**3 Hours** **Total Marks: 100**

1. **Attempt all questions.**
2. **All questions carry equal marks.**
3. **Draw neat labelled diagrams wherever necessary.**
4. **Use of log tables and non-programmable calculator is allowed.**

**Q.1 a. Explain the following terms: (Any six)** **06**

1. Biodigester is a device used to _____.
   (a) Produce electricity b) Store biogas c) Produce biogas d) Clean the air)
2. Biomass energy is an example of _____ energy.
   (a) Renewable b) Non-renewable c) Nuclear d) Fossil fuel)
3. Ethanol is produced by the fermentation of _____.
   (a) sugar and starch b) cellulose and lignin c) protein and fat d) water and salt)
4. Geothermal energy is derived from the _____ of the earth.
   (a) sun b) wind c) heat d) water)
5. Hydropower is generated by harnessing the energy of _____.
   (a) the sun b) the wind c) flowing water d) the earth's heat)
6. The primary ingredient for biodiesel production is _____.
   (a) ethanol b) vegetable oil c) natural gas d) coal)
7. Which of the following is a source of ethanol production?
   (a) petroleum b) coal c) natural gas d) corn)
8. Which renewable energy source is used to turn wind turbines and generate electricity?
   (a) solar energy b) wind power c) geothermal energy d) hydropower)
9. Microbial hydrogen production involves the use of _____.
   (a) algae b) bacteria c) fungi d) viruses)

**Q.1 b. Answer the following questions: (Any Two)** **14**

1. What are the factors that affect the production of biogas
2. Describe the different stages involved in the production of ethanol.
3. Elaborate on hydrogen as a renewable fuel.

**Q.2 a. Do as instructed: (Any six)** **06**

1. The mediterranean mussel was used successfully to monitor _____ contamination
   a. heavy metal b. TNT c. DDT d. PCP
2. _____ present in aqueous wastes can be effectively detoxified using immobilized mycelia of Stemphylium loti
   a. Nitrate b. Cyanide c. Lignin d. Phenol
3. _____ has also been used to determine methanogens in samples from an anaerobic digester
   a. RIA b. ELISA c. Western blotting d. Flow cytometry
4. Sequestration by _____ in bacteria is one of the mechanisms for detoxification of heavy metals
   a. phytochelatins b. metallothioneins
   c. glutathione d. ethoxyresofurin

5. _____ has been used as a bioindicator for the contamination of the atmosphere by heavy metals
   a. honey bees b. periphyton c. lichen d. moss
6. Chemical property of xenobiotic compounds which influence their biodegradability
   a.Lack of oxygen b. Lack of nitrogen c. Lack of sulphur d. lack of carbon
7. The marker gene from eukaryotes which can be used as a genetic indicator for monitoring of pollution
   a. *luc* b. *lux AB* c. *lac ZY* d. *mer*
8. In _____ BOD sensor a microbial film is sandwiched between a porous membrane and the oxygen - permeable membrane of a Clark electrode
   a. biofilm b.respirometer c.fuel cell d.biotron
9. *Vibrio fischeri* was used to screen the effect of _____
   a. TNT b. PCP c.PCB d. PCDD

**Q.2 b. Discuss the following questions: (Any Two)** **14**

1. Any two methods of anaerobic biological treatment of wastewater.
2. Biosensors with suitable examples.
3. Non- hazardous solid wastes- methods used in treatment and disposal

**Q.3 a. Do as directed: (Any Six)** **06**

**Select the correct alternative -**

1. Energy is generated during _____ of inorganic compounds by autotrophs.
   a) Reduction b) Dehydrogenation
   c) Polymerization d) Oxidation
2. _____ means the processes by cells or biomass which is metabolically not active.
   a) Biostimulation b) Biosorption
   c) Biomethylation d) Bioaugmentation
3. *Trichoderma viride* immobilized in china clay in columns can be used to remove _____ from effluent buffered at pH 5.5.
   a) Mercury b) Cadmium c) Chromium d) Copper
4. _____ was the most toxic cadmium salt.
   a) $Cd(NO_3)_2$ b) $CdCl_2$ c) $CdSO_4$ d) CdO
5. _____ system allows effluents to pass through engineered channels that contain cyanobacteria, algae, higher plants.
   a) Meander b) Primary c) Simple d) Linear

**State True or False -**

6. Extracellular enzymes attack only those substrate molecules which can get transported into the cell.
7. *Pseudomonas aeruginosa* immobilized on reticulated foam can be used for removal of cadmium with 99 % efficiency.

**Answer the following -**

8. Define - Biostimulation.
9. Give any one major source of heavy metal pollution.

**Q.3 b.** **Answer the following: (Any Two)** **14**

1. Elaborate on - Use of bacteria in biosorption with suitable examples.
2. Describe the impact of pollutants on biotreatment.
3. Explain the advantages, constraints and potential applications in the use of GEMs.

**Q.4 a.** **Do as directed: (Any six)** **06**

**Select the correct alternative -**

1. _____ is a major atmospheric pollutant that contributes to the formation of acid rain precipitation and acid smog.
   a) $NO_2$ b) $SO_2$ c) $CO_2$ d) $H_2S$
2. Polishing pond helps to reduce TSS and _____.
   a) BOD b) COD c) pH d) Temperature
3. The most extensively characterized alkane degradation pathway is encoded by the _____ plasmid.
   a) OCT b) OTC c) OFC d) OCG
4. Use of _____ minimizes oil sorption to sediments and organisms.
   a) Dispersants b) Digesters c) Cleansers d) Controllers

**Answer the following -**

5. Give any one example of mechanical pulping processes.
6. Give any one type of natural resin acids.
7. Write any one use of aboveground bioreactors.
8. Give one example of the solid support media used in fixed film bioreactor.
9. Define - Chamoising.

**Q.4 b.** **Answer the following questions: (Any Two)** **14**

1. Explain in detail - Single phase anaerobic treatment of dairy effluents.
2. Describe the characteristic features of petroleum waste.
3. Elaborate on - Chemical methods used for waste treatment in pharmaceutical manufacturing industry.

**Q.5** **Write Short notes on the following (Any four)** **20**

**a.** Biomass energy.
**b.** Pollution indicators.
**c.** Advantages of biosorptive processes.
**d.** Microbial systems used for heavy metal accumulation.
**e.** Phytoremediation by aquatic weeds.
**f.** Steam stripping and steam stripping with rectification.

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