CEL459: River Mechanics
Minor II

Time: One Hour **Marks: 20**

Solve the following. Assume the missing data suitably.

Q.1 Derive the following expression for concentration profile of individual size fractions in multisized particulate transport starting from basic advection-diffusion governing equation:

$$\varepsilon \frac{\partial C_j}{\partial y} + C_j(w_j - v_y) = 0 \; ; j = 1,2,\ldots..,n$$

Different notations have their usual meaning. **[4]**

Q.2 Water flows at a depth of 1 m in a wide stream having a bed slope of 1 in 2500. The median diameter of the sand bed is 1 mm. Determine whether the stream bed is scouring or non-scouring. **[1]**

Q.3 A canal is to be designed to carry a discharge of 550 cumecs. The slope of canal is 1 in 1200. The soil is coarse alluvium having a grain size of 45 mm. Assume the canal to be unlined with unprotected banks and of a trapezoidal section, determine a suitable section for the canal, angle of repose ϕ and Manning's constant n may be taken as 34° & 0.023, respectively. **[5]**

Q.4 (a) Draw the shields' diagram for incipient motion of sediment particles in alluvial channel. **[2]**
(b) Draw and describe various bedforms in an alluvial channel. **[3]**

Q.5 Following table gives the suspended sand concentration in the flow through a river having rectangular cross-section. Given, the bed slope 0.00012, flow depth 7.8 m, river width 200 m, specific gravity of particles as 2.65, kinematic viscosity as 1×10^{-06} and von Karman coefficient as 0.4.

Distance from bed (m)	Concentration (mg/l)
0.7	411
1.4	299

Estimate the particle diameter. **[5]**

Fall regime and range of particle Reynolds number (R_{ed})	Relation for drag coefficient (C_D)
$R_{ed} \leq 1.0$	$C_D = 24\, R_{ed}^{-1}$
$1 < R_{ed} \leq 1000$	$C_D = 24\, R_{ed}^{-1}\,(1+0.15\, R_{ed}^{0.687})$
$1000 < R_{ed} \leq 2 \times 10^5$	$C_D = 0.44$

$$\tau_c = 0.155 + \frac{0.409 d_{50}^{\,2}}{\sqrt{1 + 0.177 d_{50}^{\,2}}} N/m^2 ; d_{50}(mm). \quad \frac{C}{C_a} = \left[\frac{a(H-y)}{y(H-a)}\right]^{\frac{w}{\kappa U_*}}$$