

10. Derive the equation of Energy.
11. Derive the expression for flow in tube of uniform cross-section.
12. Derive the expression for Karman flow.
13. Derive the expression for Stoke's first problem.

MAMT-07/MSCMT-07

June – Examination 2023

M.A./M.Sc. (Final) Examination

MATHEMATICS

(Viscous Fluid Dynamics)

Paper : MAMT-07/MSCMT-07

Time : 3 Hours]

[Maximum Marks : 80

Note :- The question paper is divided into three Sections A, B and C. Write answers as per the given instructions.

Section–A

8×2=16

(Very Short Answer Type Questions)

Note :- Answer all questions. As per the nature of the question delimit your answer in one word, one sentence or maximum up to **30** words. Each question carries 2 marks.

1. (i) Define the stress in a fluid at rest.

- (ii) Define Circulation.
- (iii) Define stagnation point and boundary layer.
- (iv) Define Stoke's stream function.
- (v) Define boundary layer thickness δ .
- (vi) Define No-slip condition.
- (vii) Write the name of two approaches to derive boundary layer equations in 2-D form.
- (viii) Write the Stoke's expression for the drag.

Section-B **4×8=32**

(Short Answer Type Questions)

Note :- Answer any *four* questions. Each answer should not exceed **200** words. Each question carries 8 marks.

2. The stress tensor at a point P is :

$$\sigma_{ij} = \begin{bmatrix} 7 & 0 & -2 \\ 0 & 5 & 0 \\ 2 & 0 & 4 \end{bmatrix}$$

Determine the stress vector on the plane at P whose

unit normal is $\hat{n} = \frac{2}{3}i - \frac{2}{3}j + \frac{1}{3}k$.

- 3. Derive the expression for vorticity.
- 4. Explain the physical importance of the following :
 - (i) Mach number
 - (ii) Grashoff number
- 5. Derive the expression for starting flow in plane Couette motion.
- 6. Derive the expression for temperature distribution of plane-couette flow with transpiration cooling.
- 7. Explain the applications of boundary layer theory.
- 8. Derive the expression for boundary layer flow over a flat plate for $Pr = 1$.
- 9. Explain the order of magnitude approach to solve velocity boundary layer equations in two dimensional form.

Section-C **2×16=32**

(Long Answer Type Questions)

Note :- Answer any *two* questions. You have to delimit your each answer maximum up to **500** words. Each question carries 16 marks.