(b) For a high head storage capacity dam of net head 800 m, it has been decided to design and install a Pelton wheel for generating power of 13,250 kw running at a speed of 600 RPM, if the coefficient of jet is 0.97 Speed Ratio = 0.46 and the Ratio of jet diameter is 1/15 of the wheel diameter calculate (i) Number of jets, (ii) Diameter of jets, (iii) Diameter of Pelton wheel, (iv) No of buckets and (v) Discharge of one jet. (15)

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

Question Paper Code : 71563

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2017.

Third/Fourth Semester

Mechanical Engineering

CE 6451 — FLUID MECHANICS AND MACHINERY

(Common to Aeronautical Engineering, Automobile Engineering, Industrial Engineering, Industrial Engineering and Management, Manufacturing Engineering, Mechanical and Automation Engineering, Mechatronics Engineering, Production Engineering)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define Viscosity and what is the effect due to temperature on liquid and gases.
2. Calculate the height of capillary rise for water in a glass tube of diameter 1mm?
3. What are equivalent pipes? Mention the equation used for it.
4. Define Boundary Layer.
5. Explain the types of Similarities.
6. Write the expression for Mach number and state its application.
7. Explain the purpose of Air Vessel and in which pump it is used?
8. Define cavitation and its effects.
9. How do you classify turbines based on flow direction and working medium?
10. What is meant by Governing of Turbines?

PART B — (5 × 13 = 65 marks)

11. (a) (i) Calculate the dynamic viscosity of an oil, which is used for lubrication between a square plate of size 0.8 m × 0.8 m in an inclined plane with an angle of inclination 30° to the horizontal. The weight of the square plate is 300N and it slides down the inclined plane with a uniform velocity of 0.3 m/s. The thickness of oil film is 1.5mm. (8)

(ii) An oil of specific gravity 0.8 is flowing through a venturimeter having inlet diameter 20 cm and throat diameter 10 cm. The oil-mercury differential manometer shows a reading of 25 cm. Calculate the discharge of oil through the horizontal venturimeter. Take $C_d = 0.98$. (5)

Or

(b) Derive the expression of Bernoulli's equation from the Euler's equation and state the assumptions made for such a derivation? (13)

12. (a) (i) A fluid of viscosity 0.7 Pa.s and specific gravity 1.3 is flowing through a pipe diameter 120 mm. The maximum shear stress at the pipe value is 205.2 N/m². Determine the pressure gradient, Reynolds number and average velocity? (9)

(ii) A crude oil of kinematic viscosity 0.4 strokes is flowing through a pipe of diameter 300mm at the rate of 300 litres per sec. Find the head lost due to friction for a length of 50 m of the pipe. Take Coefficient of friction as 0.006. (4)

Or

(b) For a flow of viscous fluid flowing through a circular pipe under laminar flow conditions show that the velocity distribution is a parabola. And also show that the average velocity is half of the maximum velocity. (13)

13. (a) A 1:100 model is used for model testing of ship. The model is tested in wind tunnel. The length of ship is 400 m. The velocity of air in the wind tunnel around the model is 25 m/s and the resistance is 55N. Determine the length of model. Also find the velocity of ship as well as resistance developed. Take density of air and sea water as 1.24 kg/m³ and 1030 kg/m³. The kinematic viscosity of air and seawater are 0.018 stokes and 0.012 stokes respectively. (13)

Or

(b) Using Buckingham's π theorem, show that the velocity through a circular orifice is given by $V = \sqrt{2gH}\,\phi\left[\frac{D}{H}, \frac{\mu}{\rho \upsilon H}\right]$, where H is the head causing flow, D is the diameter of the orifice, μ is coefficient of viscosity, ρ is the mass density and g is the acceleration due to gravity. (13)

14. (a) (i) A Single acting reciprocating pump running at 50 RPM delivers 0.01 m³/s of water. The diameter of the piston is 200mm and stroke length 400 mm. Determine

(1) The theoretical discharge of the pump

(2) Coefficient of discharge

(3) Slip and Percentage slip of the pump. (8)

(ii) Discuss the working of Gear pump using its schematic. (5)

Or

(b) A Centrifugal pump having outer diameter equal to two times the inner diameter and running at 1000 rpm works against a head of 40m. The velocity of flow through the impeller is constant and equal to 2.5 m/s. The vanes are set back at angle of 40° at outlet. If the outer diameter of the impeller is 500 mm & width at outlet is 50 mm determine (i) Vane angle at inlet, (ii) Manometric efficiency, (iii) Workdone by impeller on water per second. (13)

15. (a) (i) A kaplan turbine runner is to be designed to develop 9100 kW. The net available head is 5.6m. If the speed ratio = 2.09, flow ratio = 0.68, overall efficiency = 86% and the diameter of the boss is 1/3 the diameter of the runner. Find the diameter of the runner, its speed and the specific speed of the turbine? (8)

(ii) Explain the Performance Characteristics curves of turbine. (5)

Or

(b) The following data is given for a Francis turbine. Net head H = 60 m, Speed N = 700 RPM, Shaft power 294.3 kw, Overall efficiency 84%, Hydraulic efficiency 93%. Flow ratio = 0.2, breadth ratio n = 0.1, Outer diameter of the runner is two times inner diameter of the runner. The thickness of vanes occupies 5% of circumference area of the runner. Velocity of flow is constant at inlet and outlet and the discharge is radial at outlet. Determine (i) Guide blade angle, (ii) Runner vane angle at inlet and outlet, (iii) Diameter of runner inlet and outlet, (iv) Width of wheel at inlet. (13)

PART C — (1 × 15 = 15 marks)

16. (a) A liquid has a specific gravity of 0.72. Find its density, specific weight and its weight per litre of the liquid. If the above liquid is used as the lubrication between the shaft and the sleeve of length 100mm. Determine the power lost in the bearing, where the diameter of the shaft is 0.5 m and the thickness of the liquid film between the shaft and the sleeve is 1 mm. Take the viscosity of fluid as 0.5 N-s/m² and the speed of the shaft rotates at 200 rpm. (15)

Or

17/05/18

Reg. No. :

Question Paper Code : 40790

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2018

Third/Fourth Semester

Mechanical Engineering

CE 6451 – FLUID MECHANICS AND MACHINERY

(Common to Aeronautical Engineering/Automobile Engineering/Industrial Engineering/Industrial Engineering and Management/Manufacturing Engineering/ Mechanical and Automation Engineering/Mechatronics Engineering/ B.E. Production Engineering)

(Regulations 2013)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions.

PART – A (10×2=20 Marks)

1. What are compressible and incompressible fluids ?
2. Draw the shear stress-velocity gradient profile for Non Newtonian fluids.
3. When a tube is said to be hydraulically smooth ?
4. Define equivalent diameter of a non circular tube.
5. What is dimensional homogeneity ?
6. List the methods of dimensional analysis.
7. What is suction head of a pump ?
8. Define mechanical efficiency of a pump.
9. How are hydraulic turbines classified ?
10. Define hydraulic efficiency of a turbine.

PART – B

(5×13=65 Marks)

11. a) Explain the various properties of fluids.

(OR)

b) Explain the various classification of fluids with the help of a stress-strain graph.

12. a) An old water supply distribution pipe of 250 mm diameter of a city is to be replaced by two parallel pipes of smaller equal diameter having equal lengths and identical friction factor values. Find out the new diameter required.

(OR)

b) A pipeline 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 the pipe is 98.1 N/cm^2. Take f = 0.0065.

13. a) The pressure difference Δp in a pipe of diameter D and length l due to turbulent flow depends on the velocity V, viscosity μ, density ρ and roughness k. Using Buckingham's π theorem, obtain an expression for Δp.

(OR)

b) Explain the various types of similarities between model and prototype.

14. a) 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 rpm. The vane angles of the impeller at 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 impleller per unit weight of water.

(OR)

b) Explain the following :
   i) Manometric efficiency.
   ii) Mechanical efficiency.
   iii) Overall efficiency.

15. a) Explain the parts of Pelton wheel.

(OR)

b) A pelton wheel is supplied with water under a head of 35 m at the rate of 40.5 kl/min. the bucket deflects the jet through an angle of 160° and the mean bucket speed is 13 m/s. Calculate the power and hydraulic efficiency of the turbine.

PART – C

(1×15=15 Marks)

16. a) Derive the Euler's equation of motion.

(OR)

b) Derive the work done by the centrifugal pump on water.

08/05/19

Reg. No. :

Question Paper Code : 52763

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

Third/Fourth Semester

Mechanical Engineering

CE 6451 — FLUID MECHANICS AND MACHINERY

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

(Regulation 2013)

(Also common to PTCE 6451 — Fluid Mechanics and Machines for B.E. (Part-Time) – Second Semester – Mechanical Engineering – Regulation 2014)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Write down the effect of temperature on viscosity of liquids and gases.

2. Differentiate System and Control volume.

3. What is the average velocity and the discharge for an oil of viscosity 0.02 Ns/m^2 flowing between two stationary parallel plates 1 m wide maintained 10 mm apart if the velocity midway between the plates is 2 m/s.

4. What is the application of Moody's Diagram?

5. State Buckingham's π theorem. Why this method is considered superior to Rayleigh's method?

6. Write the scale ratio for velocity and pressure intensity using Froude model law.

7. Differentiate Vortex and Volute casing.

8. What is an air vessel in reciprocating pumps?

9. Define manometric head of the turbine.

10. Write short notes on Draft tube.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Derive the Bernoulli's equation with the basic assumptions. (8)

(ii) Calculate the capillary effect in millimeters in a glass tube of 4 mm diameter, when immersed in (i) water, and (ii) mercury. The temperature of the liquid is 20°C and the values of the surface tension of water and mercury at 20°C in contract with air are 0.073575 N/m and 0.51 N/m respectively. The angle of contact for water is zero and that for mercury is 130°. Take density of water at 20°C as equal to 998 kg/m^3. (5)

Or

(b) Derive the Continuity Equation in three dimensions. (13)

12. (a) Derive the Hagen Poiseuille formula for the flow through Circular pipes. (13)

Or

(b) 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 are connected with two tanks whose difference of water levels is 18 m. If the coefficient of friction for this pipe is same and equal to 0.005, determine the discharge through the compound pipe neglecting first the minor losses and then including them. (13)

13. (a) Using Buckingham π theorem, show that the velocity through a circular orifice is given by $V = \sqrt{2}gh\phi[D/H, \mu/\rho\ VH]$, where H is the head causing flow, D is the diameter of the orifice, μ is the coefficient of the viscosity, ρ is the mass density and g is the acceleration due to gravity. (13)

Or

(b) (i) The pressure drop in an airplane model of size 1/10 of its prototype is 80 N/cm^2. The model is tested in water. Find the corresponding pressure drop in the prototype. Take density of air = 1.24 kg/m^3. The viscosity of water is 0.01 poise while the viscosity of air is 0.00018 poise. (7)

(ii) Explain similitude with its types. (6)

14. (a) Derive the expression for pressure head due to acceleration in the suction and delivery pipes of the reciprocating pumps. (13)

Or

(b) The internal and external diameter of an impeller of a centrifugal pump which is running at 1200 rpm are 350 mm and 650 mm. The discharge through the pump is 0.05 m^3/s and the velocity of the flow is constant and equal to 2.5 m/s. The diameters of the suction and delivery pipes are 150 mm and 100 mm respectively and suction and delivery heads are 6 m (abs) and 30 m (abs) of water. If the outlet vane angle is 45° and power required to drive the pump is 19 kw determine (i) Vane angle of the impeller at inlet (ii) Overall efficiency of the pump (iii) Manometric efficiency of pump. (13)

15. (a) Design a Pelton wheel for a head of 60 m when running at 200 rpm. The Pelton wheel develops 95.6475 kW shaft power. The velocity of buckets = 0.45 times the velocity of the jet, overall efficiency 0.85 and coefficient of velocity = 0.98. (13)

Or

(b) The following data is given for Francis turbine : Net Head = 65 m, speed = 720 rpm, shaft power = 297.3 kW, η_o = 84%, η_h = 93%, flow ratio = 0.2, breadth ratio = 0.1, outer diameter of the runner = 2*inner diameter of runner. The thickness of vanes occupies 5% of the circumferential area of the runner. Velocity of flow is constant at inlet and outlet and discharge is radial at outlet. Determine :

(i) The guide blade angle

(ii) Runner vane angle at the inlet and outlet

(iii) Diameter of the runner at inlet and outlet

(iv) Width of the wheel at inlet. (13)

PART C — (1 × 15 = 15 marks)

16. (a) Explain the principle and main working components of the centrifugal pump. (15)

Or

(b) Explain the principle and main working of components of a Kaplan turbine with neat sketch.

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

Question Paper Code : 80203

03/11/16

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016.

Third Semester

Mechanical Engineering

CE 6451 — FLUID MECHANICS AND MACHINERY

(Common to Aeronautical Engineering, Automobile Engineering, Mechatronics Engineering, Mechanical and Automation Engineering and Production Engineering, Also common to Fourth Semester Industrial Engineering, Industrial Engineering and Management and Manufacturing Engineering)

(Regulations 2013)

Time : Three hours | Maximum : 100 marks

Any missing data can be suitably assumed

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Write down the effect of temperature on viscosity of liquids and gases.

2. Calculate the capillary rise in a glass tube of 2.5 mm diameter when immersed vertically in (a) water and (b) mercury. Take surface tension σ = 0.0725 N/m for water and σ = 0.52 N/m for mercury in contact with air. The specific gravity for mercury is given as 13.6 and angle of contact = 130°.

3. Find the displacement thickness for the velocity distribution in the boundary layer given by $u/U = 2(y/\delta) - (y/\delta)^2$.

4. Draw the velocity distribution and the shear stress distribution for the flow through circular pipes.

5. State Buckingham's π theorem. Why this method is considered superior to Rayleigh's method?

6. Derive the scale ratio for velocity and pressure intensity using Froude model law.

7. What is meant by priming of a centrifugal pump? Why is it necessary?

8. What is the function of air vessel in reciprocating pumps?

9. Explain the type of flow in Francis turbine.

10. What is draft tube?

PART B — (5 × 13 = 65 marks)

11. (a) (i) Derive the Reynold's Transport theorem. (6)

(ii) The dynamic viscosity of an oil used for lubrication between a shaft and sleeve is 6 poise. The shaft is of diameter 0.4 m and rotates at 190 rpm. Calculate the power lost in the bearing for a sleeve length of 90 mm. The thickness of oil film is 1.5 mm. (7)

Or

(b) Derive the Bernoulli's equation with the basic assumptions. (13)

12. (a) Derive the Hagen Poiseuille formula for the flow through circular pipes. (13)

Or

(b) 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 are connected with two tanks whose difference of water levels is 16 m. If the coefficient of friction for these pipe is same and equal to 0.005, determine the discharge through the compound pipe neglecting first the minor losses and then including them. (13)

13. (a) (i) The pressure difference Δp in a pipe of diameter D and length l due to turbulent flow depends on the velocity v, viscosity μ, density ρ and roughness k. Using Buckingham's π theorem, obtain an expression for Δp. (7)

(ii) Define similitude and explain its types. (6)

Or

(b) (i) The pressure drop in an airplane model of size 1/10 of its prototype is $80\,N/cm^2$. The model is tested in water. Find the corresponding pressure drop in the prototype. Take density of air = $1.24\,kg/m^3$. The viscosity of water is 0.01 poise while the viscosity of air is 0.00018 poise. (6)

(ii) Derive the five different types of dimensionless numbers. (7)

14. (a) Derive the expression for pressure head due to acceleration in the suction and delivery pipes of the reciprocating pumps. (13)

Or

(b) The internal and external diameter of an impeller of a centrifugal pump which is running at 1200 rpm are 300 mm and 600 mm. The discharge through the pump is $0.05\ m^3/s$ and the velocity of the flow is constant and equal to 2.5 m/s . The diameters of the suction and delivery pipes are 150 mm and 100 mm respectively and suction and delivery heads are 6 m(abs) and 30 m(abs) of water. If the outlet vane angle is 45° and power required to drive the pump is 17 kW determine :

(i) Vane angle of the impeller at inlet

(ii) Overall efficiency of the pump

(iii) Manometric efficiency of pump. (13)

15. (a) (i) Describe the efficiencies of a turbine. (6)

(ii) Explain the working of Kaplan turbine. Construct its velocity triangles. (7)

Or

(b) The following data is given for Francis turbine : Net Head = 60 m, speed = 700 rpm, shaft power = 294.3 kW, $\eta_0 = 84\%$, $n_h = 93\%$, flow ratio = 0.2, breadth ratio = 0.1, outer diameter of the runner = 2 inner diameter of runner. The thickness of vanes occupies 5% of the circumferential area of the runner. Velocity of flow is constant at inlet and outlet and discharge is radial at outlet. Determine :

(i) The guide blade angle

(ii) Runner vane angle at the inlet and outlet

(iii) Diameter of the runner at inlet and outlet

(iv) Width of the wheel at inlet. (13)

PART C — (1 × 15 = 15 marks)

16. (a) Find the displacement thickness, the momentum thickness and the energy thickness for the velocity distribution in the boundary layer given by $u/U = 2(y/\delta) - (y/\delta)^2$. (15)

Or

(b) (i) Explain the Reynold's Experiment. (5)

(ii) Derive the Darcy – Weisbach equation for the loss of head due to friction in Pipes. (10)

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15. a) A Francis turbine works under a head of 100 m, the flow rate being 6 m^3/s. The flow velocity remains constant at 18 m/s. The blade inlet is at 90°. The width of the runner at inlet is 0.16 times the diameter and the inner diameter is 0.6 times the outer diameter. Determine the runner diameter and hydraulic efficiency. Also calculate the guide blade and runner outlet angles. Assume zero whirl at exit. Assume that blade thickness reduces the flow area by 10%. If the flow rate is 12 m^3/s, estimate the above parameters.

(OR)

b) A Kaplan turbine runner hub and tip diameters are 2.5 m and 5 m respectively. When running at 150 rpm under a head of 30 m, it develops 30 MW. The overall efficiency is 85% and hydraulic efficiency is 90%. Determine the runner blade angles at inlet and outlet both at the tip and the hub. Assume zero whirl at exit and the product of whirl and tip speed is constant at all diameters.

PART – C **(1×15=15 Marks)**

16. a) A centrifugal pump delivers water at 0.075m^3/s with a head of 20 m while operating at 880 rpm. The hub-to-shroud radius ratio at the inlet is 0.35 and the relative velocity makes an angle of −52° at the inlet, (i) Find the reversible work done by the pump, (ii) What is the work done by the impeller ? (iii) Find the impeller radius and the inlet radius of the shroud, (iv) Determine the blade width at the exit of the impeller, (v) Assume a reasonable number of blades, and calculate the blade angle at the exit. Use the Pfleiderer equation to determine more accurately the number of blades and recalculate the blade angle at the exit if needed, (vi) What is the power required to drive the pump ?

(OR)

b) Water is to be supplied to the Pelton wheel of a hydroelectric power plant by a pipe of uniform diameter, 400 m long, from a reservoir whose surface is 200 m vertically above the nozzles. The required volume flow of water to the Pelton wheel is 30 m^3/s. If the pipe skin friction loss is not to exceed 10% of the available head and f = 0:0075, determine the minimum pipe diameter. You are required to select a suitable pipe diameter from the available range of stock sizes to satisfy the criteria given. The range of diameters (m) available are : 1.6, 1.8, 2.0, 2.2, 2.4, 2.6, 2.8. For the diameter you have selected, determine : (i) the friction head loss in the pipe; (ii) the nozzle exit velocity assuming no friction losses occur in the nozzle and the water leaves the nozzle at atmospheric pressure; (iii) the total power developed by the turbine assuming that its efficiency is 75% based upon the energy available at turbine inlet.

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24/11/2017 FN

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

Question Paper Code : 50272

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2017
Third/Fourth Semester
Mechanical Engineering
CE 6451 – FLUID MECHANICS AND MACHINERY
(Regulations 2013)

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

Time : Three Hours Maximum : 100 Marks

Any missing data can be suitably assumed.
Answer ALL questions.

PART – A **(10×2=20 Marks)**

1. Brief on the consequences of Pascal's Law.
2. Differentiate between steady and unsteady flow.
3. State significance of Navier-Stokes equation.
4. What is meant by roughness Reynolds number ?
5. A piping system involves two pipes of different diameters (but of identical length, material and roughness) connected in parallel. How would you compare the flow rates and pressure drops in these two pipes ?
6. The excess pressure Δp inside a bubble is known to be a function of the surface tension and the radius. By dimensional reasoning determine how the excess pressure will vary if we double the surface tension and the radius.
7. Define Net Positive Suction Head.
8. Draw the outlet velocity triangle for a forward curved centrifugal pump.
9. What is the need for draft tube ?
10. Discuss the importance of Muschel curves.

PART – B (5×13=65 Marks)

11. a) A 'U' tube manometer is used to measure water in a pipeline which is in excess of atmosphere pressure. The right limb of the manometer contains mercury and is open to atmosphere. The contact between water and mercury is in the left limb. Calculate the pressure of water in the mainline if the difference in level of mercury in the limbs is 10.5 cm and the free surface of mercury is in level with centre of pipe. If the pressure of water in the pipeline is reduced by (i) 10000 N/m^2 and (ii) 12000 N/m^2 find the new difference if level of mercury.

(OR)

b) In a vertical pipe carrying water, pressure gauges are inserted at points X and Y where the pipe diameters are 0.2 m and 0.1 m respectively. The point Y is 2.25 m below X and when the flow rate down the pipe is 0.025 m^3/s, the pressure at Y is 15686 N/m^2 greater than that at X. Assuming the losses in the pipe between X and Y can be expressed as $k\frac{v^2}{2g}$ where v is the velocity at X, find the value of k.

If the gauges at X and Y are replaced by tubes filled with water and connected to a U-tube containing mercury of relative density 13.6, calculate difference in the levels in the two limbs of the U-tube.

12. a) Water at 10° C ($\rho = 999.7$ kg/m^3 and $\mu = 1.307 \times 10^{-3}$ kg/m.s) is flowing steadily in a 0.20 cm-diameter, 15 m long pipe at an average velocity of 1.2 m/s. Determine the pressure drop, the head loss and the pumping power requirement to overcome this pressure drop. If the velocity is increased by two times find the above parameters.

(OR)

b) Water flowing through an 10 cm diameter pipe enters a porous section of same diameter which allows a uniform radial velocity v_w through the wall surfaces for a distance of 2 m. (i) If the entrance average velocity V_1 is 12 m/s, find the exit velocity V_2 if v_w = 15 cm/s out of the pipe walls; v_w = 10 cm/s into the pipe. What value of v_w will make V_2 = 9 m/s ? (ii) If the entrance average velocity V_1 is 18 m/s, find the exit velocity V_2 if v_w = 18 cm/s out of the pipe walls; v_w = 12 cm/s into the pipe. What value of v_w will make V_2 = 12 m/s ?

13. a) Consider flow over a very small object in a viscous fluid. Analysis of the equations of motion shows that the inertial terms are much smaller than the viscous and pressure terms. It turns out, then that fluid density drops out of the equations of motion. The only important parameters in the problem are the velocity of motion U, the viscosity of the fluid μ and the length scale of the body. Using the Buckingham pi theorem, generate an expression for the two-dimensional drag $D_{2\text{-}D}$ as a function of the other parameters in the problem. Use cylinder diameter d as the appropriate length scale. Repeat the dimensional analysis with ρ included as a parameter. Find the non dimensional relationship between the parameters in this problem.

(OR)

b) Vortex shedding at the rear of a structure of a given section can create harmful periodic vibration. To predict the shedding frequency, a smaller model is to be tested in a water tunnel. The air speed is expected to be about 90 kmph. If the geometric scale is 1:6.8 and the water temperature is 28° C determine the speed to be used in the tunnel. Consider air temperature as 40° C. If the shedding frequency of the model was 60 Hz, determine the shedding frequency of the prototype. The dimensions of the structure are diameter 0.2 m and height 0.4 m.

14. a) The dimensionless specific speed of a centrifugal pump is 0.06. Static head is 30 m . Flow rate is 50 lit/s. The suction and delivery pipes are each of 15 cm diameter. The friction factor is 0.02. Total length is 55 m and other losses equal 4 times the velocity head in the pipe. The vanes are forward curved at 120°. The width is one tenth of the diameter. There is a 6% reduction in flow area due to the blade thickness. The manometric efficiency is 80%. Determine the impeller diameter if inlet is radial.

(OR)

b) A centrifugal pump delivers 50 lit/s when running at 1500 rpm. The inner and outer diameters are 0.15 m and 0.25 m respectively. The blades are curved at 30° to the tangent at the outlet. The flow velocity is 2.5 m/s and is constant. The suction and delivery pipe diameters are 15 cm and 10 cm, respectively. The pressure head at suction is 4 m below atmosphere. The pressure at the delivery is 18 m above atmosphere. The power required was 18 kW. Determine the vane angle at inlet for zero whirl at inlet. Also find the manometric efficiency and overall efficiency.

02/11/18

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

Question Paper Code : 20264

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

Third/Fourth Semester

Mechanical Engineering

CE 6451 — FLUID MECHANICS AND MACHINERY

(Common to : Aeronautical Engineering/Automobile Engineering/Industrial Engineering/Industrial Engineering and Management/Manufacturing Engineering/Mechanical and Automation Engineering/Mechatronics Engineering/Production Engineering)

(Regulations 2013)

(Also Common to : PTCE 6451 — Fluid Mechanics and Machinery – for B.E. (Part-Time) — Second Semester – Mechanical Engineering – Regulations – 2014)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. A clean tube of diameter 2.5 mm is immersed in a liquid with a coefficient of surface tension as 0.4 N/m. The angle of contact of the liquid with the glass can be assumed to be 135 degree. The density of liquid is 13600 kg/m^3. What would be the level of the liquid in the tube relative to the free surface of the liquid inside the tube?
2. State Bernoulli's theorem
3. What is meant by TEL and HGL?
4. List the minor losses in the pipe flow.
5. Differentiate Dynamic and Kinematic similarities.
6. State Buckingham's π theorem
7. List the components of the centrifugal pump.
8. Under which condition negative slip occurs.
9. Draw the velocity triangle for Pelton Wheel turbine.
10. What is the function of a draft tube?

PART B — (5 × 13 = 65 marks)

city distribution of flow over a plate is parabolic with vertex m the plate, where the velocity is 180 cm/s. If the viscosity of the 0.9 Ns/m² find the velocity gradients and shear stresses at a of 0, 15 cm and 30 cm from the plate.

Or

e continuity equation in cartesian coordinates.

at the maximum velocity in a circular pipe for viscous flow is two times the average velocity of flow.

Or

n expression for the major loss in pipe flows.

Rayleigh method of dimensional analysis that the resistance R otion of a sphere of diameter D moving with uniform velocity V a fluid having density ρ and viscosity μ may be $^2 V^2)\phi\left(\frac{\mu}{\rho VD}\right)$. Also show that the above expression reduces to D when the motion is through viscous fluid at low velocity, s a dimensionless constant.

Or

ormance of a spillway of a power project is to be studied by a model constructed to a scale of 1:9 neglecting the viscous and ension effect, determine the rate of flow in the model for a discharge of 1000 m³/s and the dissipation of energy in the hydraulic jump, if the jump in the model studies dissipates

n expression for the pressure head due to acceleration of the a reciprocating pump, assuming motion of the piston to be armonic.

Or

fugal pump has an impeller 0.5 m outer diameter and when at 600 rpm discharges water at the rate of 8000 *lpm* against a 3.5 m. The water enters the impeller without whirl and shock. r diameter is 0.25 m, and the vanes are set back at outlet at an 45° and the area of flow which is constant from inlet to outlet of ller is 0.6 m². Determine the manometric efficiency of the pump, angle at inlet and the least speed at which the pump commences

15. (a) Compare and contrast the components, velocity traingles and working between an impulse turbine and reaction turbine.

Or

(b) Draw and discuss the performance characteristic curves of turbines.

PART C — (1 × 15 = 15 marks)

16. (a) A pelton wheel has a mean bucket speed of 12 m/s and is supplied with water at a rate of 750 lps under a head of 35 m. If the buckets deflect the jet through an angle of 160 degrees, find the power developed by the turbine and its hydraulic efficiency. Take the coefficient of velocity as 0.98. Neglect friction in the bucket. Also determine the overall efficiency of the turbine if its mechanical efficiency is 80%.

Or

(b) Determine the efficiency of Kaplan turbine developing 3000 kW under a net head of 5 m. It is provided with a draft tube with its inlet diameter 3 m set 1.6 m above the tail race. A vacuum gauge connected to the draft tube indicates a reading of 5 m of water. Assume a draft tube efficiency as 78%.

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B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019

Third/Fourth Semester

Mechanical Engineering

CE 6451 – FLUID MECHANICS AND MACHINERY

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

(Regulations 2013)

(Also common to PTCE 6451 – Fluid Mechanics and Machinery for B.E. (Part-Time) – Third Semester – Mechanical Engineering (Regulations – 2014))

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions.

PART – A **(10×2=20 Marks)**

1. Define Viscosity and what is the effect due to temperature on liquid and gases.
2. Calculate the height of capillary rise for water in a glass tube of diameter 1 mm.
3. Differentiate Hydraulic Gradient Line and Total Energy Line.
4. Define boundary layer.
5. Differentiate Dynamic and Kinematic similarities.
6. State Buckingham's π theorem.
7. When does negative slip occur ?
8. Why is forward curved blading rarely used in pumps ?
9. Distinguish between an impulse turbine and a reaction turbine.
10. Define specific speed and unit speed of a turbine.

PART – B (5×13=65 Marks)

11. a) The velocity distribution of flow over a plate is parabolic with vertex 30 cm from the plate, where the velocity is 180 cm/s. If the viscosity of the fluid is 0.9 Ns/m^2 find the velocity gradients and shear stresses at a distances of 0, 15 cm and 30 cm from the plate.

(OR)

b) Derive the three dimensional continuity equation in cartesian coordinates.

12. a) Oil flows through a pipe 150 mm in diameter and 650 mm in length with a velocity of 0.5 m/s. If the kinematic viscosity of oil is 18.7×10^{-4} m^2/s, find the power lost in overcoming friction. Take the specific gravity of oil as 0.9.

(OR)

b) A pipe line of 0.6 m diameter is 1.5 km long. To increase the discharge, another line of the same diameter is introduced parallel to the first in the second half of the length. Neglecting minor losses, find the increase in discharge if Darcy's friction factor is 0.04. The head at inlet is 300 mm.

13. a) Using Buckingham's π theorem, show that the velocity through a circular orifice is given by $v = \sqrt{gH\Phi}\left[\frac{D}{H}, \frac{\mu}{\rho vH}\right]$ where H is the head causing flow, D is the diameter of the orifice, μ is the coefficient of viscosity, ρ is the mass density and g is the acceleration due to gravity.

(OR)

b) i) Explain the types of similarities. (6)

ii) The ratio of lengths of a submarine and its model is 30:1. The speed of the prototype is 10 m/s. The model is to be tested in a wind tunnel. Find the speed of air in wind tunnel. Also determine the ratio of the drag between the model and prototype. Take values of kinematic viscosities of sea water and air as 0.012 stokes and 0.016 stokes respectively. The density of sea water and air is given as 1030 kg/m^3 and 1.24 kg/m^3 respectively. (7)

14. a) i) A single acting reciprocating pump running at 50 RPM 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) Coefficient of discharge.
3) Slip and Percentage slip of the pump. (8)

ii) Discuss the working of Gear pump using its schematic diagram. (5)

(OR)

b) A Centrifugal pump having outer diameter equal to two times the inner diameter and running at 1000 rpm works against a head of 40 m. The velocity of flow through the impeller is constant and equal to 2.5 m/s. The vanes are set back at angle of 40° at outlet. If the outer diameter of the impeller is 500 mm and width at outlet is 50 mm determine (i) Vane angle at inlet, (ii) Manometric efficiency (iii) Workdone by impeller on water per second.

15. a) At a location selected to install a hydro electric plant, the head is estimated as 540 m. The flow rate was determined as 22 m^3/s. The plant is located at a distance of 2 km from the reservoir. Two pipes of 2 m diameter are proposed with a friction factor of 0.03. Additional losses amount to about 1/4th of frictional loss. Assuming on overall efficiency of 85%, determine how many single jet unit running at 330 rpm will be required.

(OR)

b) A Kaplan turbine delivering 40 MW works under a head of 40 m and runs at 150 rpm. The hub diameter is 3 m and runner tip diameter is 6 m. The overall efficiency is 90%. Determine the blade angles at the hub and tip and also at a diameter of 4 m. Also find the speed ratio and flow ratio based on tip velocity. Assume hydraulic efficiency as 95%.

PART – C (1×15=15 Marks)

16. a) A 45° reducing bend is connected in a pipeline, the diameter and outlet of the bend being 600 mm and 300 mm respectively. Find the force exerted by water on the bend if the intensity of pressure at inlet to bend is 88290 N/m^2 and rate of flow of water is 0.6 m^3/s.

(OR)

b) A laminar flow is taking place in a pipe of diameter 200 mm. The maximum velocity is 1.5 m/s. Find the mean velocity and the radius at which this occurs. Also, calculate the velocity at 4 cm from the wall of the pipe.

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