Name:

Enrolment No:

UPES

End Semester Examination, December 2023

Course: Biofertilizers and Bioremediation

Semester: III

Program: MSc Microbiology **Duration : 3 Hours**

Course Code: HSMB8010P **Max. Marks: 100**

Instructions:

A. All questions are compulsory.
B. Do not scribble anything on the question paper.
C. Draw neat-labelled diagrams and flow-charts wherever applicable.

S. No.	Section A Short answer questions/ MCQ/T&F (20Qx1.5M= 30 Marks)	Marks	COs
Q 1	Which of the following is incorrectly matched? a. Alnus – *Frankia* b. Alfalfa – *Rhizobium* c. Nitrogen fixer – *Anabaena* d. Mycorrhiza – *Rhodospirrilum*	**1.5**	**CO1**
Q 2	Which of the following is used as a biocontrol agent against caterpillars of butterflies? a. *Trichoderma* b. *Streptococcus* c. *Bacillus thuringiensis* d. *Saccharomyces cerevisiae*	**1.5**	**CO1**
Q 3	Which of the following is not a component of biofertilizer? *a. Mycorrhiza* *b. Rhizobium* *c. Agrobacterium* d. *Nostoc*	**1.5**	**CO1**
Q 4	What is the difference between biodegradation and bioremediation.	**1.5**	**CO2**
Q 5	Define Biofertilizers.	**1.5**	**CO1**
Q 6	Define Biopesticides.	**1.5**	**CO1**

Q 7	An effective biocontrol agent against plant diseases are different strains of: a. *Trichoderma* b. *Glomus* c. *Bacillus thuringiensis* d. *Baculovirus*	**1.5**	**CO1**
Q 8	6. Which of the following is a biocontrol agent for nematodal diseases? a. *Pseudomonas cepacia* b. *Pisolithus tinctorius* c. *Paecilomyces lilacinus* d. *Gliocladium virens*	**1.5**	**CO1**
Q 9	Given an example of Phytodegradation.	**1.5**	**CO2**
Q 10	Name one 'specialist' marine bacteria that becomes naturally enriched in crude-oil when nitrogen and phosphorus nutrients are supplemented.	**1.5**	**CO2**
Q 11	Why dispersed oil particles (natural or otherwise) are more amenable to microbial degradation?	**1.5**	**CO2**
Q 12	BATH assay is a way to test: a. Microbial surface hydrophobicity b. Surface Tension c. Emulsification index d. None of the above.	**1.5**	**CO3**
Q 13	A preferred marker for Nitrogenase gene expression studies in *Rhizobium* is: a. nif H b. nif A c. nif L d. nif D	**1.5**	**CO3**
Q 14	The following type of nitrogenase from *Azotobacter vinelandii* strains can be more efficient at temperatures as low as $5^{o}C$: a. Fe – Fe Nitrogenase b. Mo – Fe Nitrogenase c. V – Fe Nitrogenase	**1.5**	**CO2**
Q 15	Give an example of anaerobic hydrocarbon degradation via microbial syntrophy.	**1.5**	**CO2**

Q 16	A common bacterium that forms wastewater flocs in the activated sludge process is: a. *Zoogloea ramigera* b. *Ralstonia eutropha* c. *Shewanella algae* d. *Desulfotomaculum*	**1.5**	**CO2**
Q 17	The following microaerophilic diazotroph living in association with plant surfaces are promising for plant-growth promotion and as biofertilizers: a. *Azotobacter* spp. b. *Azospirillum* spp. c. *Anabena* spp. d. *Nostoc* spp.	**1.5**	**CO1**
Q 18	Reductive dechlorination is a form of anaerobic respiration in which various chlorinated organic compounds act as _____ to release chlorides: a. Electron donors b. Terminal electron acceptors	**1.5**	**CO2**
Q 19	RT-PCR method targets Homologous Genes _____ for quantification of Alkane Monooxygenase in Environmental Samples: a. alk B b. alk A c. alk C d. alk D	**1.5**	**CO3**
Q 20	Uranium (U) exists in two redox states as U (VI) or U(IV). Which microbially mediated reaction, oxidation or reduction, is key to U bioremediation and why?	**1.5**	**CO2**
Section B (4Qx5M=20 Marks)			
Q 1	a. Give examples of different career materials for soil and seed inoculation of Rhizobia based biofertilizers. (2) b. State the essential criteria for carrier selection. (3)	**5**	**CO1**
Q2	a. What are BTEX compounds? (1) b. Write down their chemical structures. (4)	**5**	**CO2**
Q3	a. What are biosurfactants? (1) b. Write a short note on their applications for bioremediation. (4)	**5**	**CO2**
Q4	Explain two simple methods for isolation and screening of: a. Phosphate solubilising bacteria. (2.5) b. Siderophore producing microbes. (2.5)	**5**	**CO3**

Section C **(2Qx15M=30 Marks)**			
Q 1	Growing interest in sustainable agriculture is leading to screening of various Rhizobia species for beneficial traits that improve nodulation and nitrogen fixation under abiotically stressed conditions. In the context of climate change, agriculture faces complex and unique problems. Crop production is directly dependent on natural resources, weather, and climatic conditions. a. How climate change affects nodulation of legumes? (3) b. Write down isolation method of Rhizobia from nodules. (4) a. Explain various methods used for screening efficient strains of Rhizobium. (8)	**15**	**CO1 and CO3**
Q 2	Arsenic (As) in drinking-water is a major public health problem in many areas of the Indo-Gangetic plains. Arsenicosis is a serious health condition due to prolonged ingestion of As from ground-waters. Microbial transformations can affect mobilization of As in groundwater from aquifer sediments / industrial wastes into ground water and agricultural fields. Certain bacteria can utilise As for energy conservation and thereby alter the redox state from more toxic to less toxic forms of As. This approach is emerging as a promising way for bioremediation. a. What is the permissible limit of As in ground water? (1) b. Write down redox states of As oxyanions with chemical structures. Which is the more toxic form of As? (2) c. State a hypothesis for microbial remediation of As from contaminated soils. (2) d. Design an experimental study to test your stated hypothesis from As contaminated soils. (10)	**15**	**CO2 and CO3**
Section D **(2Qx10M=20 Marks)**			
Q 1	a. How do monooxygenases differ from dioxygenases? (2) b. What is the final product of hydrocarbon catabolism? (1) c. Explain the biodegradation pathway of Toluene in details by *P putida* under aerobic conditions. (7)	**10**	**CO2**
Q 2	Describe the symbiotic associations of *Azolla* with a neat diagram and their effective applications as biofertilizers.	**10**	**CO1**