

B.E., DEGREE EXAMINATIONS: NOV/DEC 2012

Third Semester

MECHATRONICS ENGINEERING

MCT103: Fluid Mechanics and Machinery

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. The value of kinetic energy correction factor (α) for the viscous flow through a circular pipe is
 - a) 1.33
 - b) 1.50
 - c) 2.0
 - d) 1.25
2. Power transmitted through pipes, will be maximum when
 - a) Head lost due to friction = $1/2$ total head at inlet of the pipe
 - b) Head lost due to friction = $1/4$ total head at inlet of the pipe
 - c) Head lost due to friction = total head at inlet of the pipe
 - d) Head lost due to friction = $1/3$ total head at inlet of the pipe
3. Gauge pressure at a point is equal to
 - a) Absolute pressure + atmospheric pressure
 - b) Absolute pressure - atmospheric pressure
 - c) Vacuum pressure + atmospheric pressure
 - d) Absolute pressure + Vacuum pressure
4. A real fluid in which the shear stress is not proportional to the velocity gradient is known as
 - a) Ideal fluid
 - b) Newtonian fluid
 - c) Ideal plastic fluid
 - d) Non-Newtonian fluid
5. The ratio of actual velocity of a jet of water at vena-contracta to the theoretical velocity, is known as
 - a) Co-efficient of discharge
 - b) Co-efficient of velocity
 - c) Co-efficient of contraction
 - d) Co-efficient of viscosity
6. The range for co-efficient of discharge for a venturimeter is
 - a) 0.65 to 0.75
 - b) 0.79 to 0.85
 - c) 0.86 to 0.95
 - d) 0.95 to 0.99
7. 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 sum of pressure energy, kinetic energy and potential energy
8. Draft tube is used for discharging water from the exit of

- a) an impulse turbine
 - b) a Francis turbine
 - c) a Kaplan turbine
 - d) a Pelton wheel
9. 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 series
 - d) in curved branches
10. The work saved by fitting an air vessel to a double acting reciprocating pump is
- a) 39.2%
 - b) 84.8%
 - c) 48.8%
 - d) 92.3%

PART B (10 x 2 = 20 Marks)

11. Define negative slip of a reciprocating pump.
12. What is a draft tube? What are its functions?
13. What do you mean by 'Viscous flow'?
14. Define Momentum correction factor.
15. What is the difference between pitot-tube and pitot-static tube?
16. Distinguish between uniform and non-uniform flow?
17. Define cavitation. What are the effects of cavitation?
18. Differentiate between an inward and an outward flow reaction turbine.
19. State Newton's law of viscosity.
20. One litre of crude oil weighs 9.6N. Calculate its specific weight and density.

PART C (5 x 14 = 70 Marks)

21. a) Two large plane surfaces are 2.4cm apart. The space between the surfaces is filled with glycerine. What force is required to drag a very thin plate of surface area 0.5 square metre between the two large plane surfaces at a speed of 0.6m/s, if: 1) the thin plate is in the middle of the two plane surfaces and 2) the thin plate is at a distance of 0.8cm from one of the plane surfaces? Take dynamic viscosity of glycerine as $8.10 \times 10^{-1} \text{ Ns/m}^2$.

(OR)

- b) (i) Explain the working principle of dead weight pressure gauge with a neat sketch. (7)
- (ii) An inverted differential manometer containing an oil of specific gravity 0.9 is connected to find the difference of pressures at two points of a pipe containing water. If the manometer reading is 40cm, find the difference of pressures. (7)

22. a) (i) Water flows through a pipe AB 1.2m diameter at 3m/s and then passes through a pipe BC 1.5m diameter. At C, the pipe branches. Branch CD is 0.8m diameter and carries one-third of the flow in AB. The flow velocity in branch CE is 2.5m/s. Find the volume rate of flow in AB, the velocity in BC, the velocity in CD and the diameter of CE. (8)
- (ii) The velocity vector in a fluid flow is given by $V = 4x^3i - 10x^2yj + 2tk$. Find the velocity and acceleration of a fluid particle at (2, 1, 3) at time $t=1$. (6)

(OR)

- b) Explain the principle of venturimeter with a neat sketch. Derive an expression for the rate of flow of fluid through it.

23. a) What is Hagen Poiseuille's formula? Derive an expression for Hagen Poiseuille's formula.

(OR)

- b) (i) A horizontal pipe of diameter 500mm is suddenly contracted to a diameter of 250mm. The pressure intensities in the large and smaller pipe are given as 13.734 N/cm^2 and 11.772 N/cm^2 respectively. Find the loss of head due to contraction if $C_e=0.62$. Also determine the rate of flow of water. (10)
- (ii) Three pipes of lengths 800m, 500m and 400m and of diameters 500mm, 400mm and 300mm respectively are connected in series. These pipes are to be replaced by a single pipe of length 1700m. Find the diameter of the single pipe. (4)

24. a) The three-jet Pelton turbine is required to generate 10,000KW under a net head of 400m. The blade angle at outlet is 15° and the reduction in the relative velocity while passing over the blade is 5%. If the overall efficiency of the wheel is 80%, $C_v= 0.98$ and speed ratio = 0.46, then find: 1) diameter of the jet, 2) total flow in m^3/s and 3) the force exerted by a jet on the buckets. If the jet ratio is not to be less than 10, find the speed of the wheel for a frequency of 50 Hertz/sec and the corresponding wheel diameter.

(OR)

- b) (i) Explain the working principle of radial flow reaction turbine with a neat sketch. (9)
- (ii) A turbine is to operate under a head of 25m at 200 r.p.m. The discharge is 9 cumec. If the efficiency is 90%, determine: 1) Specific speed of the machine, 2) Power generated and 3) Type of turbine (5)

25. a) The internal and external diameter of an impeller of a centrifugal pump which is running at 1000 r.p.m., are 200mm and 400mm respectively. The discharge through pump is $0.04\text{m}^3/\text{s}$ and velocity of flow is constant and equal to 2m/s. The diameters of the suction and delivery pipes are 150mm and 100mm respectively and suction and delivery heads are 6m (abs.) and 30m (abs.) of water respectively. If the outlet vane angle is 45° and power required to drive the pump is 16.186KW, determine: 1) Vane angle of the impeller at inlet, 2) Overall efficiency of the pump and 3) Manometric efficiency of the pump.

(OR)

- b) (i) Describe the principle and working of a reciprocating pump with a neat sketch. (9)
(ii) What is an air vessel? Describe the function of the air vessel for reciprocating pumps with a neat sketch. (5)
