M.E. (Water Resources & Hydraulic Engg.) Examination (6 Semester), 2019

(2nd Semester)

HYDRAULICS & SEDIMENT TRANSPORT

(Paper - III)

Time : Three Hours

Full Marks : 100

Answer any ***four*** questions.

1. a) What do you mean by Fluvial Hydraulics?
   b) Mention the various types of problems related to alluvial rivers and channels.
   c) Define and explain the following:
   (i) nominal diameter, (ii) fall diameter, (iii) sedimentation diameter and (iv) sieve diameter.
   d) Define "roundness" based on shape of a sedimentary particle.
   e) What are the bulk properties of sediment?

   3+6+10+3+3= 25

2. a) Define (i) volume constant, (ii) surface constant, (iii) triaxial size (iv) sphericity, (v) flatness ratio and (vi) fall velocity.
   b) What are the assumptions made in the derivation of Stokes' Law? Derive the Stokes' Law for the terminal fall velocity of a sphere and find out the Stokes' Number?

   15+10 = 25

3. a) Find out the linear law in viscous sub layer.
   b) Explain the Prandtl's mixing-length theory with neat sketch.
   c) Prove the following relationship between total shear stress (τ) and bed shear stress (τ_0):

$$\tau = \left[1 - \frac{z}{h}\right]\tau_0$$

   where z and h are the instantaneous depth and total depth of a channel.

   7+8+10 = 25

4. a) Compare between (i) aggradation and degradation, (ii) silt extractor and silt excluder and (iii) shinning surface and markings on the surface.
   b) A sample of 2×10^{-3} m^3 of river water is evaporated to collect suspended sediment of 5.2 N (dry weight), having d_{50} = 0.2 mm and s = 2.65. Determine (i) sediment concentration by volume (C), (ii) sediment concentration by mass (c), (iii) mass density of fluid sediment mixture (ρ_m),

(iv) specific weight of water sediment mixture (γ_m), and (v) kinematic viscosity of water sediment mixture (ν_m). Consider dynamic viscosity for a clear water (μ) as 10^{-3} Pa.s.

10+15 = 25

5. a) In case of a fluid flow over a solid boundary classify different flow layers like laminar sub layer, buffer layer, turbulent logarithmic layer and turbulent outer layer using suitable sketch. Then show the depth wise variation of turbulent shear stress and viscous shear stress with respect to total shear stress. Also draw the velocity profiles of different layers.

   b) Water flows at a depth of 0.8 m in a 10 m wide stream having a bed slope of 1 in 2500. The median diameter of the sand bed is 3 mm. Determine whether the soil particles are stationary or moving, and comment as to whether the stream bed is scouring or non-scouring. Assume specific gravity of the sand bed is 2.65.

   c) Differentiate between dunes and ripples.

11+9+5 = 25

6. a) Find out the relation between critical Shields' parameter and critical Reynolds' number due to critical shear velocity in case of a steady flow over a bed composed of non-cohesive sediment particles.

   b) The median diameter of the sediment particles are 1.83 mm, specific gravity of the sediment particles are 2.5, dynamic viscosity (μ) of water at 20^0C is 0.9×10^{-3} Ns/m^2.

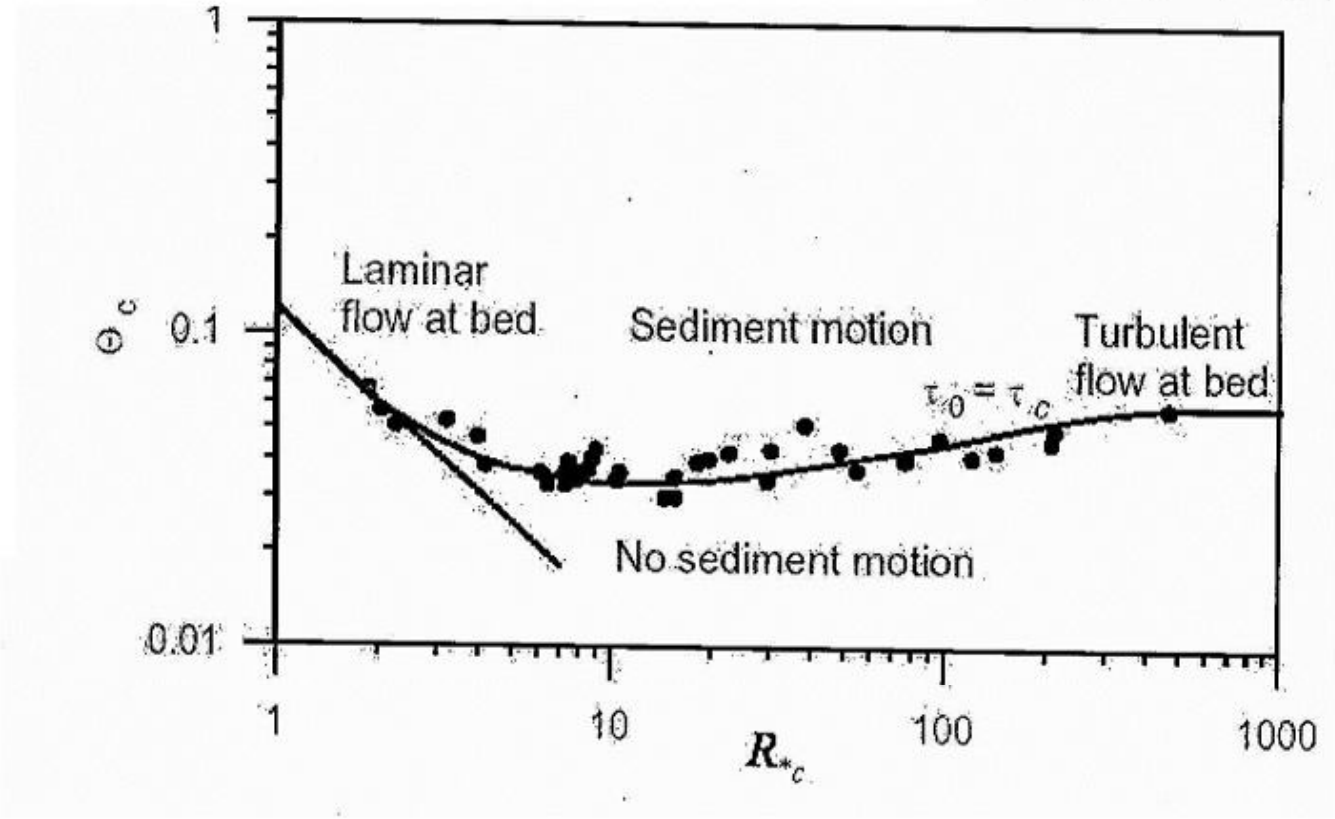
      (i) Find out the particle parameter (D_*) and critical Shields' parameter (Θ_c) from van Rijn empirical equations of the Shields' curve.

      (ii) Then from the obtained critical Shields' parameter, calculate the critical shear velocity (u_{*_c}) and critical bed shear stress (τ_{0c}) of the sedimentary particles.

      (iii) From the Shields' diagram find the value of Reynolds' number for the critical shear velocity (R_{*_c}) and comment about the nature of the flow. Also calculate the value of (u_{*_c}) and compare with the previous one.

   Calculate the angle of repose from the empirical equations of the Shields' curve proposed by Julien.

13+12 = 25


1
0.1
0.01
Θ^c
Laminar
flow at bed
Sediment motion
Turbulent
flow at bed
$\tau_0 = \tau_c$
No sediment motion
1
10
100
1000
R_{*c}