

Curriculum Framework

B.Sc. Microbiology

Department of Microbiology

Faculty of Science

2023-2024

Outline of Choice Based Credit System

(https://www.ugc.gov.in/pdfnews/8023719_guidelines-for-cbcs.pdf)

1. **Core Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

2. **Elective Course:** Generally, a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

2.1 **Discipline Specific Elective (DSE) Course:** Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

2.2 **Dissertation/Project:** An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project.

2.3 **Generic Elective (GE) Course:** An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective. P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

3. **Ability Enhancement Courses (AEC):** The Ability Enhancement (AE) Courses may be of two kinds: Ability Enhancement Compulsory Courses (AECC) and Skill Enhancement Courses (SEC). "AECC" courses are the courses based upon the content that leads to Knowledge enhancement; i. Environmental Science and ii. English/MIL Communication. These are mandatory for all disciplines. SEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.

3.1 Ability Enhancement Compulsory Courses (AECC): Environmental Science, English Communication/MIL Communication.

3.2 Skill Enhancement Courses (SEC): These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge.

4. Research Component in Under-Graduate Courses

Project work/Dissertation is considered as a special course involving application of knowledge in solving / analysing /exploring a real-life situation / difficult problem. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper.

Programme Outcomes (PO)

On completing B.Sc. Microbiology, the students shall be able to realize the following outcomes:

PO	Description
PO1	Understand the basic concepts, fundamental principles, and the scientific theories related to Microbiology and their relevance in day-to-day life.
PO2	Acquire the skills in planning, performing and handling scientific instruments during laboratory experiments
PO3	Realize how developments in one science subject help in the development of other science subjects and vice-versa.
PO4	Able to think creatively (divergently and convergent) to propose novel ideas in explaining facts and figures or providing new solutions to the problems.
PO5	Learn how an interdisciplinary approach helps in providing better solutions and new ideas for sustainable development.
PO6	Develop scientific outlook not only with respect to science subjects but also in all aspects of life.
PO7	Understand the knowledge of subjects in other faculties that can greatly and effectively influence the evolving new scientific theories and inventions.
PO8	Imbibe ethical, moral and social values in personal and social life
PO9	Develop various communication skills which will help in expressing ideas and views clearly and effectively.
PO10	Analyze the given scientific data critically and systematically and the ability to draw the objective conclusions.
PO11	The skills of observations and drawing logical inferences from scientific experiments.
PO 12	Develop an overall personality by making them participate in various social and cultural activities voluntarily.
PO 13	Prepare for higher studies and employment in chosen field

Programme Specific Outcomes (PSO)

On completing B.Sc. Microbiology, the students shall be able to realize the following outcomes:

PSO 1	Shall be able to design and execute experiments related to Basic Microbiology, Molecular Biology, Immunology, Recombinant DNA Technology, Biochemistry, Environment, Agriculture, Medical, Industrial, and Food Microbiology.
PSO 2	Shall practice safe microbiology, using appropriate protective, biosafety and emergency procedures.
PSO 3	Shall have in-depth theoretical and practical knowledge of huge diversity of microorganisms, their metabolism & physiology, concepts of molecular genetics and genetic engineering, biosynthetic pathways, enzymology, microbial pathogenicity, role of microbes in food, agriculture and environment, health and disease.
PSO 4	Shall be able to apply the scientific method and hypothesis testing in the design and execution of experiments including the understanding of theoretical background, hypothesis generation, collection and analysis of data, and interpretation and presentation of results.
PSO 5	Shall be able to communicate scientific results to the general public and experts by writing well-structured reports and contributions for scientific publications and posters, and by oral presentations
PSO 6	Shall be able to perform minor research projects incorporating techniques of Basic and Advanced Microbiology. The learners will be equipped to progress to higher studies, research and industrial/ corporate job.

Graduate Attributes

The graduate attributes of our students shall be aligned with those of our University in terms of touching “the life of every student through inculcating virtues of empathy, ethics, efficiency, respect for diversity, prudence and creativity with compassion”. We wish to achieve this through rigorous teachings and research efforts, which remains the basic tenet of our teaching-learning philosophy. The following are the graduate attributes of the subject:

- Broaden the outlook and attitude, develop the current skills and abilities, learn new one to excel in studies and career, grow into responsible global citizens.
- Contour the academic career of the students, make them employable, enhance research acumen and encourage the participation in co-curricular and extracurricular activities.
- Instill skills and abilities to develop a positive approach and be self-contained to shape one’s life and also that of colleagues and peers.
- Demonstrate behavioral attributes for the enhancement of soft skills, socialistic approach and leadership qualities for successful career and nurture responsible human being.
- Provide highly skilled and knowledgeable human resources for agricultural sector, food industry, dairy industry, medical and paramedical field, environment management, space research and research institutes.

LOI of Discipline Specific Core Courses (DCC):

PSO	DCC1	DCC2	DCC3								
PSO1	X		X								
PSO2	X	X									
PSO3		X	X								
PSO4	X	X									
PSO5	X	X									
PSO6	X	X	X								

Semester I Microbiology

Total 6 credits: 150 marks

Type of Course	Course Code	Title	Credit	L	P	T	Marks (External + Internal)	**Minimum Passing Marks (%)	Hours in a week
Paper I Core course (DCC) (Theory) [Micro-T-1]	Micro-T-1-4.5 DCCT12	Introduction and Principles of Microbiology	2	2	0	0	50 (40 + 10)	Total 36 % Aggregate	3
Paper II Core course (DCC) (Theory) [Micro -T-2]	Micro -T-2-4.5 DCCT12	Bacteriology and Systematics	2	2	0	0	50 (40 + 10)		3
Paper III Core course (DCC) (Lab) [Micro -L-1]	Micro-L-1-4.5 DCCP12	Laboratory course	2	0	2	0	50 (40 + 10)	36	4
	Total		6	4	2	0	150 (120 + 30)		10

Note: Students have pass separately in Internal and External examinations.

SEMESTER I

COURSE LEARNING OUTCOMES & CONTENTS OF THE COURSES

Discipline Centric Core (Compulsory)

Paper Code : Micro-T-1-4.5 DCCT12 Paper Name- Core Course- I Part- A Introduction and Principles of Microbiology (2 Credits)		
Introduction and Principles of Microbiology (2 Credits)		
Course learning outcomes: At the conclusion of this course the students -		
Outcome 1. Have developed a good knowledge of the development of the discipline of Microbiology and the contributions made by prominent scientists in this field.		
Outcome 2. Have developed a very good understanding of the characteristics of different types of microorganisms, methods to organize/classify these into and basic tools to study these in the laboratory.		
Outcome 3. Are able to explain the useful and harmful activities of the microorganisms.		
Outcome 4. Are able to perform basic experiments to grow and study microorganisms in the laboratory.		
Unit – 1:	History of microbiology and introduction to the microbial world. Germ theory of disease, Contributions of Antony von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Martinus W. Beijerinck, Sergei N. Winogradsky and Edward Jenner. Scope of microbiology.	5 Lectures
Unit – 2:	Binomial Nomenclature, Whittaker’s five kingdom and Carl Woese’s three kingdom classification systems and their utility. Difference between prokaryotic and eukaryotic microorganisms. General concept and examples of phytoplanktons and zooplanktons.	5 Lectures
Unit – 3:	General characteristics and importance of of Acellular microorganisms (Viruses, Viroids, Prions). General characteristics, occurrence, structure and importance of Cellular microorganisms (Bacteria, Algae, Fungi , Protozoa, cyanobacteria and mycoplasma). Beneficial and harmful microbes and their role in daily life.	7 Lectures

Unit – 4:	Techniques in microbiology: Bright field Microscopy - Principal and functions. Staining techniques: Principle of staining, simple staining, negative staining and Gram staining. Sterilization and Disinfection Techniques: Physical methods- Dry heat Moist heat, Filtration, Radiation. Chemical methods - disinfectants, types and mode of action.	7 Lectures
Unit – 5:	Microbial Cultivation: Nutritional requirements and nutritional categories (Phototrophs, chemotrophs) in microorganisms. Culture media: components of media, natural and synthetic media, chemically defined media, complex media, selective, differential and enrichment media. Pure culture isolation: Streaking, serial dilution and plating methods; maintenance and preservation of pure cultures.	6 Lectures

Paper Code : Micro-T-1-4.5 DCCT12
Paper Name- Core Course- I Part- A
Bacteriology and Systematics (2 Credits)

Bacteriology and Systematics (2 Credits)

Course learning outcomes: At the completion of this course, the students are able to –

Outcome 1. Describe characteristics of bacterial cells, cell organelles, cell wall composition and various appendages like capsules, flagella or pili.

Outcome 2. Differentiate a large number of common bacteria by their salient characteristics; classify bacteria into groups.

Outcome 3. Describe the nutritional requirements of bacteria for growth; developed knowledge and understanding that besides common bacteria there are several other microbes which grow under extreme environments.

Outcome 4. Perform basic laboratory experiments to study microorganisms; methods to preserve bacteria in the laboratory; calculate generation time of growing bacteria.

Unit – 1	Cell size, shape and arrangement, capsule, flagella, fimbriae and pili. Cell-wall: Composition and detailed structure of Gram-positive and Gram-negative cell walls, archaeobacterial cell wall, sphaeroplasts, protoplasts and L-forms.	6 Lectures
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	Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell membranes. Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid. Endospore: Structure, formation, stages of sporulation.	
Unit – 2	Microbial Growth and multiplication - Asexual reproduction, Growth curve and phases of bacterial growth. factors affecting growth; measurement of microbial growth (cell number, cell mass) . Batch culture, continuous culture, Anaerobic culture, Chemostat and turbidostat.	5 Lectures
Unit – 3	Aim and principles of classification, systematics and taxonomy, concept of species, taxa, strain; conventional, molecular and recent approaches to polyphasic bacterial taxonomy, evolutionary chronometers. Outline of Bergey's classification. Differences between eubacteria and archaebacteria	5 Lectures
Unit – 4	General characteristics and Overview of archaebacteria. Introduction to Nanoarchaeota (Nanoarchaeum), Crenarchaeota (Sulfolobus) and Euryarchaeota [Methanogens (Methanobacterium, Methanocaldococcus), thermophiles (Thermococcus, Thermoplasma), and Halophiles (Halobacterium)]. General characteristics and economic importance of actinomycetes.	6 Lectures
Unit – 5	Gram negative and Gram positive bacteria: characteristics and examples. Study of typical eubacteria (<i>Bacillus</i> , <i>Clostridium</i> , <i>Staphylococcus</i> , <i>Streptococcus</i> , <i>Corynebacterium</i> , <i>Mycobacterium</i> , <i>Escherichia</i> , <i>Salmonella</i> , <i>Shigella</i> , <i>Vibrio</i> , Spirochetes, <i>Rickettsia</i> and <i>Chlamydia</i> ..	8 Lectures

Paper Code : Micro DCCP12
Paper Name- Core Course I-PART C (2 Credits)

LAB. COURSE
(2 Credits)

1. Microbiology Good Laboratory Practices and Bio-safety.
2. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH
a. meter) used in the microbiology laboratory.
3. Preparation of culture media (liquid & solid) for bacterial cultivation.
4. Sterilization of media using autoclave and assessment of sterility.
5. Sterilization of glassware using hot air oven.
6. Demonstration of the presence of microflora in the environment by exposing nutrient agar plates to air.
7. Study of common fungi, algae and protozoan using temporary / permanent mounts.
8. Simple staining
9. Negative staining
10. Gram staining
11. Isolation of pure cultures of bacteria by streaking method.
12. Preservation of bacterial cultures by various techniques.
13. Estimation of CFU count by spread plate method/pour plate method.

Reference Books

1. Prescott, M.J., Harley, J.P. and Klein, D.A. Microbiology. 5th Edition WCB McGraw Hill, New York
2. Black J.G. Microbiology-Principles and Explorations. John Wiley & Sons Inc. New York,
3. Pelczar, MJ Chan ECS and Krieg NR, Microbiology McGraw-Hill.
4. Jacquelyn G. Black. Microbiology Principles and explorations. John Wiley & Sons, inc.
5. Madigan, Martinko, Bender, Buckley, Stahl. Brock Biology of Microorganisms. Pearson
6. Text book of Microbiology D K Maheshwari & R C Dubey, S Chand Publications.
7. Text book of Microbiology Sullia & Shantharaman, Oxford Publishing House
8. Modern Concept of Microbiology H D Kumar Vikas Publishing House.
9. Microbiology P D Sharma Rastogi Publications.

SCHEME OF PRACTICAL EXAMINATION

Practical Based on Theory Papers.

Time: - 4hrs

Maximum Marks : 40

Minimum Marks : 13

Combined Practical

Marks

1. Experimental Work	
Major	[08]
Minor	[06]
2. Bacterial staining	[04]
3. Spots (Five)	[10]
4. Viva-voce	[05]
5. Practical Record	[07]

- **Internal evaluation of 30 marks will be based on internal tests, assignment/seminar and application of knowledge and skills.**

SCHEME OF EXAMINATION

Theory (term end paper)-SCHEME OF EXAMINATION

Max. Marks: 40

Min. Marks: 14

Time: 3 Hours

Pattern for Questions for term end semester exam Total marks per paper 40

Types	Marks
<i>Part A (total 10 questions, 2 questions from each unit; answer all questions, each question carry 0.5 mark, word limit for answer is 50 words)</i>	05
<i>Part B (total 10 questions, 2 questions from each unit with internal choice; answer 5 questions selecting 1 question from set, each question carry 2.5 mark, word limit for answer is 200 words)</i>	13
<i>Part C (total 5 questions, 1 question from each unit; each question carry 7.5 mark, word limit for answer is 500 words)</i>	23

Note :-

The marks of the Internal Examination should be given on the basis of two-term tests (should be conducted within a minimum gap of 40 days), regular class tests, seminars, quizzes, artwork, model preparations, student fest, science club activities etc.)

For Term-end practical examination, one external shall be appointed by the University and one examiner shall be internal. Both will conduct the examination.