DISCIPLINE SPECIFIC CORE COURSE – 4: Bacterial Diversity and Systematics

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
MICROB-DSC201: Bacterial Diversity and Systematics	4	3	0	1	Class XII pass with Biology/ Biotechnology/ Biochemistry	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- The main objective of this course is for students to acquire in-depth knowledge of bacterial cell structure and organization, cultivation methods and growth patterns, and reproduction.
- Further, the student gains insights into the vastness of bacterial diversity and its significance

Learning outcomes

The Learning Outcomes of this course are as follows:

- Student will be able to describe the classification of bacteria based on their modes of nutrition, and the diverse physiological types of bacteria as determined by variable environmental factors.
- Student will be able to describe the fundamental concepts and terminology of taxonomic organization and parameters used in classifying bacteria, and the molecular analytic approaches used to classify diverse bacteria. Student will be avle to discuss about the use of rRNA analysis as a means of developing phylogenetic relationships.
- Student will be able to describe the major groups of archaea, their stand-out physiological and structural features, as well as their ecological niches and economic significance.
- Student will be able to discuss the major groups of eubacteria, including bacteria with special features such as mycoplasma, rickettsia, chlamydia and spirochetes.

- Student will be able to demonstrate bacteria count by serial dilution and identify different types of bacteria using various media.
- Student will be able to analyze bacteria microscopically using various staining methods.

SYLLABUS OF DSC-4

UNIT – I (1 Week)

Bacterial diversity based on nutritional and physiological factors: Classification of bacteria based on nutrition: lithotrophs, organotrophs, phototrophs, chemotrophs. Diversity based on physiological factors: solutes, pH, temperature, oxygen, pressure, radiation.

UNIT – II (4 Weeks)

Bacterial systematics: Definitions: Concepts of systematics, taxonomy, taxa, species, strains. Conventional and modern approaches to classification: Phenetic, phylogenetic, genotypic classification, evolutionary chronometers, rRNA oligonucleotide sequencing (ribotyping) and signature sequences, nucleic acid hybridization, genomic fingerprinting, MLSA, RFLP to study polyphasic bacterial taxonomy, FAME analysis

UNIT – III (4 Weeks)

Diversity of Archaea: General characteristics with reference to genera belonging to Crenarchaeota (*Sulfolobus*) and Euryarchaeota: Methanogens (*Methanobacterium)*, thermophiles (*Pyrococcus)*, acidophiles (*Picrophilus*) and halophiles (*Halobacterium*). Key features of other groups: Thaumarchaeota, Lokiarchaeota, Nanoarchaeota

UNIT – IV (6 Weeks)

Diversity of Eubacteria: Key features and significance of the following genera: Deeply Branching Bacteria**:** *Thermotoga, Deinococcus.* Proteobacteria: Classes and Types. Alphaproteobacteria: *Rhizobium, Ricketssia.* Betaproteobacteria: *Neisseria, Thiobacillus.* Gammaproteobacteria: *Escherichia, Yersinia.* Deltaproteobacteria: *Myxococcus* and *Bdellovibrio.* Epsilonproteobacteria: *Campylobacter, Helicobacter.* Zetaproteobacteria: *Mariprofundus ferrooxydans.* Non-Proteobacteria: Chlamydia, Spirochaetes. Gram Positive bacteria having genomes of low GC content: Firmicutes *Clostridium, Bacillus.* Tenericute *Mycoplasma.* Gram Positive bacteria having genomes of high GC content: *Mycobacterium, Streptomyces*

Practical component

UNIT 1: (5 Weeks)

Use of McConkey agar medium as a differential medium to distinguish between lactose- fermenting and lactose-nonfermenting gram negative bacteria. Enumeration of viable bacterial / CFU count using serial dilution and spread plate method/pour plate method.

Unit 2: (10 Weeks)

Bacterial staining methods: Use of light microscope to observe bacteria. Simple staining, Gram staining, Negative staining and Acid-fast staining (permanent mount). Endospore staining using malachite green. Observation of bacterial capsules by negative staining. Demonstration of bacterial motility by hanging drop method/flagellar staining.

Essential/recommended readings

Theory:

1. Brock Biology of Microorganisms by M.T. Madigan,J. Aiyer,D. Buckley,W.Sattley and D. Stahl.16th edition. Pearson, USA. 2021.
2. Prescott's Microbiology by J. M. Willey, K. Sandman and D. Wood. 11th edition. McGrawHill Higher Education, USA. 2019.
3. Microbiology: Principles and Explorations by J.G. Black and L.J. Black. 10th edition. Wiley, USA. 2019.
4. Microbiology: An Introduction by G.J. Tortora, B.R. Funke,and C.L. Case. 13th edition. Pearson, USA. 2018.
5. Principles of Microbiology by R. M. Atlas. 2nd edition. W.M.T. Brown Publishers, USA. 1997.
6. Microbiology by M. J. Pelczar, E. C. S. Chan and N. R. Krieg. 5th edition. McGraw Hill, USA. 1993.

Practicals:

1. Microbiology: A Laboratory Manual by J. Cappuccino and C.T. Welsh. 12th edition. Pearson Education, USA. 2020.
2. Basic Lab Manual of Microbiology, Biochemistry and Molecular Biology by A. Ray and R. Mukherjee. Taurean Publisher, India. 2019.
3. Benson's Microbiological applications: Laboratory manual in general microbiology by A.E. Brown and H. Smith H. 15th edition. McGraw-Hill Education, USA. 2022.
4. Manual of Microbiology: Tools & Techniques by A.K. Sharma. 1st edition. Ane Books, India. 2007.

Suggestive readings

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