

Reg. No. _____

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
THIRD SEMESTER B.TECH DEGREE EXAMINATION, JULY 2017

Course Code: **ME203**Course Name: **MECHANICS OF FLUIDS (ME)**

Max. Marks: 100

Duration: 3 Hours

PART A

Answer any three questions.

1. (a) Differentiate between Newtonian fluids and Non-Newtonian fluids. (4)
(b) In a stream of glycerine in motion at a certain point the velocity gradient is 0.25 s^{-1} . If for the fluid, the density is 1268 kg/m^3 and kinematic viscosity is $6.3 \times 10^{-4} \text{ m}^2/\text{s}$. Calculate the shear stress at the point. (6)
2. (a) Differentiate between gauge pressure and absolute pressure. (4)
(b) Determine the total pressure and position of centre of pressure on an isosceles triangular plate of base 5m and altitude 5m when the plate is immersed vertically in an oil of specific gravity 0.8. The base of the plate is 1m below the free surface of oil. (6)
3. (a) Define metacentre and metacentric height. (4)
(b) A solid cylinder of diameter 5m has a height of 4m. Find the metacentric height of the cylinder when it is floating in water with its axis vertical. The specific gravity of the cylinder = 0.6. (6)
4. (a) Define streak lines and path lines. (4)
(b) If for a two dimensional potential flow, the velocity potential is $\Phi = x(2y-1)$, determine the velocity at the point P(2,3). Determine also the value of stream function ψ at the point P. (6)

PART B

Answer any three questions.

5. (a) Derive Euler's equation of motion. Obtain Bernoulli's equation from Euler's equation. (6)
(b) What are the assumptions made in deriving Bernoulli's equation? (4)
6. (a) What is a Venturimeter? Derive an expression for the discharge through a venturimeter. (6)
(b) An oil of specific gravity 0.8 is flowing through a venturimeter having inlet diameter 20cm and throat diameter 10cm. The oil-mercury differential manometer

- shows a reading of 15cm. Calculate the discharge of oil through the horizontal venturimeter. Take $C_d = 0.98$ (4)
7. (a) What are minor losses? (4)
- (b) Derive Darcy-Weisbach equation. (6)
8. (a) Define hydraulic gradient line and total energy line. (4)
- (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 15m. Calculate the difference of pressure at the two ends of the pipe, if 100kg of oil is collected in a tank in 25 seconds. (6)

PART C

Answer any four questions.

9. Obtain Von-Karman momentum integral equation. (10)
10. For the velocity profile in laminar boundary layer is given as $u/U = 3/2(y/\delta) - 1/2(y/\delta)^3$ where u = velocity in boundary layer at a distance y , U = Free stream velocity and δ = Boundary layer thickness. Find the thickness of the boundary layer and shear stress 1.8m from the leading edge of a plate. The plate is 2.5m long and 1.5m wide and is placed in water and which is moving with a velocity of 12cm/s. Find the drag on one side of the plate. Viscosity of water = 0.01 poise. (10)
11. The resistance R to the motion of completely submerged body depends upon the length of the body L , velocity of flow V , mass density of fluid ρ and kinematic viscosity of fluid ν . By dimensional analysis prove that $R = \rho V^2 L^2 \Phi(VL/\nu)$. (10)
12. (a) Define boundary layer thickness and momentum thickness. (4)
- (b) State Buckingham's π theorem. How are the repeating variables selected in dimensional analysis? (6)
13. Define the following:
- (i) Froude number
 - (ii) Reynolds number
 - (iii) Weber number
 - (iv) Cauchy number
 - (v) Euler number (10)
14. The velocity distribution in a laminar boundary layer is given by $u/u_a = 3/2(y/\delta) - 1/2(y/\delta)^2$. Calculate the displacement thickness and momentum thickness. (10)