Math-4.3

Sl.No. :

Total No. of Pages : 2

Fourth Semester M.Sc. Degree Examination, May/June - 2023

(Non CBCS) (SLM Scheme)

MATHEMATICS

Fluid Mechanics

Time : 3 Hours **Max. Marks : 80**

Instructions : 1) Answer any five full questions.

2) All questions carry equal marks.

Q1) a) Define the terms :

i) Compressible and incompressible fluids

ii) Viscons fluid and shearing stress.

b) Derive the relation between stress and rate of strain component.

c) If the velocity distribution is $q = Ax^2y\hat{i} + By^2z\hat{j} + Czt^2\hat{k}$, A, B, C are constants. Find the velocity and acceleration components.

[5 + 6 + 5]

Q2) a) Write short note on thermal conductivity and generalised law of heat conduction.

b) The velocity components of a flow in cylindrical polar co-ordinates are ($r^2z\cos\theta$, $rz\sin\theta$, z^2t) determine the components of acceleration of a fluid particle.

[8 + 8]

Q3) a) Derive the Navier-stoke's equation for a viscous incompressible fluid in the form :

$p\left(\frac{\partial q}{\partial t}+q\nabla q\right)=-\nabla P+p\vec{g}+\mu\nabla^2 q$. Explain the meaning of each term.

b) A mass of a fluid moves in such a way that each particle describes a circle in one plane about a fixed axis, show that the equation of continuity is $\frac{\partial f}{\partial t}+\frac{\partial(pw)}{\partial\theta}=0$ where W is the angular velocity of a particle whose azimuthal angle is θ at time t.

[8 + 8]

Q4) Derive the equation of energy for an incompressible viscous fluid. **[16]**

Q5) a) With usual notation prove $\frac{D\vec{\Omega}}{Dt}=\nu\nabla^2\vec{\Omega}$.

b) Write short note on Dimensional analysis.

[8 + 8]

Q6) a) State and prove Buckingham π-theorem.

b) Explain Reynolds principles of similarity.

[8 + 8]

Q7) a) Determine the maximum value of the velocity profile in the annular space between two coaxial cylinders.

b) Explain stagnation point in two dimensional flow.

[8 + 8]

Q8) a) Write short note on Jeffery-Hamel flow.

b) Derive an expression for coutte-flow between two concentric rotating cylinders.

[8 + 8]

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