KATHMANDU UNIVERSITY
End Semester Examination
January/February 2024

Level : B.E.
Year : III
Time : 2 hrs. 30mins.

22 JAN 2024

Course : CIEG 301
Semester : I
F. M. : 40

SECTION "B"

Attempt *ALL* questions. Make suitable assumptions when needed.

1. What do you understand by hydraulic models? What type of models would you prefer in making headworks of hydropower? And why? [1+3]

2. A spillway is to be built to a geometrically similar scale of 1/30 across of flume of 650 mm width. The prototype is 18m high and maximum head on it is expected to be 2.1m. [1+1+2]
   a. What height of model and what head on the model should be used?
   b. If the flow over the model at a particular head is 12 l/s, what flow per meter length of the prototype is expected?

3. What are the losses experienced in pipe flow? Explain briefly. [3]

4. Steel pipe 2 km long x 60cm diameter x 1.2cm wall thickness conveys water at the rate of 2 m^3/s. Determine the increase in pressure when a valve provided at D/S end of pipe is closed instantaneously. Consider the pipe to be elastic and take bulk modulus of water $k = 2 \times 10^9$ N/m^2, and modulus of elasticity of steel $E = 2 \times 10^{11}$ N/m^2. [3]

5. What do you understand by GVF? Differentiate GVF and RVF with examples. [1+3]

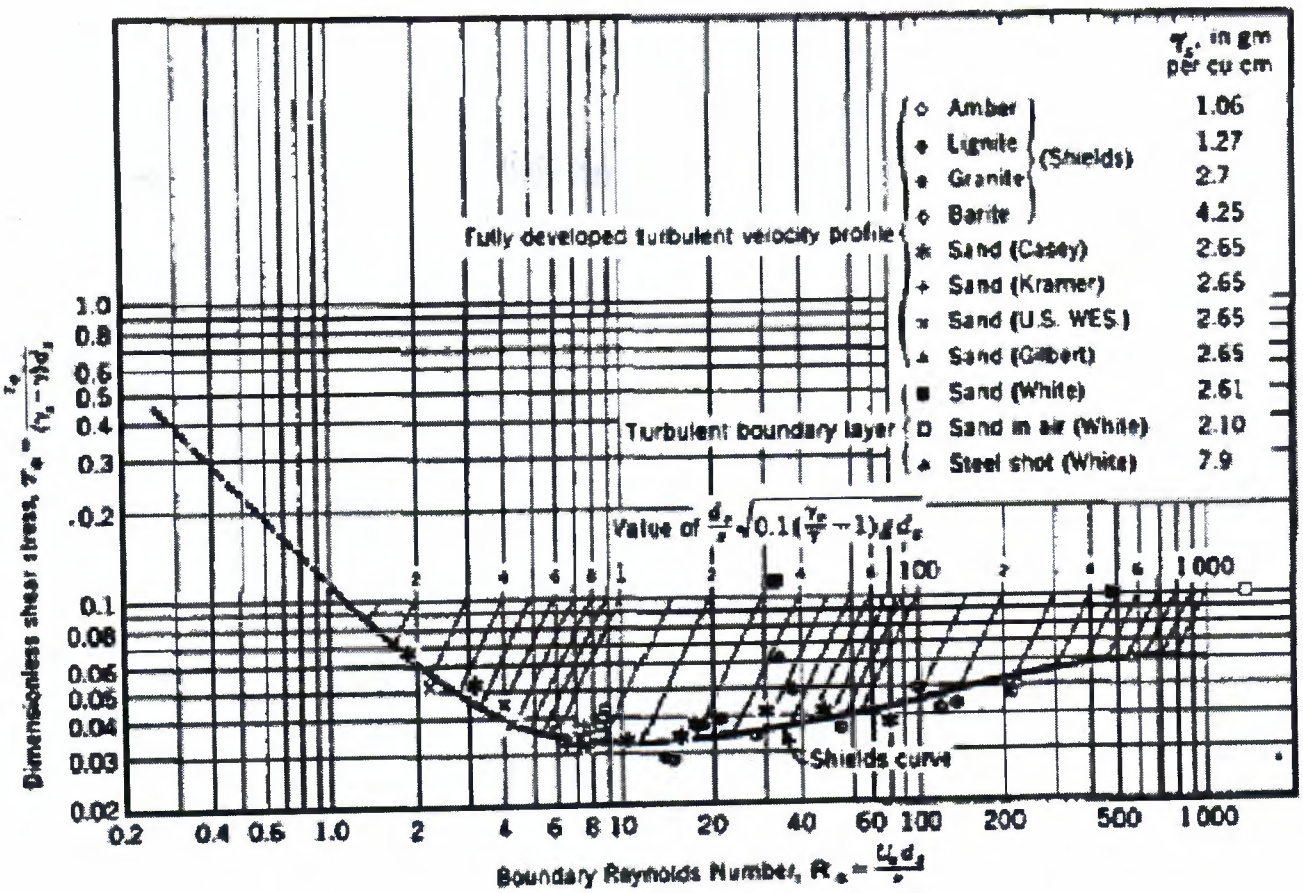
6. A trapezoidal channel has a side slope of 3H: 2V and the slope of bed is 1 in 2000. The area of section is $27m^2$. Find the dimensions of the sections, if it is most economical. Determine the discharge of the most economical section if C = 65. [4]

7. State the differences in designing of rigid boundary and mobile boundary channel. [3]

8. Water flows at a steady and uniform depth of 1.8 m in an open channel of rectangular cross-section having base width equal to 8m and laid at a slope of 1 in 1500. It is desired to obtain critical flow in the channel by providing a hump in the bed. Calculate the height of the hump and sketch the flow profile. Consider the value of Manning's rugosity coefficient N=0.02 for the channel surface. [5]

9. Water flow in 16 m wide rectangular channel at a rate of $120m^3/s$. Bed slope is 0.002 and n = 0.014. A dam placed downstream raises the height to 6.2m immediately behind the dam. What is the distance upstream to a point where depth is 3.6 m. Find by two step? [5]

10. In a wide rectangular mobile boundary channel average velocity is 0.8m/s, depth of flow is 0.8m, sediment size 0.92mm, specific gravity of sediment is 2.65, bed slope is 1 in 5000 and $\upsilon = 10^{-6}$ m^2/s. Examine the possibility of motion of sediment by Shield's tractive force theory. [5]


γ_s, in gm per cu cm
Amber 1.06
Lignite 1.27
Granite (Shields) 2.7
Barite 4.25
Sand (Casey) 2.65
Sand (Kramer) 2.65
Sand (U.S. WES) 2.65
Sand (Gilbert) 2.65
Sand (White) 2.61
Sand in air (White) 2.10
Steel shot (White) 7.9
Fully developed turbulent velocity profile
Turbulent boundary layer
Value of $\frac{d_s}{s}\sqrt{0.1(\frac{\gamma_s}{\gamma}-1)gd_s}$
Shields curve
Dimensionless shear stress, $\tau_* = \frac{\tau_0}{(\gamma_s-\gamma)d_s}$
Boundary Reynolds Number, $R_* = \frac{u_* d_s}{\nu}$
1.0
0.8
0.6
0.5
0.4
0.3
.0.2
0.1
0.08
0.06
0.05
0.04
0.03
0.02
0.2
0.4
0.6
1.0
2
4
6
8
10
20
40
60
100
200
500
1 000

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Marks Scored:

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Registration No.:
Date :

SECTION "A"
[20Q. × 0.5 =10 marks]

Encircle the most appropriate answer.

1. If three pipes of different diameters, lengths and friction factors are connected in series
   a. $f = f_1 = f_2 = f_3$ b. $v = v_1 + v_2 + v_3$ c. $Q = Q_1 + Q_2 + Q_3$ d. $Q = Q_1 = Q_2 = Q_3$

2. Depth at which the specific energy is minimum is known as
   a. Conjugate depth b. Critical depth c. Alternate depth d. Normal depth

3. Dynamic similarity between model and prototype implies that
   a. The forces acting at corresponding locations are same
   b. The flow pattern is similar
   c. There is point to point correspondence between the two systems
   d. Both the systems undergo similar rates of change of motion

4. Which of the following has the form of Reynolds number?
   a. $\Delta p/\rho v^2$ b. $v2L\rho/\sigma$ c. $vd\rho/\mu$ d. $v/\sqrt{gd}$

5. The closure of valve is said to be sudden when the time of closure t is
   a. $t = L/c$ b. $t = 2L/c$ c. $t < 2L/c$ d. $t = 2L/v$

6. According to Darcy's formula, the loss of head due to friction in the pipe is (where f = coefficient of friction, L = Length of pipe, v = velocity of liquid in pipe and D = Diameter of pipe)
   a. $(f*L*v^2)/gD$ b. $(4f*L*v^2)/2gD$
   c. $(3f*L*v^2)/2gD$ d. $(f*L*v^2)/2gD$

7. The most economical section of a trapezoidal channel is the one which has
   a. Breadth half the depth b. Depth half the sloping side
   c. Hydraulic radius half the breadth d. Side slope half the top width

8. If the depth of flow in an open channel is less than the critical depth, the flow is called……..
   a. Critical flow b. Turbulent flow c. Subcritical flow d. Supercritical flow

9. The channel in which the flow transport sediment having the same characteristic as that of material in the channel is called……..
   a. Prismatic b. Alluvial
   c. Non- Prismatic d. Rigid boundary channel

10. The force exerted by the flowing liquid on the channel perimeter is called……
    a. Normal force b. Pressure force c. Tractive force d. Lift force

11. Kinematic similarity between the model and prototype is the
    a. Similarity of motion
    b. Similarity of lengths
    c. Similarity of discharge
    d. Similarity of forces

12. In Hardy Cross method of solving pipe network, the algebraic sum of head losses round each loop must be .....
    a. Positive
    b. Zero
    c. Negative
    c. One

13. The dynamic equation of gradually varied flow is given by.....
    a. $S_b-S_f = (dy/dx)[1-(Q^2*T/g*A^3)]$
    b. $S_f-S_b = (dy/dx)[1-(Q^2*T/g*A^3)]$
    c. $S_b-S_f = [1-(Q^2*T/g*A^3)]$
    d. $S_b-S_f = (dy/dx)\ [1-(Q^2*A^3/g*T)]$

14. In uniform flow there is a balanced between
    a. Gravity and frictional forces
    b. Gravity and inertial forces
    c. Inertial and frictional forces
    d. Inertial and viscous forces

15. A hydraulic jump occurs when there is a break in grade from a
    a. Mild slope to steep slope
    b. Steep slope to mild slope
    c. Steep slope to steeper slope
    d. Mild slope to milder slope

16. In a hydraulic jump the energy loss is expressed as
    a. $(y_2 - y_1)^2/4y_1.y_2$
    b. $(y_2 - y_1)^3/4y_1.y_2$
    c. $(y_2 - y_1)/4y_1.y_2$
    d. $(y_2 - y_1)^{1/2}/4y_1.y_2$

17. Identify the incorrect statement:
    a. Mild slope channels are M_1, M_2, and M_3
    b. Adverse slope channels are A_2 and A_3
    c. Horizontal channels are H_1 and H_3
    d. Critical slope channels are C_1 and C_3

18. In the uniform flow in a channel of small bed slope, the hydraulic grade line is
    a. Coincides with the bed
    b. is considerably below the free surface
    c. is considerably above the free surface
    d. essentially coincides with the free surface

19. Rigid boundary channel is designed by
    a. Method of economic section
    b. Method of tractive force
    c. Alluvial soil regime approach
    d. Hardy cross method

20. For maximum discharge through a circular channel, the depth of flow should be equal to
    a. 0.6 times the diameter of the channel
    b. 0.8 times the diameter of the channel
    c. 0.95 times the diameter of the channel
    d. 1.2 times the diameter of the channel