78463

M. Sc. Mathematics 4th Semester
(CBCS Scheme)
Examination – May, 2024

VISCOUS FLUID DYNAMICS

Paper : 17MAT24C3

Time : Three Hours] ***[Maximum Marks : 80***

Before answering the questions, candidates should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.

Note : Attempt ***five*** questions in all, selecting ***one*** question from each Section. Question No. 9 **(Section – V)** is ***compulsory***. All questions carry equal marks.

SECTION – I

1. (a) Find the image of a circular cylinder. 8

(b) Verify that $W = iK\log\left(\frac{z - ia}{z + ia}\right)$, K and a both real, is the complex potential of a steady flow of liquid about a circular cylinder, the plane $y = 0$ being a rigid boundary. Find the force exerted by the liquid on unit length of the cylinder. 8

2. (a) Derive the complex potential for double infinite row of vortices. 8

(b) Discuss flow through a nozzle. 8

SECTION – II

3. Establish the relation between stresses and rates of strain. 8

4. Derive the Navier-Stoke equations of a motion for spherical co-ordinates. 8

SECTION – III

5. Discuss steady flow between rotating cylinders. 16

6. (a) Explain the flow through a tube having equilateral triangular cross-section. 8

(b) Discuss the theory of very slow motion. 8

SECTION – IV

7. (a) Write a note on physical significance of non-dimensional parameters. 8

(b) Explain physical importance of non-dimensional parameters. 8

8. Discuss Von Karman Pohlhausen method. 16

SECTION – V

9. Attempt *all* parts : $2 \times 8 = 16$

(a) What is very slow motion ?

(b) Write the expression for frictional drag coefficient.

(c) Define vortex source.

(d) What is the difference between laminar and turbulent flow ?

(e) Define supersonic flow.

(f) What is energy dissipation ?

(g) Define lubrication.

(h) For what value of Reynolds number, the flow is turbulent in case of Hagen Poiseuille flow.