Programme: M.Sc. (Microbiology)

Course Code: MIO 102

Title of the Course: ARCHAEA [T]

Number of Credits: 3

Effective from Academic Year: 2018-19

Prerequisites	Basic knowledge of 3 domains of life, difference between prokaryotic cells, eukaryotic cells and archaea.	
Objective:	This course develops concept of Three domains of Life, Ecology, physiology and diversity of Archaea, cell structure and architecture of archaea, metabolism and energetics of archaea and Genetics of domain Archaea.	
Content:		
1.		**(12)**
1.1	**Significance of Archaea**: Biotechnology, Biogeochemical cycling, Evolutionary developments.	
1.2	**Ecology, physiology and diversity of Archaea** Global econiches: Deep Sea, Hydrothermal vent, Dead Sea, solar salterns, geothermal vents, solfataras, Antarctica, soda lake. Study of archaeal biodiversity; unculturable archaea by metagenomics. Archaeal culture retrieval methods, novel samplers. Preservation and maintainance of archaeal cultures. Nutrition, growth and growth kinetics and physiological versatility, Stress response of Methanogens (*Methanobacterium thermoautotrophicum)*; Halophiles (*H. salinarum)*; Thermophiles (*Thermoplasma acidophilum*); Thermoacidophiles (*Sulfolobus acidocaldarius)*; Psychrophilic archaea (*Methanogenium frigidum, Methanococcoides burtonii*); Methanotrophs.	
1.3	**Cell structure and architecture of Archaea:** Cellular organization: cell morphotypes, cell envelopes -archaeal membrane lipids and cell wall, appendages -pili, flagella, cannulae, hami. Novel bio-molecules: Glycerol diether moieties and macrocyclic lipid, novel enzymes, co-enzymes: methanopterin, formaldehyde activation factor, Component B, Coenzyme M, F420, F430, corrinoids.	
2.	**Metabolism and energetics of Archaea**	**(12)**
2.1	Modified anabolic pathways of carbohydrates and lipids; methanogenesis and acetoclastic reactions.	
2.2	Modified central metabolic pathways: EMP, ED, incomplete TCA; reverse Kreb cycle, carbon dioxide reduction pathways: reductive acetyl-CoA pathway, 3-hydroxypropionate pathway. Chemolithoautotrophy.	

2.3	Bioenergetics: ATP synthesis (i) respiration-driven (ii) light-driven, involving bacteriorhodopsin (iii) chloride-driven, involving halorhodopsin	
3.	**Genome of Archaea**	**(12)**
3.1	Size of genome, G + C content, associated proteins, archaeal histones and nucleosomes, introns in archaea, archaeal RNA polymerases, reverse DNA gyrase.	
3.2	Plasmids, transposons -IS elements. Modifications in tRNA and rRNA structure. Novel 7S rRNA. DNA replication, translation and transcription in archaea.	
3.3	Gene organization in Archaea: (i) *his* operon (ii) *bob* operon (iii) *mcr* operon.	
Pedagogy:	Lectures/tutorials/assignments/self-study	
References/ Readings	Woese, C. R., Fox, G. E., (1977) Phylogenetic structure of the prokaryotic domain: the primary kingdoms. Proc Natl Acad Sci USA. 74: 5088–5090.	
	Blum, P., Archaea: New Models for Prokaryotic Biology, Academic Press.	
	Cavicchioli, R., Archaea**:** Molecular and Cellular Biology, ASM Press.	
	Garrett, R. A. and Hans-Peter, K., Archaea: Evolution, Physiology and Molecular Biology, John Wiley and Sons.	
	Howland, J. L., The Surprising Archaea: Discovering Another Domain of Life, Oxford University Press.	
	Barker, D. M., Archaea: Salt-lovers, Methane-makers, Thermophiles and Other Archaeans, Crabtree Publishing Company.	
	Munn, C., Marine Microbiology: Ecology and Applications, Garland Science, Taylor and Francis Group, N.Y.	
	Boone, D. R. and Castenholz, R. W., Bergey's Manual of Systematic Bacteriology: The Archaea and The Deeply Branching and Phototrophic Bacteria, Springer Science and Business Media.	
	Corcelli, A. and Lobasso, S., (2006) Characterization of Lipids of Halophilic Archaea. Methods in Microbiology, 35: 585-613.	
	Rothe, O. and Thomm, M., (2000) A simplified method for the cultivation of extreme anaerobic archaea based on the use of sodium sulfite as reducing agent, Extremophiles. 4: 247-252.	
Learning Outcomes	1) Explains concept of third domain of Life Archaea. 2)Explains Ecology, Physiology and Biochemistry of domain Archaea. 3)Principles of Archaeal Genetics and application. 4)Application of Archaea and archaeal bioactive compounds in Industry.	