Program : M.A./M.Sc. (Mathematics)
M.A./M.Sc. (Final)
Paper Code:MT-07
Viscous Fluid Dynamics
Section – A
(Very Short Answers Questions)

1. By fluid what do we mean?

A Fluid is a substance which is capable of flowing.

2. What is ideal fluid?

A A fluid is said to be ideal if it does not exert any shearing stress however small.

3. Liquid are ________ fluid and gases are _______ fluid.

A Incompressible, compressible

4. Write the Newton's law of viscosity.

A $\tau = \mu \frac{du}{dy}$

5. What are the dimensions of coefficient of viscosity?

A $M\,L^{-1}T^{-1}$

6. Viscosity coefficient μ__________ rapidly with increasing temperature for liquid and ________ with temperature for gases.

A decreases, increases

7. Express the state of stress in a moving fluid.

A $\sigma_{ij} = -p\partial_{ij} + \tau_{ij}$

8. What do you mean by stress vector

A $\overrightarrow{F_n} = \lim_{\delta s \to 0} \frac{\delta \vec{F}}{\delta S}$

9. What is fourier's law of heat conduction?

A $q = -k\,\frac{dt}{dy}$

10. Fluid which obeys Newton's law of viscosity in known as _______?

A Newtonian fluid.

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11. The ratio of thermal conductivity to the product of density and specific heat is known as _____?

A Thermal diffusivity

12. Write down the equation of state for the incompressible viscous fluid.

A ϕ = constant

13. State Boyle's law.

A $P = \varphi RT$

14. What is law of conservation of mass?

A The fluid mass can neither be created nor destroyed.

15. State equation of continuity in Cartesian tensor notation.

A $\frac{\partial e}{\partial t} + \frac{\partial (PV_j)}{\partial x_j} = 0$

16. State Newton's second law of motion.

A rate of change of linear momentum = total applied force.

17. Define Vorticity transport equation.

A Naurier stokes equations for viscous incompressible fluid motion.

18. Write Vorticity transport equations:

A $\frac{D\overline{\pi}}{Dt} = (\overline{\pi}\, \nabla\,)\overline{q}\, + v\nabla^2\overline{\pi}$

19. State Kelvin's circulation theorem.

A The circulation round any closed curve moving with in viscid fluid does not change with time.

20. Write the equation of continuity in polar-coordinates (r, θ, z)

A $\frac{1}{r}\frac{\partial}{\partial r}(r\ v_r) + \frac{1}{r}\frac{\partial v_\theta}{\partial \theta} + \frac{\partial v_z}{\partial z} = 0$

21. Write down equation of energy of a viscous incompressible fluid in spherical polar coordinates.

A $PC_V \frac{DT}{Dt} = \frac{\partial Q}{\partial t} + K\nabla^2 T + \phi_s$

22. What do you mean by dynamical similarity?

A If with geometrically similar boundaries the flow patterns are geometrically similar then fluid motion are dynamically similar.

23. State the Buckingham – π-theorem.

A The important theorem about the non-dimensional numbers is the π-theorem.

24. The ratio of inertial forces and viscous forces is termed as ______.

A Reynolds Number

25. What do you mean by critical Reynolds number?

A The value of Reynolds number, when the nature of flow changes from laminar to turbulent.

26. If Ma=1 then type of flow is ________

A sonic

27. What is Prandtl number for mercury.

A 0.44

28. Write down the dimensions of Eckert Number.

A dimensionless

29. What is the Eckert number for gases in high speed flow.

A $E_C = (v-1)Ma^2$

30. Which dimensionless parameter is product of Reynolds and Prandtl numbers?

A Pr'celt Number Pe = Re.Pr

31. Define Brinkman number

A $B_r = \frac{\mu U^2}{K(T_2 - T_1)}$

32. What is the value of C_f coefficient of skin friction.

A $C_f = \frac{\tau w}{PU^2/z}$

33. Define Newton's law of cooling.

A $q(x) = \alpha(x)(T_w - T_\infty)$

34. The Navier stoke's equations are second order linear partial differential equation. (True or False)

A False

35. Write Fourier law of heat exchange.

A $q(x) = -K\left(\frac{\partial T}{\partial y}\right) y = 0$

36. Write the boundary conditions of plane couete flow.

A y = o ; u = 0

Y = h ; u = U

37. What is the coefficient of skin friction of plane covette flow.

A $C_f = \frac{\tau w}{PU^2/2} = \frac{2}{R_e}$

38. When does the Generalised plane coucette flow become plane couttet flow.

A When P = 0

39. The coefficient of skin friction at the stationary plate is given by ______.

A $C_f = \frac{2(1+P)}{R_e}$

40. What is the value of volume rate of flow Q of tube or circular cross section.

A $Q = \frac{PTT\ a^4}{8\mu}$

41. Write the volume rate of flow is tube of elliptic cross-section.

A $Q = \frac{TTP a^3 b^3}{4\mu(a^2+b^2)}$

42. What is the average flow over an equilateral triangular corss-section.

A $\frac{3\ Pa^2}{20\mu}$

43. Define TORQUE

A Torque is the force which is require to the outer cylinder.

44. What is Karman flow?

A Flow due to a rotating circular disc.

45. Discuss the potential flow.

A Flow of an ideal or non-viscous fluid.

46. What is stagnation point?

A The point where the velocity is zero in the potential flow.

47. State the boundary layer.

A It is small layer near wall in which all the viscous effects are supposed to be confined.

48. What do you say of flow in the neighborhood of a stagnation point in two dimensions.

A Hieminz flow

49. $\phi^{111} + \phi\phi^{111} - \phi^{12} + 1 = 0$ equation correspond to _____ flow.

A Heimanz flow.

50. What do you say the flow due to a plane wall suddenly set in motion.

A Stokes first problem

51. Flow due to oscillating plane wall is known as _____.

A Stokes second problem or Rayleigh problem.

52. Define the existence of eigenvalues.Write Reduce Navier stokes equation

A $\frac{\partial u}{\partial t} = v\frac{\partial^2 u}{\partial y^2}$

53. What is meant by porous boundaries?

A The boundary has very fine holes distributed uniformly all along the boundary.

54. How the starting flow is an unsteady motion?

A In such flow problems initial velocity consideration are made so that all the subsequent motion becomes time dependent.

55. erfη = ______?

A erfη =$\frac{2}{\sqrt{\pi}}\int_0^{\pi} e^{-\eta^2}\, d\eta$

56. Write down the temperature distribution equation in plane coquette flow.

A $\frac{T-T_0}{T_1-T_0} = \frac{y}{h} + \frac{1}{2}Ec.Pr.\frac{y}{h}\left(1\frac{y}{h}\right)$

57. Write down dimensionless temperature distribution in Hagen poiseville flow.

A $\frac{T-T_0}{T_m-T_0} = 1 - \frac{r^4}{r^4}$

58. Write down the energy equation in plane-coutte follow with transpiration cooling.

A $PC_pV_0\frac{dT}{dy} = K\frac{d^2T}{dy^2} + \mu\left(\frac{du}{dy}\right)^2$

59. The condition for very slow motion is :
(a) Re>1 (b) Re<1 (c) Re>>1 (d) Re<<1

A (d)

60. In the theory of very slow motion which of the following is true for pressure P.
(a) $\nabla p = 0$ (b) $\nabla p \neq 0$ (c) $\nabla^2 p = 0$ (d) $\nabla^2 p \neq 0$

A (c)

61. IN stoke's flow past a sphere the sphere of radius a where notations have their usual meanings.
(a) Experiences no drag.
(b) Experiences drag of magnitude $6\mu \cup \infty$
(c) Experiences drag of magnitude $6\mu \cup \infty a$
(d) Experiences drag of magnitude $6\mu \cup \infty aTT$

A (d)

62. Oseen's equation for slow motion are valid:
    (a) in the neighborhood of the body only
    (b) not in the neighborhood of the body
    (c) in the neighborhood of the body but not at large distance.
    (d) At any distance from the body

A (d)

63. In Oseen slow motion analysis for the flow past a sphere perturbation is assumed in:
    (a) Viscosity (b) pressure (c) density (d) velocity

A (d)

64. Boundary layer theory was formulated by:
    (a) Reynolds (b) Sakidis (c) Blasius (d) Prandtl

A (d)

65. Boundary layer theory formulation considers:
    (a) Slip-condition (b) No-Slip-condition
    (c) Variable pressure (d) Variable temperature

A (b)

66. In the pressure in the boundary layer is same ____?

A As that of at the edge of boundary layer.

67. The boundary layer flow the viscous effect of the fluid is ____?

A Confined in a thin layer adjacent to the wall.

68. Velocity component in the boundary layer adjacent to stationary plane wall:
    (a) remain same throughout.
    (b) dimension as one goes towards the potential flow.
    (c) Grows rapidly as one does towards the potential flow.

A (c)

69. Boundary layer equation are _______ from of Navier stokes equation at large ________.

A asymptotic

Reynolds number

70. Boundary layer flow on a flat plate is also known as _____>

A Blasius-Topper solution

71. Blasius equation have closed form situation. (True or False)

A False

72. What is croccos first integral?

A $\frac{T - T_\infty}{T_w - T_\infty} = 1 - \frac{\mu}{\cup_\infty}$

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