UF-5721

# M. A. / M. Sc. (Sem.-IV) Examination, June - 2025

## MATHEMATICS

## PAPER - MATH 402

## Fluid Dynamics-II

Time Allowed : **Three Hours**

Maximum Marks : **100**

*This question paper contains* ***two*** *sections as under:*

https://pyqdelo.com

***Section-A*** ***Max. Marks-20***

*This section will have 10 questions, having 02 questions from each unit with no internal choice. Answer in about 20 words. All questions will have equal marks. (02×10=20)*

***Section-B*** ***Max. Marks-80***

*This section will have 10 questions, having 02 questions from each unit, one question to be attempted from each unit. Words limit approximately 400-500 words. Questions may have sub divisions. All questions will have equal marks. (16×05=80)*

## SECTION - A

1 (a) Write equation of motion of a sphere.

(b) Define vortex line.

(c) Write stress in a fluid at rest.

(d) Write fundamental equation of motion of a viscous compressible fluid in cylindrical polar coordinates.

(e) Define dynamically similar motions.

(f) Define lift and drag coefficients.

(g) Define plane couette flow.

(b) Define Hogen-Poiseuille flow.

(i) Explain boundary layer thickness.

(j) Write Karman momentum integral equation.

## SECTION - B

### UNIT - I

2 (a) Find the velocity potential for motion of a sphere in an infinite mass of a liquid at rest at infinity.

(b) Show that when a sphere of radius '$a$' moves with uniform velocity v through a perfect incompressible fluid, the acceleration of a particle of the fluid at (r, 0°) is

$$3v^2\left(\frac{a^3}{r^4}-\frac{a^6}{r^7}\right)$$

**OR**

(a) State and prove Kelvin's circulation theorem.

(b) Find the necessary and sufficient condition that the vortex lines may be at right angles to the stream lines.

### UNIT - II

3 Derive Stokes' law of friction.

**OR**

Derive Navier - Stokes' equation of motion.

## UNIT - III

4 State and prove Buckingham $\pi$ -theorem.

**OR**

Explain following Non-dimensional parameters:

(a) Reynolds number.

(b) Grashoff number.

(c) Nusselt number.

(d) Prandtl number.

## UNIT - IV

5 Explain velocity distribution of flow between two parallel plates.

**OR**

Explain temperature distribution of Hogen-Poiseuille flow.

https://www.uokonline.com

## UNIT - V

6 Obtain Blasius - Topfer solution for boundary layer flow on a flat plate.

**OR**

Obtain Prandtl boundary layer equations for a two dimensional unsteady incompressible flow.

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