*Ref. No.EX/PG/EBT/T/127/2024*

**M. TECH. ENVIRONMENTAL BIOTECHNOLOGY FIRST YEAR SECOND SEMESTER - 2024**

**Subject: WASTEWATER TREATMENT & BIOREMEDIATION** **Time: Three Hours** **Full Marks: 100 (70/30 for Part-I/Part-II)**

**Part: Part-I (70 Marks)**

**Use a Separate Answer-Script for Each Part**
**Answer any 3 (Three) questions (One Mark for Neatness)**

1. Design a bar rack and screen chamber for fully cleaned as well as 50% clogged conditions with raised floor downstream to the bars. Also, sketch a hydraulic profile through the bar rack and screen chamber. The data given is as follows: Average Flow = 60 MLD; Peak Flow = 180 MLD; Diameter of Incoming Sewer = 1.40 m; Depth of Flow in Sewer at Peak Flow = 1.05 m; Velocity in Sewer at Peak Design Flow = 1.16 m/sec; Drop of Screen Chamber Floor with respect to Sewer Invert = 0.10m; Width of Rectangular Bars = 10 mm; Clear Spacing between Bars = 25 mm; Bar Shape Factor $\beta = 2.42$; Inclination of the Bar Screen = $75^{O}$. Assume any other suitable data and suitable formula as and when necessary. 23

2. Design grit chamber to remove grit particles based on the following given data. Also design a proportional flow weir (symmetrical sharp-edged; c = 0.61) which acts as a control device at the effluent point. Average Flow = 60 MLD; Peak Flow = 180 MLD; Size and Specific Gravity of the Grit Particles to be removed = 0.15 mm and 2.65; The Minimum Temperature = $15^{O}$C and Viscosity $\nu = 1.14 \times 10^{-6}$ $m^2/s$; Efficiency of Removal $\eta = 75\%$; Measured Settling Basin Performance n = 1/8; K = 0.04 and f = 0.03. Assume any other suitable data and suitable formula as and when necessary. 23

3. (a) Applying the mass balance approach on bio-mass and food, derive the driving equations for an activated sludge process with a completely mixed reactor (with a neat diagram). 5

(b) An activated-sludge system will be used to secondary treatment of 60 MLD municipal wastewater. Raw Wastewater $BOD_5$ = 300 mg/L; Raw Wastewater SS Concentration = 400 mg/L; Primary Sedimentation Efficiency for BOD Removal = 30%; Primary Sedimentation Efficiency for SS Removal = 70%; Primary Sludge SS Concentration = 40 $kg/m^3$. It is desired to have not more than 5 mg/L of soluble BOD in the ASP effluent. A completely mixed reactor is to be used, and pilot plant analysis has established flowing kinetic values: Y = 0.5 kg/kg, $k_d$ = 0.05/day. Assuming an MLSS concentration of 3000 mg/L and an underflow concentration of 10 $kg/m^3$ from the secondary clarifier. Determine the following: Volume of the Reactor; Quantity of the Secondary Sludge; The Sludge Recycle Ratio. Assume any other suitable data and suitable formula as and when necessary. 18

4. Design a secondary sedimentation tank (circular) to treat effluent from an Activated Sludge Process based on the following data: Average Flow = 60 MLD and Peak Flow Factor = 2.25; Influent MLSS concentration = 3000 mg/L; Surface Loading Rate = 20 $m^3$/ day/ $m^2$; Solid Loading Rate = 80 kg/ day/ $m^2$ (Average Flow); Solid Loading Rate = 210 kg/ day/ $m^2$ (Peak Flow); Permissible Weir Loading = 150 $m^3$/ day/ m; For effluent weir, provide $90^{O}$ V-notches @ 20 cm c-c with $C_d$ = 0.60. 23

[ Turn over

**Ref. No.: Ex/PG/EBT/T/127/2024** **2nd Semester Examination**

**M. Tech. (Environmental Biotechnology) Session 2023-24**

**BIOREMEDIATION**

**Full marks : 100** **Time 3 hrs**

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**Part - II (30 Marks)**

*Each question carries 10 marks. Answer any three questions*

1. Discuss briefly the biochemical pathways for the anaerobic biodegradation of perchloroethene and aerobic degradation of trichloroethene.

2. Discuss briefly the biochemical pathways for the biodegradation of aliphatic and aromatic petroleum hydrocarbons.

3. Discuss briefly the importance of biodegradable plastics.

4. Discuss briefly how the molecular modification of a detergent transformed it from a recalcitrant to a biodegradable one.

5. With diagrams briefly explain sequential anaerobic and aerobic bioremediation in the real field situation.

6. Briefly discuss the Lasagna Process of soil bioremediation.