KATHMANDU UNIVERSITY
End Semester Examination
June/July, 2023

Marks Scored:

Level : B.Tech.
Year : II

Course : MEEG 218
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date : 26 JUN 2023

SECTION "A"
[20 Q. × 1 = 20 marks]

Mark [X] in the most appropriate option.

1. A fluid is a substance that
   [ ] is practically incompressible
   [ ] always expands until it fills any container
   [ ] obeys Newton's law of viscosity
   [ ] cannot remain at rest under action of any shear force

2. Property of a fluid by which molecules of different kinds of fluid are attracted to each other is called
   [ ] adhesion [ ] cohesion [ ] surface tension [ ] viscosity

3. A U-tube manometer measures
   [ ] absolute pressure at a point
   [ ] local atmospheric pressure
   [ ] difference in total energy between two points
   [ ] difference in pressure between two points

4. Metacentric height is the distance between the metacenter and
   [ ] water surface [ ] center of gravity [ ] center of pressure [ ] center of buoyancy

5. A metallic body weighs 80 N in air and 60 N in water. The relative density of metallic body is
   [ ] 8 [ ] 6 [ ] 4 [ ] 2

6. Continuity equation is related to conservation of
   [ ] mass [ ] energy [ ] momentum [ ] pressure

7. The flow field represented by the velocity vector $V = axi + by^2 j + czk$
   [ ] three-dimensional and steady [ ] two-dimensional and steady
   [ ] three-dimensional and unsteady [ ] two-dimensional and unsteady

8. Irrotational flow is characterized by one in which
   [ ] fluid flows along a straight line
   [ ] fluid does not rotate as it moves along
   [ ] net rotation of fluid particles about their mass centers remains zero
   [ ] streamlines of flow are curved and closely spaced

9. Which of the following assumption is incorrect in derivation of Bernoulli's equation?
   [ ] ideal fluid [ ] steady flow
   [ ] incompressible flow [ ] rotational flow

10. Which of the following is not a dimensionless parameter?
[ ] Reynolds number [ ] friction factor
[ ] kinematic viscosity [ ] pressure coefficient

11. Rotameter is used to measure
[ ] pressure [ ] discharge [ ] rotation [ ] momentum

12. While using boundary layer equation, Bernoulli's equation
[ ] can be used anywhere
[ ] can be used only outside boundary layer
[ ] can be used only inside the boundary layer
[ ] cannot be used either inside or outside the boundary layer

13. Velocity distribution in laminar flow through a circular pipe follows the _____ law.
[ ] linear [ ] parabolic [ ] cubic power [ ] logarithmic

14. A pipeline is said to be equivalent to one another if
[ ] length and discharge are same
[ ] velocity and discharge are same
[ ] discharge and frictional head loss are same
[ ] length and diameters are same

15. Whenever a plate is submerged at an angle with the direction of flow of liquid, it is subjected to some pressure. The component of this pressure in the direction of flow of liquid is
[ ] lift [ ] drag
[ ] stagnation pressure [ ] bulk modulus

16. Which one of these causes lift on an immersed body in a fluid stream?
[ ] buoyancy forces
[ ] resultant fluid force on body
[ ] dynamic fluid force component exerted on the body parallel to the approach velocity.
[ ] dynamic fluid force component exerted on the body perpendicular to the approach velocity

17. The head loss in turbulent flow varies
[ ] directly as the velocity [ ] inversely as the square of the velocity
[ ] inversely as the square of diameter [ ] approximately as the square of velocity

18. Euler's equation is a statement of
[ ] energy balance
[ ] momentum conservation for inviscid flow
[ ] momentum conservation for incompressible flow
[ ] momentum conservation for real fluid flow

19. An orifice meter with $C_d = 0.61$ is substituted by venturimeter with $C_d = 0.98$ in a pipeline carrying crude oil, having the same throat diameter as that of the orifice. For the same flow rate, the ratio of the pressure drops for the venturimeter and the orifice meter is
[ ] 0.61/0.98 [ ] $0.61^2/0.98^2$ [ ] 0.98/0.61 [ ] $0.98^2/0.61^2$

20. The velocity of a water stream is being measured by a L-shaped Pitot-tube and the reading is 20 cm. Then what is the approximate value of velocity?
[ ] 19.6 m/s [ ] 2.0 m/s [ ] 9.8 m/s [ ] 20 cm/s

KATHMANDU UNIVERSITY
End Semester Examination
June/July, 2023

26 JUN 2023

Level : B.Tech.
Year : II
Time : 2 hrs. 30 mins.

Course : MEEG 218
Semester : I
F. M. : 55

SECTION "B"
[5 Q. × 11 = 55 marks]

Attempt *ALL* questions. Assume suitable data if necessary.

1.

a. What is a fluid? With appropriate diagram explain no-slip condition. [1+4]

b. Two large stationary plane surfaces are 2.4 cm apart. The space between the surfaces is filled with glycerin having coefficient of viscosity 8.1 Poise. What force is required to drag a very thin plate of surface area 0.5 m^2 between the two large plane surfaces at a speed of 0.6 m/s if [3+3]

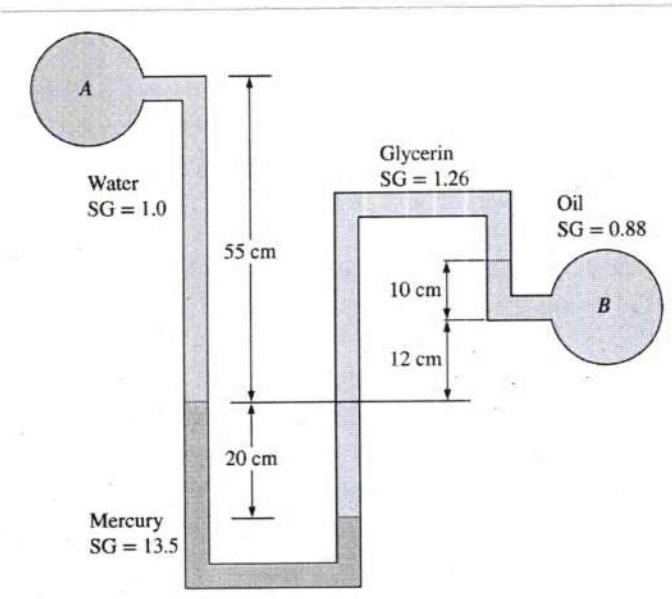
i. Thin plate is in the middle of the two planes

ii. Thin plate is at distance of 0.8 cm from one of the surfaces.

2.

a. Differentiate between Lagrangian and Eulerian descriptions of fluid flow with suitable examples. Write down an expression for material derivative of acceleration. [4+1]

b. The pressure difference between an oil pipe and water pipe is measured by a double-fluid manometer. For the given fluid heights and specific gravities, calculate the pressure difference between the two pipes. [6]



3.

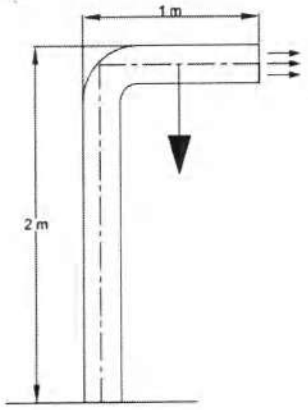
a. Applying conservation of mass principle, derive an expression for mass conservation in integral form for a control volume of arbitrary shape [5]

b. Air flows steadily at low speed through a horizontal nozzle (*by definition a device for accelerating a flow*), discharging to atmosphere. The area at the nozzle inlet is 0.1 m^2. At the nozzle exit, the area is 0.02 m^2. Determine the gage pressure required in kPa at the nozzle inlet to produce an outlet speed of 50 m/s. Take density of air as 1.23 kg/m^3. [6]

4.

a. Write down and explain each term in incompressible Navier-Stokes equation. Applying necessary assumptions, determine the simplified form of the equation for inviscid flow and irrotational flow. [1+2+2]

b. Underground water is pumped through a 10 cm diameter pipe that consists of a 2 m long vertical and 1 m long horizontal section. Water discharges to atmospheric air at an average velocity 3 m/s and the mass of the horizontal pipe section when filled with water is 12 kg per meter length. The pipe is anchored on the ground by a concrete base. Determine the bending moment at the base of the pipe and the required length of the pipe horizontal section that would make the moment at base zero. Take density of water as 1000 kg/m^3. [6]



5.

a. Explain how drag and lift forces are generated in an object moving in a fluid. Does streamlining always reduce drag? Explain. [2+2]

b. Water is to be discharged from a reservoir at a rate of 18 L/s using two horizontal cast iron pipes connected in series and a pump between them. The first pipe is 20 m long and has a 6-cm diameter, while the second pipe is 35 m long and has a 4-cm diameter. The water level in the reservoir is 30 m above the centerline of the pipe. The pipe entrance is sharp-edged, and losses associated with the connection of the pump are negligible. Determine the required pumping head to maintain the indicated flow rate. Density of water is 999.1 kg/m^3, $\mu = 1.138 \times 10^{-3}$ kg/m.s, loss coefficient for sharp-edged entrance is 0.5 and roughness of cast iron pipes is $\varepsilon = 0.00026$ m. [7]
Friction factor relations are given as:

$f = \frac{64}{Re}$ for laminar flow

$\frac{1}{\sqrt{f}} = -2\log\left(\frac{\varepsilon}{3.7\,D} + \frac{2.51}{Re\sqrt{f}}\right)$ for turbulent flow