B.Sc. (MICROBIOLOGY)
Syllabus (CBCS)
(w.e.f. 2025-2026)

FACULTY OF SCIENCE
SATAVAHANA UNIVERSITY
KARIMNAGAR – 505002

2025

Proposed CBCS structure for Undergraduate (B.Sc) program.

Courses		Papers	Credits	Credits for each paper / Semester					
				I	II	III	IV	V	VI
B.Sc	Major-1	6	30	5	5	5	5	5	5
	Major-2	6	30	5	5	5	5	5	5
	Minor-1	4	20	5	5	5	5	-	-
English		4	20	5	5	5	5	-	-
Sec. language		4	20	5	5	5	5	-	-
MDC		1	4	-	-	-	-	4	-
SEC 1		2	4	-	-	-	-	2	-
SEC 2								2	-
SEC 3								-	2
SEC 4		2	4	-	-	-	-	-	2
VAC 1		2	6	-	-	-	-	3	-
VAC 2								-	3
Internship/Project		1	4	-	-	-	-	-	4
Total credits in each semester		-	-	25	25	25	25	21	21
Total credits in UG			142						
Credits under Non-CGPA (Community engagement and service)		NSS/ NCC/Sports/ Extra curricular	Upto 6 (2 in each year)						
		IKS	Upto 4 (2 in each, after I and II years)						

Students will pursue two Majors and one Minor, collectively referred to as Discipline Specific Core (DSC). Both Major and Minor courses will remain integrated upto the fourth semester, after which students will have option to drop one Minor course in both the fifth and sixth semesters. The syllabus and credits for Major and Minor courses will remain consistent upto the fourth semester, with the Major continuing for Fifth and Sixth Semester.

MDC - Multi-Disciplinary Course (Proposed paper across other Disciplines)

SEC- Skill Enhancement Course

VAC - Value Added Course

OSMANIA UNIVERSITY
PROPOSED SCHEME FOR CHOICE BASED CREDIT SYSTEM IN
B.Sc MICROBIOLOGY (2025-26)

Code	Course Title	Course Type	HPW	Credits
FIRST YEAR- SEMESTER-1				
	English			5
	Second Language			5
Major - 1/ Minor-1	**Introductory Microbiology**	DSC-1A	4+1	5
	Major/Minor - Optional paper			5
	Major/Minor - Optional paper			5
	TOTAL Semester I			**25**
SEMESTER-II				
	English			5
	Second Language			5
Major-1 / Minor-1	**Biomolecules**	DSC-1B	4+1	5
	Major/Minor - Optional paper			5
	Major/Minor - Optional paper			5
	TOTAL Semester II			**25**
SECOND YEAR - SEMESTER-III				
	English			5
	Second Language			5
Major-1 / Minor-1	**Applied Microbiology**	DSC-1C	4+1	5
	Major/Minor - Optional paper			5
	Major/Minor - Optional paper			5
	TOTAL Semester III			**25**
SEMESTER- IV				
	English			5
	Second Language			5
Major -1/ Minor-1	**Immunobiology and Clinical Microbiology**	DSC-1D	4+1	5
	Major/Minor - Optional paper			5
	Major/Minor - Optional paper			5
	TOTAL Semester – IV			**25**

THIRD YEAR-SEMESTER- V				
	Multi-Disciplinary Course (Paper proposed across other disciplines)	MDC	4	4
	Skill Enhancement Course 1	SEC- 1*	2	2
	Skill Enhancement Course 2	SEC- 2*	2	2
	Value Added Course	VAC-1*	3	3
Major -1	**Molecular Biology & Microbial Genetics**		4+1	5
	Optional paper (Major)			5
	TOTAL Semester V			**21**
SEMESTER-VI				
	Skill Enhancement Course 3	SEC - 3*	2	2
	Skill Enhancement Course 4 **Quality Control and Accreditation** **or** **Bioinformatics and *In silico* drug discovery**	SEC - 4	2	2
	Value added Course	VAC-2*	3	3
Elective Paper for **Major-1**	**1A. Industrial Microbiology** **or** **1B. Pharmaceutical Microbiology** **or** **1C. Microbial Omics**	DSE-1A or DSE-1B or DSE-1C	4+1	5
	Optional paper (Major)			5
	PROJECT WORK / Internship		4	4
	TOTAL Semester VI			**21**
	Program Total			**142**

***Paper and curriculum details will be provided by TGCHE**

- **SEC-4, Subject specific two papers are given (Anyone paper can be selected)**
- **MDC is proposed across other disciplines**
- **Elective papers are given only in VI semester**

PROGRAM OUTCOMES

The B.Sc. Microbiology program syllabus is designed and practiced to benefit the students for their higher education and technical skills. Practical experiments in the syllabus are designed according to the industrial task force requirement in pharma and biotech sectors. In addition, these practical's with real time samples will train the students to work on different innovative projects. This will motivate the students to participate in conferences and understand about filing patents for novel process. Latest subject oriented theoretical and practical knowledge is imparted to the students, which will benefit them in their future endeavors.

PROGRAM OUTCOMES (PO)

PO1: Students can pursue Masters program in Microbiology and allied subjects.
PO2: Students can work in Diagnostic labs, Biotech and Pharma industries
PO3: Students can develop skill in microbiological culturing methods
PO4: Students can pursue a research career or prepare for civil services examinations
PO5: Students can prepare for a Microbiology related career abroad (MS/ PhD in Europe, USA, etc)

PROGRAM SPECIFIC OUTCOMES (PsO)

PsO1: Students will develop good communication and writing skills
PsO2: Students will be able to write research projects at industries, research labs and diagnostic centers
PsO3: Students will be trained in basics of BIG data management
PsO4: Students will be able to understand the usage of micoorganisms in diverse sectors.

DEPARTMENT OF MICROBIOLOGY

Discipline Specific Core (DSC)

B.Sc. Microbiology program under choice based credit system (CBCS)

With effect from 2025-26

Syllabus for B.Sc. Microbiology (MAJOR/MINOR)

B.Sc. I year: I Semester

Code: DSC-1A **4HPW -Credits-4**

Title: INTRODUCTORY MICROBIOLOGY (Paper -I)

Course outcomes:

CO1: Students will learn fundamentals of Microbiology.

CO2: Students will learn classification structural features of microbes

CO3: Students will study microbial diversity and growth

CO4:Students will learn sterilization and pure culture methods

Unit-1: Introduction to Microbiology

History of Microbiology: Contribution of Antony Van Leewenhock, Louis Pasteur and Robert Koch, Edward Jenner. Information about Microorganisms (sukshmjeevanu) in Vedas.

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- Gram staining and Acid Fast. Negative staining. Structural stain-spore, capsule, flagella. Bacterial motility - Hanging drop method.

Unit-2: Microorganisms: Classification & Structural features

Introduction to Classification of living organisms. General characteristics and classification of viruses. Morphology and structure of TMV and HIV. Structure and multiplication of lambda bacteriophage. Prokaryotes- Ultra structure of eubacteria. Cellular components. Differentiation of prokaryotes and eukaryotes. Morphological characteristics and features of typical eubacteria, Chlamydia, Rickettsiae, Mycoplasma, Archaebacteria, Cyanobacteria, Algae, Fungi

Unit-3: Microbial Diversity, Nutrition & Growth

Basic concept of Biodiversity and Conservation. National Biodiversity authority (NBA). Understanding microbial diversity in the genomics era. Introduction to Metagenomics.

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

Unit-4: Sterilization & Pure Culture Techniques

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 Hypo chlorides.

Use of Biological safety cabinets, types. Primary containment for Biohazards. Biosafety levels. Isolation of pure culture; Techniques- Enrichment culturing, Dilution plating, end point method, streak plate, spread plate, Micromanipulator.

Preservation of Microbial cultures – Sub culturing, overlaying cultures with minerals oils, lyophilization, sand cultures and storage at low temperature.

References:

1. Michael J. Pelczar, Jr. E. C.S. Chan, Noel R. Krieg Microbiology Tata McGraw-Hill Publisher.
2. Prescott, L.M., Harley, J.P. and Klein, D.A. (2002) Microbiology: Food and Industrial Microbiology. 5th Edition, McGraw-Hill, Boston, 978-981.
3. Madigan, M.T., Martinko, J.M. and Parker, J. (1997) Brock Biology of Microorganisms. 8th Edition, Prentice Hall International, Inc., New York..
4. A. Mani, A.M.Selvaraj, N.Arumugam L.M. Narayanan . Microbiology- General and Applied. 2017. Saras publications.
5. Chand Pasha and Hameeda Bee (2024) Text Book of General Microbiology. Professional Books Publishers, Hyderabad

Introductory Microbiology

PRACTICALS 2HPW-Credits-1

1. Handling and calibration of light microscope.
2. Simple and differential staining (Gram staining)
3. Demonstration of spore staining
4. Isolation of bacteriophage from sewage sample.
5. Preparation of media for culturing autotrophic and heterotrophic microorganisms–algal medium, mineral salts medium, nutrient agar medium, Mac Conkey agar and blood agar.
6. Sterilization techniques: Autoclave, Hot air oven and filtration.
7. Enumeration of bacterial numbers by serial dilution and plating (viable count and calculation of CFU and conversion to log value)
8. Isolation of bacteria and fungi from soil
9. Pure culture technique: streak, spread and pour plate method
10. Isolation of halophilic bacteria
11. Microscopic observation of cyanobacteria (Nostoc, Spirulina), algae and fungi (Saccharomyces, Rhizopus, Aspergillus, Penicillium).
12. Winogradsky's column to demonstrate microbial diversity
13. Preservation of microbial cultures -Slant, Stab, Sand cultures, mineral oil overlay and glycerol stocks
14. Turbidometry measurement of bacterial growth and plotting growth curve.

References:

1. Alfred Brown and Heidi Smith, 2017, Bensons Microbiological application: A laboratory manual in General Microbiology, Indian Edition, Mc.Graw Hill (13e)
2. Chand Pasha and Bhima (2024) Laboratory Experiments in Microbiology. ISBN no 978-81-969070-5-1, Professional Books Publishers, Hyderabad
3. Laboratory manual of Microbiology and Biotechnology by K.R. Aneja. 2014
4. Practical Microbiology, R.C. Dubey and D.K. Maheshwari, 2012, Chand Publications
5. Gopal Reddy.M., Reddy.M.N., Sai Gopal, DVR and Mallaiah K.V. Laboratory Experiments in Microbiology.

DEPARTMENT OF MICROBIOLOGY

Discipline Specific Core (DSC)

B.Sc. Microbiology program under choice based credit system(CBCS)

With effect from 2025-26

Syllabus for B.Sc. Microbiology (MAJOR/MINOR)

B.Sc. I year: II Semester

Code: DSC-1B **4HPW-Credits-4**

Title: BIOMOLECULES (Paper-II)

Course outcomes:

CO1: Students will learn microbial diversity and interactions.
CO2: Students will gain knowledge on microbial classification and taxonomic updates
CO3: Students will comprehend the structure and features of biomolecules.
CO4: Students will be exposed to basics of enzyme kinetics and regulations

Unit-1:

Biological Macromolecules

Carbohydrates: Monosaccharides: aldoses and ketoses, epimers, mutarotation and anomers of glucose, Sugar derivatives. Glucosamine, Galactosamine, Muramic acid, N-acetylneuraminic acid. Disaccharides, Polysaccharides.

Amino acids and Proteins: Types, Structure and functions. Classification of enzymes. Active site and activation energy. Lock and key hypothesis, induced fit hypothesis.

Lipids: Introduction to storage and structural lipids. Storage lipids: triacylglycerols, building blocks, fatty acids structure and properties, essential fatty acid. Saponification. Structural lipids. Phosphoglycerides- building blocks.

Unit-2: Basics to Molecular Biology

Structure of DNA –Watson and Crick model. Types of DNA, RNA.

DNA and RNA as genetic material. Extra chromosomal genetic elements–Plasmids and Transposons

Replication of DNA- Semi conservative mechanism. Concept of gene.

Transcription and translation of prokaryotes. Introduction to operon concept-Lac operon model.

Unit-3: Biomolecular Chemistry

Concept of aerobic respiration, anaerobic respiration. Respiration – Glycolysis, HMP Pathway, ED Pathway, TCA Cycle. Electron transport chain (ETC): components of respiratory chain, comparison of mitochondrial and bacterial ETC, Oxidative and substrate level phosphorylation. Fermentation-Common microbial fermentations

Unit-4: Biochemical Techniques

Buffers- Types of buffers and their use in biological reactions, Hydrogen ion concentration in biological fluids, measurement of pH. Principle and applications of Colorimetry and Spectrophotometry.

Chromatographic techniques: Thin layer and coloumn. Electrophoresis. Agarose gel electrophoresis and PAGE (Poly acrylamide gel electrophoresis).

References:

1. PelczarJr .M.J., Chan.E.C., SandKreig.N.R (2006)."Microbiology"-5th Edition Mc Graw Hill Inc. New York.
2. Brown J.W. (2015) Principles of Microbial Diversity, ASM Press
3. Epstein S.S. (2009) Uncultivated microorganisms, Springer-Verlag Publishers
4. Madigan M.T., Bender K.S., Buckley D. H., Sattley W.M. and Stahl D.A. (2017) Brock Biology of Microorganisms, 15th Edition (Global Edn.)Pearson Education.
5. Principles of Biochemistry, by A.H. Lehninger
6. Berg, Tymoczko and Stryer, Textbook of Biochemistry. Fifth Edition.

BIOMOLECULES

PRACTICALS **2HPW-Credits-1**

1. Qualitative analysis of carbohydrates
2. Study of protein structures with the help of models
3. Determination of acid value of fatty acids
4. Enzyme assay of Amylase and Protease
5. Handling of pH meter
6. Demonstration for Colorimetry
7. Demonstration for Chromatographic techniques and applications
8. Demonstration of agarose gel electrophoresis

References:

1. Chand Pasha, Bhima (2024) Laboratory Experiments in Microbiology. ISBN no 978-81-969070-5-1, Professional Books Publishers, Hyderabad
2. Aneja, K. R. (2001).Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom Production Technology, 3rd Edition, New Age International (P) Ltd., New Delhi.
3. Dubey, R.C.and Maheswari,D.K.(2002).Practical Microbiology, S. Chand &Co., New Delhi.
4. Kannan, N. (2003). Hand Book of Laboratory Culture Media, Reagents, Stains and Buffers. Anima Publishing Co., New Delhi.
5. Gopal Reddy, M., Reddy, M.N., Saigopal, DVR and Mallaiah, K.V. (2007) .Laboratory Experiments in Microbiology, 2nd edition. Himalaya Publishing House, Mumbai.
6. Microbial diversity with practicals. A. Madhuri and Bi Susmitha DLPD.2021

DEPARTMENT OF MICROBIOLOGY

Discipline Specific Core (DSC)

B.Sc. Microbiology program under choice based credit system (CBCS)

With effect from 2025-26

Syllabus for B.Sc. Microbiology (MAJOR/MINOR)

B.Sc. II year: III Semester

Code: DSC-1C **4 HPW-Credits-4**

Title: Applied Microbiology (Paper III)

Course outcomes:

CO 1: Students will be trained in management of quality in food and beverage industry

CO 2: Students will learn the importance of microbial world

CO 3: Students will learn about the waste water treatment

CO 4: Students will be exposed to the importance of microbes in Agriculture

Unit-1: Food Microbiology

Microorganisms and their use in Food industry. Introduction to fermented foods; Importance of traditional fermented foods in India. Microorganisms associated with fermented vegetables: Processing and fermentation of Sauerkraut and pickles, idly. Dairy Microbiology - Types of Microorganisms in milk. Fermented dairy products - Bulgarian milk, Kefir, cheese, yogurt; Importance of probiotics microorganisms as food; Cultivation of Mushroom. Microbial Spoilage of foods; Microbial Food poisoning, risks and hazards

Unit-2: Air, Water and Soil Microbiology

Microorganisms in air and their importance. Microorganisms and water pollution. Sanitary quality of water; Water pollution due to degradation of organic matter; Aerobic and Anaerobic sewage treatment. Soil properties (physical, chemical and biological). Soil microorganisms. Carbon and Nitrogen cycle. Introduction to microbial bioremediation, Microbial degradation of organic and inorganic pollutants or heavy metals

Unit- 3: Agricultural Microbiology

Microbes in agriculture, Microbes and plant interactions – Rhizosphere, Phyllosphere and Mycorrhizae; Nitrogen fixation and phosphate solubilization. Biofertilizers- Algal biofertilizers. Production of Azolla, Rhizobium and Mycorrhizae. Introduction to nano-biofertilizers for sustainable agriculture. Bio-fungicides- Mass production of Trichoderma and Pseudomonas. Biopesticides- Examples of bacteria, fungi and virus. Role of Microorganisms for Sustainable Development Goals (SDGs). Significance of organic farming for soil fertility.

Unit – 4: Microbial Biotechnology for industrial products

Introduction to Microbial Technology. Microorganisms as tools for various products. Plasmids and vectors used in cloning. Gene cloning methods for industrial products. R-DNA technology. Production of insulin and other industrial products using microorganisms.

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, NewYork.
5. Ray, B. (1996). Fundamental Food Microbiology, CRC Press, USA.
6. Rangaswami, G. and Bhagyaraj, D.J.(2001).AgriculturalMicrobiology,2ndEdition, Prentice Hall of India, New Delhi.
7. Chand Pasha, Hameeda Bee . Food, Environmental and Agricultural Microbiology. Professional Books Publishers, Hyderabad

APPLIED MICROBIOLOGY PRACTICALS
2HPW-Credits-1

1. Determination of microbiological quality of milk by MBRT method.
2. Isolation of fungi and bacteria from spoiled fruits/vegetables/Milk/Meat products.
3. Isolation of microorganisms from air by different methods
4. Microbiological examination of water by coliform test.
5. Determination of biological oxygen demand.
6. Isolation and identification of probiotic bacteria and yeast
7. Demonstration of microorganisms associated with traditional fermented foods
8. Isolation of Nitrogen fixing, phosphate solubilizing microorganisms
9. Production and formulation of biofertilizer -Rhizobium

References:

1. Chand Pasha, Bhima (2024) Laboratory Experiments in Microbiology. ISBN no 978-81-969070-5-1, Professional Books Publishers, Hyderabad
2. Stanbury, P.F., Whitaker, A and Hall, S.J.(1997).Principles of Fermentation Technology, Aditya Books (P) Ltd. New Delhi.
3. Doyle, M.P., Beuchat, L.R. and Montville, T.J.(1997).Food Microbiology: Fundamentals and Frontiers.ASM Press, Washington D.C., USA.
4. Frazier, W.C. and Westhoff, D.C. (1988). Food Microbiology, McGraw-Hill, New York.
5. Jay, J.M. (1996). Modern Food Microbiology, Chapman and Hall, New York.15
6. Ray, B. (1996). Fundamentals of Food Microbiology, CRC Press, USA.
7. Atlas, R.M. and Bartha, R. (1998). Microbial Ecology-Fundamentals and Applications, Addison Wesley Longman, Inc., USA
8. Subba Rao, R. 2017. Text Book of Agriculture Microbiology.

DEPARTMENT OF MICROBIOLOGY

Discipline Specific Core (DSC)

B. Sc. Microbiology program under choice based credit system (CBCS)

With effect from 2025-26

Syllabus for B.Sc Microbiology

B.Sc II year: IV Semester

Code: DSC-1D **4HPW-Credits-4**

Title: IMMUNOBIOLOGY & CLINICAL MICROBIOLOGY (Paper-IV)

Course outcomes:

CO1: Students will understand about immunity and health

CO2: Students will learn about viruses, parasites causing infections

CO3: Students will learn about the pathogenic microorganisms, infections

CO4: Students will be trained to work in diagnostic labs and hospitals

Unit-1: Introduction to Immunology

History of immunology. Cells and organs of immune system-Primary and Secondary lymphoid organs. Functions of B and 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-2: 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 grouping, precipitation, neutralization, complement fixation test. Labeled antibody-based techniques-ELISA, RIA and Immunofluorescence; Polyclonal and monoclonal antibodies production and application

Unit-3: Bacterial Pathogenesis

Introduction to clinical microbiology. Normal flora of human body. Host pathogen interactions. Bacterial toxins. Virulence and attenuation.

Air borne diseases -Tuberculosis.

Food and waterborne diseases-Cholera, Typhoid.

Contact diseases-Syphilis, Gonorrhea. General account of nosocomial infections.

Unit-4: Infections and Diseases

Food and water borne diseases-Poliomyelitis, Amoebiasis.

Insect borne diseases-Malaria, Dengue fever. Zoonotic diseases –Rabies

Viral diseases-Hepatitis B, HIV, SARS, Covid-19; Influenza.

Fungal infections - Systemic mycoses: Histoplasmosis, Opportunistic mycoses: Candidiasis

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. Chand Pasha. Text Book of Medical Microbiology & Immunology. Professional Books Publishers, Hyderabad

IMMUNOBIOLOGY & CLINICAL MICROBIOLOGY PRACTICALS
2HPW-Credits-1

1. Determination of blood grouping and RH typing.
2. Total count of RBC and WBC.
3. Differential count of blood leucocytes.
4. WIDAL test for typhoid (slide test)by Ag-Ab reactions
5. VDRL test for syphilis (slide test) by Ag-Ab reactions.
6. Ouchterlony, double diffusion test
7. Separation of serum and plasma
8. IMViC test -Indole test, Methyl red test, Voges Proskauer test, Citrate utilization test.
9. Oxidase test.
10. Catalase test.
11. Antibiotic sensitivity test

References:

1. Chand Pasha, Bhima (2024) Laboratory Experiments in Microbiology. ISBN no 978-81-969070-5-1, Professional Books Publishers, Hyderabad
2. Gopal Reddy,M.,Reddy,M.N.,Saigopal,DVRandMallaiah,K.V.(2007). Laboratory Experiments in Microbiology, .Himalaya Publishing House, Mumbai.
3. Alfred Brown and Heidi Smith, 2017, Bensons Microbiological application: A laboratory manual in General Microbiology, Indian Edition, Mc.Graw Hill (13e)
4. Laboratory manual of Microbiology and Biotechnology by K.R. Aneja. 2014

DEPARTMENT OF MICROBIOLOGY

Discipline Specific Core (DSC)

B.Sc Microbiology program under choice based credit system (CBCS)

With effect from 2025-26

Syllabus for B.Sc Microbiology (MAJOR)

B.Sc III year: V Semester

Code: DSC-1E **4HPW-Credits-4**

Title: MOLECULAR BIOLOGY & MICROBIAL GENETICS (Paper - V)

Course outcomes:

CO1 : Students will be introduced to molecular biology

CO2 : Students will learn biomolecular synthesis and control

CO3: Students will gain understanding of recombination process and microbial genetics

CO4: Students will be able to take up cloning strategies and its application in making new products.

Unit-1: Mutations

Mutations–Spontaneous and induced, Base pair changes, Frameshift, Deletion, Inversion, Tandem duplication, Insertion. Various physical and chemical mutagens. Molecular basis of mutations; Functional mutants, Reversion and suppression: True revertants; Intra- and inter-genic suppression; Ames test; Mutator genes. DNA damage and repair mechanism.

Unit -2: Genetic Recombination

Brief account on gene transfer among bacteria. Molecular basis of recombination in bacteria. Gene transfer mechanisms: Transformation: Natural transformation, competence, DNA uptake, artificially induced competence, electroporation method. Transduction (Generalized and Specialized). Conjugation and different steps involved. Gene mapping studies. Types of Gene mapping, methods and applications.

Unit-3: Gene Expression

Concept of gene –Muton, Recon and Cistron. Benzer's fine structure of gene.

Structure of Ribosomes. Process of protein synthesis in prokaryotes and eukaryotes. Genetic code.

Type of genes – Structural, Constitutive, Regulatory

Regulation of gene expression in bacteria – Tryptophan (Trp) operon and Arabinose operon

Unit-4: Molecular techniques

Gene cloning strategies, Enzymes used in gene cloning. Use of restriction enzymes. Principle and technique of PCR. Making and use of genomic and cDNA libraries, Application of genetic engineering. Introduction to molecular diagnostics. Fluorescence in situ hybridization (FISH), DNA Finger printing.

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. Dunnand, 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.
10. Bindu Sharma, Dr. A. Madhuri and Dr. B. Susmitha. Molecular Biology and Recombinant DNA Technology with Practicals.

MOLECULAR BIOLOGY & MICROBIAL GENETICS PRACTICALS

HPW- Credits-1

1. Colorimetric estimation of proteins by Biuret method.
2. Colorimetric estimation of DNA by Diphenyl amine method.
3. Colorimetric estimation of RNA by Orcinol method
4. Extraction of genomic DNA
5. Extraction plasmid DNA
6. Separation and observation of genomic DNA by Agarose gel Electrophoresis
7. Separation and observation of plasmid DNA by Agarose gel Electrophoresis
8. Demonstration about the molecular markers used in agarose gel electrophoresis and SDS PAGE

References:

1. Chand Pasha, Bhima (2024) Laboratory Experiments in Microbiology. ISBN no 978-81-969070-5-1, Professional Books Publishers, Hyderabad
2. Gopal Reddy, M., Reddy,M.N., Saigopal, DVR and Mallaiah, K.V.(2007). Laboratory Experiments in Microbiology, Himalaya Pub House Mumbai.
3. Experiments in Microbiology by K.R. Aneja.
4. Dubey, R.C. and Maheshwari, D.K. Practical Microbiology, S. Chand and Co New Delhi.
5. Alcamo, I.E. Laboratory Fundamentals of Microbiology. Jones and Bartlett Publishers, USA.

DEPARTMENT OF MICROBIOLOGY

B.Sc Microbiology program under choice based credit system(CBCS)

with effect from 2025-26

Syllabus for B.Sc Microbiology

B.Sc III year: V Semester

Code: Multi-Disciplinary Course (MDC) – Paper proposed across other disciplines

4HPW-Credits 4

Title: MICROBIOLOGY AND HUMAN HEALTH

Course outcomes:

CO1: Students will understand about the microbial world

CO2: Students will be able to know about good and bad microorganisms

CO2: Students will be acquainted with immunity and health

CO4: Students will be informed for management of bio and hazardous waste

Unit-1: Introduction

Historic developments of Microbiology. Contributions of Van Leeuwenhoek, Edward Jenner, Louis Pasteur, Robert Koch. Information about microorganisms in Vedic literature. Types of microorganisms, Morphological characteristics of bacteria, Staining, cultivation methods of bacteria, Culture Media used for the growth of microorganisms. Unculturable Microorganisms.

Unit-2: Microorganisms: Good and Bad

How good bacteria support human health. Introduction to the term prebiotics and probiotics. Indian traditional fermented foods and their health benefits.

Normal microbial flora and Human microbiome concept.

Use of bacteria in bio preservation and vaccine production.

Bacterial disease: Typhoid, Tuberculosis, Syphilis

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

Insect borne: Malaria and Dengue

Unit-3: Immunity and Health

Introduction to immune system; Understanding the terms: Disease, Infection, Pathogenicity, Prophylaxis, Host resistance, Epidemics, Endemics and Pandemics; Importance of probiotics. Types immunity, Human vaccination & schedule, Antibody structure and types of Antigen antibody reactions. Hypersensitivity reactions.

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. Sewage treatment. Waste to wealth creation and understanding circular bioeconomy.

References:

1. MichaelJ. Pelczar, Jr.E.C.S.Chan, Noel R. Krieg Microbiology, Tata McGraw-Hill Publisher.
2. Prescott, M.J., Harly,J.P.and Klein Microbiology5thEdition,WCBMcGrawHill,New York.
3. Madigan, M.M., Martinko, J.M and Parker, J. Brock's Biology of Microorganism, 9th Edition, Pearson.
4. Dubey, R.C. and Maheshwari, D.K. General Microbiology S. Chand, New Delhi.
5. R. Ananthanarayan and Paniker.Jayaram. C.K. (Ed. Reba Kanungo) Text book of

DEPARTMENT OF MICROBIOLOGY

Skill Enhancement Course – 1 (SEC-1)

B.Sc. Microbiology program under choice based credit system (CBCS)

With effect from 2025-26

Syllabus for B.Sc. Microbiology

B.Sc. III year: V Semester

Code: SEC-1 2HPW-Credits-2

Details of content will be given by TGCHE

DEPARTMENT OF MICROBIOLOGY

Skill Enhancement Course – 2 (SEC-2)

B.Sc. Microbiology program under choice based credit system (CBCS)

With effect from 2025-26

Syllabus for B.Sc. Microbiology

B.Sc. III year: V Semester

Code: SEC-2 2HPW-Credits-2

Details of content will be given by TGCHE

Value Added Course – 1 (VAC -1)

B.Sc. Microbiology program under choice based credit system (CBCS)

With effect from 2025-26

Syllabus for B.Sc. Microbiology

B.Sc. III year: V Semester

Code: VAC -1 3HPW-Credits-3

Details of content will be given by TGCHE

DEPARTMENT OF MICROBIOLOGY
Discipline Specific Elective (DSE-1A)
B.Sc. Microbiology program under choice based credit system(CBCS)
With effect from 2025-26
Syllabus for B.Sc Microbiology (MAJOR)
B.Sc III year: VI Semester

DSE-1A **4 HPW-Credits-4**
Title: INDUSTRIAL MICROBIOLOGY (Elective - 1A) – PAPER VI
Course outcomes:
CO1: Students will learn the uses of microorganisms as cell factories
CO2: Students will use microbial technology and understand about patent filing
CO3: Students will be able to operate fermentor at laboratory level.
CO4: Students will be oriented towards taking up Entrepreneurship

Unit-1: Microorganisms and Selection
Introduction to Industrial Microbiology, Microorganisms of industrial importance- Yeast, Molds, Bacteria, Actinomycetes, uncultivable bacteria. Screening and selection of industrially useful microbes. Steps to maintain seed culture and inoculation strategies for enhanced product yield. Inoculum development. Strain improvement strategies. Immobilization methods – cells and enzymes.

Unit-2: Fermentation
Design of bioreactor. Physico-chemical standards used in bioreactors. Type of fermenters, 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. Types of fermentations: Batch, Fed batch, continuous types and basic equations in growth kinetics. Submerged, surface, solid state, dual and multiple fermentations.

Unit-3: Microbial Products
Common Microbial fermentation, alcohol and lactic acid fermentation. Industrial products derived from microorganisms; vitamins: B12; Vaccines: recombinant vaccines, production of beverages (beer and wine), biofuels (biogas and Bioethanol), enzymes (amylase), antibiotics (penicillin), amino acids (Lysine, Glutamic acid), and organic acid (citric acid). Management and disposal of industrial wastes or effluents.

Unit-4: IPR, Entrepreneurship and Biosafety
Microorganisms and process development for patent filing. Introduction to Intellectual property rights, issues in patenting biotechnological inventions. Indian patent filing application and information.
Entrepreneurship: Sciencepreneur, Entrepreneurial principles, business planning, market research, financial management, Gender Inclusive case studies of Indian Bio-Entrepreneurs.
GLP and GMP procedures at biotech industry. Ethical Regulations and norms. Biosafety regulation of products, microbial products and biosafety concerns – individual, society, national and international, biosafety regulations in laboratories, handling of recombinant products. Ethical regulations in Microbial Sciences.

References:

1. Patel, A.H. (1984). Industrial Microbiology, Mac Milan India Ltd., Hyderabad.
2. Cassida ,L.E. (1968). Industrial Microbiology, 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. Reed, G. (Ed.) (1987). Prescott and Dunn's Industrial Microbiology,4th Edition, CBS Publishers & Distributors, New Delhi.
5. Chand Pasha, Hameeda Bee. Text Book of Industrial Microbiology Professional Books Publishers, Hyderabad

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 titrimetric method.
6. Estimation of penicillin.
7. Slides for observation: Bacillus, Lactobacillus, Yeast, Aspergillus, Penicillium
8. LAL test for endotoxins presence in industrial finished products
9. Drafting of Patent and SOPs followed at industries

References:

1. Chand Pasha, Bhima (2024) Laboratory Experiments in Microbiology, ISBN no 978-81-969070-5-1, Professional Books Publishers, Hyderabad
2. Patel, A.H. (1984). Industrial Microbiology, Mac Milan India Ltd., Hyderabad.
3. Cassida, L. E. (1968). Industrial Microbiology, Wiley Eastern Ltd. & New Age International Ltd., New Delhi.
4. Crueger, W. and Crueger, A. (2000). Biotechnology–AText Book of Industrial Microbiology, Panima Publishing Corporation, New Delhi
5. Reddy,S.R. and Singara Charya ,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.

DEPARTMENT OF MICROBIOLOGY

Discipline Specific Elective (DSE-1B)
B.Sc. Microbiology program under choice based credit system (CBCS)
With effect from 2025-26
Syllabus for B.Sc. Microbiology (MAJOR)
B.Sc. III year: VI Semester

Code: DSE-1B **4 HPW-Credits-4**

Title: PHARMACEUTICAL MICROBIOLOGY (Elective-1B) - PAPER VI

Course outcomes:

CO1: Students will learn the principles of chemotherapeutic agents
CO2: Students will be understand about chemotherapeutics and mode of action
CO3: Students will can work at pharma industry
CO4: Student can work on different microbiological assays for testing novel products

Unit-1: Principles of Chemotherapy

History of chemotherapy –Paul Ehrlich and his contributions. Indian tradition and knowledge about medicinal plants for antimicrobials. 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. Difference between bactericidal and bacteriostatic agents

Unit-2: Chemotherapeutics

Development of synthetic drugs – Sulfonamides, anti-tuberculous drugs, nitrofurans, nalidixic acid, metronidazole group of drugs. Selective toxicity and target sites of drug action in microbes. A brief account of natural products derived from marine, plant source with special reference to cardiovascular (Digoxin), anticancer (Paclitaxel, Cytarabine), antiviral (Vidarabine), antimicrobial, antiparasitic, anticoagulant and ant-inflammatory agents. Introduction to Pharmacopeia. GMP. SOPs., WHO Certification. Pharmacokinetics (ADME).

Unit-3: Drugs – Mechanism of Action

Mechanism of action of important drugs – Cell wall inhibitors (Beta lactams – e.g. Penicillin), membrane inhibitors (polymyxins), Mechanism of action of Trimethoprim and Sulfamethoxazole, Antifungal drugs (Nystatin). The phenomenon of drug resistance, clinical basis of drug resistance, biochemistry of drug resistance, genetics of drug resistance in bacteria. Emerging AMR, challenges and containment methods.

Unit-4: Microbiological Assays

Methods of different microbiological assays. Assays of growth promoting substances, measureing stimulation of microbial growth by test 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, J.K.S.(2000).Text Book of Microbiology, 6th Edition, Oriental Longman Publications, USA.
2. Gupte, S. (1995) Short Text Book of Medical Microbiology, 8thEdition, Jaypee Brothers Medical Publishers (P) Ltd, New Delhi.

3. Biochemistry of antimicrobial action Franklin, D.J. and Snow, G.A. Pub: Chapman & Hall. Antibiotics and Chemotherapy. Garrod, L.P., Lambert, HP And C' Grady, F. (eds). Publ: Churchill Livingstone.
4. Antibiotics. Lancini, G. and Parenti, F. publ: Springer-Verlag.
5. Chand Pasha, Hameeda Bee. Text Book of Pharmaceutical Microbiology Professional Books Publishers, Hyderabad

PHARMACEUTICAL MICROBIOLOGY PRACTICALS 2HPW-Credits-1

1. Tests for disinfectants (Phenol coefficient/RWC)
2. Determination of antibacterial spectrum of drugs
3. Colorimetric estimation for antimicrobial drugs
4. Testing for antibiotic drug susceptibility assay (sensitivity / resistance)
5. Determination of MIC for anti-microbial compounds
6. Microbiological assays for antibiotics (Liquid tube assay, agar tube assay, agar plate assays)
7. Creating awareness on AMR in society through survey or any other methods

References

1. Chand Pasha, Bhima (2024) Laboratory Experiments in Microbiology. ISBN no 978-81-969070-5-1, Professional Books Publishers, Hyderabad
2. Disinfection, sterilization and preservation. Block, S.S. (ed) .Lea and Febigor, Baltimore
3. Pharmaceutical Microbiology. Huge, W.B. and Russel, AD. Blackwell Scientific, Oxford
4. Inhibition and destruction of microbial cell by Hugo, WB. (ed). Pub: Academic Press,NY
5. Manual of Clinical Microbiology. Lennette, EH.(ed).Pub:American Society for Microbiology, Washington.
6. Principles and Practices of disinfection. Russell, AP., Hugo, WB.,and Ayliffe, GAJ.(eds). Publ. Blackwell Sci.
7. Biochemistry of antimicrobial action. Franklin, DJ. andSnow, GA.Pub:Chapman&Hall.
8. AntibioticsandChemotherapy.Garrod,L.P.,Lambert,HP.AndC'Grady,F.(eds).Publ: Churchill Livingstone.
9. The Molecular Basis of antibiotic action.Ga.e, EF. Et al.Publ: Wiley, New York.
10. Antimicrobial Drug action. Williams, RAD., Lambart, PA. & Singleton, P. Pub:BiosSci.

DEPARTMENT OF MICROBIOLOGY
Discipline Specific Elective (DSE-1C)
B.Sc. Microbiology program under choice based credit system (CBCS)
With effect from 2025-26
Syllabus for B.Sc. Microbiology (MAJOR)
B.Sc. III year: VI Semester

Code: DSE-1C **4 HPW-Credits-4**

Title: MICROBIAL OMICS (Elective-1C) - PAPER VI

Course outcomes:
CO1: Students will be able to understand omics concept in biological research
CO2: Students will be trained for theoretical and practical genomics for further research aspect
CO3: Students will be able to improve skills in computational biological
CO4: Students will be able to corelate interactomics approach.

Unit-1: Introduction to Omics
Introduction to molecular biology. Structure of DNA, RNA. Multi-omics approach. 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, pharma, 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 microarrays- 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 tool such as CRISPR/Cas9. Databases of Microbial Genomics; Importance of Microbial whole genome sequence.

Unit-4: Metabolomics
Introduction to metabolism, metabolic pathways, metabolite, metabolomics; Methods/ approaches employed to study metabolism; Inter-relationship between genome, transcriptome, proteome and metabolome; Methods for measurement of metabolites level / concentration. Metabolic regulation and control – Homeostasis and metabolic control, metabolic flux. Regulation of glycolysis in muscle as an example of metabolic regulation.

References

1. Chand Pasha. Text Book of Microbial Omics. Professional Books Publishers, Hyd.
2. Principles of Protein structure, Schultz, G. E., and Schirmer, R. H. Dr. Shakti Sahi
3. Proteins: Structures and Molecular Principles (2d ed.), TE Creighton
   Organic spectroscopy, William Kemp
4. Proteome Research: Two-Dimensional Gel Electrophoresis and Detection Methods (Principles and Practice), T. Rabilloud (Editor), 2000, Springer Verlag

MICROBIAL OMICS PRACTICALS 2HPW-1 Credit

1. Protein isolation from *E coli*
2. Isolation of Genomic DNA from *E. coli*, its quantification by OD and separation by agarose electrophoresis
3. Isolation of Plasmid DNA from *E. coli* its quantification by OD and separation by agarose electrophoresis
4. Determine the molecular size/ weight of DNA molecular and solving problems.
5. Demonstration of PCR technique, amplification of genes and detection of amplicon by agarose gel electrophoresis
6. Demonstration of 2D electrophoresis
7. Demonstration of Mass Spectrophotometry
8. Demonstration of NMR for analysis of metabolites

References:

1. Chand Pasha, Bhima (2024) Laboratory Experiments in Microbiology. ISBN no 978-81-969070-5-1, Professional Books Publishers, Hyderabad
2. Molecular biotechnology by Chanarayappa. CRC press. 2007
3. Sambrook, J., Fritsch, E. R., and Maniatis, T. (1989). Molecular Cloning: A laboratory Manual (2nd ed.). Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
4. Gopal Reddy,M., Reddy,M.N.,Saigopal, DVR and Mallaiah, K.V. (2007). Laboratory Experiments in Microbiology, 2nd edition. Himalaya Publishing House, Mumbai.

DEPARTMENT OF MICROBIOLOGY

Skill Enhancement Course – 2 (SEC-2)

B.Sc. Microbiology program under choice based credit system (CBCS)

With effect from 2025-26

Syllabus for B.Sc. Microbiology

B.Sc. III year: VI Semester

Code: SEC-3 2HPW-Credits-2

Details of content will be given by TGCHE

Value Added Course – 2 (VAC -2)

B.Sc. Microbiology program under choice based credit system (CBCS)

With effect from 2025-26

Syllabus for B.Sc. Microbiology

B.Sc. III year: VI Semester

Code: VAC -2 3HPW-Credits-3

Details of content will be given by TGCHE

DEPARTMENT OF MICROBIOLOGY
Skill Enhancement Course - 4 (SEC-4)
B.Sc. Microbiology program under choice based credit system (CBCS)
With effect from 2025-26
Syllabus for B.Sc. Microbiology (MAJOR)
B.Sc. III year: VI Semester

Code: SEC-4 **2HPW-Credits-2**

Title: QUALITY CONTROL AND ACCREDITATION PROCESS (SEC-4) (OR) BIOINFORMATICS AND *IN SILICO* DRUG DISCOVERY

Course Outcomes:
CO1: Understanding Quality Control in Microbiology
CO2: Practical Application and Regulatory Compliance

Unit 1: Introduction to QC for Microbiology Lab
Overview of Quality Control (QC) in Microbiology. Definition and Importance of QC, Good Laboratory Practices (GLP) and Quality Assurance (QA)
Principles of Microbiological Quality Control. Accuracy, Precision, Specificity, and Sensitivity, Concept of Validation and Verification. Quality Control Testing in Microbiology. Media Preparation and Quality Check, Positive and Negative Controls. Identification of Microorganisms. Morphological, Biochemical, and Physiological Identification, Molecular Techniques
Microbial Viability and Endotoxin Testing. Viable but Non-Culturable (VBNC) State, Limulus Amebocyte Lysate (LAL) Test for Endotoxin Detection, Pyrogen Testing and Its Significance

Unit 2: Standards, Biosafety and Accreditation
SOPS in Microbiology Labs. Quality Standards, Sources of contamination. Qualitative tests for detection of pathogens in food, beverages etc. Microbial Spoilage and Foodborne Pathogens, Food Preservation and Safety Standards, HACCP and GMP in Food Quality Control.
Microbial Contamination in Medical Devices.
Biosafety Guidelines: Biosafety guidelines and regulations. Role of Institutional Biosafety Committees Regulatory process and Accreditation protocols (NABL, NBA)

References

1. Microbiological Quality Assurance: A Laboratory GuideM.R. Adams & M.O. Moss
2. Quality Control in Microbiology: A Practical Approach"M. Koch.
3.Microbiology: An Introduction"Gerard J. Tortora, Berdell R. Funke, & Christine L. Case
4.Microbiological Examination of Water and Wastewater"Clesceri, Greenberg, & Eaton
5.Fundamental Food Microbiology"B. Ray & A.K. Bhunia
6.Disinfection, Sterilization, and Preservation by S. Block
7.Medical Device Quality Control: Microbiological Testing and Sterility"C. Rathore & R. Rajput
8.Good Manufacturing Practices for PharmaceuticalsJoseph D. Nally

Bioinformatics and *In silico* drug discovery (SEC 04)

Course outcomes:

CO1: To provide students with knowledge of Biological databases and Phylogenetic Analysis

CO2: To demonstrate predictive models and applications of *in silico* drug design

Unit: 1 Biological Databases

Introduction to Bioinformatics and Molecular Databases.

Primary Databanks – NCBI, EMBL, DDBJ

Database similarity search (FASTA, BLAST). Introduction, concepts of trees, phylogenetic trees and multiple alignments. Phylogenetic softwares (CLUSTAL W, PHYLIP etc).

Whole genome sequence; Genome Annotation and Gene Prediction

Unit:2 Molecular modeling, Drug design and Discovery

Predictive Methods using Nucleotide sequences: Framework, Masking repetitive DNA, Database searches, Codon Bias Detection, Detecting Functional Sites in the DNA (promoters, transcription factor binding sites, translation initiation sites).

Generation of Rational Approaches in Drug Design, molecular docking, quantitative structure-activity relationship (QSAR), Receptor Mapping, Estimating Biological Activities, Molecular Interactions: Docking, Calculation of Molecular Properties, Energy Calculations (no derivation), Target identification, and validation, Modeling, Virtual screening, Lead Identification and Validation.

Reference Books:

1. Introduction to Bioinformatics – Arthur Lesk, Oxford, 2006.
2. Bioinformatics – Stuart M Brown, NYU Medical Center, NY USA. 2000.
3. Fundamental Concepts of Bioinformatics – D E Krane& M L Raymer, Pearson, 2006.
4. Computational methods for macromolecular sequence analysis – R F Doolittle. Academic Press, 1996.
5. Computational methods in Molecular Biology – S.L.Salzberg, D B Searls, S. Kasif, Elsevier, 1998.
6. Bioinformatics, Methods And Applications– Genomics, Proteomics And Drug discovery – S C Rastogi, Mendiratta & P Rastogi 2006.
7. The molecular modeling perspective in drug design – N Claude Cohen, 1996, Academic Press 8. Analytical Tools for DNA, Genes & Genomes: – ArseniMarkoff, New Age, 2007

DEPARTMENT OF MICROBIOLOGY

B.Sc. Microbiology program under choice based credit system (CBCS)

With effect from 2025-26

Syllabus for B.Sc Microbiology (MAJOR)

B.Sc III year: VI Semester

Title: PROJECT/INTERNSHIP **4 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 five students per group).
2. Project work will involve experimental work and the student will have to complete this in stipulated time.
3. Project work with In silico and molecular docking studies corelating wet lab work can also be carried out (specific to Microbial Sciences only).
4. The final evaluation of the project work will be through a Panel involving internal and external examiners.
5. 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.
6. Project work will be offered in lieu of expertise and infra-structural facilities of the department and will be evaluated for 4 credits.

The distribution of marks for project work will be:

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