

Reg No.: _____

Name: _____

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

Course Code: ME203

Course Name: MECHANICS OF FLUIDS (ME)

Max. Marks: 100

Duration: 3 Hours

PART A

Answer any three full questions, each carries 10 marks.

Marks

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| 1 | a) Differentiate between ideal fluids and real fluids. Mark those on rheological diagram. | (4) |
| | b) A plate weighing 150N and measuring 0.8m x 0.8m slides down an inclined plane over an oil film of 1.2mm thickness for an inclination of 30° and a velocity of 0.2m/s. Compute the dynamic viscosity of the fluid. | (6) |
| 2 | a) What is metacentre? Explain the equilibrium conditions of floating bodies. | (4) |
| | b) A triangular plate of base width 2m and height 3m is immersed in water with its plane making an angle of 60° with the free surface of water. Determine the hydrostatic pressure force and the centre of pressure when the apex of the triangle lies 5m below the free water surface. | (6) |
| 3 | a) Explain the working principle and use of the following devices.
i) Hydraulic lift ii) Piezometer iii) Bourden tube pressure gauge | (6) |
| | b) Differentiate between rotational and irrotational fluid flow. | (4) |
| 4 | a) Define the following with example.
i) Stream lines ii) Stream tube iii) Path lines iv) Streak lines | (4) |
| | b) The stream function for a flow field is given by $\psi = 2xy$. Check whether the flow is continuous or irrotational. | (6) |

PART B

Answer any three full questions, each carries 10marks.

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| 5 | a) Derive Euler's equation of motion. Obtain Bernouli's equation from Euler's equation. | (6) |
| | b) What are the applications and limitations of Bernouli's equation? | (4) |
| 6 | a) What is Venturimeter? Derive an expression for discharge through a venturimeter. | (6) |
| | b) Water flows at the rate of 15litre/s through a pipe 100mm diameter orifice used in a 200 mm diameter pipe. What is the difference of pressure head between upstream section and vena contracta section? Take coefficient of contraction as 0.6 and coefficient of velocity as 1. | (4) |
| 7 | a) Differentiate between laminar and turbulent flows. | (4) |
| | b) Derive Darcy- Weisbach equation. | (6) |
| 8 | a) Explain the causes of major and minor energy losses in pipe flows. | (4) |

- b) Glycerine flows at a velocity of 5m/s in a 10cm diameter pipe. Dynamic viscosity and density of glycerine is assumed as 1.50Pa.s and 1260kg/m³ respectively. (6)
 Estimate: i) The boundary shear stress in the pipe due to the flow.
 ii) Head loss in a length of 10m of pipe.
 iii) Power developed by the flow in a distance of 10m.

PART C

Answer any four full questions, each carries 10marks.

- 9 Determine the displacement thickness, momentum thickness and energy thickness in terms of normal boundary layer thickness δ in respect of the following velocity profile in the boundary layer on a flat plate $\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$ where u is the velocity at height y above plate surface and U is the free stream velocity. (10)
- 10 Obtain Von – Karman momentum integral equation from conservation principles. (10)
- 11 a) Derive an expression for i) displacement thickness and ii) momentum thickness. (6)
 b) A 2.5m ship model was tested in fresh water ($\rho=1000\text{kg/m}^3$) and measurements indicated that there was a resistance of 45N when the model was moved at 2m/s. Work out the velocity of 40m prototype. Also calculate the force required to drive the prototype at this speed through sea water ($\rho =1025\text{kg/m}^3$). (4)
- 12 a) Define the following: i) boundary layer thickness ii) displacement thickness iii) momentum thickness and iv) energy thickness. (4)
 b) Explain: i)Geometric similarity ii)Kinematic similarity iii) Dynamic similarity. (6)
- 13 Show that the power P developed in a water turbine can be expressed as: $P = \rho N^3 D^5 \Phi \left\{ \frac{D}{B}, (\rho D^2 N)/\mu, \frac{H}{D}, ND/\sqrt{gH} \right\}$ where D and B are diameter and width of runner, N is the speed in rpm; H is the operating head, μ and ρ are respectively the coefficient of dynamic viscosity and mass density of the liquid. (10)
- 14 Define the following dimensionless number with their field of application: (10)
 i) Froude Number ii) Weber Number iii) Newton number iv) Mach number
