Register number:

Date and session:

ST. JOSEPH'S COLLEGE (AUTONOMOUS), BENGALURU-27
M.Sc MATHEMATICS - IV SEMESTER
SEMESTER EXAMINATION: April, 2023
(Examination conducted in May 2023)

MT 0222: FLUID MECHANICS

For current batch students only.

Duration: $2\frac{1}{2}$ Hours **Max. Marks:** 70

The paper contains **TWO** pages and **ONE** part.

Answer any SEVEN full questions, each carrying 10 marks.

1. a) State and prove the expression for Navier-Stokes equation.
   b) Derive Euler's equation of motion. (6+4)

2. a) Derive Cauchy-Riemann equation in polar form.
   b) The velocity potential for a two-dimension flow is $\phi = x(2y-1)$ at a point $(4,5)$. Find the velocity and the stream function value. (4+6)

3. a) Find the source and sink in two-dimension.
   b) State Blasius Theorem.
   c) Show that $u_{avg} = \frac{2}{3}u_{max}$ for a plane Poiseuille flow, whose velocity distribution is given as $u = \frac{Pz}{2\mu}(z-h)$where μ, h and P are constants. (3+2+5)

4. Find the velocity distribution inside and outside a rotating cylinder for a steady flow between two concentric rotating cylinders.

5. a) Discuss the types of similarities to be considered between the actual model and prototype.
   b) Define and find the dimensionless form of Reynold's number and Prandtl number. (6+4)

6. a) Find the resistance force R of a supersonic plane during flight that is dependent upon the length of the air craft L, velocity v, air velocity μ, air density ρ and bulk modulus of air K, using Rayleigh's technique.
   b) Show that in the dynamics of compressible fluids, there are only five independent dimensionless groups (5+5)

7. Explain the different boundary conditions associated with velocity.

8. Derive the expression of critical Rayleigh number for Rayleigh Bènard problem.

9. Derive the Pellow Southwell variation problem for a Rayleigh Bènard convection.

OR

Derive Blasius solution for boundary layer flow over a flat plate.

**********END**********