

B.E. DEGREE EXAMINATIONS: APRIL / MAY 2009

Third Semester

U07ME303 Fluid Mechanics and Machinery

(Common to Aeronautical Engineering & Mechanical Engineering)

Time: Three Hours

Maximum Marks: 100

Answer ALL the Questions:-

PART A (20 x 1 = 20 Marks)

1. A Newtonian fluid is defined as the fluid which
 - (a) is incompressible and non-viscous
 - (b) obeys Newton's law of viscosity
 - (c) is highly viscous
 - (d) is compressible and non-viscous
2. Kinematic viscosity is defined as equal to
 - (a) dynamic viscosity x density
 - (b) dynamic viscosity / density
 - (c) dynamic viscosity x pressure
 - (d) pressure x density
3. Surface tension has the units of
 - (a) force per unit area
 - (b) force per unit length
 - (c) force per unit volume
 - (d) none of the above
4. Pascal's law states that pressure at a point is equal in all directions
 - (a) in a liquid at rest
 - (b) in a fluid at rest
 - (c) in a laminar flow
 - (d) in a turbulent flow
5. A stream line is a line
 - (a) which is along the path of particle
 - (b) which is always parallel to the main direction of flow
 - (c) across which there is no flow
 - (d) on which tangent drawn at any point gives the direction of velocity.
6. Continuity equation can take the form
 - (a) $A_1 V_1 = A_2 V_2$
 - (b) $\rho_1 A_1 = \rho_2 A_2$
 - (c) $\rho_1 A_1 V_1 = \rho_2 A_2 V_2$
 - (d) $P_1 A_1 V_1 = P_2 A_2 V_2$
7. Pitot tube is used for measurement of
 - (a) pressure
 - (b) flow
 - (c) velocity at a point
 - (d) discharge.
8. Euler's number is the ratio of
 - (a) inertia force to pressure force
 - (b) inertia force to elastic force
 - (c) inertia force to gravity force
 - (d) inertia force to viscous force
9. For the laminar flow through a circular pipe
 - (a) The maximum velocity = 1.5 times the average velocity.
 - (b) The maximum velocity = 2.0 times the average velocity.
 - (c) The maximum velocity = 2.5 times the average velocity.
 - (d) The maximum velocity = 3.0 times the average velocity.

10. The velocity distribution in laminar flow through a circular pipe follow the
 (a) parabolic law (b) linear law
 (c) logarithmic law (d) turbulent law
11. The co-efficient of friction for laminar flow through a circular pipe is given by
 (a) $f = 0.0791/(Re)^{1/4}$ (b) $f = 16/Re$ (c) $f = 64/Re$ (d) $f = 16 \cdot Re$
12. Geometric similarity between model and prototype means
 (a) the similarity discharge (b) the similarity of linear dimensions
 (c) the similarity of motion (d) the similarity of forces
13. The hydraulic mean depth is given by
 (a) p/A (b) p^2/A (c) A/P (d) A/p
14. Specific speed of a turbine is defined as the speed of the turbine which
 (a) produces unit power at unit head
 (b) produces unit horse power at unit discharge
 (c) delivers unit discharge at unit head
 (d) delivers unit discharge at unit power.
15. Efficiency, of the jet of water having velocity V and striking a series of vertical plates moving with a velocity u , is given by
 (a) $u = 2V$ (b) $u = V/2$ (c) $u = 3V/2$ (d) $u = 4V/3$
16. A turbine is called impulse if at the inlet of the turbine
 (a) total energy is only kinetic energy
 (b) total energy is only pressure energy
 (c) total energy is the sum of kinetic energy and pressure energy
 (d) total energy is only potential energy
17. Kaplan turbine is
 (a) an impulse turbine (b) a radial flow impulse turbine
 (c) an axial flow reaction turbine (d) a radial flow reaction turbine
18. A pump is defined as a device which converts
 (a) Hydraulic energy into mechanical energy
 (b) Mechanical energy into hydraulic energy
 (c) Kinetic energy into mechanical energy
 (d) Mechanical energy into pressure energy
19. To discharge a large quantity of liquid by multi-stage centrifugal pump, the impellers are connected
 (a) in parallel (b) in series (c) in parallel and in series (d) in normal

20. The discharge through a single acting reciprocating pump is
(a) $Q = ALN/60$ (b) $Q = 2ALN/60$ (c) $Q = ALN$ (d) $Q = 2ALN$

PART B (5x16 = 80 Marks)

21. (a) (i) State the Newton's law of viscosity and give examples of its applications (6)
(ii) The dynamic viscosity of oil, used for lubrication between a shaft and sleeve is 6 poise. The shaft is of diameter 0.4 m and rotates at 190 r.p.m. Calculate the power lost in the bearing for a sleeve length of 90 mm. The thickness of the oil film is 1.5 mm. (10)

(OR)

21. (b) (i) Define pressure. Obtain an expression for the pressure intensity at a point in a fluid. (6)
(ii) The diameter of a small piston and a large piston of a hydraulic jack are 3 cm and 10 cm respectively. A force of 80 N is applied on the small piston. Find the load lifted by the large piston when:
1. The pistons are at the same level.
2. Small piston is 40 cm above the large piston
The density of the liquid in the jack is given as 1000kg/m^3 (10)

22. (a) (i) Define the equation of continuity. Obtain an expression for continuity equation for a three dimensional flow. (6)
(ii) A fluid flow field is given by $V = x^2yi + y^2zj - (2xyz + yz^2)k$
Prove that it is a case of possible steady incompressible fluid flow.
Calculate the velocity and acceleration at the point (2, 1, 3). (10)

(OR)

22. (b) State Bernoulli's theorem for steady flow of an incompressible fluid. Derive an expression for Bernoulli's theorem from first principle and state the assumptions made for such a derivation.

23. (a) Find an expression for the loss of head of a viscous fluid flowing through a circular pipe.

(OR)

23. (b) A pipe line of length 2000 m is used for power transmission. If 110.3625 kW power is to be transmitted through the pipe in which water having a pressure of 490.5 N/cm^2 at inlet is flowing. Find the diameter of the pipe and efficiency of transmission if the pressure drop over the length of pipe is 98.1 N/cm^2 . Take $f=0.0065$.

24. (a) Obtain an expression for the work done per second by water on the runner of a Pelton wheel. Hence derive an expression for maximum efficiency of the Pelton wheel giving the relationship between the jet speed and bucket speed.

(OR)

24. (b) A reaction turbine works at 450 r.p.m. under a head of 120 m. Its diameter at inlet is 120 cm and the flow area is 0.4 m^2 . The angles made by absolute and relative velocities at inlet are 20° and 60° respectively with the tangential velocity. Determine:

- (i) The volume flow rate,
- (ii) The power developed, and
- (iii) Hydraulic efficiency. Assume whirl at outlet to be zero.

25. (a) With a neat sketch, explain the principle and working of a centrifugal pump.

(OR)

25. (b) The length and diameter of a suction pipe of a single acting reciprocating pump are 5 m and 10 m respectively. The pump has a plunger of diameter 15 cm and a stroke length of 35 cm. The centre of the pump is 3 m above the water surface in the pump. The atmospheric pressure head is 13.0 m of water and pump is running at 35 r.p.m. Determine

- (i) Pressure head due to acceleration at the beginning of the suction stroke,
- (ii) Maximum pressure head due to acceleration, and
- (iii) Pressure head in the cylinder at the beginning and at the end of the stroke.
