

Enrollment No.....



Faculty of Engineering
End Sem (Odd) Examination Dec-2017
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. The specific gravity of water is 1
(a) 1.4 (b) 1 (c) 1000 (d) 100
- ii. The S.I units of kinematic viscosity (ν) are 1
(a) $\frac{m^3}{s}$ (b) $\frac{kg}{s}$ (c) $\frac{m^2}{s}$ (d) $\frac{N}{s}$
- iii. Which property is constant for an incompressible flow? 1
(a) Density (b) Velocity (c) Acceleration (d) None of these
- iv. Which of the following expressions is correct for a stream function? 1
(a) $v = \frac{\partial \psi}{\partial y}$ (b) $v = -\frac{\partial \psi}{\partial y}$
(c) $u = \frac{\partial \psi}{\partial y}$ (d) $u = -\frac{\partial \psi}{\partial y}$
- v. The unit of pressure head is 1
(a) Pa (b) N (c) m (d) N-m
- vi. The ratio of area of the jet at vena contracta to area of orifice is known as 1
(a) Co-efficient of velocity (b) Co-efficient of contraction
(c) Co-efficient of discharge (d) None of these
- vii. The dimensions of surface tension in M-L-T system are given by 1
(a) MLT^{-1} (b) LT^{-1} (c) ML^2T^2 (d) MT^{-2}
- viii. The dimensionless number defining the ratio of actual velocity to sonic velocity is 1
(a) Froude (b) Mach (c) Reynold (d) Euler

P.T.O.

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- ix. Reynold number is given by **1**
 (a) $\rho V l / \mu$ (b) $\rho \mu V l$ (c) $\mu / \rho V$ (d) None of these
- x. The Reynold number for a flow comes out to be 230. Which of the **1**
 following statement is true?
 (a) The flow is turbulent.
 (b) The flow is impossible.
 (c) The flow is laminar.
 (d) The flow is neither laminar nor turbulent.
- Q.2 i. Define : **4**
 (a) Compressibility
 (b) Bulk modulus, along with suitable mathematical expressions.
- ii. A rectangular box with base 2.5 m x 4 m. is filled with kerosene oil of **6**
 specific gravity 0.8 to a depth of 6 m. Determine the resultant pressure
 force and its point of application on the base and on each vertical face
 of box.
- OR iii. A piston of 5cm radius and 12.5 cm long slides vertically down in a **6**
 10.05 cm diameter cylinder. The oil filling in the annular space has a
 viscosity of 0.08 Ns/m². Find the speed with which the piston slides
 down if load on the piston is 10 N.
- Q.3 i. Distinguish between uniform flow and non-uniform flow. **2**
 ii. For the velocity field given by $V = 10xyi + 5x^2j + (t^2x+z)k$, find the **8**
 velocity and acceleration of a fluid particle at co-ordinates (1,2,3) and
 at t=1 sec.
- OR iii. Check whether the flow defined by the stream function $\psi = 2xy$ is **8**
 irrotational. If so, determine the corresponding velocity potential
 function.
- Q.4 i. Write a short note on Orifice with diagram and how it is used for flow **4**
 measurement?
- ii. Derive Euler's equation along streamline flow and hence derive **6**
 Bernoulli's theorem. State assumptions for Bernoulli's theorem and
 throw light on terms obtained by it.

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- OR iii. A 2 m. long water pipeline tapers uniformly from 10 cm diameter to 20 **6**
 cm diameter at its upper end. The pipe centre line slopes upwards at an
 angle of 30° to the horizontal and the flow direction is from smaller to
 bigger cross-section, due to motive force of a pump. If the pressures at
 lower ends and upper ends are 200 kPa and 230 kPa respectively,
 determine the flow rate.
- Q.5 i. What is the significance of Froude number? **2**
 ii. With the help of Rayleigh's method of dimensional analysis, express **8**
 efficiency η of a fan in terms of dimensionless parameters, if η depends
 on the density ρ , the dynamic viscosity μ , the angular velocity ω ,
 diameter D of rotor, and the discharge Q.
- OR iii. Show by the use of Buckingham's π theorem, that the velocity through **8**
 an orifice is given by
- $$V = \sqrt{2gh} f\left(\frac{D}{H}, \frac{\mu}{\rho V H}, \frac{\sigma}{\rho V^2 H}\right)$$
- Where H is the head causing flow, D is the diameter of the orifice, μ is
 the coefficient of viscosity, ρ is mass density, σ is the surface tension
 and g is the gravitational acceleration.
- Q.6 Write short notes on any two: Support your answers with diagrams and **5**
 mathematical expressions:
 i. Reynold's experiment **5**
 ii. Navier-Stokes equations of motion **5**
 iii. Hydrodynamic lubrication **5**

Marking Scheme

	F = 565056 N	- 1 mark	
	C _p = 4 m. from free surface	- 1 mark	
	Step marking should be given		
OR	iii. Ans.: formula of Newton's law of viscosity	- 2 marks	6
	speed = 0.796 m/s	- 4 marks	
	Step marking should be given		
Q.3	i. Difference b/w two flows		2
	ii. Ans: formula of velocity	- 1 mark	8
	Velocity = 21 units	- 3 marks	
	Formula of acceleration	- 1 mark	
	Acceleration = 493.13 units	- 3 marks	
	Step marking should be given		
OR	iii. Checking of vorticity = 0, hence irrotational	- 4 marks	8
	Vel potential $\Phi = x^2 - y^2 + \text{const}$	- 4 marks	
Q.4	i. Short note on Orifice and mouth piece	- 3 marks	4
	Diagram	- 1 mark	
	ii. Derivation of Eulers equation	- 2 marks	6
	Derivation of Bernoulli's theorem	- 2 marks	
	Assumptions	- 1 mark	
	Interpretation of terms	- 1 mark	
OR	iii. Formula: Bernoulli's theorem	- 2 marks	6
	Discharge Q formula (continuity equation)	- 1 mark	
	Ans: 0.0723 m ³ /s (Step marking should be given)	- 3 marks	
Q.5	i. Significance of Froude number with mathematical expression)		2
	ii. Ans: $\eta = f\left(\frac{\mu}{\rho\omega D^2}, \frac{Q}{\omega D^3}\right)$ (Step marking should be given		8
OR	iii. Step marking should be given		8
	Formulation of π terms	- 4 marks	
	Obtaining the final expression	- 4 marks	
Q.6	Write short notes on (any two):		5
	Each note with diagram and suitable expressions (5 marks each)		
