VTU B.E/B.TECH QUESTION PAPER SET

CBCS
SEMESTER IV

FLUID MECHANICS

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CBCS Scheme

USN | | | | | | | | | | |

15MR46

Fourth Semester B.E. Degree Examination, June/July 2017
Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. Define following properties of fluid
   i) Density
   ii) Specific volume
   iii) Specific gravity
   iv) Viscosity. **(04 Marks)**

b. State and prove Pascal's law and hydrostatic law. **(08 Marks)**

c. Find out the minimum size of glass tube that can be used to measure water level if the capillary rise in the tube is to be restricted to 2mm. consider surface interface with air as 0.0736 N/m. **(04 Marks)**

OR

2 a. Determine the total pressure on a circular plate of diameter 1.5m which placed vertically in water in such a way that the centre of the plate is 3m below the free surface of water. Find the position of centre of pressure also. **(08 Marks)**

b. Explain pressure measurement method by manometer for flow through pipes. **(04 Marks)**

c. Explain:
   i) Vapour pressure and cavitation
   ii) Viscosity of fluids. **(04 Marks)**

Module-2

3 a. A block of wood of specific gravity 0.8 floats in water. Determine the meta centric height of the block if its size is 3m×2m×1m. State whether stable or unstable. **(08 Marks)**

b. Derive the continuity equation in Cartesian coordinates with respect to steady flow and incompressible with definition express the continuity equation for steady flow and incompressible flow. **(08 Marks)**

OR

4 a. Derive the Euler's equation of motion along a stream line. Also derive Bernoulli's equation from Euler's equation of motion and list the assumptions made for deriving Bernoulli's equation. **(04 Marks)**

b. A pipe of diameter 400mm carries water at velocity of 25m/s. The pressures at point A and B are 294:3 kN/m^2 and 225.63 kN/m^2 respectively while the datum head at A and B are 28m and 30m. Find the loss of head between A and B. **(12 Marks)**

Module-3

5 a. Derive the expression for rate of flow through venturimeter. **(08 Marks)**

b. A submarine moves horizontally in sea and has its axis 15m below the surface of water. A pitot-tube properly placed just in front of the sub-marine and along its axis is connected to the two limbs of a U-tube containing mercury. The difference of mercury level is found to be 170mm. Find the speed of the submarine in km/hr knowing that specific gravity of mercury is 13.6 and that of sea water is 1.026 with respect of fresh water. **(05 Marks)**

c. Differentiate V-notch and Rectangular notch related to discharge measurement. **(03 Marks)**

OR

6 a. The efficiency η of a fan depends on density ρ, dynamic viscosity μ of the fluid, angular velocity w, diameter D of rotor and the discharge Q, express η in terms of dimensionless parameter. **(08 Marks)**

b. Define and explain :
   i) Reynold's number
   ii) Euler's number
   iii) Mach number
   iv) Froude number. **(08 Marks)**

Module-4

7 a. Derive Darcy-Weisbach expression for head loss due to friction in a pipe flow. **(08 Marks)**

b. A pipe line 300mm in diameter and 3200m long is used to pump up 50kg/sec of an oi whose density is 950 kg/m^3 and whose density kinematic viscosity is 2.1×10^{-4}m^2/sec. The centre of the pipe line at the upper end is 40m above than that at the lower end. The discharge at the upper end is atmospheric. Find the pressure at lower end. Draw the HGL and TGL. **(08 Marks)**

OR

8 a. Derive Hagen-Poseuille equation for a laminar flow in a circular tube. **(10 Marks)**

b. Water at 15°C flows through between two parallel plates at a distance of 1.6mm apart Determine :
   i) The maximum velocity
   ii) Pressure drop/unit length
   iii) Shear stress at the plates is average velocity is 0.2 m/sec force viscosity of water a 15°C as 0.01 poise. **(06 Marks)**

Module-5

9 a. State the Bernoulli's theorem for compressible flow derives an expression for Bernoulli' equation when the process is isothermal. **(08 Marks)**

b. Derive an expression for drag and lift with usual notation. **(08Marks)**

OR

10 a. A sub marine which may be supposed to approximate a cylinder 4m in diameter and 20r long travels submerged at 1.3 m/sec in sea water. Find the drag excreted on it, if the drag co efficient for Renolds number greater than 10^5 may be taken as 0.75. The density of sea wate is given as 10356 kg/m^3 and kinematic viscosity as 0.015 stokers. **(06 Marks)**

b. A projectile travels in air of pressure 10.1043 N/cm^2 at 10°C at a speed of 1500km/hr. Fin the mach number and the mach angle. Take K = 1.4 and R = 287J/kg K. **(06 Marks)**

c. Define the terms subsonic and supersonic flow. **(04 Mark)**

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CBCS Scheme

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15MR46

Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. Define fluid. Distinguish between liquid and gasses. **(05 Marks)**

b. Derive on expression for a capillary fall, when the glass tube is dipped in mercury. **(05 Marks)**

c. $10m^3$ of mercury Weighs 136×10^4N. Calculate its specific weight, mass density, specific volume and specific gravity. **(06 Marks)**

OR

2 a. Define the following fluid properties :
- i) Density
- ii) Weight density
- iii) Specific volume
- iv) Specific gravity
- v) Surface tension
- vi) Viscosity. **(06 Marks)**

b. A cylinder of 120mm diameter rotates concentrically inside a fixed cylinder of diameter 125mm. both the cylinder are 300mm long. Find the viscosity of the fluid that fills the space between the cylinders if a torque 0.90 Nm required maintains speed of 60rpm. **(10 Marks)**

Module-2

3 a. Derive an expression for the meta centric height of a floating body. **(10 Marks)**

b. A jet of water from a 25mm diameter nozzle is directed vertically upwards. Assuming that the jet remains circular and neglecting any loss of energy that will be the diameter at a point 4.5m above the nozzle if the velocity with which the Jet leaves the nozzle is 12 m /s. **(06 Marks)**

OR

4 a. Classify the different types of fluid flow. **(06 Marks)**

b. A wooden cylinder of specific gravity = 0.6 and circular in cross – section is required to float in oil (sp.gr = 0.90). Find L/D ratio for the cylinder to float with its longitudinal axis vertical in oil, where 'L' is the height of cylinder and 'D' is its diameter **(10 Marks)**

Module-3

5 a. What is a Venturimeter? Derive an expression for discharge through a venturimeter. **(10 Marks)**

b. The frictional torque 'T' of a disc of diameter 'D' rotating at a speed 'N' in a fluid of viscosity 'μ' and density 'ρ' in a turbulent flow is given by $T = D^5N^2\rho\phi\left[\frac{\mu}{D^2N\rho}\right]$. Prove this by method of dimensions. **(06 Marks)**

OR

6 a. Explain the methods of dimensional analysis. **(06 Marks)**

b. A 30cm × 15cm venturimeter is provided in a vertical pipe line carrying oil of specific gravity 0.9, the flow being up wards. The difference in elevation of the throat section and entrance section of the venturimeter is 30cm. The differential U-tube mercury monometer shown a gauge deflation 25cm. calculate :

i) The discharge of oil, and

ii) The pressure difference between entrance section and the throat section. Take the co-efficient of meter 0.98 and specific gravity of mercury as 13.6. **(10 Marks)**

Module-4

7 a. Explain the terms

i) Major energy loss

ii) Minor loss

iii) Hydraulic gradient line

iv) Total energy line. **(10 Marks)**

b. Find the diameter of a pipe of length 2000mm when the rate of flow of water through the pipe is 200 ℓ/s and the head lost due to friction is 4m take the value of C = 50 in Chezy's formula. **(06 Marks)**

OR

8 a. Derive on expression for laminar flow through circular pipe (Hagen Poiseuille equation]. **(12 Marks)**

b. A crude oil of Kinematic viscosity 0.4 stokes is flowing through a pipe of diameter 300mm at the rate of 300 liters per second. Find the head lost due to friction for a length of 50m of the pipe. **(04 Marks)**

Module-5

9 a. Derive on expression for drag and lift. **(08 Marks)**

b. Define :

i) Boundary layer

ii) Displacement thickness

iii) Momentum thickness

iv) Energy thickness. **(08 Marks)**

OR

10 a. Define mach number. With neat sketch, explain the propagation of disturbance for M < 1 and M = 1. **(08 Marks)**

b. A flat plate 1.5m × 1.5m moves 50km/hour in stationary air of density 1.15kg/m^3. If the co-efficient of drag and lift are 0.15 and 0.75 respectively. Determine :

i) The lift force

ii) The drag force

iii) The resultant force

iv) The power required to keep the plate in motion. **(08 Marks)**

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15MR46

Fourth Semester B.E. Degree Examination, June/July 2018
Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

Note: ***Answer FIVE full questions, choosing one full question from each module.***

Module-1

1 a. Explain following fluid properties with relevant equations:
(i) Bulk modulus. (ii) Capillarity.
(iii) Surface tension. (iv) Mass density and specific weight. **(08 Marks)**

b. A vertical gap 2.2 cm wide of infinite extent contains a fluid of viscosity 2 N-sec/m^2 and specific gravity 0.9. A metallic plate $1.2m \times 1.2m \times 0.2cm$ is to be lifted up with a constant velocity of 0.15 m/sec through the gap. If the plate in the middle of the gap, find the force required if the weight of plate is 40 N. **(08 Marks)**

OR

2 a. Derive an expression for the depth of centre of pressure from free surface of liquid of a inclined plane surface submerged in liquid. **(08 Marks)**

b. Explain Gauge pressure and Vaccum pressure with reference point. **(04 Marks)**

c. An inverted U-tube manometer is connected to the two points A and B of two horizontal pipes. The vertical distance between the axes of these pipes is 30 cm. When an oil of specific gravity 0.8 is used as a gauge fluid. The vertical heights of water columns in the two limbs of inverted manometer (when measured from respective centre lines of the pipes A and B) are found to be same and equal to 35 cm. Determine the difference of pressure between the pipes. **(04 Marks)**

Module-2

3 a. What is metacentric? Explain stability of floating body. With usual notation derive expression for metacentric height for a floating body in liquid. **(08 Marks)**

b. A trapezoidal channel 2 m wide at the bottom and 1 m deep has side slopes 1 : 1 determine (i) Total pressure force (ii) The point of application of centre of pressure on the vertical gate closing the channel when it is full of water. **(08 Marks)**

OR

4 a. Define the equation of continuity. Obtain an expression for continuity equation for a three dimensional steady incompressible flow. **(08 Marks)**

b. Derive Bernoulli's equation from fundamentals. List all the assumptions made. **(08 Marks)**

Module-3

5 a. Derive the expression for rate of flow through rectangular notches. **(06 Marks)**

b. Explain with reference to dimensional analysis (i) Kinematic similarity (ii) Dynamic similarity. **(04 Marks)**

c. A horizontal venturimeter with inlet diameter 20 cm and throat diameter 10 cm is used to measure the flow of water. The pressure at inlet is 147 KPa and vaccum pressure at the throat is 40 cm of mercury. Find the discharge of water through venturimeter. Take $C_d = 0.98$ **(06 Marks)**

OR

6 a. Derive equation for velocity measurement by pitot tube. **(04 Marks)**

b. Explain Mach number and Reynolds number. **(04 Marks)**

c. The function torque T of a disc of diameter D, rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given that $T = D^5N^2\rho\phi\left[\frac{u}{D^2N\rho}\right]$ hence prove by taking D, N and ρ as repeating variables by Buckingham π theorem. **(08 Marks)**

Module-4

7 a. Derive Darcy Weisbach and Chezy's equation for loss of head due to friction in pipes. **(10 Marks)**

b. The rate of flow of water through a horizontal pipe is 0.25 m^3/sec. The diameter of the pipe which is 200 mm is suddenly to 400 mm. The pressure intensity in smaller pipe is 11.772 N/cm^2. Determine

(i) Loss of head due to sudden enlargement.

(ii) Pressure intensity in the larger pipe. **(06 Marks)**

OR

8 a. Derive Hagen-Poseuille equation for a laminar flow in a circular tube. **(10 Marks)**

b. An oil of viscosity 10 poise flows between two parallel fixed plates which are kept at a distance of 50 mm apart. Find the rate of flow of oil between the plates if the drop of pressure in a length of 1.2 m be 0.3 N/cm^3. The width of the plates is 200 mm. **(06 Marks)**

Module-5

9 a. Explain the terms (i) Lift (ii) Drag (iii) Displacement thickness (iv) Momentum thickness. **(08 Marks)**

b. A flat plate 1.5m × 1.5m moves at 50 kmph in stationary air of density 1.15 kg/m^3. If the co-efficient of drag and lift are 0.15 and 0.75 respectively. Determine

(i) The drag force.

(ii) The lift force.

(iii) The resultant force.

(iv) Power required to keep the plate in motion. **(08 Marks)**

OR

10 a. With a neat sketches, explain the propogation of pressure waves in a compressible fluid for M = 1 and M > 1. **(08 Marks)**

b. Find the velocity of bullet fired in standard air if the mach angle is 30°. Take R = 287.14 J/kgK, K = 1.4 for air. Assume temperature as 15°C. **(06 Marks)**

c. Explain Mach angle. **(02 Marks)**

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CBCS SCHEME

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15MR46

Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. Derive the expression for capillary rise of liquid by explaining phenomenon of capillarity. **(06 Marks)**

b. A 90 N rectangular solid block slides down a 30° inclined plane. The plane is lubricated by 3 mm thick film of oil relative density 0.9 and viscosity 8 poise. If the contact area is 0.3 m^2, estimate the terminal velocity of the block. **(05 Marks)**

c. A simple U-tube manometer containing mercury is connected to a pipe in which a fluid of specific gravity 0.8 and having vacuum pressure is flowing. The other end of the manometer is open to atmosphere. Find the vacuum pressure in pipe, if the difference of mercury level in the two limbs is 40 cm and the height of fluid in the left from the center of pipe is 15 cm below. **(05 Marks)**

OR

2 a. Derive an expression for the depth of centre of pressure from free surface of liquid of an inclined plane surface submerged in the liquid. **(08 Marks)**

b. State and prove hydrostatic law. **(04 Marks)**

c. Define the following:
i) Specific weight ii) Density
iii) Specific gravity iv) Specific volume. **(04 Marks)**

Module-2

3 a. Explain stability of unconstrained submerged bodies in fluid. **(05 Marks)**

b. A solid cylinder of diameter 4 m has a height of 3 meters. Find the meta-centric height of the cylinder when it is floating in water with its axis vertical. The specific gravity of the cylinder is 0.6. **(05 Marks)**

c. Derive the continuity equation in Cartesian coordinates with respect to fluid flow. **(06 Marks)**

OR

4 a. Explain the following:
i) Steady and unsteady flow
ii) Uniform and non-uniform flow **(04 Marks)**

b. State the assumptions made for driving the Bernoulli's equation and derive the same. **(06 Marks)**

c. The water is flowing through a taper pipe of length 100 m having diameter 600 mm at the upper end and 300 mm at the lower end, at the rate of 50 liters/sec. the pipe has a slope of 1 in 30. Find the pressure at the lower end if the pressure at the higher level is 19.62 N/cm^2. **(06 Marks)**

Module-3

5 a. Derive the expression for flow through orfice meter. **(08 Marks)**

b. Water flows over a rectangular weir. 1 m wide at a depth of 150 mm and afterwards passes through a triangular right angled weir. Taking C_d for the rectangular and triangular weir as 0.62 and 0.59 respectively. Find the depth over the triangular weir. **(08 Marks)**

OR

6 a. The variables controlling the motion of a floating vessel in water are the drag force F, which depends on speed V, length L, mass density ρ, dynamic viscosity μ and acceleration due to gravity g. Derive the expression for F using Buckingham's π theorem. **(10 Marks)**

b. Explain: i) Geometric similarity
ii) Kinematic similarity
iii) Dynamic similarity. **(06 Marks)**

Module-4

7 a. Derive Parcy-Weisbach expression for head loss due to friction in a pipe flow and obtain Chazy's equation. **(10 Marks)**

b. The rate of flow of water through a horizontal pipe is 0.25 m^3/sec. The diameter of the pipe which is 200 mm is suddenly enlarged to 400 mm. the pressure intensity in the smaller pipe is 11.772 N/cm^2, determine loss of head due to sudden enlargement, pressure intensity in the large pipe and power lost due to enlargement. **(06 Marks)**

OR

8 a. The flow between two parallel stationary plates show that maximum velocity is 1.5 times average velocity. **(10 Marks)**

b. A fluid of viscosity 0.7 N-Sec/m^2 and specific gravity 1.3 is flowing through a circular pipe of diameter 100 mm. The maximum shear stress at the pipe wall is given as 196.2 N/m^2. Find:
(i) The pressure gradient
(ii) The average velocity
(iii)Reynold's number of the flow. **(06 Marks)**

Module-5

9 a. Derive an expression for drag and lift with usual notations. **(08 Marks)**

b. A metallic ball with diameter of 2 mm is dropped in a liquid of mass density 950 kg/m^3 and velocity 15 poise. Specific gravity of ball is 12. Find:
i) Drag force on ball
ii) The pressure drag
iii) Terminal velocity of the ball **(08 Marks)**

OR

10 a. Explain the following terms:
i) Mach number
ii) Subsonic flow
iii) Sonic flow
iv) Supersonic flow **(06 Marks)**

b. Explain the terms:
i) Boundry layer thickness
ii) Displacement thickness **(06 Marks)**

c. Calculate the Mach number at a point on a jet propelled aircraft, which is flying at 1100 km/hr at sea-level where air temperature is 20°C. Take K = 1.4 and R = 287 J/kg°K. **(04 Marks)**

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15MR46

Fourth Semester B.E. Degree Examination, June/July 2019
Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define following properties of fluid with equation i) Density ii) Specific Volume iii) Specific gravity iv) Viscosity. **(08 Marks)**

b. An oil of viscosity 5 poise is used for lubrication between a shaft and sleeve. The diameter of the shaft is 0.5m and it rotates at 200 rpm. Calculate the power lost in oil for a sleeve length of 100mm. The thickness of oil film is 1mm. **(08 Marks)**

OR

2 a. A differential monometer is connected at the two points A and B two pipes as shown in Fig Q2(a). The pipe a contains a liquid of specific gravity 1.5 while pipe B contains a liquid of specific gravity 0.9. The pressure at A and B 1 kgf/cm^2 and 1.8 kgf/cm^2 respectively. Find the difference in mercury level in the differential monometer. **(08 Marks)**

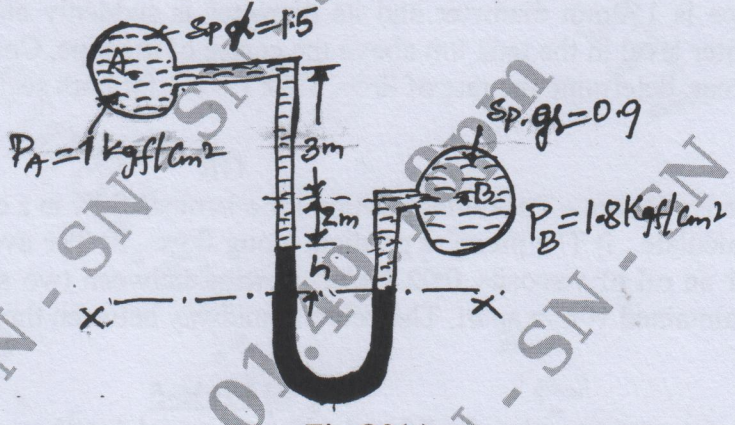

Fig Q2(a)

b. A square aperture in the vertical side of a tank has one diagonal vertical and is completely covered by a plane plate hinged along one of the upper sides of the aperture. The diagonals of the aperture are 2m long and the tank contains a liquid of specific gravity 1.15. The centre of aperture is 1.5m below the free surface. Calculate the thrust exerted on the plate by the liquid and position of it center of pressure. **(08 Marks)**

Module-2

3 a. Derive the continuity equation in Cartesian coordinates with assumptions. **(08 Marks)**

b. The stream function for a two dimensional at the point given by $\psi = 2xy$, calculate the velocity at the point P(2, 3). Find the velocity potential function ϕ. **(08 Marks)**

OR

4 a. Derive the Euler's equation of motion along a stream line. Also derive Bernoulli's equation form Euler's equation. **(08 Marks)**

b. A pipe line carrying oil of specific gravity 0.87, changes in diameter from 200μ diameter at a position A to 500mm diameter at a position B which is 4 meters at a higher level. If the pressure at A and B 9.81 N/cm^2 and 5.886N/cm^2 respectively and the discharge is 200 liters/s. Determine the loss of head and direction of flow. **(08 Marks)**

Module-3

5 a. Derive the expression for rate of flow through venturimeter. **(08 Marks)**

b. An orifice meter with orifice diameter 10cm inserted in a pipe of 20cm diameter. The pressure gauges fitted upstream and downstream of the orifice meter gives readings of 19.62N/cm^2 and 9.8N/cm^2 respectively. Co-efficient of discharge for the meter is given as 0.6. Find the discharge of water through pipe. **(08 Marks)**

OR

6 a. Define the following Dimensionless number
i) Reynolds number ii) Froude number iii) Euler's number iv) Weber is number. **(08 Marks)**

b. The frictional torque T of disc of diameter D rotating at a speed N is a fluid of viscosity μ and density ρ in a turbulent flow is given by $T = D^5N^2\rho\phi\left[\frac{\mu}{D^2N\rho}\right]$ **(08 Marks)**

Module-4

7 a. Derive Darcy – Weisbach expression for head loss due to friction in a pipe flow. **(08 Marks)**

b. A horizontal pipe line 40m long is connected to a water tank at one end and discharges freely is to the atmosphere at the other end. For the first 25m of its length from the tank, the pipe is 150mm diameter and its diameter is suddenly enlarged to 300mm. The height of water level in the tank 8m above the centre of the pipe. Considering all losses of head which occur, determine the rate of flow. Take f = 0.1 for both section of the pipe. **(08 Marks)**

OR

8 a. Derive Hagen – Poseuille equation for a laminar flow in a circular tube. **(10 Marks)**

b. Calculate : i) The pressure gradient along flow ii) The average velocity iii) The discharge for an oil of viscosity 0.02 Ns/m^2 flowing between two stationary parallel plates 1m wide maintained 10mm apart. The velocity midway between the plates is 2m/s. **(06 Marks)**

Module-5

9 a. Derive an expression for lift and drag with usual notation. **(08 Marks)**

b. A truck having a projected area of 6.5m^2 travelling at 70km/hr has total resistance of 2000N, of this 20% is due to rolling friction and 10% is due to surface friction. The rest is due form drag. Calculate the co-efficient of form drag. Take density of air 1.25 kg/m^3. **(08 Marks)**

OR

10 a. Define the following with respect to boundary layer concept i) Boundary layer thickness ii) Displacement thickness iii) Momentum thickness. **(06 Marks)**

b. Define : i) Subsonic flow ii) Sonic flow ii) Supersonic flow. **(05 Marks)**

c. Find the velocity of bullet fired in standard air if the Mach angle is 30°. Take R = 287.14 J/kg K and K = 1.4 for air. Assume temperature as 15°C. **(05 Marks)**

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CBCS SCHEME

USN | | | | | | | | | | |

15MR46

Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define the following properties of fluid with a suitable sketches:
i) Newtonian and Non-newtonion fluids.
ii) Viscosity
iii) Compressibility and capillarity. **(06 Marks)**

b. State and prove Pascal law. **(05 Marks)**

c. A circular plate 3m diameter is immersed in water in such a way that its greatest and least depth below the free surface are 4m and 1.5m respectively. Determine the total pressure on face of the plate and position of the centre of pressure. **(05 Marks)**

OR

2 a. Derive an expression for the depth of centre of pressure from free surface of liquid of a vertical plane surface submerged in the liquid. **(08 Marks)**

b. A flat plate $0.1m^2$ area is pulled at 30cm/sec relative to another plate located at a distance of 0.01cm from it, the fluid separating them being water of viscosity 0.001 N-sec/m^2. Find the force and power required to maintain the velocity. **(04 Marks)**

c. State and prove Hydrostatic law. **(04 Marks)**

Module-2

3 a. Derive the expression for metacentric height for a floating body and state the conditions for stability of floating body. **(08 Marks)**

b. Explain Lagrangian and Eulerian method. **(04 Marks)**

c. Find the density of a metallic body which floats at the interface of mercury of specific gravity 13.6 and water such that 40% of its volume is submerged in mercury and 60% in water. **(04 Marks)**

OR

4 a. A stream function is given by $\varphi = 5x - 6y$. Calculate the velocity components and also magnitude and direction of the resultant velocity at any point. **(04 Marks)**

b. Derive Bernoulli's equation and state the assumptions made. **(06 Marks)**

c. A pipe of diameter 400mm carries water at a velocity of 25m/sec. The pressures at the points A and B are given as 29.43 N/cm^2 and 22.563N/cm^2 respectively while the datum head at A and B are 28m and 30m. Find the loss of head between A and B. **(06 Marks)**

Module-3

5 a. Derive an expression for flow through V-notch. **(08 Marks)**

b. A horizontal venturimeter with inlet diameter 20cm and throat diameter 10cm is used to measure the flow of water. The pressure at inlet is 147kPa and vaccum pressure at the throat is 40cm of mercury. Find the discharge of water through venturimeter. Take $C_d = 0.98$. **(06 Marks)**

c. Explain briefly pitot tube. **(02 Marks)**

OR

6 a. A partially submerged body is towed in water. The resistance 'R' to its motion depends on the density ρ, the viscosity μ of water, length L of the body, velocity V of the body and the acceleration due to gravity g. Show that the resistance to the motion can be expressed in the form $R = \rho L^2 V^2 \phi\left[\left(\frac{\mu}{\rho v L}\right),\left(\frac{Lg}{V^2}\right)\right]$. **(10 Marks)**

b. Explain following dimensionless number:
i) Mach's number (M) ii) Reynold's number iii) Euler's number. **(06 Marks)**

Module-4

7 a. Derive an expression for Darcy-Weisbach equation for loss of head due to friction. **(08 Marks)**

b. A horizontal pipe line 40m long is connected to a water tank at one end discharges freely into the atmosphere at the other end. For first 25m its length from the tank, the pipe is 150mm diameter and its diameter is suddenly enlarges to 30mm. The height of water level in tank is 8m above the center of pipe. Considering all losses of head which occur, determine the rate of flow. Take f = 0.01 for both sections of pipe. **(08 Marks)**

OR

8 a. Derive the Hagen-Poiseuille equation for lead loss in circular pipe through laminar flow. **(10 Marks)**

b. Determine:
i) Pressure gradient
ii) Shear stress at the two horizontal plates
iii) Discharge per meter width for laminar flow of oil with a maximum velocity of 2m/sec between two plates which are 150mm apart. Given μ = 2.5 pa-sec. **(06 Marks)**

Module-5

9 a. Explain the following: i) Momentum thickness ii) Energy thickness. **(06 Marks)**

b. Experiments were conducted in a wind tunnel with a wind speed of 50km/hr on a flat plate of size 2m long and 1m wide the density of air is 1.15kg/m^3. The coefficients of lift and drag are 0.75 and 0.15 respectively.
Determine:
i) The lift force
ii) The drag force
iii) The resultant force
iv) The direction of resultant force
v) Power exerted by air on the plate. **(10 Marks)**

OR

10 a. Obtain an expression for velocity of the sound wave in a compressible fluid in terms of change of pressure and change of density. **(08 Marks)**

b. An air plane is flying at an altitude of 15km where the temperature is -50°C the speed of the plane corresponds to mach number is 1.6. Assuming K = 1.4 and R = 287J/kg K for air. Find the speed of the plane and mach angle α. **(04 Marks)**

c. Differentiate between:
i) Stream body and bluff body
ii) Pressure drag and friction drag. **(04 Marks)**

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CBCS SCHEME

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17MR46

Fourth Semester B.E. Degree Examination, June/July 2019
Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1 a. Define the following properties of fluid with their units.
i) Mass density ii) Viscosity iii) Surface Tension iv) Capillarity v) Cavitation. **(10 Marks)**

b. Give classification of fluids. Explain. **(10 Marks)**

OR

2 a. State and prove Pascal's law. **(10 Marks)**

b. Explain the following simple manometers :
i) Piezometer ii) U-tube manometer iii) Single column monometer. **(10 Marks)**

Module-2

3 a. Define : i) Buoyancy ii) Meta centre **(04 Marks)**

b. Define : i) Steady and unsteady flow ii) Uniform and non-uniform flow
iii) Laminar and turbulent flow. **(06 Marks)**

c. Derive the continuity equation in three dimensional steady, incompressible flows. **(10 Marks)**

OR

4 a. Derive Euler's equation of motion for a steady flow and deduce Bernoulli's equation. **(10 Marks)**

b. The water is flowing through a pipe having diameters 20cm and 10cm at section 1 and 2 respectively. The rate of flow through pipe is 35 liters/secs. The section 1 is 6m above datum and section 2 is 4m above datum. If the pressure at section 1 is 39.24 N/cm^2. Find the intensity of pressure at section 2. **(10 Marks)**

Module-3

5 a. Derive expression for actual discharge through orifice meter. **(10 Marks)**

b. A horizontal venturimeter with inlet and throat diameters 30cm and 15cm respectively is used to measure the flow of water. The reading of differential manometer connected to the inlet and the throat is 20cm of mercury. Determine the rate of flow. Take $C_d = 0.98$. **(10 Marks)**

OR

6 a. Explain different types of similitudes. **(08 Marks)**

b. The pressure differences Δp in a pipe of diameter D and length ℓ due to viscous flow depends on the velocity V, viscosity μ and density ρ. Using Buckingham's π-theorem, obtain on expression for Δp. **(12 Marks)**

Module-4

7 a. Derive Darcy – Weisbach equation for determining loss of head due to friction in a pipe. **(10 Marks)**

b. The rate of flow of water though horizontal pipe is $0.25m^3/s$. the diameter of the pipe which is 200mm is suddenly enlarged to 400mm. The pressure intensity in the smaller pipe is $11.772N/cm^2$. Determine :
   i) Loss of head due to sudden enlargement
   ii) Pressure intensity in the large pipe
   iii) Power lost due to enlargement. **(10 Marks)**

OR

8 a. Prove that the velocity distribution across a cross section of a circular pipe during viscous fluid flow is parabolic in nature. Also show that the maximum velocity is in the centre of the pipe and is equal to twice the average velocity. **(12 Marks)**

b. A crude oil of viscosity 0.97 poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 100mm and of length 10m. Calculate the difference of pressure at the two ends of the pipe, if 100kg of the oil is collected in a tank in 30secs. Assume laminar flow. **(08 Marks)**

Module-5

9 a. Define: i) Drag ii) Lift. **(04 Marks)**

b. Derive an expression for drag and lift. **(08 Marks)**

c. Find the displacement thickness the momentum thickness and energy thickness for the velocity distribution in the boundary layer given by $\frac{u}{U} = \frac{y}{\delta}$, where u is the velocity at a distance y from the plate and u = U at y = δ, wherever δ = boundary layer thickness. **(08 Marks)**

OR

10 a. Derive an expression for velocity of sound wave in a fluid. **(10 Marks)**

b. An aeroplane is flying at an altitude of 15km where the temperature is $-50°C$. The speed of the plane corresponds to Mach Number of 1.6. Assuming K = 1.4, R = 287J/kg K for air, find the speed of the plane and Mach angle α. **(08 Marks)**

c. Define Mach number. **(02 Marks)**

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