

Government College of Engineering, Amravati
(An Autonomous Institute of Government of Maharashtra)

Third Semester B. Tech. (Civil Engineering)

Summer Term – 2015

Course Code: CEU302

Course Name: Fluid Mechanics

Time: 2 Hrs. 30 Min.

Max. Marks: 60

Instructions to Candidate

- 1) All questions are compulsory.
- 2) Assume suitable data wherever necessary and clearly state the assumptions made.
- 3) Diagrams/sketches should be given wherever necessary.
- 4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
- 5) Figures to the right indicate full marks.

1. A Distinguish between ideal fluid and real fluid 2

B i) A circular jet of water 0.5 mm in diameter issues from an opening. What is the pressure difference between the inside and outside of the jet. The surface tension at the water-air interface is 0.073 N/m.

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ii) What is bulk modulus of Elasticity?

OR

A circular plate 3.5 m in diameter is submerged in water in such way that the least and greatest depths of plate below free surface of water are

Imp

h m

z th

H₁ m
2.2
C_f

2.5 m and 4 m respectively. Find the total pressure force on the plate and the position of center of pressure.

A hot plate of area 0.125 m^2 is pulled at 0.25 m/s with respect to another stationary parallel plate 1 mm distant from it the space between the plates containing water of viscosity 0.001 N-s/m^2 , find the force necessary to maintain this velocity and also the power required.

2. A Define the terms "center of pressure" and "total pressure" in immersed body.

OR

Define i) Stream line and ii) Streak line

B A wooden block (specific gravity 0.8) of dimensions $1 \text{ m} \times 0.5 \text{ m} \times 0.4 \text{ m}$ floats in water with its shortest axis vertical. Determine the metacentric height and state the condition of its equilibrium.

C A pipeline carrying water changes in diameter from 20 cm at section 1 to 40 cm diameter at section 2 which is 6m at higher level. If the pressure at section 1 and 2 are 120 kN/m^2 and 80 kN/m^2 , respectively and the discharge is 200 liters/sec, determine the head loss and direction of flow.

3. A Explain the term "minor losses" in pipe line. 3

OR

Explain briefly causes, effects and remedial measures for water hammer in pipes.

- B If stream function for steady flow is given by 4

$\psi = y^2 - x^2$, determine whether the flow is rotational or irrotational. Find the potential function.

C A 45° reducing pipe bend in a horizontal plane has an inlet diameter of 300 mm and outlet diameter of 150 mm. The pressure at the outlet is 20kPa gauge and rate of flow of water through the bend is $0.09 \text{ m}^3/\text{s}$. Neglecting friction, determine the magnitude and direction of force required to keep the bend in position. Neglect the weight of water in the bend. 5

4. A What are the various hydraulic coefficients of 3 orifice?

OR

Explain briefly Moody's diagram.

B Water flows through a $300 \text{ mm} \times 150 \text{ mm}$ venturimeter at the rate of $0.065 \text{ m}^3/\text{s}$ and the differential gauge is deflected 1.2 m. Specific gravity of the manometric liquid is 1.6. Determine the coefficient of the venturimeter.

C Two reservoirs are connected by two pipes in series of lengths 200 m and 300 m and the diameters 20 cm and 30 cm, respectively. The difference of head between the two surfaces is 10 m. The friction factor for the two pipes are 0.02 and 0.015, respectively. Determine the flow rate. 5

5. A Distinguish between streamlined bodies and 2 bluff bodies.

OR

What is Hagen-Poiseuille formula?

- B An airplane weighing 33200 N is flying at a

Contd.

velocity of 300 km/hr. The plane has wing surface area of 25 m^2 . If the coefficient of drag is 0.025, Find the

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- i) the coefficient of lift,
- ii) the drag force and
- iii) the power required to drive the plane. The density of air is given as 1.2 kg/m^3 .

C Water at 15°C flows between two large parallel plates at a distance of 1.6 mm apart. Determine
i) the maximum velocity ii) the pressure drop per unit length and iii) the shear stress at the walls of the plate if the average velocity is 0.2 m/s. The viscosity of water at 15°C is given as 0.01 poise.

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Government College of Engineering, Amravati
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IV Semester B. Tech. (Civil Engg.)

Summer - 2010

Course Code: CE403

Course Name: Fluid Mechanics II

Time: 2 Hrs. 30 Min.

Max. Marks: 60

Instructions to Candidate

- 1) All questions are compulsory.
- 2) Assume suitable data wherever necessary and clearly state the assumptions made.
- 3) Diagrams/sketches should be given wherever necessary.
- 4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
- 5) Figures to the right indicate full marks.

1. a) Define Drag force and Lift force. (2)
- b) A fluid of viscosity 8 poise and specific gravity 1.2 is flowing through a circular pipe of diameter 100 mm. The maximum shear stress at the pipe wall is 210 N/m^2 . Find
 i). The pressure gradient
 ii). The average velocity
 iii). Reynolds number

OR

A Kite weighing 9.8 N and having an area 1m^2 (6) makes an angle of 7° to horizontal when in a wind of 36 km/h. If pull on the string is 49 N and it is inclined to the horizontal at 45° , Calculate the

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lift and drag coefficient. Take ρ for air = 1.2 kg/m³.

- c) The velocity distribution in the boundary layer is (4)
given by $u/U = (y/\delta)^{1/7}$

Calculate the
 i) Displacement thickness
 ii) Momentum thickness
 iii) Shape factor

2. a) Explain the meaning of hydrodynamically smooth (2)
and rough boundaries.

- b) Derive the dynamic equation of gradually varied (4)
flow

OR

A 3.6 m wide rectangular channel conveys 9.0 (4)
m³/s of water with velocity of 6 m/s.

- i) Is there a condition for hydraulic jump to occur?
 ii) If so, calculate the height, length and strength of jump.

- c) Describe with sketch various Gradually Varied (6)
flow profiles.

3. a) What is meant by Kinematic and dynamic (2)
similarity?

OR

Define the following dimensionless number (2)
 i.) Froude number and ii.) Mach number

- b) The resistance force R of the supersonic plane (4)
during flight can be considered as depend up on the length of aircraft l, velocity v, air viscosity μ , air density ρ and gravitational acceleration g.

Express the functional relationship between these variables and the resisting force. Use Buckingham's II theorem.

- c) A Jet of water having a velocity of 45 m/s (6) impinges without shock on a series of vanes moving 15 m/s. The direction of motion of the vanes is inclined at 20° to that of jet, the relative velocity at outlet is 0.9 of that at inlet, and absolute velocity of water at exist is to be normal to the motion of vanes. Find:
 i) Vane angle at inlet and outlet
 ii) Work done on vane per unit weight.

4. a) State the advantages of centrifugal pump over a (2)
reciprocating pump.

- b) It is required to deliver 0.048 m³/s of water to a (4)
height of 24 m through a 150 mm diameter pipe and 120 m long by centrifugal pump. If the overall efficiency of pump is 75% and coefficient of friction $f = 0.01$ for the pipe line, Find the power required to drive the pump.

- c) A single acting reciprocating pump has a (6)
diameter (piston) of 150 mm and stroke length 350 mm. The centre of pump is 3.5 m above the water surface in the sump and 22 m below the delivery water level. Both the suction and delivery pipes have the same diameter of 100 mm and are 5 m and 30 m long respectively. If the pump is working at 30 r.p.m, determine the pressure head on the piston at the beginning, middle and end of suction and delivery pipe.

OR

A plunger diameter and stroke length of a single (6)

Contd..

acting reciprocating pump are 300 mm and 500 mm respectively. The speed of the pump is 50 rpm. The diameter and length of delivery pipe is 150 mm and 55 m respectively. If the pump is equipped with an air vessel on the delivery side at the centre line of the pump, find the power saved in overcoming friction in the delivery pipe. Take $f = 0.01$

5. a) Discuss the classification of hydraulic turbines (2)
- b) A Pelton wheel is to be designed for the following (6) specifications:
- Power (Brake or shaft)9560 kW
Head350 m
Speed... 750 rpm
Overall efficiency... 85%
Jet diameter ... not to exceed $1/6^{\text{th}}$ of the wheel diameter
Determine the following
i)The wheel diameter ii)Diameter of the jet
iii) Number of jet required.

OR

In an inward flow reaction turbine the head on the turbine is 32 m. The external and internal diameters are 1.44 m and 0.72 m respectively. The velocity of flow through the runner is constant and is equal to 3 m/s. The guide blade angle is 10° and the runner vanes are radial at inlet. If the discharge at outlet is radial, determine: (6)

- i) The speed of turbine
ii) The vane angle at the outlet of runner, and
iii) Hydraulic efficiency.
- c) Define specific speed of the turbine and explain its significance. (4)



IV Semester B. Tech.(Civil)

Summer - 2009

Course Code : CE403

Course Name : Fluid Mechanics II

Time : 2 hr.30min.

Max. Marks : 60

Instructions to Candidate

- 1) All questions are compulsory.
- 2) Assume suitable data wherever necessary and clearly state the assumptions made.
- 3) Diagrams/sketches should be given wherever necessary.
- 4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
- 5) Figures to the right indicate full marks.

1. (a) Define the terms: (2)
i) Displacement thickness
ii) Momentum thickness
- (b) Determine the thickness of the boundary layer at the trailing edge of smooth plate of length 4m and width 1.5 m, when the plate is moving with velocity of 4 m/s in a stationary air. Take kinematic viscosity of air as $1.5 \times 10^{-5} \text{ m}^2/\text{s}$. Also, determine the total drag on one side of the plate assuming that the boundary layer is laminar over the entire length of the plate. Assume mass density of air as 1.226 kg/m^3 (6)

Cont.

OR

A fluid of viscosity 8 poise and specific gravity 1.2 is flowing through a circular pipe of dia. 100 mm. The maximum shear stress at the pipe wall is 210 N/m^2 . Find –
 i) pressure gradient
 ii) Average Velocity
 iii) Reynold no. of the flow

- (c) What is meant by hydraulically smooth and rough boundary? Why the hydraulic losses in pipe are influenced by surface roughness only at higher Reynold's number? (4)

- 2 (a) Define the terms: (2)
 i) Rapidly varied flow
 ii) Pressure Drag
- (b) In rectangular channel of width 24 m and depth of flow 6 m, the rate of flow of water is $86.4 \text{ m}^3/\text{s}$. If the bed slope of the channel is 1 in 4000, find the slope of the free water surface. Take Chezy's constant $C = 60$.
- (c) Derive an expression for conjugate depths of hydraulic jump? (6)

OR

A 3.6 m wide rectangular channel conveys $9 \text{ m}^3/\text{s}$ of water with a velocity of 6 m/s. Is there a condition for hydraulic jump to occur? If so, calculate the height, length and energy dissipated in the jump.

- 3 (a) Derive the dynamic equation of gradually varied flow. (6)

OR

State Buckingham's [] theorem. How repeating variables are selected? (6)

- (b) A spillway model is to be built to a geometrically similar scale of 1/50 across a flume of 600 mm width. The prototype is 15 m high and the maximum head on it is expected to be 1.5 m.
 i) What height of model and what head on model should be used?
 ii) If flow over model for a particular head is 12 liters /second, what flow per meter length of prototype is expected?

- (c) What is distorted and undistorted model? (2)
- 4 (a) What is priming in centrifugal pump? Why it is necessary? (2)
- (b) A 75 mm diameter jet having a velocity of 30 m/s strikes a flat plate, the normal of which is inclined at 45° to the axis of the jet. Find the normal pressure on the plate.
 i) When the plate is stationary
 ii) When the plate is moving with velocity of 15 m/s in the direction of jet, away from the jet.
 iii) Determine the power and efficiency of the jet when the plate is moving.

OR

It is required to deliver $0.048 \text{ m}^3/\text{s}$ of water to a height of 24 m through a 150 mm diameter pipe and 120 m long, by centrifugal pump. If the overall efficiency of the pump is 75 percent and coefficient of friction, $f = 0.01$ for the pipe line, Find the power required to drive the pump. (6)

Cont.

- (c) Explain the working of Jet pump with neat sketch. (4)
5. (a) How the hydraulic turbines are classified? (2)
- (b) A Pelton wheel has a mean bucket speed of 10 m/s with the jet of water flowing at the rate of $0.7 \text{ m}^3/\text{s}$ under a head of 30 m. If the buckets deflect the jet through an angle of 160° , determine the output power, input power and efficiency of the turbine. (6)
- OR**
- Explain the working of Francis turbine with suitable sketch. (6)
- (c) A single acting reciprocating pump operating at 120 rpm has piston diameter 200 mm and stroke of 300 mm. The suction and delivery heads are 4 m and 20 m respectively. If the efficiency of both suction and delivery strokes is 75 percent, determine the power required by the pump (4)