kleinsmith LJ. Becker's World of the Cell. Pearson.
2. Karp G. Cell and Molecular Biology: Concepts and Experiments. John Wiley & Sons. Inc.
3. De Robertis, EDP and De Robertis EMF. Cell and Molecular Biology. Lipincott Williams and Wilkins, Philadelphia.
4. Cooper, G.M. and Hausman, R.E. The Cell: A Molecular Approach. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
5. Lodish H., Berk A., Kaiser C., Krieger M., Scott M., Bretscher A., Ploegh H., Matsudaira P., Molecular cell biology .W H Francis and company, New

York.

6. Alberts B., Johnson A., Lewis J., Raff M., Roberts K., Walter P., Molecular Biology of The Cell Garland science, Taylor and Francis group.

7. Adler J. Chemotaxis in Bacteria .Annual Reviews of Biochemistry. 44:341-356.

Semester: Semester VI

Title of the paper: Virology (MID 105)

Class: T.Y.B.Sc.

No. of Credits: 4 credits = 3 (Theory) + 1 (Practical)

Objectives: To study bacteriophages and understand the classification of viruses along with their role in cancers in humans.

Course content (Syllabus in brief):

1. Nature and Properties of Viruses
2. Bacteriophages
3. Viruses and Cancer
4. Prevention & control of viral diseases

Course level learning outcomes:

1. Students will learn to differentiate between types of viruses and their role in disease and cancer.
2. Ability to isolate and cultivate bacteriophages.

Suggested reading (Bibliography):

1. Dimmock, NJ, Easton, AL, Leppard, KN. Introduction to Modern Virology. Blackwell Publishing Ltd.
2. Carter J and Saunders V. Virology: Principles and Applications. John Wiley and Sons.
3. Flint SJ, Enquist, LW, Krug, RM, Racaniello, VR, Skalka, AM. Principles of Virology, Molecular biology, Pathogenesis and Control. ASM press Washington DC.
4. Levy JA, Conrat HF, Owens RA. Virology. Prentice Hall publication,

Semester: Semester VI

Title of the paper: Project (MIP)

Class: T.Y.B.Sc.

No. of Credits: 4 credits

Objectives: Planning and execution of various research related practicals independently or as a group.

Course content (Syllabus in brief):

1. Identification of research problem in Microbiology.
2. Review of literature associated with project.
3. Listing the various objectives.
4. Planning and conducting experiments related to project work.
5. Collection and analysis of data for preparation of project report.
6. Final preparation of project report to be submitted as dissertation in partial fulfillment of B.Sc. Programme.

Course level learning outcomes: Ability to apply the tools and techniques of Microbiology in conducting research. Enhanced capacity to analyze observations and results & prepare project report.

Suggested reading (Bibliography):

As required for review of literature and methodology for compilation of project report.