ASSIGNMENT SET – I

Mathematics: Semester-II

M.Sc (CBCS)

Department of Mathematics

Mugberia Gangadhar Mahavidyalaya

PAPER - MTM-201

Paper: Fluid Mechanics

1. Derived the value of Nusselt number.
2. Describe the properties of fluid.
3. Describe the properties of fluid.
4. What is Circulation?
5. Describe real and ideal flow.
6. State the boundary layer theory.
7. State Blasius theorem.
8. Describe real and ideal flow.
9. Describe one, two and three dimensional flow.
10. What is vortex line and complex potential.
11. Find the substantial derivative of the steady state velocity field represented by the velocity vector V=(-3x, -3y, 6z).
12. What are the differences between laminar and turbulent flows? Also show the rout to turbulent flow from laminar flow.
13. Approximate the boundary layer equations outside the boundary layer.
14. Write about the Reynolds number.
15. What is vortex line and complex potential?
16. Write the assumption of the boundary layer theory.
17. The diameter of a pipe at the section 1 and 2 are 10cm and 20cm respectively. If the velocity of water through the pipe at section 1 is 7 m/s. determine also the velocity at section 2.
18. Derive the equation $\frac{D}{Dt} = \frac{\partial}{\partial t} + (V.\nabla)$.
19. Discuss the model of an infinitesimally small element fixed in space.

20. State and Proof Kelvin's theorem.
21. Determine the equation of the rate of work done on element due to body and free surface.
22. State the conservation of energy for fluid elements. Calculate the net heat flux into the fluid elements.
23. Describe the $\frac{\partial T}{\partial t} = \alpha \frac{\partial^2 T}{\partial t^2}$ *using* Crank-Nicolson scheme and hence write the algebraic expression in a matrix form for the case of Neumann boundary conditions.
24. Derive the momentum equation for Newtonian fluid in conservation form.
25. A circular cylinder is moving in a liquid at rest to infinite to calculate the forces on the cylinder owing to the pressure of the field.
26. Find the Navier-Stokes equations for Newtonian fluids.
27. Find the Net flux of heat into the fluid element using Fourier's law of heat conduction.
28. Derive the vorticity equation for an in-compressible viscous fluid.
29. What do you mean by analytical / exact solution of Navier-stokes Equation? With the necessary assumptions, find the exact solution for the case of couette flow.
30. State the conservation of energy for fluid elements. Calculate the net heat flux into the fluid elements.
31. Derive the momentum equation for Newtonian fluid in conservation form.
32. Write the x-component of Navier-Stokes equation and energy equation for Newtonian, incompressible, viscous fluid flow with negligible gravity and radiation effects.
33. Show that for steady , fully developed laminar flow down the slope the N-S equation reduces to $\frac{d^2u}{dy^2} = -\frac{\rho g}{\mu}\sin\theta$ where u is the velocity in the x-direction, ρ is the density, μ is the viscosity, g is acceleration due to gravity and θ is the angle of the plane to the horizontal. Solve the above equation to obtain the velocity profile u and obtain the expression for the volumetric flow rate for a following film of thickness' h .
34. Find the necessary and sufficient conditions that vortex lines may be at right angles to the streamlines.
35. Make the above equations in non-dimensional form (Navier-Stokes equation in terms of Reynolds number $Re = \frac{UL}{\gamma}$, and energy equation in terms of Re and Prandtl number $= \frac{\gamma}{\alpha}$) with the help of characteristics length, velocity, pressure and temperature as L,U,ρU^2 and $T_W - T_C$,respectively, where symbols have their usual meaning.
36. If $U = \frac{ax - by}{x^2 + y^2}, V = \frac{ay + bx}{x^2 + y^2}, w = 0$
    Investigate the nature of motion. Also find the velocity potential.

37. Consider steady, laminar, fully developed flow between two parallel plates separated by a distance $2H$. The fluid is driven between the plates by an applied pressure gradient in the x-direction. It is assumed that conduction in the y-direction is much greater than conduction in x-direction.
(i) Determine the fully developed velocity distribution of the fluid as a function of the mean velocity.
(ii) Determine the fully developed temperature distribution as a function of the surface and mean temperatures.

__________________________End__________________________