7. Derive the Navier-Stokes-equations of motion for a various compressible fluid. Also give the equation for the following cases :

(a) Constant coefficient of viscosity

(b) Incompressible fluid. 14

Unit IV

8. Discuss steady flow between parallel planes and hence describe Coutte's flow problem giving shearing stress, average and maximum velocity for the flow. 14

9. Describe the steady flow between co-axial circular pipes and hence determine the average velocity in the annulus. Also determine the shear stress at the walls of the inner and outer cylinders. 14

Roll No. ....

(01/21-I)

11662

M. Sc. (2 Year) EXAMINATION

(For Batch 2017 Only)

(Third Semester)

MATHEMATICS

MTHCC-2302

Fluid Mechanics

Time : Three Hours *Maximum Marks* : 70

Note : Attempt *Five* questions in all, selecting *one* question from each Unit and Q. No. **1** is compulsory. All questions carry equal marks.

1. (i) Explain Eulerian method to describe fluid motion.

(ii) Determine the acceleration of a fluid particle of fixed identity for the velocity field $\vec{q} = \hat{i}Ax^2y + \hat{j}By^2zt + \hat{k}Czt^2$.

(iii) Describe stream function for two dimensional flow.

(iv) For the given velocity field $u = Ut$, $v = x$, find the stream function.

(v) Describe the stress in a fluid in motion.

(vi) Give the Navier-Stokes' equation of motion for an inviscid fluid.

(vii) Write a short note on Plane Poiseuille flow. 2×7=14

Unit I

2. Show that the motion specified by $\vec{q} = \dfrac{A\left(x\hat{i} - y\hat{j}\right)}{x^2 + y^2}$, (A is a constant) is a possible. motion of potential kind and hence find the velocity potential. Also show that the given motion is for an incompressible fluid and hence determine the equations of the streamlines. 14

3. State and prove Raynold's transport theorem. 14

Unit II

4. Derive the Euler's equation of motion of an ideal fluid. Also write the equation in cylindrical and spherical polar coordinates. 14

5. (a) Show that the kinetic energy of the moving fluid of an infinite liquid in irrotational motion, which is considered to be at rest at infinity and is bounded internally by solid surfaces $s_1, s_2, \ldots, s_n$ is

$$T = \frac{1}{2}\rho \int_{s_i} \phi \frac{\partial \rho}{\partial n} ds,$$ where ϕ is the velocity potential, ρ is the uniform density and the normal to the surfaces is drawn outward to the fluid. 7

(b) Describe the motion of a uniform stream with a simple source in the fluid. 7

Unit III

6. Derive the relation between stress and gradient of velocity for viscous fluid. 14