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PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

MSc DEGREE EXAMINATION MAY 2025
(Fourth Semester)

Branch - **MATHEMATICS**

FLUID DYNAMICS

Time: Three Hours Maximum: 75 Marks

SECTION-A (10 Marks)
Answer **ALL** questions
ALL questions carry **EQUAL** marks (10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	The pressure at a point in the fluid can be expressed as _____. a) $p = \lim_{\Delta A \to 0} \frac{\Delta F}{\Delta A}$ b) $p = \lim_{\Delta F \to 0} \frac{\Delta A}{\Delta F}$ c) $p = \frac{\Delta A}{\Delta F}$ d) $\frac{\Delta F}{\Delta A}$	K1	CO1
	2	The thermal conductivity in fourier heat conduction law is *a)* $q_n \propto \frac{\partial T}{\partial n}$ *b)* $-\frac{\partial T}{\partial n}$ *c)* $q_n \propto -\frac{\partial T}{\partial n}$ *d)* $q_n \propto -\frac{\partial n}{\partial T}$	K2	
2	3	A tensor of order --- is a quantity which is completely specified by magnitude and two directions. a) 1 b) 3 c)4 d)2	K1	CO1
	4	------ is a non dimensional deformation which measures the change of relative positions of the parts of a body under any cause. a)vorticity b)strain c) force d) stress	K2	
3	5	The equation of continuity in an incompressible fluid is_____. *a)* $\nabla \times q = 0$ *b)* $\nabla \cdot q = 0$ *c)* $\nabla \cdot q \neq 0$ *d)* $\nabla \times q \neq 0$	K1	CO1
	6	In a vector force field, the line integral represented as_____. *a)* $\oint F \cdot dr$ *b)* $\oiint F \cdot dr$ *c)* $\oint F \times dr$ *d)* $\oiint F \times dr$	K2	
4	7	Reynolds number of flow based on the average velocity is ---- *a)* u_{av} *b)* $\frac{h}{v}$ *c)* $u_{av}\frac{h}{v}$ *d)* $u_{hv}\frac{h}{v}$	K1	CO1
	8	$\frac{dp}{dx} = \mu\frac{d^2\mu}{dy^2}$ is known as_____. a)Navier Stoke's equation b) Blacius solution c) Hooke's law d)Momentum theorem	K2	
5	9	In the region outside of the thin boundary layer, when ======, viscous forces can be completely neglected in comparison with the inertial forces. a) Ω=0 b) $\Omega \neq 0$ c) Ω=1 d) $\Omega \neq 1$	K1	CO1
	10	Von Karman Pohlhausen method is based on the ----------. a) Hooke's law b) Integral theorem c) Newton's law d) Stokes theorem	K2	

Cont...

SECTION - B (35 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** Marks (5 × 7 = 35)

Module No.	Question No.	Question	K Level	CO
1	11.a.	Derive the equation for vorticity in polar coordinates.	K3	CO3
		(OR)		
	11.b.	Determine the acceleration of a fluid particle of fixed identity of the velocity field $q = iAx^2y + jBy^2zt + kczz^2$.		
2	12.a.	Consider an incompressible steady flow with constant viscosity. The velocity components are given by $u(y) = y\frac{U}{h} + \frac{h^2}{2\mu}(-\frac{dp}{dx})\frac{y}{h}(1-\frac{y}{h})$, where h, U and $\frac{dp}{dx}$ are constants and $p = p(x)$. with $v = w = 0$. If the body force is neglected, does u(y) satisfy the equation of motion?.	K3	CO3
		(OR)		
	12.b.	Prove the following; $\sigma_{yz} = \sigma_{zy}$; $\sigma_{xz} = \sigma_{zx}$; $\sigma_{xy} = \sigma_{yz}$		
3	13.a.	Consider the vertical flight of a rocket in a frictionless medium. If the rocket motor is assumed to operate under steady conditions so that the chamber pressure and the effective exhaust velocity do not change with time, calculate the velocity of the rocket at any instant t with reference to a fixed reference.	K5	CO5
		(OR)		
	13.b.	Show that the velocity vector q is everywhere tangent to lines in the xy plane along which $\Psi(x,y) = constant$.		
4	14.a.	Derive the equations of flow between two coaxial cylinders.	K5	CO5
		(OR)		
	14.b.	Water at 70°F flows between two large parallel plates at a distance of 1/16 in apart. If the average velocity is 0.5 ft/sec, find a) the maximum velocity b) the pressure drop c) the wall shearing stress		
5	15.a.	Derive the equation of Von Karman Integral equation.	K3	CO3
		(OR)		
	15.b.	Write the properties of Navier Stokes equation.		

SECTION -C (30 Marks)

Answer **ANY THREE** questions

ALL questions carry **EQUAL** Marks (3 × 10 = 30)

Module No.	Question No.	Question	K Level	CO
1	16	Derive the equation of vorticity in orthogonal curvilinear coordinates.	K4	CO4
2	17	Write the relation between stress and rate of strain.	K4	CO4
3	18	Derive the equation the momentum theorem.	K5	CO5
4	19	Derive the equation of flow between two concentric rotating cylinders.	K5	CO5
5	20	Derive the equation of the Blasius solution.	K4	CO4

Z-Z-Z END