Telangana State Council of Higher Education, Govt.of Telangana
(Osmania University)
PROPOSED SCHEME FOR CHOICE BASED CREDIT SYSTEM IN B.Sc.
MICROBIOLOGY (2020-21)

Code	Course Title	Course Type	HPW	Credits
FIRST YEAR-SEMESTER-1				
BS	AEC-1			2
BS	English			4
BS	Second Language			4
BS	**General Microbiology**	DSC-1A	4+2	5
BS	Optional-II			5
BS	Optional-III			5
SEMESTER-2				
BS	AEC-2			2
BS	English			4
BS	Second Language			4
BS	**Microbial Diversity**	DSC-1B	4+2	5
BS	Optional-II			5
BS	Optional-III			5
SECOND YEAR-SEMESTER-3				
BS	**Haematology**	SEC-1	2	2
BS	**UGC Given**	SEC-2		2
BS	English			3
BS	Second Language			3
BS	**Food & Environmental Microbiology**	DSC-1C	4+2	5
BS	Optional-II			5
BS	Optional-III			5
SEMESTER-4				
BS	**Mushroom Cultivation**	SEC-3	2	2
	UGC Given	SEC-4		2
	English			3
BS	Second Language			3
BS	**Medical Microbiology & Immunology**	DSC-1D	4+2	5
BS	Optional-II			5
BS	Optional-III			5
THIRD YEAR-SEMESTER-5				
	English			3
	Second language			3
BS	**Microbiology and Human Health**	GE	4	4
BS	**1A.Molecular Biology & Microbial Genetics** **or** **1B. Microbial Omics**	DSE-I	3+2	5
BS	Optional-II			5
BS	Optional-III			5

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SEMESTER-6				
BS	English			3
BS	Second language			3
BS	**2.A Industrial Microbiology** **2.B Pharmaceutical Microbiology**	DSE-2	4+2	5
BS	**PROJECT WORK / Applied Microbiology**		3+2	4
BS	Optional-II-A/B/C			5
BS	Optional-III-A/B/C			5
Total				**150**

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Proposed scheme for B.ScMicrobiology program under choice based credit system (CBCS)
With effect from 2020-21

Syllabus for B.Sc Microbiology **Code: BS, DSC- 1A**

B.Sc I year: I Semester

Title: GENERAL MICROBIOLOGY **4HPW -Credits-4**

UNIT-1: INTRODUCTION TO MICROBIOLOGY

Meaning, definition and scope. History of microbiology: Contribution of Louis Pasteur and Robert Koch. Importance and application of Microbiology.

Principles of Microscopy-Bright field, Dark field, Phase-contrast, Fluorescent and Electron microscopy (SEM and TEM). Principles and types of stains-simple stain, differential stain, negative stain.Structural stain-spore, capsule, flagella.Bacterial motility - Hanging drop method.

UNIT-2: STRUCTURE OF BACTERIA, VIRUSES & PURE CULTURE CONCEPT

Prokaryotes - Ultra structure of eubacteria.

General characteristics and classification of virus.

Morphology and structure of TMV and HIV. Structure and multiplication of lambda bacteriophage.

Isolation of pure culture techniques- Enrichment culturing, Dilution plating, streak plate, spread plate, Micromanipulator. Preservation of Microbial cultures – Sub culturing, overlaying cultures with minerals oils, lyophilization, sand cultures, storage at low temperature.

UNIT-3: MICROBIAL NUTRITION AND METABOLISM

Microbial Nutrition – Nutritional requirement, Uptake of nutrients by cell. Nutritional groups of microorganisms – Autotrophs, Heterotrophs, Mixotrophs. Components and types of bacterial growth media – simple and complex media.

Respiration – Glycolysis, HMP Pathway, ED Pathway , TCA Cycle and Anaplerotic reaction, Electron Transport, Oxidative and substrate level phosphorylation.

UNIT-4: STERILIZATION TECHNIQUES AND MICROBIAL GROWTH

Sterilization and disinfection techniques - Physical methods- Autoclave, Hot air oven, Laminar air flow, Filter sterilization. Radiation methods - U.V rays, Gamma rays, Ultrasonic methods. Chemical methods - Alcohols, Aldehydes, Phenol, Halogens and Hypochlorides.

Microbial growth – Different Phases of Growth in Batch culture. Factors Influencing microbial growth. Synchronous, Continuous, Biphasic Growth. Methods for measuring microbial growth – Direct Microscopic, Viable count, Turbidometry, Biomass.

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References:

1. Michael J. Pelczar, Jr. E.C.S.Chan, Noel R. Krieg Microbiology Tata McGraw- Hill Publisher.
2. Prescott, M.J., Harly, J.P. and Klein Microbiology 5th Edition, WCB McGrawHill, New York.
3. Madigan, M.T., Martinkl, J.M and Parker,j. Broch Biology of Microorganism, 9th Edition, MacMillan Press, England.
4. Dube, R.C. and Maheshwari, D.K. General Microbiology S Chand, New Delhi.
5. Anthanarayan and Panicker, Medical Microbiology.

General Microbiology

PRACTICALS

2HPW-Credits-1

- Handling and calibration of light microscope.
- Simple and differential staining (Gram staining), Spore staining.
- Microscopic observation of cyanobacteria (Nostoc,Spirulina), algae and fungi (Saccharomyces, Rhizopus, Aspergillus, Pencillium, Fusarium).
- Isolation of T2 bacteriophage from sewage sample.
- Preparation of media for culturing autotrophic and heterotrophic microorganisms – algal medium, mineral salts medium , nutrient agar medium, McConkey agar and blood agar.
- Sterilization techniques: Autoclave, Hot air oven and filtration.
- Enumeration of bacterial numbers by serial dilution and plating (viable count)
- Isolation of pure cultures by streak, spread and pour plate techniques
- Preservation of microbial cultures- Slant, Stab, Sand cultures, mineral oil overlay and glycerol stocks
- Turbidometric measurement of bacterial growth and plotting growth curve.

References:

1. Experiments in Microbiology by K.R. Aneja.
2. GopalReddy.M., Reddy. M.N., SaiGopal, DVR and Mallaiah K.V. Laboratory Experiments in Microbiology.
3. Dubey, R.C. and Maheshwari, D.K. Practical Microbiology, S. Chand and Co New Delhi.
4. Alcamo, I.E. Laboratory Fundamentals of Microbiology. Jones and Bartlett Publishers, USA.

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Syllabus for B.Sc Microbiology **Code: BS, DSC-1B**

B.Sc I year: II Semester

Title: MICROBIAL DIVERSITY **4HPW- Credits-4**

UNIT 1: CONCEPT OF BIODIVERSITY

Basic concept of Biodiversity and Conservation. Elements of Biodiversity - Ecosystem Diversity, Genetic Diversity, Species Abundance & Diversity. Economic Value of Biodiversity & Legal, Ethical and Conservation issues related to uses of biodiversity.
Classification of living organisms; Haeckel, Whittaker and Carl Woese systems. Differentiation of prokaryotes and eukaryotes.
Classification of bacteria as per the second edition of Bergey's manual of systematic bacteriology.

UNIT 2: PROKARYOTIC MICROBIAL DIVERSITY

General characteristics of eubacteria, Rickettsia and Mycoplasma.
Microbial richness: Exploration, significance, conservation and applications. Structural and physiological diversity of Archaea bacteria, Metabolic characteristics of extremophiles (Methanogens, Halophiles, thermoacidophiles).
Gram negatives: Cyanobacteria and Proteobacteria, Gram positives and heterogenous members including Firmicutes, Actinobacteria, Bacteroidetes, Acidobacteria and Planctomycetes

UNIT 3: EUKAROTYIC MICROBIAL DIVERSITY

Eukaryotic microbial diversity. Structural, physiological and metabolic characteristics, of Algae - Cyanophyta, Chlorophyta Bacillariophyta, Phacophyta, Rhodophyta; Fungi -Phycomycetis, Basidiomycetis, Zygomyetes, Oomycets, Asomycetes, Deuteromycetes (imperfect and perfect stages) and Protozoa - Giardia, Entamoeba and Plasmodium.

UNIT 4: MICROBIAL ECOSYSTEMS

Microbial interactions: Symbiosis, neutralism, commensalism, competition, antagonism, synergism, parasitism.
Understanding microbial diversity with Cultivated vs Uncultivated microorganisms.
The Great Plate count anomaly . Cultivation independent methods to assess microbial diversity.
Preserved and perturbed microbial ecosystems, microbiome for sustainable agroecosystems, Human microbiome

References:
1. Pelczar Jr. M.J. Chan. E.C.S and Kreig.N.R (2006)."Microbiology"- 5th Edition McGraw Hill Inc. New York.
2. David, B.D., Delbecco,. R., Eisen, H.N and Ginsburg, H.S (1990) "Microbiology" 5th Edition. Harper & Row, New York.

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3. Stainer, R.Y., Ingraham, J.L., Wheelis, M.L and Painter, P.R. (1986). "General Microbiology" - Mac Milan Education Ltd. London.
4. Brown J.W. (2015) Principles of Microbial Diversity, ASM Press
5. Epstein S.S. (2009) Uncultivated microorganisms, Springer-Verlag Publishers
6. Madigan M.T., Bender K.S., Buckley D.H., Sattley W.M. and Stahl D.A. (2017) Brock Biology of Microorganisms, 15th Edn. (Global Edn.)Pearson Education

MICROBIAL DIVERSITY

PRACTICALS

2HPW-Credits-1

- Isolation of Methanogenic bacteria from manure by anaerobic culturing
- Isolation and enumeration of halophiles from saline environment
- Isolation of bacteria from diversified habitats to demonstrate antagonism, commensalism and synergism
- Isolation of *Cyanobacteria* and fungi from different habitats
- Identification of fungi by staining techniques
- Microscopic observation of soil algae and Protozoa
- Winogradsky's column to demonstrate microbial diversity
- Visit and observe any nearby unique ecosystems to understand the role of microorganisms
- Demonstration of the great plate count anomaly

References:

1. Aneja, K.R. (2001). Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom Production Technology, 3rd Edition, New Age International (P) Ltd., New Delhi.
2. Dubey, R.C. and Maheswari, D.K. (2002). Practical Microbiology, S. Chand & Co., New Delhi.
3. Burns, R.G. and Slater, J.H. (1982). Experimental Microbiology and Ecology. Blackwell Scientific Publications, USA.
4. Peppler, I.L. and Gerba, C.P. (2004). Environmental Microbiology – A Laboratory Manual.Academic Press. New York.
5. Gupte, S. (1995). Practical Microbiology. Jaypee Brothers Medical Publishers Pvt. Ltd.
6. Kannan, N. (2003). Hand Book of Laboratory Culture Medias, Reagents, Stains and Buffers.Panima Publishing Co., New Delhi.
7. Gopal Reddy, M., Reddy, M.N., Saigopal, DVR and Mallaiah, K.V. (2007). Laboratory Experiments in Microbiology, 2nd edition.Himalaya Publishing House, Mumbai.
8. Reddy, S.M. and Reddy, S.R. (1998). Microbiology – Practical Manual, 3rd Edition, Sri Padmavathi Publications, Hyderabad

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SKILL ENHANCEMENT COURSE-I (SEC-I)

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Syllabus for B.Sc Microbiology **Code: BS, SEC-1**

B.Sc II year: III Semester

Title: HAEMATOLOGY **2HPW-Credits-2**

UNIT-1: INTRODUCTION TO BLOOD

Blood: definition, characters, composition. Collection of blood – capillary blood: from adults and infants, examinations employed. Venous blood: from adults and infants, examinations employed Composition of blood (RBC, WBC, Plasma, Serum, Platelet cells), Staining of blood films. Total blood picture, Differential count. Blood grouping, Rh-typing. Haemoglobin: composition and normal values, haemoglobin estimation Anti-coagulants.

UNIT-2: BLOOD TRANSFUSION

Principles of blood transfusion, Donor screening – cross matching, collection of blood, preservation and storage. Precautions of handling blood and it's products. Challenges in management of Hemophilia and Anaemia. General account on spread of diseases through blood and blood products. Coagulation mechanism: factors, bleeding time, clotting time. Haematological indices: packed cell volume. Erythrocyte sedimentation: principle – determination.

References:

1. Kawthalkar.Essentials of Haematology Paperback – 2013
2. Lokwani.D.P.The ABC of CBC Interpretation of Complete Blood Count and HistogramsPaperback – 2013
3. RamnikSood . Medical Laboratory technology Methods and Interpretation Jaypee Publications.
4. ShirishMKawthalkar. Essential Of Hematology. Jaypee Publications.

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Syllabus for B.Sc Microbiology **Code: BS, DSC-1C**

B.Sc II year: III Semester

Title: FOOD AND ENVIRONMENTAL MICROBIOLOGY **4 HPW-Credits-4**

UNIT 1: FERMENTED FOODS

Introduction to fermented foods; Health aspects of fermented foods; Fermented vegetables: Processing and fermentation of Sauerkraut and pickles, idly. Dairy Microbiology - Types of microorganisms in milk, significance of microorganisms in milk, Microbial products of milk-Bulgarian milk, Kefir, cheese, yogurt; Microorganisms as food; Probiotics and Prebiotics.

UNIT 2: MICROBIAL FOOD SPOILAGE AND POISONING

Microbial Spoilage of foods; Microbial Food poisoning, risks and hazards; Mycotoxins and their poisoning/toxicity; Food preservation methods and food safety issues. Food Quality: Importance and functions of quality control. Methods of quality assessment of foods; Screening and Enumeration of spoilage microorganisms, Detection of pathogens in food.

UNIT 3: AIR AND WATER MICROBIOLOGY

Microorganisms in air and their importance (brief account); Microorganisms and water pollution Water-borne pathogenic microorganisms and their transmission; Sanitary quality of water; Water pollution due to degradation of organic matter; Aerobic and Anaerobic sewage treatment,

UNIT 4: SOIL MICROBIOLOGY

Soil properties (physical, chemical and biological), Soil microorganisms, Methods of enumeration and activity of microbes in environment/soil; Microbes and plant interactions – Rhizosphere, Phyllosphere and Mycorrhizae; Introduction to Microbial Bioremediation, Microbial degradation of organic pollutants; Carbon and Nitrogen cycle.

References:

1. Stanbury, P.F., Whitaker, A. and Hall, S.J. (1997). Principles of Fermentation Technology, Aditya Books (P) Ltd. New Delhi.
2. Doyle, M.P., Beuchat, L.R. and Montville, T.J. (1997). Food Microbiology: Fundamentals and Frontiers.ASM Press, Washington D.C., USA.
3. Frazier, W.C. and Westhoff, D.C. (1988). Food Microbiology, McGraw-Hill, New York.
4. Jay, J.M. (1996). Modern Food Microbiology, Chapman and Hall, New York.

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5. Ray, B. (1996). Fundamentals of Food Microbiology, CRC Press, USA.
6. Rangaswami, G. and Bhagyaraj, D.J. (2001). Agricultural Microbiology, 2nd Edition, Prentice Hall of India, New Delhi.
7. Atlas, R.M. and Bartha, R. (1998). Microbial Ecology - Fundamentals and Applications, Addison Wesley Longman, Inc., USA
8. Paul, E.A. and Clark, F.E. (1989). Soil Microbiology and Biochemistry, Academic Press, USA.

FOOD AND ENVIRONMENT MICROBIOLOGY PRACTICALS

2HPW-Credits-1

- Determination of microbiological quality of milk by MBRT method.
- Isolation of fungi & bacteria from spoiled fruits/vegetables/Milk/Meat products.
- Isolation of microorganisms from air by impingement method.
- Microbiological examination of water by coliform test.
- Determination of biological oxygen demand.
- Extraction of Mycotoxins from contaminated grains/foods.
- Detection of Mycotoxins
- Isolation and identification of probiotic bacteria
- Isolation and identification of probiotic yeast

References:

1. Stanbury, P.F., Whitaker, A. and Hall, S.J. (1997). Principles of Fermentation Technology, Aditya Books (P) Ltd. New Delhi.
2. Doyle, M.P., Beuchat, L.R. and Montville, T.J. (1997). Food Microbiology: Fundamentals and Frontiers.ASM Press, Washington D.C., USA.
3. Frazier, W.C. and Westhoff, D.C. (1988). Food Microbiology, McGraw-Hill, New York.
4. Jay, J.M. (1996). Modern Food Microbiology, Chapman and Hall, New York.15
5. Ray, B. (1996). Fundamentals of Food Microbiology, CRC Press, USA.
6. Atlas, R.M. and Bartha, R. (1998). Microbial Ecology - Fundamentals and Applications, Addison Wesley Longman, Inc., USA

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SKILL ENHANCEMENT COURSE-III (SEC-3)

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Syllabus for B.Sc Microbiology **Code: BS, SEC-3**

B.Sc III year: IV Semester

Title: MUSHROOM CULTIVATION **2HPW-Credits-2**

UNIT-1

- Introduction to mushroom cultivation
- Importance and history of mushroom cultivation in India
- Global status of mushroom production
- Edible mushrooms (white button oyster, Paddy straw).
- Nutritional value and health benefits of mushrooms

UNIT-2

- Steps in mushroom cultivation
  a. Selection of site and types of mushroom
  b. Mushroom farm structure, design layout
  c. Principle and techniques of compost and composting
  d. Principle of spawn production
  e. Casing and crop production
  f. Harvesting and marketing
  g. Entrepreneurship development in Mushroom cultivation
- Pest and pathogens of mushrooms
- Post harvest handling and preservation of mushrooms

Reference:

1. Mushroom cultivation in india by B.C.Suman and V.P. Sharma Published by Daya publishing house New Delhi.
2. Mushrooms Cultivation, Marketing and Consumption Manjit Singh Bhuvnesh Vijay Shwet Kamal G.C. Wakchaure Directorate of Mushroom Research (Indian Council of Agricultural Research) Chambaghat, Solan –173213 (HP)

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Syllabus for B.Sc Microbiology **Code: BS, DSC-1D**

B.Sc II year: IV Semester

Title: MEDICAL MICROBIOLOGY & IMMUNOLOGY **4 HPW-Credits-4**

UNIT-1: MEDICAL BACTERIOLOGY

Histroy of Medical Microbiology. Normal flora of human body,
Host pathogen interactions.Bacterial toxins, virulence and attenuation.Antimicrobial resistance.
Air borne diseases -Tuberculosis.
Food and waterborne diseases- Cholera, Typhoid.
Contact diseases - Syphilis, Gonorrhea. General account of nosocomial infections.

UNIT-2: MEDICAL VIROLOGY AND PARASITOLOGY

Food and waterborne diseases - Poliomyelitis, Amoebiasis.
Insect borne diseases-Malaria, Dengue fever.
Zoonotic diseases – Rabies
Viral diseases- Hepatitis B, HIV, SARS, MERS; Air borne diseases- Influenza.

UNIT-3: INTRODUCTION TO IMMUNOLOGY

History of immunology. Cells and organs of immune system- Primary and Secondary lymphoid organs.Functions of B&T Lymphocytes, Natural killer cells, Polymorphonuclear cells.
Structure and classification of Antigens, Factors affecting antigenicity.
Antibodies-Basic structure,Types,properties and functions of immunoglobulins.
Types of immunity-Innate and Acquired; Humoral and cell mediated immune response.
Major Histocompatibility Complex- Class I and II

UNIT-4: IMMUNOLOGICAL DISORDERS AND AG-AB REACTIONS

Types of hypersensitivity - Immediate and delayed.
Systemic and localized autoimmune disorders
Complement pathways – Classical and Alternate.
Types of Antigen-Antibody reactions- Agglutination, blood groups, precipitation, neutralization, complement fixation test. Labeled antibody based techniques-ELISA, RIA and Immunofluorescence; Polyclonal and monoclonal antibodies production and application

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References:

1. Gottschalk, G. (1986). Bacterial Metabolism, Springer-Verlag, New-York.
2. Caldwell, D.R. (1995). Microbial Physiology and Metabolism, W.C. Brown Publications, Iowa, USA.
3. Moat, A.G. and Foster, J.W. (1995). Microbial Physiology, John-Wiley, New York.
4. White, D. (1995). The Physiology and Biochemistry of Prokaryotes, Oxford University Press, New York.
5. Reddy, S.R. and Reddy, S.M. (2004). Microbial Physiology, Scientific Publishers, Jodhpur, India.
6. Lehninger, A.L., Nelson, D.L. and Cox, M.M. (1993). Principles of Biochemistry, 2nd Edition, CBS Publishers and Distributors, New Delhi.
7. Elliot, W.H. and Elliot, D.C. (2001). Biochemistry and Molecular Biology, 2nd Edition, Oxford University Press, U.S.A.

MEDICAL MICROBIOLOGY & IMMUNOLOGY

PRACTICALS

2HPW- Credits-1

- Determination of blood grouping and RH typing.
- Total count of RBC and WBC.
- Differential count of blood leucocytes.
- WIDAL test for typhoid(slide test)by Ag-Ab reactions
- VDRL test for syphilis (slide test) by Ag-Ab reactions.
- Ouchterlony double diffusion test
- Separation of serum and plasma
- IMViC test - Indole test, Methyl red test,VogesProskauer test, Citrate utilization test.
- Oxidase test.
- Catalase test.
- Antibiotic sensitivity testing – Disc diffusion method

References:

1. Gopal Reddy, M., Reddy, M.N., Saigopal, DVR and Mallaiah, K.V. (2007). Laboratory Experiments in Microbiology, .Himalaya Publishing House, Mumbai.
2. Experiments in Microbiology by K.R. Aneja.

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Syllabus for B.Sc Microbiology **Code: BS, GE**

B.Sc III year: V semester

Title: MICROBIOLOGY AND HUMAN HEALTH **4 HPW-credits-4**

UNIT-1: INTRODUCTION

Historic developments of Microbiology, contributions of Van Leeuwenhoek, Edward Jenner, Louis Pasteur, Robert Koch.

Types of microorganisms, Morphological characteristics of bacteria, Staining, cultivation methods of bacteria, Culture Media used for the growth of microrganisms.

UNIT-2: MICROORGANISMS: GOOD AND BAD

Microorganisms related to human health. Normal microbial flora, Human microbiome concept.

Bacterial disease: Typhoid, Tuberculosis, Syphilis

Viral diseases: Flu, SARS, MERS, SARS-CoV-2, HIV

Insect borne: Malaria and Dengue

UNIT-3: IMMUNITY AND HEALTH

Introduction to immune system; Understanding the terms: Disease, Infection, Pathogenicity, Prophylaxis, Host resistance, Innate immunity and acquired immunity, Epidemics, Endemics and Pandemics; Importance of probiotics and vaccines for human health

UNIT-4: WASTE MANAGEMENT AND HEALTH HAZARDS

Health hazards associated with dumpage of Industrial and Biomedical waste.

National and international guidelines for the disposal of waste. Guidelines of Central Pollution Control Board (CPCB). Safe disposal and pretreatment of wastes. Mechanical and chemical treatment of the waste. Autoclaving, incineration.

References:

1. Michael J. Pelczar, Jr. E.C.S.Chan, Noel R. Krieg Microbiology Tata McGraw- Hill Publisher.
2. Prescott, M.J., Harly, J.P. and Klein Microbiology 5th Edition, WCB McGrawHill, New York.
3. Madigan, M.T., Martinkl, J.M and Parker,j. Broch Biology of Microorganism, 9th Edition, MacMillan Press, England.
4. Dube, R.C. and Maheshwari, D.K. General Microbiology S Chand, New Delhi.
5. Ananthanarayan and Panikar. Text book of Microbiology. Universities Press.

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Syllabus for B.Sc Microbiology **Code: BS, DSE-1A**

B.Sc III year: V Semester

Title: MOLECULAR BIOLOGY & MICROBIAL GENETICS **4HPW-credits-4**

UNIT-1: MICROBIAL GENETICS

Fundamentals of Genetics – Mendelian laws, Alleles, Crossing over and Linkage
DNA and RNA as genetic material
Structure of DNA – Watson and Crick model
Extra chromosomal genetic elements – Plasmids and Transposons
Replication of DNA- Semi conservative mechanism

UNIT-2: MUTATIONS AND GENETIC RECOMBINATION

Mutations – Spontaneous and induced, Base pair changes, Frameshift, Deletion, Inversion, Tandem duplication, Insertion
Various physical and chemical mutagens
Outline of DNA damage and repair mechanism
Brief account on gene transfer among bacteria – Transformation, Transduction and Conjugation

UNIT-3-GENE EXPRESSION

Concept of gene – Muton, Recon and Cistron
One gene – one enzyme , One gene – one Poly peptide , One gene – one product hypothesis
Types of RNA and their functions
Outline of RNA transcription in Prokaryotes
Genetic code, Structure of Ribosomes and brief account on protein synthesis
Type of genes – Structural, Constitutive, Regulatory
Operon concept.Regulation of gene expression in bacteria – Lac Operon.

UNIT-4-RECOMBINANT DNA TECHNOLOGY

Basic principles of genetic engineering –Restriction endonucleases,
DNA polymerases and Ligases, vectors
Outline of gene cloning methods.
Genomic and cDNA libraries
General account on application of genetic engineering in industry, agriculture and medicine.

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References:

1. Freifelder, D. (1997). Essentials of Molecular Biology. Narosa Publishing House, New Delhi.
2. Crueger, W. and Crueger, A. (2000). Biotechnology: A Text Book of Industrial Microbiology, Prentice-Hall of India Pvt. Ltd., New Delhi.
3. Glick, B.P. and Pasternack, J. (1998). Molecular Biotechnology, ASM Press, Washington D.C., USA.
4. Freifelder, D. (1990). Microbial Genetics. Narosa Publishing House, New Delhi.
5. Strickberger, M.W. (1967). Genetics. Oxford & IBH, New Delhi.
6. Sinnot E.W., L.C. Dunn and T. Dobzhansky. (1958). Principles of Genetics. 5th Edition. McGraw Hill, New York.
7. Glazer, A.N. and Nikaido, H. (1995). Microbial Biotechnology – Fundamentals of Applied Microbiology, W.H. Freeman and company, New York.
8. Old, R.W. and Primrose, S.B. (1994) Principles of Gene Manipulation, Blackwell Science Publication, New York.
9. Verma, P.S. and Agarwal, V.K. (2004). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Co. Ltd., New Delhi.

MOLECULAR BIOLOGY & MICROBIAL GENETICS

PRACTICALS

2HPW- credits-1

- Colorimetric estimation of proteins by Biuret method.
- Colorimetric estimation of DNA by Diphenyl amine method.
- Colorimetric estimation of RNA by Orcinol method
- Extraction of genomic DNA
- Extraction of plasmid DNA
- Separation and observation of genomic DNA by Agarose gel Electrophoresis
- Separation and observation of plasmid DNA by Agarose gel Electrophoresis

References:

1. Experiments in Microbiology by K.R. Aneja.
2. GopalReddy.M., Reddy. M.N., SaiGopal, DVR and Mallaiah K.V. Laboratory Experiments in Microbiology.
3. Dubey, R.C. and Maheshwari, D.K. Practical Microbiology, S. Chand and Co New Delhi.
4. Alcamo, I.E. Laboratory Fundamentals of Microbiology. Jones and Bartlett Publishers, USA.
5. Mahy, B.W.J. and Kangro, H.O. Virology – Methods Manual Academic Press, USA.

Burleson et al Virology – A Laboratory Manual.Academic Press, USA.

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Syllabus for B.Sc Microbiology **Code: BS, DSE-1B**

B.Sc III year: 5thsemester

Title: MICROBIAL OMICS **4 HPW-Credits-4**

UNIT 1: INTRODUCTION TO OMICS

Introduction to molecular biology. Structure of DNA, RNA. Multi omics approach for analysis of Microbial biology: Genomics, Transcriptomics (RNA-Seq), Proteomics, Metabolomics, Metagenomics and their applications; Basic Concepts in high throughput sequencing or Next-Generation Sequencing methods for use in food-microbiology, diagnostics and Human health.

UNIT 2: PROTEOMICS

Protein structure – Different levels of protein structure, Protein Folding and unfolding. Protein secondary and 3D structure prediction methods. X-ray crystallography, NMR and homology modeling. Protein micro arrays- Protein Markers, Clinical Proteomics, Protein engineering, Proteomic strategies in Cancer, Prions.

UNIT 3: GENOMICS

An introduction of functional genomics; Site-directed mutagenesis, Transposon mutagenesis, DNA microarray, RNA interference, and Chromatin immune precipitation.
Genome annotation, Applications of functional genomics in vaccine and drug designing, Genome editing tools such as CRISPR/Cas9. Databases of Microbial Genomics; Microbial genome projects

UNIT 4: BIOINFORMATICS

Introduction to Bioinformatics and Molecular Databases, Primary Databanks – NCBI, EMBL, DDBJ; Secondary Databases – UNIPROT; Structural Database –PDB; Database similarity search (FASTA, BLAST); Alignment: Pairwise and Multiple sequence alignment; Whole genome sequence; Genome Annotation and Gene Prediction; Primer Designing; Phylogenetic analysis and Tree construction.

References

1. Principles of Protein structure, Schultz, G. E., and Schirmer, R. H. Dr. ShaktiSahi
2. Proteomics, Daniel C. Leibler
3. Microbial Proteomic, MarjoPoutanen
4. Proteins: Structures and Molecular Principles (2d ed.), TE Creighton
5. Organic spectroscopy, William Kemp
6. Proteome Research: Two-Dimensional Gel Electrophoresis and DetectionMethods (Principles andPractice), T. Rabilloud (Editor), 2000, Springer Verlag

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7. Introduction to Protein Architecture: The Structural Biology of Proteins, M.Lesk, 2001, Oxford University Press.
8. Molecular Biotechnology by Bernard R. Glick and Jack J Pasternak
9. DNA Microarrays Ed. M. Schena.

MICROBIAL OMICS

PRACTICALS

2HPW-credits-1

1. Protein isolation from *E coli.*
2. Sequence analysis of proteins (by BLAST, ClustalW and Phylip).
3. Protein structure prediction by Homology modeling.
4. Isolation of Genomic DNA from *E.coli* and its demonstration by OD and agarose electrophoresis
5. Isolation of plasmid DNA from *E.coli* and its demonstration by OD and agarose electrophoresis
6. DNA molecular size determination
7. Primer designing using online software
8. PCR amplification of genes and detection of amplicon by agarose gel electrophoresis

References:

1. Molecular biotechnology by Chanarayppa

2. Methods in Molecular Cloning by Sambrook.

3. Gopal Reddy, M., Reddy, M.N., Saigopal, DVR and Mallaiah, K.V. (2007). Laboratory Experiments in Microbiology, 2nd edition.Himalaya Publishing House, Mumbai.

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With effect from 2020-21

Syllabus for B.Sc Microbiology **Code: DSE-2A**

B.Sc III year: VI Semester

Title: INDUSTRIAL MICROBIOLOGY **4 HPW-Credits-4**

UNIT-1: MICROORGANISMS AND SELECTION

Introduction to Industrial Microbiology, Microorganisms of industrial importance -Yeast, Molds, Bacteria, Actinomycetes. Screening and selection of industrially useful microbes. Steps to maintain seed culture and inoculation strategies for enhanced product yield. Strain improvement strategies. Immobilization methods – adsorption and entrapment.

UNIT-2: FERMENTATION

Design of bioreactor. Physico-chemical standards used in bioreactors. Limitations of bioreactor, Fermentation equipment and its use. Design of fermentor, type of fermenter, agitation, aeration, antifoam, pH and temperature control. Stages of fermentation process. Inoculation media and fermentation media ; Raw materials used in fermentation industry and their processing, Downstream processing.

Unit-3: TYPES OF FERMENTATON

Types of fermentations: Batch, Fed batch, continuous types and kinetics. Submerged, surface, solid state, dual and multiple fermentations. Advantages and disadvantages of solid substrate and liquid fermentations. Fermentation. Common Microbial fermentation, alcohol and lactic acid fermentation.

UNIT-4: MICROBIAL PRODUCTS

Industrial products derived from microbes: vitamins: B12; Vaccines: recombinant vaccines, production of beverages (beer and wine), biofuels (biogas and methane), enzymes (amylase), antibiotics (penicillin), aminoacids (glutamic acid), organic acid (citric acid). Disposal of industrial waste.

References:

1. Patel, A.H. (1984). Industrial Microbiology, Mac Milan India Ltd., Hyderabad.
2. Cassida, L.E. (1968). Industrial Microbilogy, Wiley Eastern Ltd. & New Age International Ltd., New Delhi.
3. Crueger, W. and Crueger, A. (2000). Biotechnology – A Text Book of Industrial Microbiology, Panima Publishing Corporation, New Delhi
4. Reedy, G. (Ed.) (1987). Prescott & Dunn's Industrial Microbiology, 4th Edition, CBS Publishers & Distributors, New Delhi.
5. Reddy, S.R. and SingaraCharya, M.A. (2007). A Text Book of Microbiology - Applied Microbiology.Himalaya Publishing House, Mumbai.
6. Singh, R.P. (2007). Applied Microbiology. Kalyani Publishers, New Delhi.
7. Demain, A.L. and Davies, J.E. (1999). Manual of Industrial Microbiology and Biotechnology, ASM Press, Washington, D.C., USA

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INDUSTRIAL MICROBIOLOGY

PRACTICALS

2HPW-Credits-1

1. Screening for amylase producing microorganisms
2. Screening for organic acid producing microorganisms
3. Estimation of Ethanol by potassium dichromate method.
4. Production of citric acid by submerged fermentation
5. Estimation of Citric acid by titrimetry method.
6. Estimation of penicillin.
7. Bacterial slides- Bacillus, Lactobacillus, Yeast, Aspergillus, Pencillium

References:

1. Patel, A.H. (1984). Industrial Microbiology, Mac Milan India Ltd., Hyderabad.
2. Cassida, L.E. (1968). Industrial Microbilogy, Wiley Eastern Ltd. & New Age International Ltd., New Delhi.
3. Crueger, W. and Crueger, A. (2000). Biotechnology – A Text Book of Industrial Microbiology, Panima Publishing Corporation, New Delhi
4. Reedy, G. (Ed.) (1987). Prescott & Dunn's Industrial Microbiology, 4th Edition, CBS Publishers & Distributors, New Delhi.
5. Reddy, S.R. and SingaraCharya, M.A. (2007). A Text Book of Microbiology - Applied Microbiology.Himalaya Publishing House, Mumbai.
6. Singh, R.P. (2007). Applied Microbiology. Kalyani Publishers, New Delhi.
7. Demain, A.L. and Davies, J.E. (1999). Manual of Industrial Microbiology and Biotechnology, ASM Press, Washington, D.C., USA.

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Syllabus for B.Sc Microbiology **Code: DSE-2B**

B.Sc III year: VI Semester

Title: PHARMACEUTICAL MICROBIOLOGY **4 HPW-Credits-1**

Unit-1: INTRODUCTION TO CHEMOTHERAPY

History of chemotherapy – plants and arsenicals as therapeutics, Paul Ehrlich and his contributions, selective toxicity and target sites of drug action in microbes. Development of synthetic drugs – Sulphanamides, antitubercular compounds, nitrofurons, nalidixic acid, metronidazole group of drugs.

Unit-2: ANTIBIOTICS

The origin, development and definition of antibiotics as drugs, types of antibiotics and their classification. Non-medical uses of antibiotics.Principles of chemotherapy – Clinical and lab diagnosis, sensitivity testing, choice of drug, dosage, route of administration, combined/mixed multi drug therapy, control of antibiotic/drug usage.

Unit-3: DRUG RESISTANCE

The phenomenon of drug resistance, clinical basis of drug resistance, biochemistry of drug resistance, genetics of drug resistance in bacteria.

Mode of action of important drugs – Cell wall inhibitors (Betalactam – eg. Penicillin), membrane inhibitors (polymyxins), macromolecular synthesis inhibitors (streptomycin), antifungal antibiotics (nystatin)

Unit-4: MICROBIOLOGICAL ASSAYS

Assays for growth promoting substances, nutritional mutants and their importance. Drug sensitivity testing methods and their importance. Assay for antibiotics – Determination of MIC, the liquid tube assay, solid agar tube assay, agar plate assay (disc diffusion, agar well and cylinders cup method).

References:

1. Ananthanarayana, R. and Panicker, C.K.S. (2000). Text Book of Microbiology, 6th Edition, Oriental Longman Publications, USA.
2. Gupte, S. (1995). Short Text Book of Medical Microbiology, 8th Edition, Jaypee Brothers Medical Publishers (P) Ltd, New Delhi.
3. Biochemistry of antimicrobial action. Franklin,DJ. and Snow, GA.Pub:Chapman& Hall. Antibiotics and Chemotherapy.Garrod, L.P., Lambert, HP. And C'Grady, F. (eds). Publ: Churchill Livingstone.

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4. Antibiotics. Lancini, G. and Parenti, F. publ: Springer-Verlag.
The Molecular Basis of antibiotic action. Ga.e, EF.Et al.Publ: Wiley, New York.
Antimicrobial Drug action.Williams, RAD., Lambart, PA.& Singleton, P. Pub:Bios Sci.
Microbiological Assays.Hewitt.

PHARMACEUTICAL MICROBIOLOGY (CBCS)

PRACTICALS

2 HPW- Credits-1

1. Tests for disinfectants (Phenol coefficient/RWC)
2. Determination of antibacterial spectrum of drugs/antibiotics
3. Chemical assays for antimicrobial drugs
4. Testing for antibiotic/drug sensitivity/resistance
5. Determination of MIC for antimicrobial compounds
6. Microbiological assays for antibiotics (Liquid tube assay, agar tube assay, agar plate assays)

Reference/Recommended Books for MB Pharmaceutical Microbiology

1. Disinfection, sterilization and preservation. Block, S.S. (ed). Lea and Febigor, Baltimore
2. Pharmaceutical Microbiology. Huge, W.B. and Russel, AD.Blackwell Scientific, Oxford
3. Inhibition and destruction of microbial cell by Hugo, WB. (ed). Pub: Academic Press,NY
4. Manual of Clinical Microbiology. Lennette, EH. (ed).Pub: American Society for Microbiology, Washington.
5. Principles and Practices of disinfection. Russell, AP.,Hugo,WB., and Ayliffe, GAJ.(eds). Publ. Blackwell Sci.
6. Biochemistry of antimicrobial action. Franklin,DJ. and Snow, GA.Pub:Chapman& Hall.
7. Antibiotics and Chemotherapy. Garrod, L.P., Lambert, HP. And C'Grady, F. (eds). Publ: Churchill Livingstone.
8. The Molecular Basis of antibiotic action. Ga.e, EF. Et al. Publ: Wiley, New York.
9. Antimicrobial Drug action. Williams, RAD., Lambart, PA. & Singleton, P. Pub:Bios Sci.

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Elective Against Project
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Syllabus for B.Sc Microbiology **Code: BS**

B.Sc III year: VI Semester

Title: APPLIED MICROBIOLOGY **3 HPW-Credits-3**

UNIT-1: MICROBIAL PRODUCTS FOR SMALL SCALE ENTREPRENEURS

Maintenance of type strains or reference strain of microorganisms: culture collection centres (MTCC, ATCC). Patenting process and IPR. Microorganisms in agriculture. Nitrogen fixation and phosphate solubilization. Biofertilizers- Production of azolla, rhizobium and mycorrhizae. Biofungicides- Mass production of Trichoderma and Pseudomonas. Biopesticides- Bacterial, fungal and viral.

UNIT-2: METABOLIC ENGINEERING FOR MICROBIAL PRODUCTS

Production of microbial pigments (prodigiosin, violacein, monascin). Bacterial and algal carotenoids. Microrganisms for flavor and aroma production. Biotransformation and metabolic engineering of microorganisms to produce compounds such as esters, terpenes, aldehydes, lactones, geosmin, vanillin and coumarin.

UNIT-3: MICROBIAL DIAGNOSTICS AND HEALTH

Diagnostic microbiology: collection, transport and culturing of clinical samples. Preparation and use of culture media for detection of microbial pathogens. Examination of sample by staining - Gram stain, Ziehl-Neelsen staining for tuberculosis, Blood smear for malarial parasite. Serological methods for rapid detection of bacterial, fungal and viral pathogens.
Techniques used for the diagnosis of hospital acquired infections and multi drug resistant microorganisms. Monitoring of sanitation in community –Biohazard disposal.

References:

1. Stanbury, P.F., Whitaker, A. and Hall, S.J. (1997). Principles of Fermentation Technology, Aditya Books (P) Ltd. New Delhi.
2. Rangaswami, G. and Bhagyaraj, D.J. (2001). Agricultural Microbiology, 2nd Edition, Prentice Hall of India, New Delhi.
3. Atlas, R.M. and Bartha, R. (1998). Microbial Ecology - Fundamentals and Applications, Addison Wesley Longman, Inc., USA.
4. Ananthanarayan R and Paniker CKJ (2009). Textbook of Microbiology, 8th edition, Universities Press Private Ltd.
5. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013)

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Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication.
6. Randhawa, VS, Mehta G and Sharma KB (2009) Practicals and Viva in Medical Microbiology 2nd edition, Elsevier India Pvt Ltd.

APPLIED MICROBIOLOGY

PRACTICALS

2 HPW-Credits-1

1. Isolation and enumeration of Rhizosphere microorganisms.
2. Isolation of Rhizobium from leguminous root nodules.
3. Staining & observation of mycorrhizal fungi.
4. Mass production of Rhizobium , Mycrorhizae, Trichoderma and Pseudomonas using different carriers / substrates and methods to assay quality control of bioproducts
5. Grams staining
6. Ziehl-Nielsen staining
7. Blood smear

References:

1. Aneja, K.R. (2001). Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom Production Technology, 3rd Edition, New Age International (P) Ltd., New Delhi.
2. Dubey, R.C. and Maheswari, D.K. (2002). Practical Microbiology, S. Chand & Co., New Delhi.
3. Atlas, R.M. and Bartha, R. (1998). Microbial Ecology - Fundamentals and Applications, Addison Wesley Longman, Inc., USA

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Project

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Syllabus for B.Sc Microbiology **Code: BS**

B.Sc III year: 6th semester

Title: PROJECT **5 HPW-Credits-4**

1. Number of students who will be offered project work will vary batch to batch depending upon the infrastructural facilities and may vary each year (Not exceeding 5 students per group).
2. Project work will involve experimental work and the student will have to complete this in stipulated time.
3. The final evaluation of the project work will be through a Panel involving internal and external examiners.
4. Students will be asked their choice for Project work at the beginning of VI semester and all formalities of topic and mentor selection will be completed.

Project work will be offered in lieu of expertise and infrastructural facilities of the department and will be evaluated for 4 credits.

5. The distribution of marks for project work will be:

Project work: 100 Marks (50 marks for dissertation + 25 marks for research skills + 25 marks for research work presentation).

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