

Subject Code: 1SC2020401	Subject Title: MICROBIAL DIVERSITY AND EXTREMOPHILES
COURSE TYPE: CORE COURSE	

Course Objective: The course covers in great detail, the concept of Biodiversity, Microbial habitats in different and extreme environments, their physiology and how this knowledge can help in understanding/analyzing/interpreting the presence of life in extraterrestrial habitats, if any.

Teaching scheme (hours) per week		Credit			Theory Marks		Practical Marks		Total
Theory	Practical	Theory	Practical	Total	Uni. Assessment	Cont. Assessment	Uni. Assessment	Cont. Assessment	
4	--	4	--	4	60	40	--	--	100

Unit	Content	Lectures	Weightage
1	Unit 1: (A) Biodiversity: <ul style="list-style-type: none"> ✓ Introduction to microbial biodiversity: Distribution, Abundance, Ecological Niche ✓ Types: Bacterial, Archaeal and Eucarya (B) Alkalophiles and Acidophiles: <ul style="list-style-type: none"> ✓ Alkalophiles: Classification, Alkaline environment & Habitats: soda lakes and deserts, calcium ✓ alkalophily Applications ✓ Acidophiles: Classification, life at low pH, acid tolerance, applications 	15	25%
2	Unit 2: Characteristics and Classification of Archaeobacteria (A) Thermophiles: <ul style="list-style-type: none"> ✓ Classification, hyperthermophilic habitats and ecological aspects ✓ Extremely Thermophilic Archaeobacteria ✓ Mechanism of Thermophily ✓ Commercial aspects of Thermophiles ✓ Applications of Thermozyms (B) Methanogens: <ul style="list-style-type: none"> ✓ Classification, ✓ Habitats, ✓ Biochemistry of Methanogenesis, ✓ Applications 	15	25%
3	Unit 3: Halophiles and Barophiles : (A) Halophiles: <ul style="list-style-type: none"> ✓ Classification ✓ Habitats: Dead Sea, Discovery Basin, Salt Lakes ✓ Halophilic Cell walls and Cell Membranes – Purple membrane, compatible solutes ✓ Osmoadaptation & Halotolerance ✓ Applications of Halophiles and their extremozymes (B) Barophiles: <ul style="list-style-type: none"> ✓ Classification ✓ High-pressure habitats ✓ Mechanism of Barophily - Life under extreme hydrostatic pressure 	15	25%

4	<p>Unit 4: Extraterrestrial - Space Microbiology</p> <ul style="list-style-type: none"> ✓ Aims and objectives of Space research ✓ Life detection methods <ul style="list-style-type: none"> ➤ Evidence of metabolism (Gulliver) ➤ Evidence of photosynthesis (autotrophic and heterotrophic) ➤ ATP production ➤ Phosphate uptake ➤ Sulphur uptake ✓ Martian environment (atmosphere, climate and other details): Antartica as a model for Mars, Search for life on Mars, Viking mission, Viking landers, and Biology box experiment, Gas exchange , Label release and pyrolytic release experiments . ✓ Monitoring of astronauts microbial flora: Alterations in the load of medically important microorganisms, changes in mycological autoflora, and changes in bacterial autoflora. 	15	25%
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Learning Outcome: The students will learn the fundamental aspects of life in different, extreme environments. Students will understand the role and value of biodiversity in a particular ecological niche. Exploring the possibilities of life in extraterrestrial habitats such as Mars also requires great emphasis on the deepest understanding of life and its existence in extreme environments. This course covers all such aspects in great detail that will empower the student to explore his investigative thinking.

Reference Books:

1. Extremophiles by Johri B.N. 2000. Springer Verlag, New York
2. Microbial Diversity by Colwd, D. 1999, Academic Press.
3. Microbial Life in Extreme Environments. Edited by D. J. Kushner. Academic Press.
4. Microbiology of Extreme Environments. Edited by Clive Edward. Open University Press. Milton Keynes.
5. Microbiology of Extreme Environments and its potential for Biotechnology. Edited by M.S. Da Costa, J.C. Duarate, R.A. D. Williams. Elsevier Applied Science, London
6. Extreme Environment. Mechanism of Microbial Adaptation. Edited by Milton R. Heinrich. Academic Press
7. Thermophiles. General, Molecular and Applied Microbiology. Edited by Thomas D. Brock. Wiley Interscience Publication
8. Microbiology: Dynamics and Diversity by Perry
9. Microbial Ecology. Fundamentals and Applications by. Ronald M. Atlas and Richard Bartha. 2nd and 4th Edition. The Benjamin Cummins Publication Co. Inc
10. Microbial Ecology. 2nd Edition. by R. Campbell. Blackwell Scientific Publication
11. Brocks Biology of Microorganisms. 8th Edition. (International Edition - 1997) by Michael T. Madigan, John M. Martinko. Jack Parker. Prentice Hall International Inc
12. Advances in Applied Microbiology. Vol. 10. Edited by Wayne W. Umbreit and D. Pearlman. Academic Press

Subject Code: 1SC2020405	Subject Title: MICROBIOLOGY PRACTICAL
COURSE TYPE: CORE COURSE	

Course Objective: The course covers in great detail, the concept of Biodiversity, Microbial habitats in different and extreme environments, their physiology and how this knowledge can help in understanding/analyzing/interpreting the presence of life in extraterrestrial habitats, if any.

Teaching scheme (hours) per week		Credit			Theory Marks		Practical Marks		Total
Theory	Practical	Theory	Practical	Total	Uni. Assessment	Cont. Assessment	Uni. Assessment	Cont. Assessment	
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LIST OF MICROBIOLOGY PRACTICALS:

1. Isolation of thermophiles from hot water spring [Study at least one enzyme]
2. Studies on halophiles isolated from seawater. [Pigmentation and Salt tolerance]
3. Studies on alkalophiles isolated from lonar water/sea water. [Study at least one enzyme]
4. Biogenic methane production using different wastes
5. Isolation of Thiobacillus ferrooxidans and Thiobacillus thiooxidans cultures from metal sulfides, rock coal and acid mine waters.
6. Production and estimation of lactic acid by *Lactobacillus Sp.* or *Streptococcus Sp.*
7. Extraction and estimation of diacetyl
8. Sauerkraut fermentation
9. Isolation of food poisoning bacteria from contaminated foods, Dairy products
10. Extraction and detection of aflatoxin from infected foods
11. Preservation of potato/onion by UV radiation
12. Production of fermented milk by *Lactobacillus acidophilus*
13. Tests for the Detection and confirmation of Coliforms from food samples
14. Quantitative Estimation of Coliforms from the given food samples

15. Isolation of Symbiotic Nitrogen Fixing Bacteria from the root nodules of leguminous plants
16. Isolation of Free Living Nitrogen Fixing Bacteria from Soil
17. Estimation of Calcium ions present in sporulating bacteria by EDTA Method
18. Isolation of mutants: Antibiotic resistant, Respiratory deficient, Thymine requiring
19. DNA isolation from filamentous fungi
20. Thin layer chromatography of fatty acids, sugars, amino acids
21. Study of root nodules (Detection and separation of leghaemoglobin)
22. General reactions for the detection of proteins/amino acids from the given sample

23. DNA extraction from Soil
24. DNA extraction from water
25. Library creation from metagenome
26. Isolation of m RNA
27. Immunological testing : Widal test; VDRL test; Enzyme Linked Immuno Sorbent assay (ELISA)
28. Hematology : RBC Count; Total WBC Count; Differential WBC Count; E.S.R. determination; Hb estimation;
29. Bleeding time and clotting time
30. Blood Grouping: Slide technique; Tube technique; Reverse and forward grouping/ Cross matching: Major and Minor, Coombs test: Direct & Indirect Method
31. Isolation and identification of Pathogens
32. Biochemistry : Cardiac Profile testing; Liver Profile testing; Renal Profile testing
33. Study of genome database and tools
34. Study of Metagenomics database and tools
35. Study of proteomics database and tools