M.E. (Water Resources & Hydraulic Eng.) (6 Semester) Exam., 2025

(2nd Semester)

FLUVIAL HYDRAULICS

(Paper V)

Time : Three Hours | Full Marks : 100

Answer any ***five*** questions.

1. a) What do you mean by (i) sphericity, (ii) alluvial river dynamics, (iii) roundness, (iv) nominal diameter, (v) sedimentation diameter?
   b) Differentiate between aggradation and degradation.
   c) Derive the tangential and normal acceleration components in the case of 1-D flow along a streamline, consider a fluid particle undergoing a small displacement *ds* in a short interval of time *dt*

   9+3+8= 20

2. a) Differentiate between the Eulerian method and Lagrangian Method.
   b) Consider a fluid element of lengths *dx*, *dy*, and *dz* in the direction of *x*, *y* and *z*. let *u*, *v* and *w* are the inlet velocity components in the *x*, *y* and *z* directions, respectively. Then derive the continuity equation in the case of steady, incompressible flow.
   c) Derive Euler's equation of motion. Show that the integration of Euler's equation yields Bernoulli's equation.

   2+8+10 = 20

3. a) What is clear water scour and live bed scour? Explain with a figure the time to reach equilibrium scour condition for clear water scour and live bed scour.
   b) What is bridge pier scour? What are the three types of scour that affect bridges?
   c) What is a block ramp? Explain why block ramps are preferred over check dams in mountainous rivers.
   d) What is the difference between Froude number and Densimetric Froude number?
   e) Discuss the effect of sediment size on bridge pier scour.
   f) Explain the effect of approach flow depth on bridge pier scour

   6+(1+3)+4+3+1.5+1.5 = 20

4. a) Deduce the relationship between total shear stress and bed shear stress.
   b) Show the diagrams of velocity profiles in different layers.
   c) Find out the logarithmic law in the turbulent layer.

   8+5+7=20

5. a) Classify hydraulically smooth, rough, and transitional flow.
   b) Derive the RANSE.

4+16=20

6. a) What do you mean by the condition of incipient motion?
   b) Find out the relation between the critical Shields' parameter and Reynolds' number.
   c) Find out the expression for average shear stress.

2+13+5= 20

7. a) Differentiate between wash load and suspended load.
   b) What are dunes, antidunes, ripples, chutes, and pools?
   c) Derive a bed-load transport equation

3+6+11 = 20

8. a) If the sediment particle size is 1 mm, the specific gravity of the sediment particle is 2.65, Slope of the channel is 0.0001. Find the depth of the channel at which the sediment just begins to move.
   b) A sample of 2.45×10^{-3} m^3 of river water is evaporated to collect suspended sediment of 5.1 N (dry weight), having a mean sediment size of 0.15 mm and a specific density of sediment equalling 2.65. Determine (i) sediment concentration by volume, (ii) sediment concentration by mass, (iii) mass density of fluid sediment mixture, (iv) specific weight of water-sediment mixture, and (v) kinematic viscosity of water-sediment mixture. Consider the dynamic viscosity of clear water as 10^{-3} Pa.s.
   c) The median diameter of the sediment particles is 1.84 mm, the specific gravity of the sediment particles is 2.6, and the dynamic viscosity of water at 20°C is 0.92×10^{-3} Ns/m^2.
      (i) Find out the particle parameter and critical Shields' parameter from van Rijn's empirical equations of the Shields' curve.
      (ii) Then, from the obtained critical Shields' parameter, calculate the critical shear velocity and critical bed shear stress of the sedimentary particles.
      (iii) From Shields' diagram (Fig. 1), find the value of Reynolds' number for the critical shear velocity and comment on the nature of the flow. Also, calculate the value of critical shear velocity and compare it with the previous one.

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

5+7+8= 20

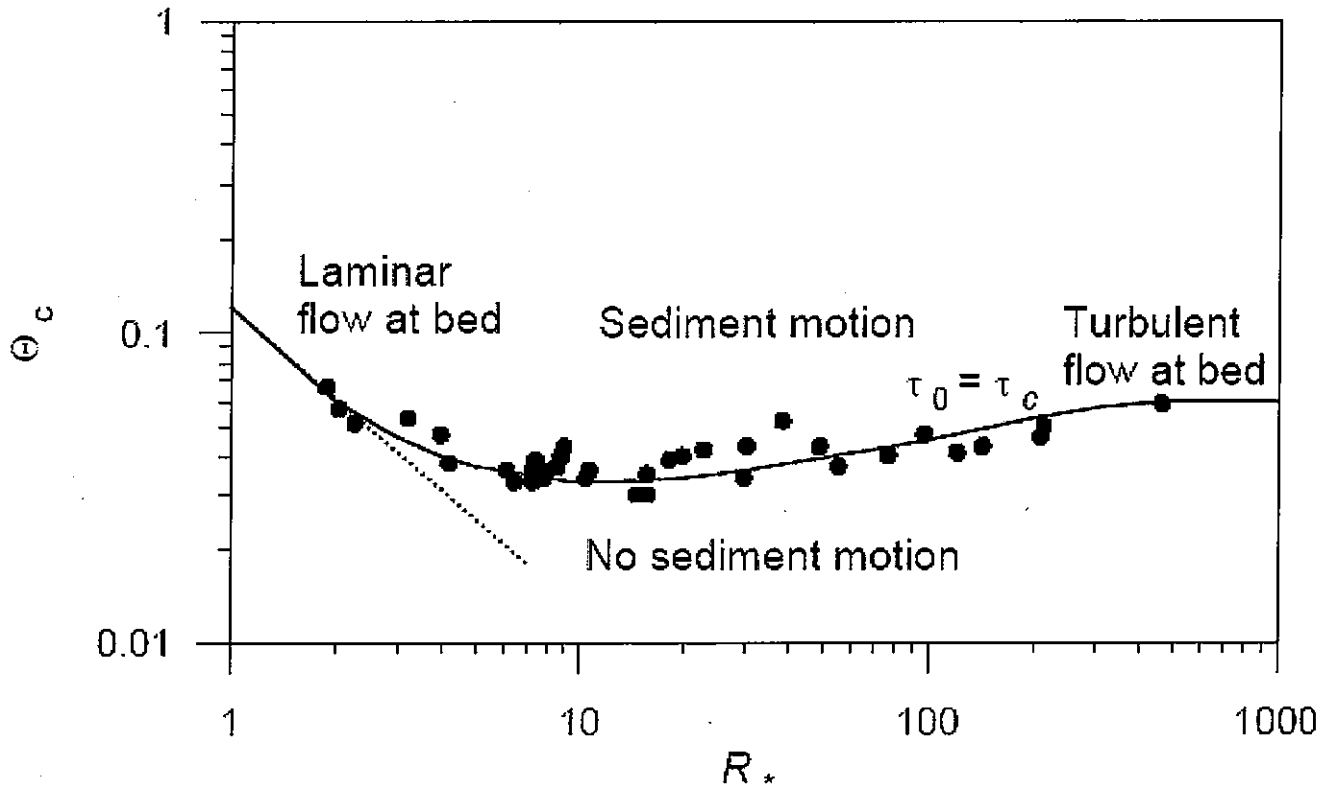

Fig. 1 Shields parameter as a function of particle Reynolds number