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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S3 (S,FE) (FT/WP) / S1 (PT) Examination November/December 2025 (2019 Scheme)

Course Code: MET203

Course Name: MECHANICS OF FLUIDS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions. Each question carries 3 marks Marks

1	Due to temperature rise, there is decrease in viscosity in liquids but it increases in gases, why?	(3)
2	With the help of a sketch, show the relationship between absolute pressure and gauge pressure.	(3)
3	Define following with examples a) streamlines b) stream tube c) path lines	(3)
4	Differentiate between rotational and irrotational fluid flow and also mention examples for each.	(3)
5	Describe the different types of notches.	(3)
6	Sketch a pitot tube and explain briefly how it is used to measure the velocity of a flowing fluid.	(3)
7	List the minor losses encountered in pipe flow.	(3)
8	Distinguish between pipes in series and parallel?	(3)
9	Describe briefly turbulent boundary layer.	(3)
10	State the limitations of dimensional analysis	(3)

PART B

Answer any one full question from each module. Each question carries 14 marks

Module 1

11a)	Distinguish between manometers and mechanical gauges. What are the different types of mechanical gauges and explain each?	(7)
b)	A 150mm diameter vertical cylinder rotates concentrically inside another cylinder of diameter 151mm. Both cylinders are 250mm high. The space between the cylinders is filled with a liquid whose viscosity is 10poise. Determine the torque required to rotate the inner cylinder at 100rpm	(7)
12a)	Derive the expression for metacentric height of the floating body.	(7)

b) A circular plane surface 3m diameter is under water with its plane making an angle of 30^0 with the free surface of water. If the top edge of the plate is 1 meter below the water surface, find the force on one side of the plate and its location. (7)

Module 2

13a) Define velocity potential function and stream function (5)

b) The velocity vector in an incompressible flow is given by $V=(6xt+yz^2)\,i + (3t+xy^2)\,j + (xy-2xyz-6tz)\,k$. Verify weather continuity equation is satisfied? Also determine the velocity and acceleration at point (1,-2, 3) at the time t=2 units. (9)

14a) Distinguish between i) Steady and Unsteady flow, ii) Laminar and Turbulent flow, iii) Uniform and Non-uniform flow, iv) Compressible and Incompressible flow. (7)

b) In a two dimensional potential flow, the velocity potential is given by $\phi = 4x(3y-4)$, determine the velocity at that point (2,3). Determine also the value of stream function ψ at the point (2,3). (7)

Module 3

15a) Derive Euler's Equation of motion along a stream line for an ideal fluid. Explain how this is integrated to get Bernoulli's equation along the stream line. (7)

b) Define an orifice meter. Prove that the discharge through an orifice meter is given by the relation $Q= \frac{c_d a_0 a_1 \sqrt{2gh}}{\sqrt{a1^2 - a0^2}}$ where a_1 =area of pipe in which orifice is fitted a_0 = area of orifice (7)

16a) State the use of a venturimeter. Derive the expression for the rate of flow through the venturimeter. (7)

b) A liquid of specific gravity 0.8 is flowing upwards at the rate of 0.08 m^3 per second, through a vertical venturimeter with an inlet diameter of 200mm and throat diameter of 100mm. The Cd = 0.98 and the vertical distance between pressure tapping is 300mm. The manometric fluid specific gravity is S_g=13.6 Find (i) the difference reading of two pressure gauges, which are connected to the pressure tapping (ii) the difference in mercury columns of the differential manometer which is connected to the tapping, in place of pressure gauges (7)

Module 4

17a) Derive Hagen-Poiseuille equation. (7)

b) A liquid is pumped through a 15 cm diameter pipe and 300m long pipe at the rate of 20 tonnes per hour. The density of the liquid is 910 kg/m^3 and kinematic viscosity = 0.002m^2/s. Determine the power required and show that the flow is viscous. (7)

18a) Obtain the condition for maximum power transmission through pipes and corresponding efficiency of transmission. (6)

b) A pipe of 75mm diameter is 5m long and the velocity of flow of water is 2.8m/s. If the central 2m length of pipe was replaced by 100mm diameter pipe and the change section being sudden, calculate the loss of head and corresponding power saving. Take f=0.038 for the pipes of both diameters. (8)

Module 5

19a) Define displacement thickness. Derive an expression for the displacement thickness. (5)

b) The velocity distribution in a boundary layer is given by $\frac{u}{U}=\frac{y}{\delta}$ where u= velocity at a distance y from the flat plate and u=U at y=δ where δ = boundary layer thickness. Determine the value of i) displacement thickness ii) momentum thickness iii) energy thickness. (9)

20a) Define and explain the following non-dimensional numbers and also mention their significances for fluid flow problems.(i)Reynolds number ii) Froude number iii) Mach number. (5)

b) The resisting force F of supersonic plane during the flight can be considered as dependent upon length of the aircraft L, velocity V, air viscosity μ, air density ρ and bulk modulus of air K. Express functional relationship between these variables and the resisting force (9)

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