UTTARAKHAND OPEN UNIVERSITY, HALDWANI (NAINITAL)

उत्तराखंड मुक्त विश्वविद्यालय, हल्द्वानी (नैनीताल)

M.A./M.Sc. Mathematics
ASSIGNMENT-Second YEAR

Last Date of Submission: 15 May जमा करने की अन्तिम तिथिः 15 मई

Course Title: Viscous Fluid Dynamics **Course Code: M.A. /M.Sc MAT 507**

Year: 2013-14 **Maximum Marks : 40**

Section 'A'
भाग क

Section 'A' contains 08 short answer type questions of 5 marks each. Learners are required to answers 4 questions only.

1. The stress matrix at a point P is given by

$$\begin{bmatrix} 2 & 1 & -3 \\ 1 & 1 & 2 \\ -3 & 2 & 1 \end{bmatrix}$$

   Find stress vector on the plane passing through P and parallel to the plane whose unit normal is

$$\left(\frac{3}{7}\right)i + \left(\frac{6}{7}\right)j + \left(\frac{2}{7}\right)k$$

2. State and prove Kelvin's circulation theorem.
3. Discuss the plane poiseuille flow between two parallel plates.
4. Derive the temperature distribution of Hagen-Poiseuille flow taking wall at constant temperature.
5. Derive Stoke's equation for very slow motion and discuss Stoke's flow past a sphere.

6. Find the displacement thickness, the momentum thickness and energy thickness for the velocity distribution in the boundary layer given by

   $\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$.

7. Find two dimensional thermal boundary layer equation for the viscous incompressible fluid flow past a thin plate.

8. State and prove Buckingham π-theorem.

Section 'B'
भाग ख

- **Section 'B' contains 04 long answer-type questions of 10 marks each. Learners are required to answers 02 questions only.**

1. Show that only six components suffice to determine the state of stress at a point.
2. Derive Navier Stokes equations of motion for viscous compressible fluid.
3. Discuss Oseen's improvement to Stoke's theory and hence determine the drag coefficient on a sphere moving in a viscous fluid.
4. Discuss the Blasius-Topfer solution for the boundary layer on a flat plate and calculate the coefficient of skin fraction.