Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 25052

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2018.

Third Semester

Aeronautical Engineering

CE 8394 — FLUID MECHANICS AND MACHINERY

(Common to Automobile Engineering / Mechanical Engineering / Mechanical and Automation Engineering / Mechatronics Engineering / Production Engineering)

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the physical phenomena which are responsible for the property of viscosity?

2. Water flows through a pipeline which reduces in cross-section. The centreline of the pipe is horizontal. If V_1 = 1.54 ms^{-1} and V_2 = 2.65 ms^{-1}, $p_1 = 20 \times 10^3$ $N m^{-2}$ and $p_2 = 16.89 \times 10^3$ $N m^{-2}$, what is the energy loss between sections 1 and 2? Give the answer in metres of water.

3. How does the velocity of fluid vary within the boundary layer zone?

4. List any four minor losses of flow in pipes.

5. List the primary physical quantities.

6. List any two phenomena for which Froude model law can be a sufficient criterion for dynamic similarity of flow in the model and the prototype.

7. A flat plate is struck normally by a jet of water 50 mm in diameter with a velocity of 18 ms^{-1}. Calculate the force on the plate when it is stationary.

8. Classify rotary pumps.

9. Define specific speed of a turbine.

10. State the principle of impulse turbines.

PART B — (5 × 13 = 65 marks)

11. (a) (i) A sliding fit cylindrical body of 1 kg mass drops vertically down at a constant velocity of 0.05 ms^{-1} as shown in Figure. Estimate the viscosity of oil. (8)

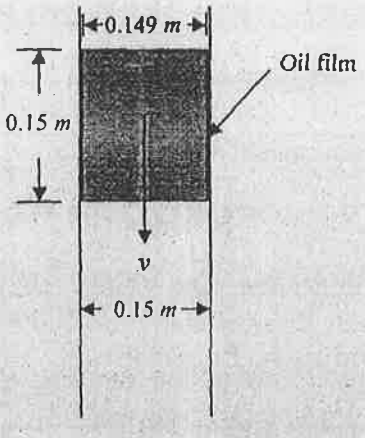

Figure 1 (Q. 11(a) (i))

(ii) Why is the pressure exerted by ejected vapour on the free surface of liquid called "partial pressure"? Discuss the influence of temperature and pressure on vapour pressure of a liquid. (2 + 3 = 5)

Or

(b) Water flows through a pipe AB 1.2 m in diameter at 3 m s^{-1} and then passes through a pipe BC which is 1.5 m in diameter. At C the pipe branches. Branch CD is 0.8 m in diameter and carries one-third of the flow in AB. The velocity in branch CE is 2.5 m s^{-1}. Find

(i) the volume rate of flow in AB,

(ii) the velocity in BC,

(iii) the velocity in CD,

(iv) the diameter of CE. (13)

12. (a) A single pipe 300 mm diameter and 300 m long carries a discharge of 0.1 m^3 s^{-1}. What is the required length of another 400 mm diameter pipe which is to be placed in parallel with the existing 300 mm diameter pipe in order to augment the discharge by 30%. Take f for each pipe = 0.015 and neglect the minor losses. (13)

Or

(b) (i) How does the velocity of fluid varies within the boundary layer zone? Define boundary layer thickness. Why is it called the nominal thickness of the boundary layer? (1 + 2 + 1 = 4)

(ii) In a water pipeline there is an abrupt change in diameter from 140 mm to 250 mm. If the head lost due to separation when the flow is from the smaller to the larger pipe is 0.6 m greater than the head lost when the same flow is reversed, determine the flow rate. (9)

Table below shows the experimental values of Cc.

A_2/A_1	0.1	0.3	0.5	0.7	1.0
Cc	0.61	0.632	0.673	0.73	1.0

13. (a) (i) In order that the relationships determined for a model can be applied to a real life application (prototype) there has to be a physical similarity between the parameters involved in each one. Discuss in brief the different types of similarity. (6)

(ii) State Reynolds model law. Obtain the scale ratio for velocity on the basis of Reynolds model law. (7)

Or

(b) By dimensional analysis show that the torque T on a shaft of diameter d, revolving at a speed N in a fluid of viscosity μ and mass density ρ is given by the expression

$$T = (\rho d^5 N^2)\phi\left(\frac{\upsilon}{d^2 N}\right)$$

Use Buckingham's method. Hence show that power P is given by

$$P = (\rho d^5 N^3)\phi\left(\frac{\upsilon}{d^2 N}\right).$$ (13)

14. (a) (i) Draw a typical layout of a centrifugal pumping installation and describe the functions of the various accessories. (7)

(ii) In a single acting pump the cylinder has a diameter of 150 mm and a stroke 300 mm. The water is to be raised to a height of 20 m when the pump is running at 40 rpm. Determine the theoretical discharge and the theoretical power. If the actual discharge of the pump is 3.5 lps, find the coefficient of discharge and the percentage slip of the pump. (6)

Or

(b) A centrifugal pump draws water from a sump through a vertical 150 mm pipe. The pump has a horizontal discharge pipe 100 mm diameter which is 3.5 m above water level in the sump. While pumping 35 litres per second, gauges near the pump at entrance and discharge read – 0.35 kgf cm^{-2} and + 1.8 kg_f cm^{-2} respectively. The discharge gauge is 0.5 m above the suction gauge. Determine the horsepower output of the pump. (13)

15. (a) (i) What is a draft tube? Explain its functions. (3 + 2 = 5)

(ii) Define specific speed of a turbine. Discuss briefly on the factors to be borne in mind in the selection of speed of Pelton Turbine. (3 + 5 = 8)

Or

(b) An inward flow reaction turbine develops 260 HP at an overall efficiency of 78% under a head of 70 m. The peripheral speed of vanes at inlet is 35 m s^{-1}. Width of wheel at inlet is one-sixth of the corresponding diameter. Velocity of flow remains constant at 5 m s^{-1}. Outlet diameter of vanes is three-fourth inlet diameter. If inlet angle of runner vane is 90° to the tangent, determine the guide blade discharge angle and runner vane outlet angle. Velocity of whirl at outlet is zero. (13)

PART C — (1 × 15 = 15 marks)

16. (a) (i) In case of Pelton turbine, for generation of maximum impact for a given flow, the angle of deflection of jet after impact on the centre of bucket must be 180°, but it is kept less than 180° at about 165°. Why? (2)

(ii) A single acting pump is equipped with an air vessel on the delivery side. The piston moves with simple harmonic motion. The diameter and stroke of the piston are 300 mm and 600 mm respectively. The delivery pipe is 175 mm in diameter and 60 m long. Determine the power saved (in horse power units) in overcoming friction in the delivery pipe by the air vessel. The pump runs at 120 rpm. Take f = 0.01. (8)

(iii) The viscosity of pure water at 0°C is 0.01793 poise and density is 1 g cm^{-3}. Express the dynamic viscosity and the kinematic viscosity in SI units. (2 + 3 = 5)

Or

(b) (i) If the equation of a velocity profile over a plate is $v = 5y^2 + y$ (where v is the velocity in m s^{-1}), determine the shear stress at $y = 0$ and $y = 7.5\,cm$. Given the viscosity of the liquid is 8.35 poise. (7)

(ii) A pipe AB tapering uniformly from a diameter of 0.1 m at A to 0.2 m at B over a length of 2 m carries water. Pressures at A and B are respectively 2.0 and 2.3 bar. The centreline of the pipe slopes upwards from A to B at an angle of 30°. Determine the flow through the pipe ignoring the losses. (8)

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Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 80075

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY, 2019.

Third/Fourth Semester

Industrial Engineering

CE 8394 — FLUID MECHANICS AND MACHINERY

(Common to Industrial Engineering and Management/Aeronautical Engineering/Automobile Engineering/Manufacturing Engineering/Mechanical Engineering/Mechanical Engineering (Sandwich)/Mechanical and Automation Engineering/Mechatronic Engineering/Production Engineering)

(Regulation 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Distinguish between Hook's law of solid with Newton's law of viscosity of fluid

2. State the assumptions in deriving Bernoulli's equation.

3. Hypothetically, under what conditions, minor losses will be higher than major loss?

4. What is HGL and TEL?

5. State the advantages of dimensional analysis.

6. List the areas in which model studies is applied.

7. State the Euler's equation of hydrodynamic machines.

8. How NPSH affects the cavitation in centrifugal pump?

9. Draw the outlet triangle for turbine when the jet angle is = 90°.

10. Define specific speed and write its equation for turbines.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Derive the differential equation for three dimensional continuity flows in cartesian coordinates. (9)

(ii) Calculate the dynamic viscosity of oil, which is used for lubrication between a square plate of size 0.8 m × 0.8 m and an inclined plane with angle of inclination 30 degree to horizontal. The weight of the square plate is 300 N and slides down with uniform velocity of 0.3 m/s. The thickness of oil film is 1.5 mm. (4)

Or

(b) The inlet and throat diameters of a vertically mounted venturimeter are 30 cm and 15 cm, respectively. The throat section is below the inlet section at a distance of 10 cm. The density of the liquid is 850 kg/m^3 .The intensity of pressure at inlet and throat are 150 kN/m^2 and 90 kN/m^2 respectively. If 4% of the differential head is lost between inlet and throat, find the volumetric flow rate. (13)

12. (a) Two reservoirs with a difference in water surface elevation of 10 m are connected by a pipeline ABC which consists of two pipes of AB and BC joined in series. Pipe AB is 10 cm in diameter and 20 m long and has a value of friction factor $f = 0.02$. Pipe BC is of 16 cm diameter, 25 m long and has $f = 0.018$.

(i) Calculate the discharge and

(ii) Determine the difference in reservoir elevations necessary to have a discharge of 15 lit/s.

Include all losses for both the cases. (13)

Or

(b) Derive an expression for steady laminar flow in circular pipes and prove that the $U_{max}/V = 2$. Draw the necessary sketches. (13)

13. (a) The power P developed by a water turbine depends on the rotational speed N, operating head H, gravity g, diameter D and width B of the runner, density ρ and viscosity μ of water. Show by dimensional analysis that $P = \rho D^5 N^3 \Phi \left[H/D, D/B, \rho D^2 N/\mu, ND/\sqrt{gH} \right]$. (13)

Or

(b) (i) A 1:10 scale model of a submarine moving far below the surface of sea water is tested in a water tunnel, If the speed of the prototype is 8 m/s, determine the corresponding velocity of water in the tunnel. Also determine the force ratio of the model and the prototype. Kinematic viscosity of seawater and water are 1.121×10^{-6} m^2/s and 10^{-6} m^2/s respectively. Density of seawater is 1027 kg/m^3. (6)

(ii) A ship 170 m long moves in fresh water at 40 km/hr. A 1:100 model of this ship is to be tested in a towing basin containing a liquid of sp.gr.0.90. What is the viscosity of liquid (model)? At what speed must the model be towed? If 120 Watts is required to tow the model at this speed, what power is required by the ship? Take viscosity of water as 0.00113 Ns/m^2. (7)

14. (a) A centrifugal pump lifts water against a static head of 32.067 m of which 3.054 m is suction lift. Both the suction and delivery pipes are 12.7 cm in diameter. The loss of head in suction pipe is 1.07 m of water and in delivery pipe is 5.955 of water. The impeller is 30.54 cm in diameter and 2.54 cm wide at the outlet. It revolves at 1450 rpm and the blade angle at exit is 35°. The manometric efficiency of the pump is 80% and its overall efficiency is 68%. Determine (i) The discharge of the pump, (ii) The power required to drive the pump and (iii) The pressures at the two branches of the pipe. Neglect the effect of vane thickness on the area of the flow.

Or

(b) (i) Write the different classifications of rotary pumps and explain the working principle of any one. (8)

(ii) Explain the working of a double acting reciprocating pump with a neat sketch. (5)

15. (a) A double jet Pelton wheel is required to generate 7500 KW. When the available head at the base of the nozzle is 400 m. The jet is deflected to 165° and the relative velocity of the jet is reduced by 15% in passing over the buckets. Determine the diameter of the jet, total flow rate and force exerted by the jet in tangential direction. Assume generator efficiency = 95%, overall efficiency = 80%, speed ratio = 0.47 and CV = 0.97. (13)

Or

(b) (i) With a neat sketch explain the function of Francis turbine. (8)

(ii) Discuss the need of draft tube for turbine. (5)

PART C — (1 × 15 = 15 marks)

16. (a) A pumping plant is forcing the water through a pipe of 60 cm diameter and frictional loss is 30 m. For reducing the power consumption, it is proposed to lay another pipe along the side of existing pipe so both pipes will run parallel for the entire length and reduces the friction head to 10 m. Find the required diameter of new pipe line assuming friction factor is same for both pipe lines.

Or

(b) The diameter of a pipe bend is 0.35 m at inlet and 0.2 m at outlet and the flow is turned through 135° in a vertical plane. The axis at inlet makes an angle of 50° to horizontal plane and the centre of the outlet section is 1 m above the centre of the inlet section. The total volume of fluid contained in the bend is 0.12 m^3. Due to losses of energy between inlet and outlet 0.2 m of head is lost. Calculate the magnitude and direction of the force exerted on the bend by the water flowing through it at 230 lit/s when the inlet pressure is 150.78 kN/m^2.

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Reg. No. : E N G G T R E E . C O M

Question Paper Code : 70060

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022.

Third Semester

Mechanical Engineering

CE 3391 – FLUID MECHANICS AND MACHINERY

(Common to: B.E. Aeronautical Engineering/B.E. Aerospace Engineering/B.E. Industrial Engineering/B.E. Industrial Engineering and Management/B.E. Manufacturing Engineering/B.E. Mechanical Engineering(Sandwich)/B.E. Mechanical and Automation Engineering/B.E. Production Engineering/B.E. Safety and Fire Engineering)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Write the Uses of the Continuity Equation.
2. What are the types of pressure measurements?
3. What do you mean by flow through parallel pipes?
4. What is meant by boundary layer separations?
5. Define undistorted model.
6. Mention the types of similarities.
7. Define specific speed.
8. Give two comparison between impulse and reaction turbine.
9. Define hydraulic efficiency.
10. When will you select a reciprocating pump?

PART B — (5 × 13 = 65 marks)

11. (a) (i) A soap bubble is formed when the inside pressure is 5 N/m² above the atmospheric pressure. If surface tension in the soap bubble is 0.0125 N/m, find the diameter of the bubble formed. (8)

(ii) Where do you observe Venturi effect? (5)

Or

(b) (i) Water is flowing through a pipe of diameter 5 cm under a pressure of 29.43N/cm² (gauge) and with mean Velocity of 2 m/s. Find the total energy per unit weight of the water at a cross-section, which is 5 m above the datum line. (6)

(ii) A Conical tube of length 2 m is fixed vertically with its smaller end upwards. The velocity of flow at the smaller end is 5 m/s while at the lower end it is 2m/s. The pressure head at the smaller end is 2.5 m of liquid. The loss of head in the tube is $0.35(v_1-v_2)^2/2g$, where V_1 is the velocity at smaller end and V_2 at the lower end respectively. Determine the pressure head at the lower end. Flow takes place in the downward direction. (7)

12. (a) In a pipe of diameter 350 mm and length 75 m water is flowing at a velocity of 2.8 m/s. Find the head lost due to friction using:

(i) Darcy – Weisbach formula;

(ii) Chezy's formula (Take C=55)

Assume kinematic viscosity of water as 0.012 stoke.

Or

(b) Two reservoirs have 6 m difference in water levels, and are connected by a pipe 60 cm diameter and 3000 m long. Then, the pipe branches into two pipes each 30 cm diameter and 1500 m long. The friction coefficient is 0.01.

Neglecting minor losses, determine the flow rates in the pipe system?

13. (a) (i) Under laminar conditions, the volume of flow Q through a small triangular-section pore of width b and length L is a function of viscosity μ pressure drop per unit length $\Delta p/L$. and b. Using the pi theorem, rewrite this relation in dimensionless form. How does the volume flow change if the pore size b is doubled? (5)

(ii) Classify the types of similarities (8)

Or

(b) (i) Classify various types of Models. (5)

(ii) What are the use of similitude? (8)

14. (a) (i) Discuss the efficiency of turbine. (7)

(ii) Explain Francis turbine working principle with neat sketch. (6)

Or

(b) The impeller of a centrifugal pump having external and internal diameters 500 mm and 250 mm respectively, width at outlet 50 mm and running at 1200 r.p.m. works against a head of 48 m. The velocity of flow through the impeller is constant and equal to 3 m/s. the vanes are set back at an angle of 40° at outlet. Determine: (i) Inlet vane angle, (ii) Work done by the impeller on water per second and (iii) manometric efficiency.

15. (a) A centrifugal pump running at 920 rpm and delivering 0.32m³/s of water against a head of 28m, the flow velocity being 3m/s. if the manometric efficiency is 80% determine the diameter and width of the impeller. The blade angle at outlet is 25°.

Or

(b) (i) Differentiate the working Principles of centrifugal pump and reciprocating pump. (7)

(ii) How does a rotary vane pump work? (6)

PART C — (1 × 15 = 15 marks)

16. (a) Derive Darcy-Weisbach equation for loss of head due to friction in pipes.

Or

(b) A single acting reciprocating pump running at 50 rpm, delivers 0.01 m³/s of water. The diameter of the piston is 200 mm and stroke length 400 mm. Determine the theoretical discharge of the pump, coefficient of discharge and slip and the percentage slip of the pump.

Reg. No. : E N G G T R E E . C O M

Question Paper Code : 30096

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

Third/Fourth Semester

Aeronautical Engineering

CE 3391 – FLUID MECHANICS AND MACHINERY

(Common to : Aerospace Engineering/Industrial Engineering/ Industrial Engineering and Management/Manufacturing Engineering/ Materials Science and Engineering/Mechanical Engineering/ Mechanical Engineering (Sandwich)/Mechanical and Automation Engineering/Production Engineering/Safety and Fire Engineering)

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State the Newton's Law of Viscosity.
2. What are the assumption made in continuity equation?
3. Write the expression for head loss due to friction.
4. Define the term "hydraulic gradient line".
5. Define dimensional homogeneity.
6. State Buckingham's π –theorem.
7. What is meant by NPSH?
8. What is draft tube? Why it is used in reaction turbine?
9. Mention the components of the centrifugal pump.
10. Write the advantages of using air vessel?

PART B — (5 × 13 = 65 marks)

11. (a) (i) Calculate the specific weight, density and specific gravity of 1.5 litre of liquid which weighs 10 N. (8)

(ii) Find the surface tension in a soap bubble of 40 mm diameter when the inside pressure is 12 N/m² above atmospheric pressure. (5)

Or

(b) A 30 cm diameter pipe, conveying water, branches into two pipes of diameters 20 cm and 15 cm respectively. If the average velocity in the 30 cm diameter pipe is 2.5 m/s, find the discharge in this pipe. Also determine the velocity in 15 cm pipe, if the average velocity in 20 cm diameter pipe is 2 m/s.

12. (a) Write the short notes on :

(i) Moody's diagram (8)

(ii) Displacement thickness. (5)

Or

(b) (i) List out the types of minor head losses in pipes. (5)

(ii) A pipe, 40 m long, is connected to a water tank at one end and flows freely in atmosphere at the other end. The diameter of pipe is 15 cm for first 25 m from the tank and then the diameter is suddenly enlarged to 30 cm. Height of water in the tank is 8 m above the center of pipes. Darcy's coefficient is 0.01. Determine the discharge neglecting minor losses? (8)

13. (a) The resisting force of (R) of a supersonic flight can be considered as dependent upon the length of aircraft "l", velocity 'V', air viscosity 'μ', air density 'ρ' and bulk modulus of air 'k'. Express the functional relationship between these variables and the resisting force. (13)

Or

(b) (i) What are distorted models? State its merits and demerits. (5)

(ii) What are the advantages of model and dimensional analysis? (4)

(iii) List the primary and derived quantities. (4)

14. (a) Explain the working of Kaplan turbine. Construct its velocity triangles. (13)

Or

(b) Explain the head and efficiencies of Pelton wheel with the help of neat sketch. (13)

15. (a) A centrifugal pump runs at 1000 rpm with their vane angles at inlet and outlet are 20° and 35° respectively. The internal and external diameters are 25 cm and 50 cm respectively. Find the work done per N of water assuming velocity of flow is constant. Water enters radially through the pipes. (13)

Or

(b) Explain the working principle of reciprocating pump with neat sketch. (13)

PART C — (1 × 15 = 15 marks)

16. (a) (i) A single-acting reciprocating pump running at 50 r.p.m delivers 0.01 m^3/s of water. The diameter of the piston is 200 mm and Stroke length 400 mm. Determine (1) the theoretical discharge of the pump (2) Co-efficient of discharge (3) Slip and percentage of slip of the pump. (6)

(ii) A pipe of diameter 20 cm and length 2000 m connects two reservoir, having difference of water level as 20. Determine the discharge through the pipe. If an additional pipe of diameter 20 cm and length 2000 m is attached to the last 1200 m length of the existing pipe find the increase in discharge. Take f = 0.015 and neglect minor losses. (9)

Or

(b) The reaction turbine (inward flow turbine) works at 450 rpm under ahead of 115 m. The diameter of the inlet is 1.2 m and the flow area is 0.4 m^3. At the inlet, absolute and the relative velocities make angles of 20° and 60° respectively with tangential velocity of whirl at the outlet to be zero. Determine hydraulic efficiency and power developed. (15)

Reg. No. : E N G G T R E E . C O M

Question Paper Code : 20509

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2023.

Third/Fourth Semester

Mechanical Engineering

CE 3391 —FLUID MECHANICS AND MACHINERY

(Common to : Aeronautical Engineering/Aerospace Engineering/ Industrial Engineering/Industrial Engineering and Management/ Manufacturing Engineering/Materials Science and Engineering/ Mechanical Engineering (Sandwich)/Mechanical and Automation Engineering/ Production Engineering and Safety and Fire Engineering)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define specific volume.
2. Calculate the relative density of diesel weighing 7 N.
3. Write expression for entry and exit loss in a pipe.
4. Define the terms hydraulic gradient line and total energy line.
5. Prove that $h = \frac{p}{\rho g}$ is dimensionally homogeneous. Where, P is pressure, ρ is density and h is pressure head.
6. What are the three types of similarities which must exist between a model and prototype?
7. Find the force per unit area exerted on a fixed vertical plate by a water jet having velocity 15 m/s?
8. What are the functions of draft tube in reaction turbine?
9. Differentiate vortex casing and volute casing in a centrifugal pump.
10. When a pump is called as positive displacement type?

PART B — (5 × 13 = 65 marks)

11. (a) The figure 1 shows a conical vessel having a U tube manometer attached to its outlet at A. When the vessel is empty the reading of the manometer is given in the figure 1. Find the reading of manometer when the vessel has been completely filled with water.

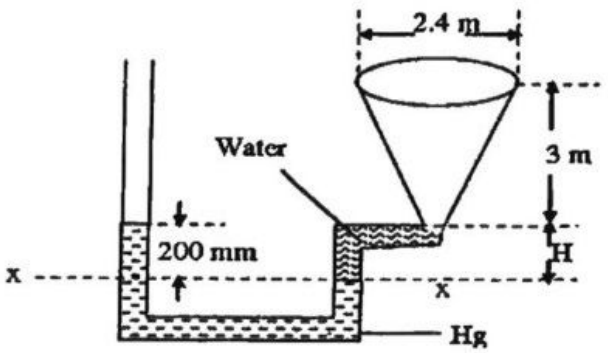

Figure. 1

Or

(b) Derive the Continuity equation in 3-Dimensional form.

12. (a) Three pipes of 400 mm, 200 mm and 300 mm diameters have lengths of 400 m, 200 m and 300 m respectively. They are connected in series to make a compound pipe. The ends of this compound pipe connected with two tanks whose difference of water levels is 16 m. If coefficient of friction for these pipes is same and equal to 0.005, determine the discharge through the compound pipe neglecting first the minor losses and then including them.

Or

(b) In the below figure. 2, when a sudden contraction is introduced in a horizontal pipe line from 50 cm to 25 cm, the pressure changes from 103500 N/m² to 67689 N/m². Calculate the rate of flow. Assume the coefficient of contraction of jet to be 0.65. Following this if there is sudden enlargement from 25 cm to 50 cm and if the pressure at the 25 cm section is 67689 N/m², What is the pressure at the 50 cm enlarged section?

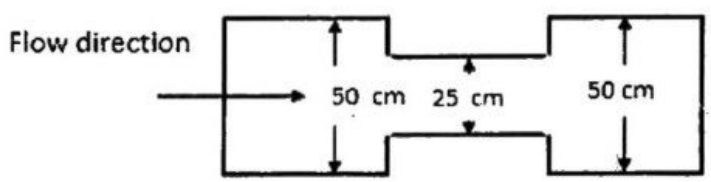

Figure. 2

13. (a) The efficiency η of a fan (figure. 3) depends on density ρ, the dynamic viscosity μ of the fluid, angular velocity ω, diameter D of the rotor and the discharge Q. Express η in terms of dimensionless parameters.

Figure. 3

Or

(b) A ship 250 m long moves in sea-water, whose density is 1030 kg/m^3. A 1:125 model of this ship is to be tested in wind tunnel. The velocity of air in the wind tunnel around the model is 20 m/s and the resistance of the model is 50 N. Determine the velocity of ship in sea-water and also the resistance of the ship in sea-water. The density of air is given as 1.24 kg/m^3. Take the kinematic viscosity of sea-water and air as 0.012 stokes and 0.018 stokes respectively.

14. (a) A jet of water having a velocity of 15 m/s strikes a curved vane which is moving with a velocity of 5 m/s. The vane is symmetrical and is so shaped that the jet is deflected through 120°. Find the angle of the jet at inlet of the vane so that there is no shock. What is the absolute velocity of the jet at outlet in magnitude and direction and the work done per unit weight of water? Assume the vane to be smooth.

Or

(b) Describe the working and the function of various components of Francis turbine with a neat sketch.

15. (a) With a neat layout, explain in detail the working of Reciprocating pump.

Or

(b) The internal and external diameters of the impeller of a centrifugal pump are 200 mm and 400 mm respectively. The pump is running at 1200 r.p.m. The vane angles of the impeller at the inlet and outlet are 20° and 30° respectively. The water enters the impeller radially and velocity of flow is constant. Determine the work done by the impeller per unit weight of water.

PART C — (1 × 15 = 15 marks)

16. (a) A 30 cm × 15 cm venturimeter is provided in a vertical pipe carrying oil of specific gravity 0.9, the flow being upwards. The difference in elevation of the throat section and entrance section of the venturimeter is 30 cm. The differential U tube mercury manometer shows a gauge deflection of 25 cm. Calculate

(i) The discharge of oil, and

(ii) The pressure difference between the entrance section and the throat section. Take $C_d = 0.98$ and sp.gr of mercury as 13.6.

Or

(b) A Pelton wheel turbine has a mean bucket speed of 10 m per second with a jet of water flowing at the rate of 700 lit/sec under a head of 30 meters. The buckets deflect the jet through an angle of 160° after flowing past buckets. Calculate the power given by water to the runner and the hydraulic efficiency of the turbine. Assume co-efficient of velocity as 0.98.

Reg. No. : | E | N | G | G | T | R | E | E | . | C | O | M |

Question Paper Code : 50533

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2024.

Third/Fourth Semester

Mechanical Engineering

CE 3391 – FLUID MECHANICS AND MACHINERY

(Common to Aeronautical Engineering/Aerospace Engineering/Industrial Engineering/Industrial Engineering and Management/Manufacturing Engineering/Materials Science and Engineering/Mechanical Engineering (Sandwich)/Mechanical and Automation Engineering/Production Engineering and Safety and Fire Engineering)

(Also Common to PTCE 3391 – Fluid Mechanics and Machinery for B.E. (Part-Time) – Second Semester – Mechanical Engineering – Regulations 2023)

(Regulations 2021)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define density and specific weight.

2. Define – Incompressible fluid.

3. What is the expression for head loss due to friction in Darcy formula?

4. What is Moody diagram?

5. List the basic dimensional units in dimensional analysis.

6. Name the methods for determination of dimensionless groups.

7. What is meant by Cavitations in turbines?

8. List the important characteristic curves of a turbine.

9. Define volumetric efficiency in pumps.

10. What is NPSH?

PART B — (5 × 13 = 65 marks)

11. (a) Explain the various types of fluids with suitable sketches.

Or

(b) Derive the continuity equation with suitable assumptions.

12. (a) Derive the Darcy-Weisbach equation for calculating pressure drop in pipe.

Or

(b) Derive the expression for momentum thickness using suitable assumptions.

13. (a) Determine the dimensions of the quantities given below :

(i) Angular velocity, (2 + 2 + 2 + 3 + 2 + 2)

(ii) Angular acceleration,

(iii) Discharge,

(iv) Kinematic viscosity,

(v) Force,

(vi) Dynamic viscosity.

Or

(b) The resisting force R of a supersonic plane during flight can be considered as dependent upon the length of the aircraft I, velocity V, air viscosity μ, air density ρ and bulk modulus of air K. Express the functional relationship between these variables and the resisting force.

14. (a) What is an air vessel? Describe the function of the air vessel for reciprocating pump with neat sketch.

Or

(b) Draw and discuss the characteristic curves of centrifugal pumps.

15. (a) Explain the working of Kaplan turbine and construct its velocity triangles with a neat sketch.

Or

(b) With a neat sketch, explain the construction and working of Pelton wheel.

PART C — (1 × 15 = 15 marks)

16. (a) The aerodynamic drag of a new sports car is to be predicted at a speed of 50.0 mile/h at an air temperature of 25°C. Automotive engineers build a one-fifth scale model of the car to test in a wind tunnel. It is winter and the wind tunnel is located in an unheated building; the temperature of the wind tunnel air is only about 5°C. Determine how fast the engineers should run the wind tunnel in order to achieve similarity between the model and the prototype.

Or

(b) The head available at a location was 1500 m. It is proposed to use a generator to run at 750 rpm. The power available is estimated at 20,000 kW. Investigate whether a single jet unit will be suitable. Estimate the number of jets and their diameter. Determine the mean diameter of the runner and the number of buckets.