Heaven's Light is Our Guide

DEPARTMET OF CIVIL ENGINEERING

RAJSHAHI UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering SECOND Year ODD SEMESTER Examination, 2019

CE 2121
Fluid Mechanics

Full Marks: 72 **Time: 3 Hours**

N.B.:-
(i) Answer any SIX questions, taking THREE from each section.
(ii) Figure in the margin indicate full marks.
(iii) Use separate answer script for each section.
(iv) Assume reasonable value for any data missing.

SECTION-A

Q.1 (a) Distinguish between 4.00

(i) 'Atmospheric pressure' and 'Gauge pressure'

(ii) 'Simple manometer' and 'Differential manometer"

(b) Derive an expression for the depth of centre of pressure from free surface of liquid of an inclined plane surface submerged in the liquid. 4.00

(c) A triangular plate of 1 m base and 1.5m altitude is immersed in water. The plane of the plate is inclined at 30° with free water surface and the base is parallel to and at a depth of 2m from water surface. Find the total pressure on the plate and the position of centre of pressure. 4.00

Q.2 (a) Define and Explain the following terms; 4.00

(i) Bouyancy (ii) Metacentre (iii) Metacentric height and (iv) Stable equilibrium.

(b) A spherical object of 1.5m diameter is completely submerged in a water reservoir and chained to the bottom. If the chain has a tension of 5.30 kN, find the weight of the object when it is taken out of the reservoir into the air. 4.00

(c) A solid metallic piece (relative density =7.2) floats above the surface of mercury in a tank. What fraction of the volume of metallic piece lies above the mercury surface? 4.00

Q.3 (a) Define the following terms: 4.00

(i) Stream line, (ii) Steady flow, (iii) Non-uniform flow, and (iv) Laminar flow

(b) Prove that stream lines and potential lines are normal to each other. 4.00

(c) A rectangular pool , 10m × 25m is to be filled to a depth of 3m. For a filling time of 2 hours, determine the uniform flow required in m^3/s. If 6cm hoses are available and the water velocity in hose is limited to 2.5m/s, determine the number of hoses required. 4.00

Q.4 (a) Derive the equation of continuity for two dimensional incompressible flow. 4.00

(b) Discuss the applicability of equation of continuity. 4.00

(c) Water is flowing through a pipe having diameter 600mm and 400mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is $350kN/m^2$ and the pressure at the upper end is $100kN/m^2$. Determine the difference in datum head, if the rate of flow through the pipe in 60 litres/sec. 4.00

SECTION-B

Q.5(a)	Define the terms: (i) coefficient of contraction (ii) coefficient of resistance (iii) Flow net.		4.00
(b)	Define large rectangular orifice. Derive the equation of discharge through a large rectangular orifice.		4.00
(c)	An external cylindrical mouthpiece of diameter 150mm is discharging water under constant head of 6m. Determine the discharge and absolute pressure head of water at Vena-contracta. Take C_d=0.855 and C_c for Vena-contracta=0.62. Atmospheric pressure head =10.3m of water.		4.00
Q.6 (a)	Define and explain briefly the followings: (i) velocity potential and (ii) Stream function.		4.00
(b)	Derive an expression for the rate of flow through a venturimeter.		4.00
(c)	A venturimeter with 200mm diameter at inlet and 130mm diameter at throat is laid with its horizontal and is used for measuring the flow of oil of specific gravity 0.90. The oil mercury differential manometer shows a gauge difference of 200mm. Calculate the discharge. Assume, coefficient of discharge as 0.98.		4.00
Q.7 (a)	Explain the terms: (i) pipe in parallel, (ii) Equivalent pipe , (iii) Equivalent size of pipe (iv) Syphon		4.00
(b)	Show that loss of head due to sudden ~~expression~~ expansion in pipe line is a function of velocity head.		4.00
(c)	A compound piping system consists of 1800m of 50cm dia., 1200m of 40cm dia., and 600m of 30cm dia. Pipes of the same material connected in series. What is the equivalent length of a 40cm dia pipe of the same material?		4.00
Q.8 (a)	Differentiate between Laminar flow and Turbulent flow.		4.00
(b)	Define Reynolds stresses. Sketch and explain velocity distribution curve for Laminar and turbulent flow.		4.00
(c)	A crude oil of viscosity 0.9 poise and relative density 0.9 is flowing through horizontal circular pipe of diameter 120mm and length 12m. Calculate the difference of pressure at the two ends of the pipe, if 785 N of the oil is collected in a tank in 25 seconds.		4.00

Heaven's Light is Our Guide

DEPARTMENT OF CIVIL ENGINEERING

RAJSHAHI UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering SECOND Year ODD Semester Examination, 2018

CE 2121

Fluid Mechanics

Full marks: 72 **Time: 3 Hours**

N.B:- (i) Answer any SIX questions, taking THREE from each section.
(ii) Figures in the margin indicate full marks.
(iii) Use separate answer script for each section.
(iv) Assume reasonable data for any data missing.

SECTION-A

Q.1(a) Define fluid. Obtain an expression for the pressure intensity at a point in a fluid. 4.00

(b) Differentiate between i) Absolute and gauge pressure ii) Simple manometer and differential manometer. 4.00

(c) In a pipeline water is flowing. A manometer is to measure the pressure drop for flow through the pipe. The difference in level was found to be 20 cm. The manometric fluid is CCl_4 (density of CCl_4 = 1.596 gm/cm^3). If the manometric fluid is changed to mercury, what will be the difference in level? 4.00

Q.2(a) Derive an expression for the magnitude and location of total pressure acting on inclined surface immerged in a liquid at rest. 4.00

(b) A trapezoidal channel 2 m wide at the bottom and 1 m deep has side slopes 1:1. Determine the total pressure and the centre of pressure on the vertical gate closing the channel when it is full of water. 4.00

(c) A hemispherical bulge of diameter 1.2 meter is provided in the bottom of a tank. If the depth of water above the horizontal floor of the tank is 3 m, calculate the magnitude and direction of the resultant force on the hemisphere. 4.00

Q.3(a) Define the following terms: 4.00
i) Buoyancy ii) Centre of Buoyancy iii) Meta-centre iv) Meta-centric height.

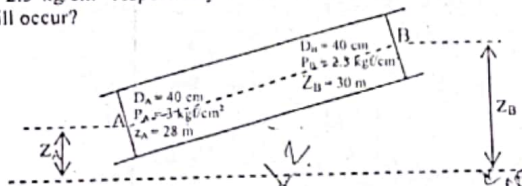
(b) Explain briefly the following types of equilibrium of floating bodies: 3.00
i) Stable equilibrium ii) Unstable equilibrium iii) Neutral equilibrium

(c) A solid cylinder of diameter 5.0 m has a height of 5.0 m. Find the meta-centric height of the cylinder if the specific gravity of the material of cylinder is 0.7 and it is floating in water with its axis vertical. State whether equilibrium is stable or not. 5.00

Q.4(a) Differentiate between: 4.00
i) Steady flow and unsteady flow ii) Rotational flow and irrotational flow.

(b) Prove the orthogonality of streamlines and equipotential lines. 4.00

(c) A pipeline of diameter 40 cm carries water at a velocity of 2.5 m/sec. The pressure at the points A and B are given 3 kg/cm^2 and 2.3 kg/cm^2 respectively while the datum head at A and B are 28 m and 30 m. Which direction the flow will occur? 4.00



SECTION-B

Q.5(a) State and prove Bernoulli's equation. Why Bernoulli's equation for ideal fluid needs to be modified for real fluid? 4.00

(b) Define free liquid jet. For a free liquid jet in motion, find: 4.00
i) Maximum height attained by the jet, h
ii) Time of flight, T
iii) Horizontal range of the jet, r

(c) A nozzle is situated at a distance of 1.2 m above the ground level and is inclined at 60° to the horizontal. The diameter of the nozzle is 40 mm and the jet of water from the nozzle strikes the ground at a horizontal distance of 5 m. Find the flow rate. 4.00

Q.6(a) Explain the classification of orifices and mouthpieces based on their shape, size and sharpness. 4.00

(b) Obtain an expression for discharge through a large rectangular orifice. 4.00

(c) A hemispherical tank of diameter 4 m contains water upto a height of 1.5 m. An orifice of diameter 5 cm is provided at the bottom. Find the time required by water i) to fall from 1.5 m to 1.0 m ii) for completely emptying the tank. Take C_d = 0.6. 4.00

Q 7(a) Explain briefly the following: 4.00
i) Hydraulic gradient line (HGL)
ii) Energy gradient line (EGL)
iii) Equivalent pipe
iv) Minor energy losses

(b) For a steady laminar flow through a circular pipe prove that velocity distribution across the section is parabolic and the average velocity is half of the maximum local velocity. 4.00

(c) A compound pipeline 1650 m long made up of pipes 450 mm diameter for 900 m, 375 mm for 450 m and 300 mm for 300 m, is required to be replaced by a pipe of uniform diameter. Find the diameter of the new pipe, assuming the length to remain the same. 4.00

Q 8(a) Using Buckingham's π theorem, show that the velocity through a circular orifice is given by, 5.00

$$V = \sqrt{2gH}\,\phi\left(\frac{D}{H}, \frac{\mu}{\rho V H}\right);$$

where H = head causing flow; D = diameter of orifice; μ = co-efficient of viscosity; ρ = mass density

(b) Explain the following similarities that must be ensured between the model and the prototype 3.00
i) Geometric similarity
ii) Kinematic similarity
iii) Dynamic similarity

(c) Define Reynolds stresses. Sketch and explain velocity distribution curve for laminar and turbulent flow. 4.00

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Heaven's Light is Our Guide

DEPARTMENT OF CIVIL ENGINEERING

RAJSHAHI UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering Second Year Odd Semester Examination, 2017

CE- 2121

Fluid Mechanics

Full marks: 72 **Time: 3 Hours**

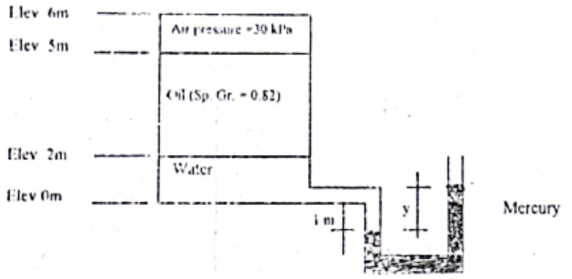
N.B:- (i) Answer any SIX questions, taking THREE from each section.
(ii) Figures in the margin indicate full marks.
(iii) Use separate answer script for each section.
(iv) Assume reasonable value for any data missing.

SECTION-A

Q.1(a) Define the following terms: (i) Absolute pressure (ii) Atmospheric pressure and (iii) Differential manometer 3.00

(b) Convert a pressure head of 100 m of water to: 4.00
(i) Kerosene of specific gravity 0.81, (ii) Carbon tetrachloride of specific gravity 1.6.

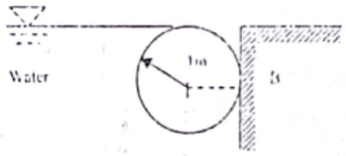
(c) A manometer is attached to a tank containing three different fluids, as shown in the figure. What will be the difference in elevation of the mercury column in the manometer (i.e. y in the figure)? 5.00



Q.2(a) Derive an expression for the depth of centre of pressure from free surface of liquid of an inclined plane surface submerged in the liquid. 4.00

(b) Explain how you would find the resultant pressure on a curved surface immersed in a liquid. 3.00

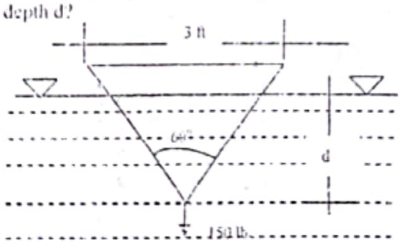
(c) The 2 m diameter cylinder in the figure is 5 m long into the paper and rests in static equilibrium against the smooth wall at point B. Compute the weight and specific gravity of the cylinder. Assume zero wall friction at point B. 5.00



Q.3 (a) Define and explain the following terms (i) Buoyancy (ii) Metacentre (iii) Metacentric height and (iv) Neutral equilibrium. 4.00

(b) Describe experimental method determination of the metacentric height of a floating object. 3.00

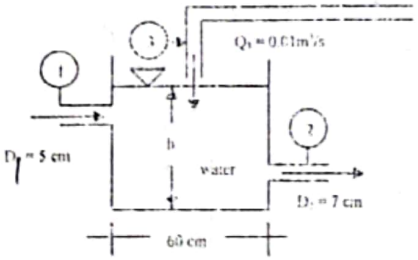
(c) In the figure, a wedge of wood having a specific gravity of 0.6 is forced into water by a 150-lb force. The wedge is 2 ft width. What is depth d? 5.00



Q.4 (a) Derive the equation of continuity for two dimensional incompressible flow. 4.00

(b) Given that $u = xy$ and $v = 2yz$. Examine whether these velocity components represents two or three-dimensional incompressible flow; if three dimensional, determine the third component. 3.00

(c) The water tank in the figure is being filled through section 1 at $v_1 = 4\ m/s$ and through section 3 at $Q_3 = 0.01 m^3/s$. If the water level h is constant, determine exit velocity v_2. 5.00

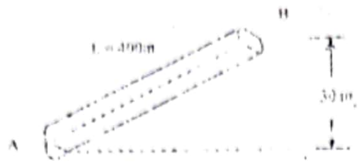


SECTION B

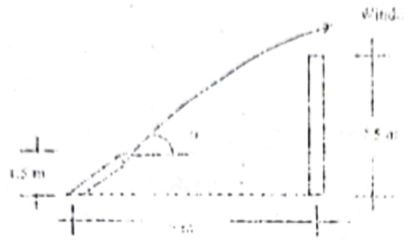
5\. (a) What are types of minor energy losses in pipe flow? Derive formulae for calculating loss of head due to sudden contraction

(b) A horizontal pipe of diameter 500 mm is suddenly contracted to a diameter of 250 mm. The pressure intensities in the large and smaller pipe is given as 13.734 N/cm² and 11.772 N/cm² respectively. If [illegible] find the value of co-efficient of contraction.

(c) The figure shown in below represents a pipe line AB of diameter 300 mm and length 400 m carries water at the rate of 50 litre/s. The flow takes place from A to B, where point B is 30 m above A. Find the pressure at A if pressure at B is 19.62 N/cm². take $f = 0.008$ 4.00



6\. (a) The figure shown at below represents Grenfell tower, West London, where fire brigade man is holding a fire stream of nozzle of 50 mm diameter. The jet issues out with a velocity of 13 m/s and strikes the window. Find angle or angles of inclination with which the jet issues from nozzles. What will be the amount of water falling on the window? 4.00



(b) Obtain the expression for time of emptying a tank through an orifice at it bottom. 3.00

(c) What is pitot tube? How is it used to [illegible] velocity of flow [illegible] in a pipe [illegible] [illegible]

(d) Water flows over a rectangular weir 1 m wide at a depth of 150 mm and after wards passes through a triangular right angled weir. Taking C_d for rectangular and triangular weir as 0.62 and 0.59 respectively, find the depth over the triangular weir. 3.00

7\. (a) What is repeating variables? How are these selected by dimensional analysis? 4.00

(b) Using Buckingham's π theorem, show the velocity through a circular orifice is given by $V = \sqrt{2gH}\,\varphi\left(\frac{D}{H}, \frac{\mu}{\rho VH}\right)$ 5.00

(c) A 1:64 model is constructed of an open channel in concrete which has Manning's N = 0.014 find the value of N for the model. 3.00

8\. (a) Write short notes on: (i) Pipe in parallel (ii) Equivalent pipe (iii) Hydraulic gradient line and (iv) Total energy line. 4.00

(b) Show that loss of head due to sudden expansion in pipe line is a function of velocity head. 4.00

(c) A piping system consists of three pipes arranged in series: the length of the pipes are 1200 m, 750 m and 600m and diameters 750 mm, 600 mm and 450 mm respectively. 4.00

(i) Transform the system to an equivalent 450 mm diameter pipe and

(ii) Determine an equivalent diameter for the pipe, 2550 m long.

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B.A.P.I.A
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DEPARTMENT OF CIVIL ENGINEERING
[illegible] UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering SECOND year THIRD SEMESTER Examination, 2014

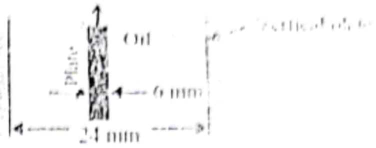
CE 221
Fluid Mechanics

Full Marks: 70 Time: 3 Hours

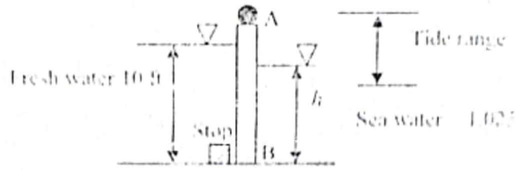
N.B.:
(i) Answer SIX questions, taking THREE from each section.
(ii) Figure in the margin indicates full marks.
(iii) Use separate answer script for each section.
(iv) Assume reasonable value for any data missing.

SECTION-A

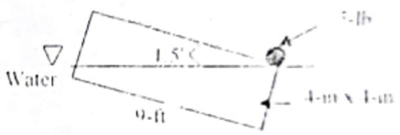
Q.1 (a) What is difference between an ideal fluid and a real fluid? 2.67
(b) Differentiate between (i) simple manometer and (ii) Differential manometer with [illegible] 4.00
(c) [illegible] 1.2 m [illegible] weighing 90 N is placed midway in the 24 mm gap between two vertical plane surfaces as shown in the Fig. The gap is filled with an oil of specific gravity 0.85 and dynamic viscosity 3.0 N s/m². Determine the force required to lift the plate with a constant velocity of 0.15 m/sec. [illegible]



Q.2 (a) Differentiate between simple and differential type of manometers. Briefly explain the principle employed in the manometer used for the measurement of pressure. 3.67
(b) Draw pressure diagrams for horizontal, vertical and inclined plane surfaces. Derive an expression for the magnitude and location of total pressure acting on vertical surface immersed in a liquid at rest. 4.00
(c) In figure, gate AB is 5 ft wide and opens to let fresh water out when the ocean tide is dropping. The hinge at A is 2 ft above the fresh water level. At what ocean level h will the gate open? Neglect the gate's weight. 4.00



Q.3 (a) Explain the terms 'meta-centre' and 'meta-centric height'. 2.67
(b) [illegible] determine the meta-centric height of a floating body experimentally? Explain with neat sketch. 4.00
(c) When a 3-lb weight is placed on the end of a floating 4 in by 4 in by 9-ft wooden beam, the beam tilts at 1.5° with its right upper corner at the surface as shown in the figure. What is the specific weight of the wood? 5.00

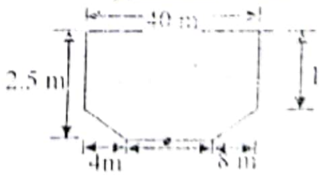


Q.4 (a) Derive the equation of continuity for two dimensional incompressible flow. 4.00
(b) Discuss the applicability of equation of continuity. 2.67
(c) Water is flowing through a pipe having diameters 600 mm and 400 mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 350 kN/m² and the pressure at the upper end is 100 kN/m². Determine the difference in datum head if the rate of flow through the pipe is 60 litres/sec. 5.00

SECTION-B

Q.5 (a) Distinguish between (i) steady flow and unsteady flow, (ii) Rotational flow and irrotational flow. 4.00
(b) Describe the important characteristics of streamlines. 2.67
(c) For steady incompressible flow, are the flow values of u and v possible? 5.00
(i) $u = 4xy + y^2$, $v = 6xy + 3x$; (ii) $u = 2x^2 + y^2$, $v = -4xy$

Q.6 (a) Define 'vena-contracta'. Describe experimental method for determination of hydraulic coefficients. 4.00
(b) What is meant by 'velocity of approach'? Find an expression for the discharge over a right angled triangular notch. 4.00
(c) The figure shows the vertical section of a swimming bath [illegible] and 25 m wide. There is an orifice 0.225 m diameter at the bottom of the bath. Find the time taken to empty the tank if c_d = 0.62. 3.67



Q.7 (a) What are the actions that cause the frictional resistance in pipe flow? Write the results of Froude experiments on frictional resistance. 2.67
(b) Define equivalent pipe. Derive an expression for the loss of head due to sudden enlargement. 5.00
(c) At a sudden contraction of a horizontal water pipe from 480 mm to 240 mm diameter, the hydraulic gradient falls by 19 mm. Estimate the rate of flow. [illegible]

Q.8 (a) Define the terms dimensional and model analysis. What are the uses of dimensional analysis? 3.67
(b) State and explain Buckingham π-theorem. Why this theorem is considered superior over the Rayleigh's method for dimensional analysis? 3.50
(c) The pressure ΔP in a pipe depends upon the mean velocity of flow (v), length of pipe (l), diameter (D), viscosity of fluid [illegible] roughness (k) and mass density (ρ). Using Buckingham π-theorem, obtain a dimensionless expression [illegible] 4.50

$T_1 = \frac{2A}{C_d a\sqrt{2g}}(\sqrt{H_1}-\sqrt{H_2})$

B.Sc. Engineering SECOND year ODD Semester Examination 201

CE 2121

Fluid Mechanics

Full Marks: 72 Time: 3 Hours

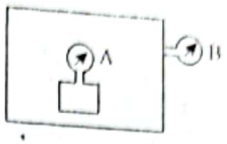
N.B.:-
(i) Answer SIX questions, taking THREE from each section.
(ii) Figure in the margin indicates full marks.
(iii) Use separate answer script for each section.
(iv) Assume reasonable value for any data not given.

SECTION-A

Q 1(a) Define the terms: (i) Atmospheric pressure, (ii) Gauge pressure, (iii) Ideal fluid and (iv) Real fluid 4.00

(b) Explain why does the viscosity of a gas increases with the increase in temperature while that of a liquid decreases with the increase in temperature. 3.00

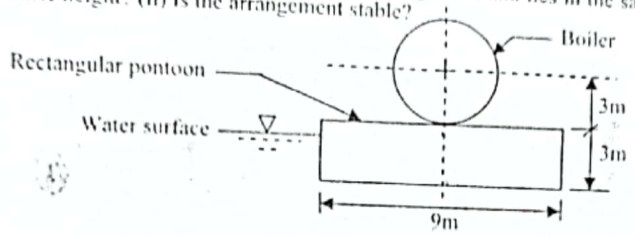
(c) Bourdan gauge A inside a pressure tank in the figure reads 12 psi. Another Bourdan gauge B outside the pressure tank and connected with it reads 20 psi, and an aneroid barometer reads 29 inch mercury. What is the absolute pressure at A in inches of mercury? 5.00



Q 2(a) Explain metacentric height as a direct measure of stability of floating body. 2.00

(b) Describe experimental method of determination of the metacentric height of a floating object. 4.00

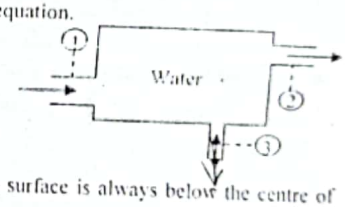
(c) A rectangular pontoon 12 m long, 9 m wide and 3 m deep weighs 1380 kN and floats in sea water. The pontoon carries on its upper deck a boiler 6 m diameter and weighing 864 kN. The centre of gravity of each unit coincides with geometrical centre of the arrangement and lies in the same vertical line. (i) What is the metacentric height? (ii) Is the arrangement stable? 6.00



Q 3(a) Derive the equation of continuity for two dimensional incompressible flow. 4.00

(b) Write down the assumptions made in the derivation of Bernoulli's equation. 3.00

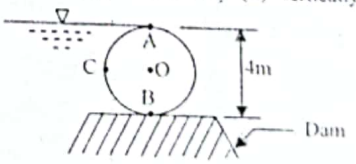
(c) Water flows steadily through a box a three section as shown in the figure. Section 1 has a diameter of 5 inch and the flow in is 1 cfs. Section 2 has a diameter of 2 inch and flow out is 30 fps average velocity. Compute the average velocity and volume flux at section 3 if D_3 = 1 inch. Is the flow at 3 in or out? 5.00



Q 4(a) Prove that the centre of pressure of a completely submerged plane surface is always below the centre of gravity of the submerged surface. 4.00

(b) Draw the pressure diagrams on a plate when submerged in a fluid (i) horizontally (ii) vertically (iii) inclined way. 3.00

(c) Find the magnitude and direction of the resultant force due to water acting on a roller gate of cylindrical form of 4 m diameter, when the gate is placed on the dam in such a way that water is just going to spill. Take the length of the gate as 8 m. 5.00



SECTION - B

Q 5(a) Define an orifice and a mouthpiece. What are the differences between these two? 2.00

(b) Define vena-contracta. How is it developed? 2.00

(c) Derive an expression of time for emptying a hemispherical tank through an orifice at its bottom. 4.00

(d) A tank has two identical orifices in one of its vertical sides. The upper orifice is 3 m below the water surface and lower one is Y m below the water surface. The point of intersection of two jets is P. The horizontal distance of P from orifices is 8 m. If the value of c_v for each orifice is 0.96, find the value of Y. 4.00

Q 6(a) Define and explain briefly the followings: (i) velocity potential and (ii) stream function. 2.00

(b) Distinguish between pathlines, streamlines and streaklines. 2.00

(c) State and prove Bernouih's equation. 4.00

(d) The following case represents the two velocity components. Determine third component of velocity such they satisfy the continuity equation: $v = 2y^2$, $w = 2xyz$. 1.00

Q 7(a) Write short notes on the following: 4.00
(i) Pipe in parallel, (ii) Equivalent pipe, (iii) Equivalent size of the pipe and (iv) Hydraulic gradient line of a flowing fluid in a pipe.

(b) Enumerate the major and minor energy losses in pipes. 3.00

(c) Three pipes of length 800 m, 500 m and 400 m and of diameters 50 cm, 40 cm and 30 cm respectively are connected in series. These pipes are to be replaced by a single pipe of length 1700 m. Find the diameter of the single pipe. 5.00

Q 8(a) Define fundamental quantities and secondary quantities. Describe the uses of dimensional analysis. 4.00

(b) What is meant by repeating variables? How are the repeating variables selected for dimensional analysis? 3.00

(c) Find the form of the equation for discharge Q through a sharp-edged triangular notch. Assume Q depends on the central angle α of the notch, head H, gravitational acceleration g and on the density ρ, viscosity μ and surface tension σ of the fluid. 5.00