

**FLUID MECHANICS
(CIVL 2113)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

***Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.***

Candidates are required to give answer in their own words as far as practicable.

**Group – A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) A rectangular channel section will be most economical when the depth of flow and bottom width are in the ratio of
(a) 1 : 4 (b) 1 : 1 (c) 1 : 2 (d) 2 : 1
- (ii) The loss of energy at exit from a pipe having 'V' as mean velocity will be
(a) $\frac{V^2}{2g}$ (b) $\frac{0.5V^2}{2g}$ (c) $\frac{2V^2}{g}$ (d) $\frac{V^2}{g}$
- (iii) In a tank or channel notch is provided to measure
(a) Velocity (b) Pressure
(c) Discharge (d) Static energy.
- (iv) The sheet of water flowing through a notch or over a weir is known as
(a) Nappe (b) Crest
(c) Height of weir (d) Sill.
- (v) Find the discharge of water flowing over a rectangular notch of 2m length when the constant head over the notch is 300 mm. Take $C_d = 0.6$
(a) 0.382 m³/s (b) 0.528 m³/s
(c) 0.782 m³/s (d) 0.982 m³/s
- (vi) A hydraulic model of a spillway is constructed with a scale 1:16. If the prototype discharge is 2048 cumec, then the corresponding discharge for which the model should be tested is
(a) 1 cumec (b) 2 cumec
(c) 4 cumec (d) 8 cumec.
- (vii) The correct sequence, in the direction of the flow of water for installations in a hydro-power plant is
(a) reservoir, surge tank, turbine, penstock
(b) reservoir, penstock, surge tank, turbine

- (c) reservoir, penstock, turbine, surge tank
(d) reservoir, surge tank, penstock, turbine.
- (viii) If the resistance R to the motion of a sphere through a fluid is a function of density ρ , viscosity η of the fluid, radius r and velocity v of the sphere, the number of π -parameters needed to express the function $F(R, \rho, \eta, r, v) = 0$ is
(a) 2 (b) 3 (c) 3 (d) 4.
- (ix) Froude number is the ratio of inertia force to
(a) viscous force (b) surface tension force
(c) gravity force (d) compressive force.
- (x) A Francis turbine under a head of 25m produces 2000kW at a speed of 250rpm. Its specific speed is
(a) 50 (b) 100 (c) 150 (d) 200.

Group – B

2. (a) Demonstrate the derivation of the expression for total pressure and centre of pressure on an inclined plane surface submerged in liquid. [(CO1)(Understand/LOCQ)]
(b) A circular opening 3m diameter in a vertical side of a tank is closed by a disc of 3m diameter which can rotate about a horizontal diameter. Evaluate the following:
(i) The force on the disc and (ii) the torque required to maintain the disc in equilibrium in the vertical position when the head of water above the horizontal diameter is 4m. [(CO1) (Evaluate/HOCQ)]
(c) Define meta-centre with neat diagram. [(CO1)(Remember/LOCQ)]
4 + 6 + 2 = 12
3. (a) Define steady and unsteady flow in open channel. [(CO4)(Remember/LOCQ)]
(b) Evaluate the slope of the bed of a rectangular channel of width 5m when depth of water is 2m and rate of flow is given as 20m³/s. Take Chezy's constant $C = 50$. [(CO4)(Evaluate/HOCQ)]
(c) A trapezoidal channel has side slopes of 1 horizontal to 2 vertical and the slope of the bed is 1 in 1500. The area of the section is 40m².
(i) Apply the concept of most economical section to find out the dimensions of the channel section. [(CO4)(Analyse/IOCQ)]
(ii) Determine the discharge of most economical section if $C = 50$. [(CO4)(Evaluate/HOCQ)]
2 + 4 + (5 + 1) = 12

Group – C

4. (a) Explain and derive expression of discharge over rectangular weir. [(CO2,CO3) (Understand/LOCQ)]

- (b) Solve the height of rectangular weir of length 6m to be built across a rectangular channel. The maximum depth of water on the upstream side of the weir is 1.8m and discharge is 2000 lit/s. Take $C_d = 0.6$ and neglect end contractions. [(CO2,CO3)(Apply/IOCQ)]
- (c) Estimate the discharge through a trapezoidal notch which is 1m wide at the top and 0.4m at the bottom and is 30cm in height. The head of water on the notch is 20cm. assume C_d for rectangular portion 0.62 and while for triangular portion = 0.6. [(CO2,CO3)(Create/HOCQ)]
- 2 + 5 + 5 = 12**
5. (a) Explain the concept of Cipolletti weir with neat diagram. [(CO2,CO3)(Understand/LOCQ)]
- (b) (i) Construct the expression of discharge over a triangular notch. [(CO2,CO3)(Understand/LOCQ)]
- (ii) What will be the final expression of discharge if the angle is 90° and C_d is 0.6. [(CO2,CO3)(Remember/LOCQ)]
- (c) Explain drag and lift. [(CO6)(understand/LOCQ)]
- 4 + 4 + 4 = 12**

Group – D

6. (a) Differentiate between Critical ,sub-critical and super-critical flow in a open channel. [(CO4)(Remember/LOCQ)]
- (b) State Buckingham's π -theorem. Why this theorem is considered superior over the Rayleigh's method for dimensional analysis? [(CO5)(Understand/LOCQ)]
- 6 + (3 + 3) = 12**
7. (a) A pipe of diameter 1.5m is required to transport an oil of sp. gr. 0.90 and viscosity 3×10^{-2} poise at the rate of 3000 litre/s. Tests were conducted on a 15cm diameter pipe using water at 20°C . Find the velocity and rate of flow in the model. Viscosity of water at $20^\circ\text{C} = 0.01$ poise. [(CO5) (Analyze/IOCQ)]
- (b) What do you mean by fundamental units and derived units? Give examples. Explain the term 'dimensionally homogeneous equation'. [(CO5) (Understand/LOCQ)]
- 6 + (4 + 2) = 12**

Group – E

8. (a) A water turbine has a velocity of 6m/s at the entrance to the draft-tube and a velocity of 1.2m/s at the exit. For friction losses of 0.1m and a tail water 5m below the entrance to the draft-tube, find the pressure head at the entrance. [(CO6) (Evaluate/HOCQ)]
- (b) What is the significance of specific speed of turbine? What are the uses of draft-tube? Describe with neat sketch different types of draft-tubes. [(CO6) (Understand/LOCQ)]
- 6 + (3 + 3) = 12**

9. (a) Differentiate between the volute casing and vortex casing for the centrifugal pump. [(CO1)(Remember/LOCQ)]
- (b) Differentiate between centrifugal pump and reciprocating pump. [(CO2)(Understand/LOCQ)]

6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	60.4	16.66	22.91

Course Outcome (CO):

After the completion of the course students will be able to

1. Understand basic fluid properties (density, viscosity, bulk modulus), flow forces (pressure, shear stress, surface tension) and flow regimes (laminar/turbulent, compressible/incompressible, steady/unsteady).
2. Use and know limitations of steady and unsteady Bernoulli equation along and normal to a streamline.
3. Explain the conservation of mass and momentum through differential analysis in simple geometries.
4. Study scope, importance, characteristics and various types of flows in an open channel.
5. Understand the techniques of dimensional analysis, similitude and modelling and introduce the important non-dimensional groups in fluid mechanics.
6. Know the concepts to internal and external flows and introduce the boundary layer concept, lift and drag, flow separation, and drag reduction fundamentals.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question

Department & Section	Submission Link
CE & SEC A	https://classroom.google.com/c/NDA1MzAyNDQ0NjEx/a/NDc0NjQ3NDg4NjQy/details
	Classroom joining link: https://classroom.google.com/c/NDA1MzAyNDQ0NjEx?cjc=4wc4as7
CE & SEC B	https://classroom.google.com/c/NDA1MzIwNzU1OTI1/a/NDc0NjQ3NDg4ODA4/details
	Classroom joining link: https://classroom.google.com/c/NDA1MzIwNzU1OTI1?cjc=plkbjsj
BACKLOG	https://classroom.google.com/c/NDc1MTQxNjg0MzUz/a/NDc1MTQyNzcyNzAy/details
	Classroom joining link: https://classroom.google.com/c/NDc1MTQxNjg0MzUz?cjc=vcbqns7