

Title of the Course: EXTREMOPHILIC MICROORGANISMS [T]

Course Code: MIC-603

Number of Credits: 3

Contact hours: 45

Effective from Academic Year: 2022-2023

Prerequisites	The student should have knowledge of microorganisms and their diversity.	
Objective:	To discuss about the extreme habitats, extremophilic microorganisms, their adaptations and biotechnological potentials.	
Content:		
1.		(15)
1.1	Concepts of extremophilic and polyextremophilic microorganisms	1
1.2	Extreme habitats and extreme microbial communities: deserts, ore deposits/ mining areas (Fe, Mn, Cu), Yellow stone national park, Ring of fire, deep biosphere (terrestrial and marine), hydrothermal vents, cold seeps, soda lake, Dead Sea, solar salterns, polar environments. Astrobiology / exobiology (Mars, Europa and asteroids). Conventional culture techniques, high throughput techniques for culturing and culture independent (metagenomics) approach to study extremophiles.	10
1.3	Significance of extremophiles in biogeochemical cycling, industry, pharma and bioremediation.	4
2	Key molecular components, unique physiological features, adaptation strategies and enzymes of various extremophilic types:	(30)
2.1	Anaerobes- oxygen toxicity and regulation in <i>Clostridium</i> , <i>Moorella thermoacetica</i> , Wood Ljungdahl pathway; barophiles / piezophiles- mechanism in barophily, <i>Photobacterium profundum</i> , <i>Shewanella</i> ; cryophiles / psychrophiles - (cold shock proteins and regulation) <i>Polaromonas</i> , <i>Pseudomonas</i> , <i>Methanococcoides burtonii</i> ; thermophiles & hyperthermophiles: heat shock proteins and regulation, <i>Aquifex</i> , <i>Tepidomonas</i> , <i>Rhodothermus</i> , <i>Pyrococcus</i> ; metallophilic - <i>Geobacter</i> ; stromatolites; microbial mat and biofilms.	(15)
2.2	Alkaliphiles / basophiles - <i>Alkalimonas</i> , <i>Nesterenconia</i> ; acidophiles - <i>Picrophilus</i> , <i>Ferroplasma</i> , <i>Thiobacillus ferrooxidans</i> ; halophiles - <i>Halomonas</i> , <i>Haloferax</i> , <i>Dunaliella salina</i> , <i>Hortaea werneckii</i> ; osmophiles - osmophilic <i>Lactobacilli</i> , <i>Schizosaccharomyces pombe</i> ; oligotrophs - <i>Pelagibacter</i> , <i>Caulobacter</i> ; xerophiles - <i>Wallemia</i> ; extreme cyanobacteria	(15)

	(<i>Phormidium</i> ; <i>Synechococcus lividus</i> , <i>Mastigocladus laminosus</i>); radiophiles - <i>Deinococcus radiodurans</i> ; xenobiotic degraders - <i>Pseudomonas</i> ; endoliths - <i>Chroococcidiopsis</i> , <i>Halotheca</i>	
Pedagogy:	Lectures/tutorials/assignments	
References/Readings	Blum, P., Archaea: New models for prokaryotic biology. Academic press. (2008)	
	Brock, T. D. Thermophilic microorganisms and life at high temperatures. Springer. (2011)	
	Cavicchioli, R., Archaea: Molecular and cellular biology. ASM Press. (2007)	
	Durvasula, R.V., Subba Rao, D.B. Extremophiles from biology to biotechnology. CRC Press. (2018)	
	Gerday, C., Glansdorff, N., Physiology and biochemistry of extremophiles. ASM Press. (2007)	
	Horikoshi, K. and Grant, W.D. Extremophiles-microbial life in Extreme Environments, Wiley. New York. (1998)	
	Kannan, P., Ignacimuthu, S., Paulraj, MG. Buffering capacity and membrane H ⁺ conductance of protease producing facultative alkaliphilic bacterium <i>Bacillus flexus</i> from mangrove soil. Indian J of Biochemistry and Biophysics. 46:261-265. (2009)	
	Medigan, M.T., Bender, K. S., Bukley, D.H., Sattley, W. M., & Stahl, D.A. Brock biology of microorganisms. Pearson. (2019)	
	Munn, C. Marine microbiology: Ecology and applications. Garland Science, Taylor and Francis Group. (2011)	
	Rainey, F.A. and Oren, A. Extremophile microorganisms and the methods to handle them. In: Extremophiles, methods in microbiology. Elsevier. (2006)	
	Satyanarayana, T., Raghukumar, C., Shivaji, S. Extremophilic microbes: diversity and perspectives. Current Science, 89(1): 78-90. (2005)	
	Ventosa, A., Nieto, J.J. and Oren, A. Biology of moderately halophilic aerobic bacteria. Microbiology and molecular biology Reviews, 62, 504–544. (1998)	
	Willey, J.M., Sherwood, L.M., and Woolverton, C.J. Prescott's Microbiology. McGraw-hill education. (2019)	
Course Outcomes	- Identify and compare different groups of extremophiles. - Analyse physiological features and adaptation strategies employed by different groups of extremophiles. - Develop extremophilic microbially derived product for industrial applications. - Apply high throughput techniques and culture independent approach to explore extremophiles from diverse niches and their unique properties.	