(AUTONOMOUS)

**MSc DEGREE EXAMINATION MAY 2026**

(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 system of units pressure is<br>a) $lbf/ft$ b) $lbf/ft^2$ c) $lb/ft^2$ d) $lbf/t^2$ | K1 | CO1 |
| | 2 | The dimensionless parameter in the case of flow of multicomponent mixtures is called as<br>a) Reynolds number b) Prandtl number<br>c) Schmidt number d) Knudsen number | K2 | CO1 |
| 2 | 3 | The relationship between the stress and strain of a solid body within the elastic limit is called a ----<br>a) Hooke's law b) Newtons Law<br>c) moment of inertia d) Gravity | K1 | CO1 |
| | 4 | The total force acting on a fluid mass enclosed in an arbitrary volume fixed in space is equal to the time rate of change of linear momentum is called ---------<br>a) Momentum theorem b) Hooke's law<br>c)Newton's law of motion d) none of these | K2 | CO1 |
| 3 | 5 | Which one of the following represent as Stoke's theorem?<br>a) $\iint q \cdot dr = \oint \Omega \cdot ndA$ b) $\oint q \cdot dr = \iint \Omega \cdot ndA$<br>c) $\iint \Omega \cdot ndA = \iint q \cdot dr$ d) $\oint \Omega \cdot ndA = \oint q \cdot dr$ | K1 | CO1 |
| | 6 | The streamlines are all -------- lines parallel to the x-axis.<br>a) curved b) vertical<br>c)Straight d) none of these | K2 | CO1 |
| 4 | 7 | Reynolds number of flow is ------<br>a) $\frac{q_\infty l}{v}$ b) $\frac{q_\infty}{v}$ c) $\frac{q_\infty l}{f}$ d) $\frac{q_\infty v}{l}$ | K1 | CO1 |
| | 8 | The flow between two parallel flat plates, one of which is at rest and the other moving with a velocity is parallel with the fixed plate is known as ----<br>a) Vortex pair b) uniform flow<br>c) Couette flow d) radial flow | K2 | CO1 |
| 5 | 9 | In the region of a thin boundary layer near the vicinity of a wall when ----, viscous forces are of the same order of magnitude as inertial forces.<br>a) $\Omega$=0 b) $\Omega \neq 0$ c) $\Omega$=1 d) $\Omega \neq 1$ | K1 | CO1 |
| | 10 | The shearing stress on the surface of the plate can be easily calculated from the results of the _____<br>a) Blasius solution b) boundary condition<br>c) steady motion d) Kelvins theorem | K2 | CO1 |

**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 of Lagrangian method. | K3 | CO3 |
| | | (OR) | | |
| | 11.b. | Determine the equation of the streamlines of the velocity vector $q = ix - jy$. | | |

**Cont...**

| | | | | |
|---|---|---|---|---|
| | 12.a. | stress components: $(\sigma_{x'x'} - \sigma_{y'y'})^2 + 4\sigma_{x'y'}^2 = (\sigma_{xx} - \sigma_{yy})^2 + 4\sigma_{xy}$ | | |
| | (OR) | | | |
| 2 | 12.b. | Consider a two-dimensional incompressible steady flow field with velocity components in rectangular coordinates given by $u(x,y) = \frac{k(x^2 - y^2)}{(x^2 + y^2)^2}$ $v(x,y) = \frac{2kxy}{(x^2 + y^2)^2}$ With k an arbitrary nonzero constant. Is the equation of continuity satisfied? | K3 | CO3 |
| 3 | 13.a. | State and prove Kelvin's theorem. | K5 | CO5 |
| | (OR) | | | |
| | 13.b. | Derive the equation of the moment of momentum theorem. | | |
| 4 | 14.a. | Determine the equation of the shearing stress model in the Hagen Poiseuille flow. | K5 | CO5 |
| | (OR) | | | |
| | 14.b. | Determine the maximum and average velocities of the plane Poiseuille flow. | | |
| 5 | 15.a. | Based on the Von Karman integral relation, determine the local frictional coefficient, $C_f$, for flow over a flat plate. | K3 | CO3 |
| | (OR) | | | |
| | 15.b. | Derive the equation of Von Karman integral relation by momentum law. | | |

## SECTION -C (30 Marks)

Answer **ANY THREE** questions

**ALL** questions carry **EQUAL** Marks $(3 \times 10 = 30)$

| Module No. | Question No. | Question | K Level | CO |
|---|---|---|---|---|
| 1 | 16 | The velocity vector in the flow field is given by $q = i(Az - By) + j(Bx - Cz) + k(Cy - Ax)$ Where A,B and C are nonzero constants. Determine the equations of the vortex lines. | K4 | CO4 |
| 2 | 17 | Derive the energy equation. | K4 | CO4 |
| 3 | 18 | Derive the Laplace's equation in spherical coordinates. | K5 | CO5 |
| 4 | 19 | 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<br>a) the maximum velocity<br>b) the pressure drop<br>c) the wall shearing stress<br>d) The frictional coefficient | K5 | CO5 |
| 5 | 20 | Determine the value of the shearing stress and boundary layer thickness. | K4 | CO4 |

Z-Z-Z END