UC-5724

M. A./M. Sc. (Sem. IV) Examination, June-2023

MATHEMATICS

Paper - MATH 4 O(ii)

Fluid Dynamics-II

Time Allowed : **Three Hours**

Maximum Marks : **70**
Min. Pass Marks : **28**

Note : *This question paper is divided into three sections as under :*

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Section-A **Max. Marks - 10**

This section contains 01 compulsory question comprising 10 short answer type questions (maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark.

Section-B ***Max. Marks-25***

This section contains 10 questions, 02 questions from each unit (answer about in 250 words). Students are instructed to attempt five questions by selecting one question from each unit. Each question shall be of five marks.

Section-C ***Max. Marks-35***

*This section contains five long answer type questions comprising one compulsory question (question no. 12) of 15 marks and four questions of 10 **marks each.** Students are instructed to attempt total three questions **with one** compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of ramaining four questions.*

SECTION-A

1 (i) Define Stoke's stream function.

(ii) Define vortex line.

(iii) Define non-Newtonian fluids.

(iv) Define incompressible fluids.

(v) What do you mean by conduction and convection.

(vi) Write the equation of continuity in Cartesian coordinates.

(vii) Define Reynolds number.

(viii) What do you mean by Plane Couette Flow?

(ix) Define boundary layer.

(x) What is displacement thickness.

SECTION - B

UNIT - I

2 Discuss the motion for which Stoke's stream function is given by

$$\psi = \frac{1}{2} V \left(a^4 r^{-2} \cos\theta - r^2 \right) \sin^2\theta$$

Where r is the distance from a fixed point and θ is the angle this distance makes with the fixed direction.

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

UNIT - II

4 Explain "Stokes law of friction".

5 The stress tensor at a point P is

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

Determine the stress vector on the plane P whose unit normal is $\hat{n} = \frac{2}{3}\hat{i} - \frac{2}{3}\hat{j} + \frac{1}{3}\hat{k}$.

UNIT - III

6 Obtain equation of continuity in Cartesian coordinate system.

7 Write the fundamental equation of a viscous incompressible fluid with constant fluid properties in cylindrical polar coordinates.

UNIT - IV

8 Discuss the flow of viscous incompressible fluid between two parallel plates which are kept at a finite distance apart.

9 Discuss the flow in tube of uniform cross-section in form of circle.

UNIT - V

10 Explain Prandtl's boundary layer theory.

11 Derive the boundary layers equation in two dimensional form for the flow past a solid plane wall.

SECTION - C

12 Define the following non-dimensional parameters and discuss the physical importance also :

(a) Reynolds number

(b) Mach number

(c) Prandtl number.

13 Derive the velocity distribution for the flow between parallel plates for the flowing types of flows :

(i) Plane Couette flow

(ii) Plane Poiseuille flow

14 Explain the motions due to rectilinear vortices.

15 Derive the two dimensional boundary layer equations for the flow over a plane wall by Asymptotic approach.

16 Derive the equation of motion of a sphere.

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https://pyqlelo.com