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Reg No.:_____ Name:_____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

Third Semester B.Tech Degree (S,FE) Examination December 2020 (2015 Scheme)

**Course Code: ME203**

**Course Name: MECHANICS OF FLUIDS**

Max. Marks: 100 Duration: 3 Hours

**PART A**

***Answer any three full questions, each carries 10 marks.*** Marks

1 a) Distinguish between the following: (6)

i) Ideal and Real fluid

ii) Newtonian and Non-Newtonian fluid

iii) Poise and Stokes

b) A hydraulic press has a ram of 30cm diameter and a plunger of 4.5cm diameter. Find the weight lifted by the hydraulic press when the force applied at the plunger is 500 N. (4)

2 Derive the expression for the force exerted on a submerged vertical plane surface by the static liquid and locate the position of centre of pressure. (10)

3 a) Derive the expression for continuity equation in 3-D. (8)

b) Differentiate between i) steady and unsteady ii) uniform and non-uniform flows. (one point) (2)

4 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. Also find the velocity at point (1, 2). (10)

**PART B**

***Answer any three full questions, each carries 10 marks.***

5 a) State the use of an orifice meter. Derive an expression for the rate of flow through orifice meter. (6)

b) An orifice meter with orifice diameter 15 cm is inserted in a pipe of 30 cm diameter. The pressure difference measured by a mercury oil differential manometer on the two sides of the orifice meter gives a reading of 50 cm of mercury. Find the rate of flow of oil of sp.gr. 0.9 when the coefficient of discharge of the orifice meter = 0.64. (4)

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| 6 | a) | Derive Euler's equation of motion. Obtain Bernoulli's equation from Euler's equation of motion. | (6) |
| | b) | State the assumptions made in the derivation of Bernoulli's equation. | (4) |
| 7 | a) | Write the expressions for shear stress and velocity distribution in a pipe and sketch a figure to show its distribution along the diameter of a pipe. | (4) |
| | b) | Describe the Reynolds experiment to classify laminar and turbulent flows with a neat figure. | (6) |
| 8 | a) | Explain the difference between major and minor losses in pipes. List any two minor losses. | (4) |
| | b) | A crude oil of viscosity 0.97 poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 100 mm and of length 10 m. Calculate the difference of pressure at the two ends of the pipe, if 100 kg of the oil is collected in a tank in 30 seconds. | (6) |

## PART C

***Answer any four full questions, each carries 10 marks.***

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| 9 | | Define displacement thickness and momentum thickness. Derive an expression for the displacement thickness and momentum thickness. | (10) |
| 10 | a) | Explain the following terms : i) Laminar boundary layer ii) Turbulent layer iii) boundary layer thickness. | (6) |
| | b) | Write the Von-Karman momentum integral equation and state the terms in it. | (4) |
| 11 | | Describe the development of boundary layer over a horizontal flat plate which is kept in a flow field with a neat sketch. | (10) |
| 12 | | The pressure difference $\Delta p$ in a pipe of diameter D and length L due to a turbulent flow depends on the velocity V, viscosity $\mu$, density $\rho$ and roughness k. Using Buckingham's pi theorem, obtain an expression for $\Delta p$. | (10) |
| 13 | | List the three types of similarities and explain them. | (10) |
| 14 | | A ship 300 m long moves in sea-water, whose density is 1030 kg/m$^3$, a 1:100 model of this ship is to be tested in a wind tunnel. The velocity of air in the wind tunnel around the model is 30 m/s and the resistance of the model is 60 N. Determine the velocity of ship in sea-water and also the resistance of the ship in sea- water. The density of air is given as 1.24 kg/m$^3$. Take kinematic viscosity of sea-water and air as 0.012 stokes and 0.018 stokes respectively. | (10) |

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