KATHMANDU UNIVERSITY
End Semester Examination
June/July, 2023

Marks Scored:

Level : B.E.
Year : II

Course : CIEG 204
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date :

SECTION "A"
[20 Q. × 0.5 = 10 marks]

Encircle the most appropriate option.

1. Stoke is the unit of
   a. Mass density
   b. Kinematic viscosity
   c. Surface tension
   d. Dynamic viscosity

2. A stream line is a line
   a. Which is along the path of a particle
   b. Which is always parallel to the main direction of flow
   c. Across which there is no flow
   d. On which tangent drawn at any point gives the direction of velocity

3. The resultant hydrostatic force acts through a
   a. Center of gravity
   b. Centroid
   c. Center of buoyancy
   d. Center of pressure

4. Continuity equation deals with the law of conservation of
   a. Mass
   b. Momentum
   c. Energy
   d. Soil

5. An orifice is known as large orifice when the head of liquid from the center of orifice is
   a. More than 10 times the depth of orifice
   b. Less than 10 times the depth of orifice
   c. Less than 5 times the depth of orifice
   d. More than 5 times the depth of orifice

6. A floating body is in stable equilibrium when
   a. The metacentric height is zero
   b. Its center of gravity is below the center of buoyancy
   c. The metacenter is above its C.G
   d. The metacenter is below its C.G

7. Newton's law of viscosity relates
   a. Stress and strain in a fluid
   b. pressure, velocity and viscosity of gas
   c. Shear stress and rate of angular deformation in a fluid
   d. Yield stress, viscosity and rate of angular deformation

8. The bulk modulus of elasticity of a fluid is defined as
   a. $(-dv/v)/dP$
   b. $dP / -(dv/v)$
   c. $dP/d\rho$
   d. $\sqrt{dP/d\rho}$

9. The buoyant force is
   a. equal to volume of liquid displaced
   b. Force necessary to maintain equilibrium of a submerged body
   c. The resultant force acting on a floating body
   d. The resultant force on a body due to the fluid surrounding it

10. For stable equilibrium of floating body

a. BG = (I/V) +GM
b. GM= (I/V) - BG
c. GM = (I/V)/BG
d. BG + GM = I/V

11. The direction of lift force on an immersed body is

a. Normal to the longitudinal axis of the body
b. Along the direction of motion of the body
c. Normal to the direction of motion of the body
d. Always in the vertical direction

12. Notch is a device used for measuring

a. Rate of flow through pipes
b. Rate of flow through a small channel
c. Flow velocity through a pipeline
d. Flow velocity through a small channel

13. If the velocity, pressure, density etc. do not change at a point with respect to time, flow is

a. Uniform
b. Incompressible
c. Non-uniform
d. Steady

14. The ratio of area of jet at venacontracta to the area of orifice is

a. Coefficient of discharge
b. Coefficient of contraction
c. Coefficient of velocity
d. Coefficient of viscosity

15. If 2.5m^3 of a certain liquid weighs 9.81 kN. Its specific gravity is

a. 3.9
b. 0.4
c. 3.5
d. 0.36

16. Turbulence in flow implies

a. Unsteady and non-uniform flow
b. Newton's law of viscosity
c. Transition in flow
d. High Reynold's number

17. Which of the following statement is **CORRECT**?

a. Absolute pressure = Gage pressure – Atmospheric pressure
b. Gage pressure = Absolute pressure – Atmospheric pressure
c. Absolute pressure = Atmospheric + Vacuum pressure
d. Gage pressure = Atmospheric – Vacuum pressure

18. The loss of head due to sudden enlargement in a pipe is expressed as

a. $(V_1^2 - V_2^2)/2g$
b. $(V_1 - V_2)/2g$
c. $(V_1 - V_2)^2/2g$
d. $(V_1 - V_2)^2/g$

19. A control volume refers to a

a. fixed region in space
b. specified mass
c. closed system
d. reversible process only

20. The discharge through a V-notch varies as

a. $H^{1/2}$
b. H
c. $H^{3/2}$
d. $H^{5/2}$

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SECTION "B"

Attempt *ALL* the questions. Make suitable assumptions wherever needed.

1. What is metacentric height? Explain the types of equilibrium of floating bodies. [1+3]

2. Derive Euler's equation of motion. State Bernoulli's equation and its assumptions. [3+2]

3. A water sprinkler has 10 mm diameter nozzles at either end of a rotating arm, which is discharging water in opposite direction at right angle to the rotating arm, at a velocity of 8m/s. If the axis of rotation is at a distance of 0.15m from one end and 0.2m from the other, determine the torque required to hold the arm stationary. If friction is neglected, determine the constant angular speed of the arm. [5]

4. What is boundary layer theory? Explain boundary layer theory for thin plate. [1+3]

5. A 300mm diameter shaft is rotating at 240 rpm in a bearing of length 1500mm. If the thickness of oil film is 1.5mm and dynamic viscosity of oil is 0.72 Ns/m^2, determine
   a. Torque required to overcome friction in bearing [2]
   b. Power required utilized in overcoming viscous resistance. [2]

   Assume a linear velocity profile.

6. An orifice meter with orifice diameter 16mm inserted in a pipe of 28mm diameter. The pressure difference measured by a mercury water differential manometer on the two sides of the orifice meter gives a reading of 40 cm of mercury. Find the rate of flow of water of specific gravity 1.0 when the coefficient of discharge of the orifice meter is 0.65 [3]

7. Water is flowing through a pipe having diameters 600mm and 400 mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 450 kN/m^2 and the pressure at the upper end is 150 kN/m^2. Determine the pressure difference in datum head if the rate of flow through the pipe is 60 liters per second. [3]

8. Water is flowing in a rectangular channel of 1m wide and 0.75m deep. Find the discharge over a rectangular weir of crest of weir is 20 cm and water from channel flows over the weir. Take C_d = 0.62. Neglect end contractions. Take velocity of approach into considerations. [2+2]

9. The pressure drop 'Δp' in a pipe of diameter D and length L depends on mass density ρ and viscosity μ of the flowing fluid, mean velocity of flow v and average height k of roughness projections on the pipe surfaces. Obtain a dimensionless expression for Δp. Hence show that

$$\mathbf{h_f = (f\, L\, v^2)/2gD},$$

Where $h_f = \Delta p/\gamma$, γ is specific weight and f is coefficient of friction [5]

10. For the figure given below determine the pressure difference between pipes A and B. Take $Z_1 = 0.4$, $Z_2 = 0.25$, $Z_3 = 0.7$ and $Z_4 = 0.3$ m [3]