Total No. of Questions: 6 *Total No. of Printed Pages:3*

Enrollment No.....

Faculty of Engineering

End Sem (Odd) Examination Dec-2019

ME3CO06 Fluid Mechanics

Programme: B.Tech. Branch/Specialisation: ME

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

Q.1 i. Surface tension has the unit of **1**

(a) Force per unit area (b) Force per unit Volume

(c) Force per unit length (d) None of these

ii. The dynamic viscosity of a liquid is 1.2×10^{-4} Ns/m^2, whereas, the density is 600 kg/m^3. The kinematic viscosity in m^2/s is **1**

(a) 72×10^{-3} (b) 20×10^{-8} (c) 7.2×10^{3} (d) 70×10^{6}

iii. Viscous forces are not present in **1**

(a) Rotational flow (b) Irrotational flow

(c) Laminar flow (d) None of these

iv. Constant of equation of continuity is known as **1**

(a) Flow rate (b) Friction

(c) Fluid flow (d) Surface tension

v. Venturi meter is used to **1**

(a) Measure the velocity of a flowing liquid in closed channel

(b) Measure the velocity of a flowing liquid in open channel

(c) Measure the discharge of liquid flowing in a closed channel

(d) Measure the discharge of liquid flowing in an open channel

vi. Bernoulli's equation cannot be applied when the flow is **1**

(a) Rotational (b) Turbulent (c) Unsteady (d) All of these

vii. Which among the following is not a criteria to achieve similitude? **1**

(a) Geometric similarity (b) Kinematic similarity

(c) Dynamic similarity (d) Conditional similarity

viii. Similitude is a concept applicable to the testing of _____ **1**

(a) Mathematical models (b) Physical models

(c) Engineering models (d) Chemical models

P.T.O.

ix. The main property that affects a boundary layer is_____ **1**
(a) Temperature (b) Pressure
(c) Viscosity (d) Surface tension

x. Water flows through a circular tube with a velocity of 2 m/s. The diameter of the pipe is 14 cm. Take kinematic viscosity of water 10^{-6} m^2/s and density of water 1000 kg/m^3. The Reynolds No is: **1**
(a) 2.8 X 10^8 (b) 2.8 X 10^5 (c) 2800 (d) 28000

Q.2 i. Explain the phenomena of capillarity. **2**

ii. State Newtons law of viscosity? Give examples of its application? **3**

iii. A circular plate 3 m diameter is submerged in water. Its greatest and least depth are below the surfaces being 2 m and 1 m respectively. Find the total pressure on the front face of the plate and the position of centre of pressure. **5**

OR iv. Find the volume of the water displaced and position of centre of buoyancy for a wooden block of width 2.5 m and of depth 1.5 m, when it floats horizontally in water. The density of wooden block is 650 kg/m^3 and its length 6.0 m. **5**

Q.3 i. (a) Define source flow and sink flow? **4**
(b) Explain the method of drawing flow net?

ii. In a two-dimensional incompressible flow, the fluid velocity components are given by u= x – 4y and v = -y -4x. Show that velocity potential exists and determine its form. Find also the stream function. **6**

OR iii. Derive one two and three-dimensional form of equation of continuity. **6**

Q.4 Attempt any two.

i. Write short note on: - **5**
(a) Weir & Notches (b) Orifices & mouth pieces

ii. A 30 cm × 15 cm venturi meter is provided in a vertical pipe line carrying oil of specific gravity 0.9 in upward direction. The difference in the elevation of the throat section and entrance section of the venturi meter 30 cm. The differential U-tube mercury manometer shows a gauge deflection of 25 cm. Calculate the discharge of the oil & the pressure difference between entrance section and throat section. C_d is 0.98. **5**

iii. In a 45° bend; a rectangular air duct of 1 m^2 cross sectional area is gradually reduced to 0.5 m^2 area. Find the magnitude and direction of the force required to hold the duct in position if the velocity of the flow at the 1 m^2 section is 10 m/s and the pressure is 2.943 $N/cm^{2.}$ Take density of air 1.16 kg/m^3. **5**

Q.5 Attempt any two:

i. Write the significance of model laws and explain Reynolds and Froude model law in detail. **5**

ii. State Buckingham π theorem? Why this theorem is considered superior over the Rayleigh's method of dimensional analysis? **5**

iii. Derive an expression on the basis of dimensional analysis, suitable parameter to present the thrust developed by a propeller. Assume that the thrust P depends upon the angular velocity ω, speed of advance V, diameter D, viscosity μ, mass density ρ and elasticity of the fluid medium which can be denoted by the speed of the sound in the medium C. **5**

Q.6 Attempt any two:

i. Define Reynold number and write any three points on the significance of Reynold number. **5**

ii. Determine the pressure gradient and shear stress at the two horizontal parallel plates and the discharge per meter width for the laminar flow of oil with a maximum velocity of 2 m/s between two horizontal parallel fixed plates which are 100 mm apart. Given μ = 2.4525 Ns/m^2. **5**

iii. Derive an expression for the velocity distribution for viscous flow through circular pipe and draw the suitable velocity profile in the pipe. **5**

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Marking Scheme
ME3CO06 Fluid Mechanics

Q.1 i. Surface tension has the unit of **1**
(c) Force per unit length

ii. The dynamic viscosity of a liquid is 1.2×10^{-4} Ns/m^2, whereas, the density is 600 kg/m^3. The kinematic viscosity in m^2/s is **1**
(b) 20×10^{-8}

iii. Viscous forces are not present in **1**
(b) Irrotational flow

iv. Constant of equation of continuity is known as **1**
(a) Flow rate

v. Venturi meter is used to **1**
(c) Measure the discharge of liquid flowing in a closed channel

vi. Bernoulli's equation cannot be applied when the flow is **1**
(d) All of these

vii. Which among the following is not a criteria to achieve similitude? **1**
(d) Conditional similarity

viii. Similitude is a concept applicable to the testing of _____ **1**
(c) Engineering models

ix. The main property that affects a boundary layer is_____ **1**
(c) Viscosity

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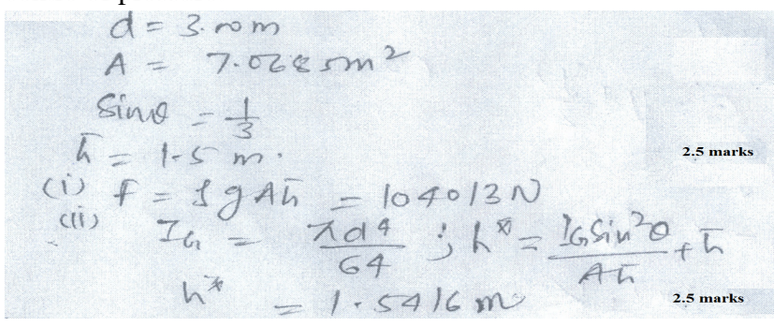
(b) 2.8 X 10^5

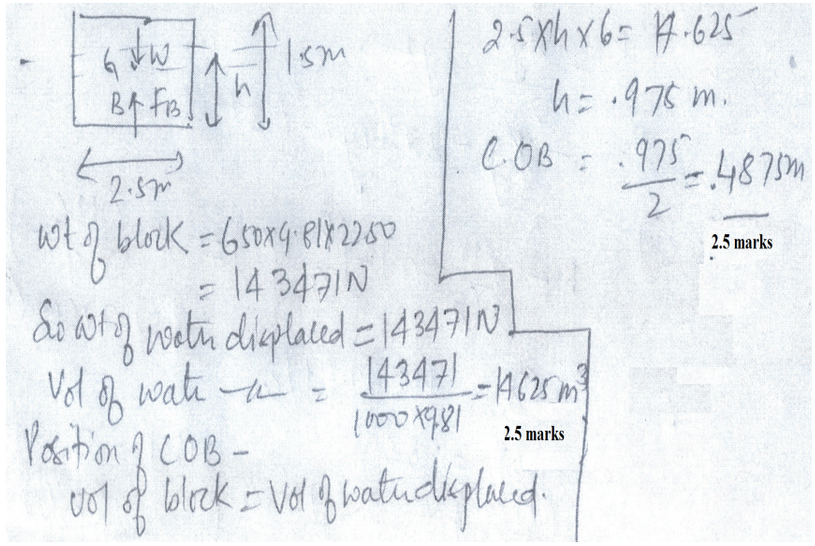
Q.2 i. Phenomena of capillarity. **2**

ii. Newtons law of viscosity 2 marks **3**
Examples of its application 1 mark

iii. Find the total pressure on the front face of the plate and the position of centre of pressure. **5**

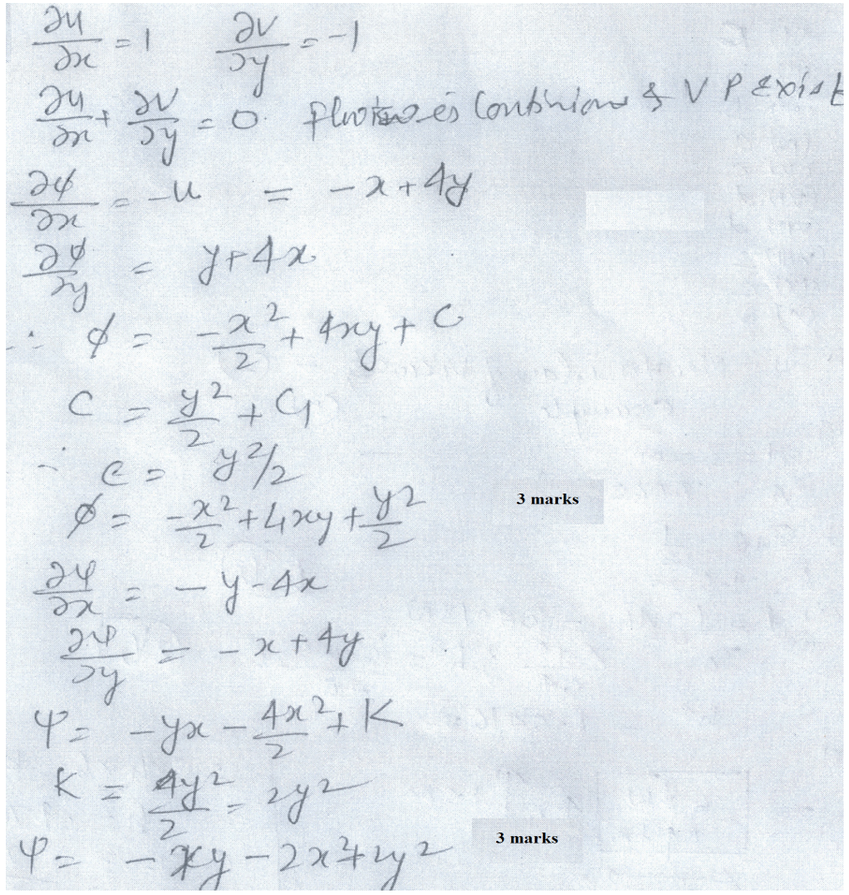


OR iv. Find the volume of the water displaced and position of centre **5**



Q.3 i. (a) Definition source flow and sink flow 2 marks **4**
(b) Method of drawing flow net 2 marks

ii. Find also the stream function. **6**



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Step wise marking

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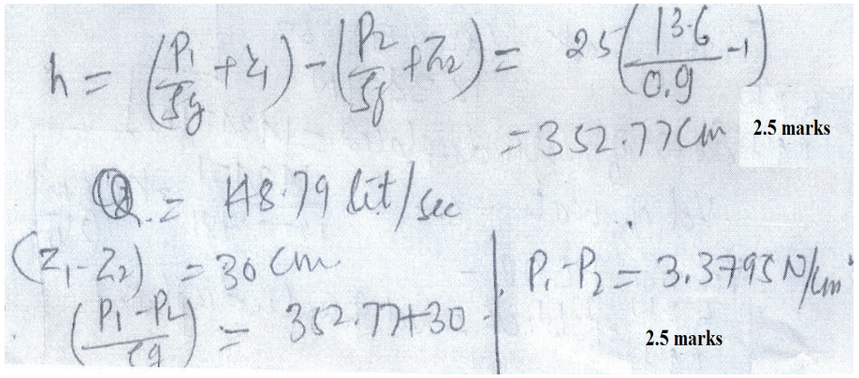
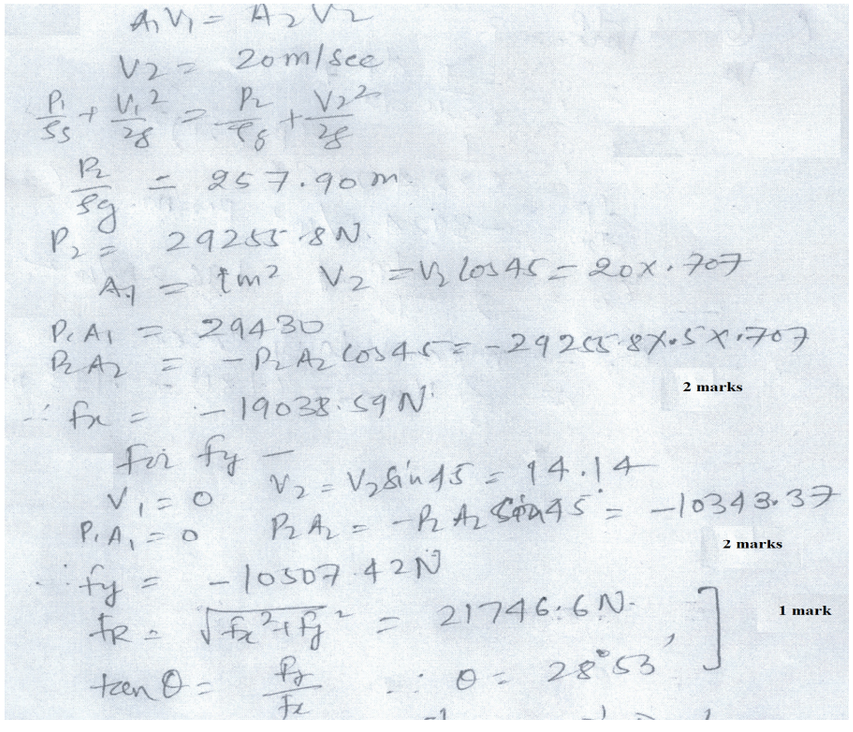
ii. Calculate the discharge of the oil & the pressure difference between entrance section and throat section. **5**



iii. Find the magnitude and direction of the force required to hold the duct in position **5**

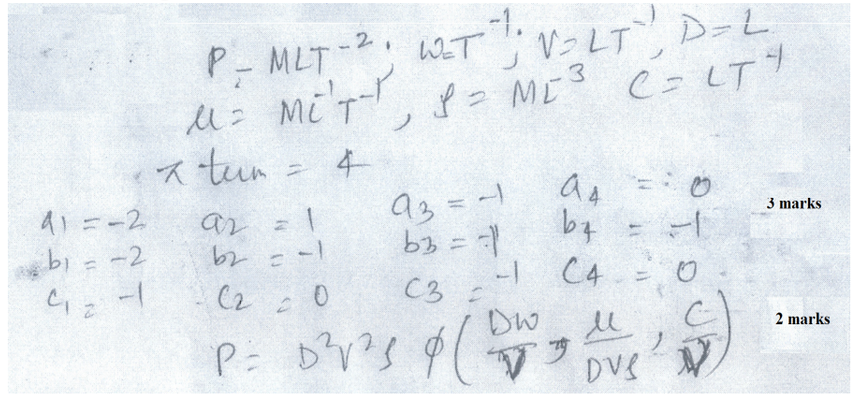


Q.5 Attempt any two:

i. Significance of model laws and Reynolds and Froude model law **5**

ii. State Buckingham π theorem? Why this theorem is considered superior over the Rayleigh's method of dimensional analysis? **5**
As per the explanation

iii. Derive an expression on the basis of dimensional analysis, **5**



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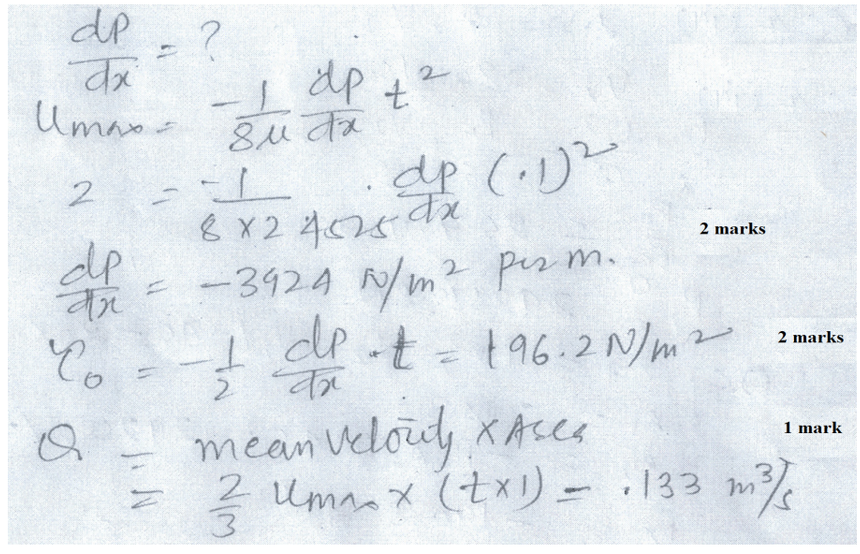

iii. Derivation for the velocity distribution for viscous flow through circular pipe and draw the suitable velocity profile in the pipe. **5**
Stepwise marking

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