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.

4

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

Contd

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

C 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. 6

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

OR

Define i) Stream line and ii) Streak line

B A wooden block (specific gravity 0.8) of dimensions 1 m × 0.5 m ×0.4m floats in water with its shortest axis vertical . Determine the metacentric height and state the condition of its equilibrium. 4

C A pipline 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. 6

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 m^3/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 orifice? 3

OR

Explain briefly Moody's diagram.

B Water flows through a 300 mm × 150 mm venturimeter at the rate of 0.065 m^3/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. 4

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 bluff bodies. 2

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

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. 4

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. 6

Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)

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 **(6)**
i). The pressure gradient
ii).The average velocity
iii). Reynolds number

OR

A Kite weighing 9.8 N and having an area 1m^2 makes an angle of 7 ^{o} 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 ^{o}, Calculate the **(6)**

Contd..

lift and drag coefficient. Take ρ for air =1.2 kg/m^3.

c) The velocity distribution in the boundary layer is given by (4)

$$u/U = (y/\delta)^{1/7}$$

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

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

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

OR

A 3.6 m wide rectangular channel conveys 9.0 m^3/s of water with velocity of 6 m/s. (4)

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 flow profiles. (6)

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

OR

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

b) The resistance force R of the supersonic plane 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. (4)

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

c) A Jet of water having a velocity of 45 m/s 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: (6)
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 reciprocating pump. (2)

b) It is required to deliver 0.048 m3/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 pump is 75% and coefficient of friction f = 0.01 for the pipe line, Find the power required to drive the pump. (4)

c) A single acting reciprocating pump has a 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. (6)

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 specifications: **(6)**

Power (Brake or shaft) ….9560 kW
Head ….350 m
Speed… 750 rpm
Overall efficiency… 85%
Jet diameter … not to exceed $1/6^{th}$ 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 redial at inlet. If the discharge at outlet is redial, 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)**

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

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 1.5×10^{-5} m^2/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 – (6)
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 m^3/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. **(4)**

(c) Derive an expression for conjugate depths of hydraulic jump? (6)

OR

A 3.6 m wide rectangular channel conveys 9 m^3/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. **(6)**

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. **(4)**
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 $^\circ$ to the axis of the jet. Find the normal pressure on the plate. **(6)**
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 m^3/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 m^3/s under a head of 30 m. If the buckets deflect the jet through an angle of 160^0, 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)

Third Semester B.Tech Civil Engineering

Winter - 2017

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 Differentiate between 2
   i) ideal fluid and real fluid
   ii) mass density and weight density.

   B i)Derive the expression for a pressure inside a water droplet. 2
   ii).A soap bubble 62.5 mm diameter has an internal pressure in excess of the outside pressure of 20 N/m^2. What is surface tension in the soap bubble? 2

   OR

   Calculate the capillary effect in mm in a glass tube of 4 mm diameter, when immersed in i) water and ii) mercury. The temperature of liquid is 20°C and the values of surface tension of water and mercury at 20°C in contact with air are 0.0735 N/m and 0.51 4

N/m respectively. Take specific weight of water is 9790 N/m^3.

C A 400 mm diameter shaft is rotating at 200 rpm in a bearing of length 120 mm. If the thickness of oil film is 1.5 mm and the dynamic viscosity of oil is 0.7 N.s/m^2, determine : 6

i) Torque required to overcome friction in bearing

ii) Power utilized in overcoming viscous resistance.

2. A Define stable and neutral equilibrium of floating bodies. 2

OR

Derive an expressions for Total pressure and centre of pressure for vertically immersed surface.

B A 1m wide and 1.5 m deep rectangular plane surface lies in water in such way that its plane makes an angle of 30° with the free water surface. Determine the total pressure and position of center of pressure when the upper edge is 0.75 m below the free surface. 4

C A solid cylinder 2 m in diameter and 2 m high is floating in water with its axis vertical. If the specific gravity of the material of cylinder is 0.65, find the metacentric height. State also whether equilibrium is stable or unstable. 6

3. A Show that the stream lines and equipotential lines from a net of mutually perpendicular lines. 2

B The velocity components in a fluid flow are given by 4

$u = 2xy;\ v = a^2 + x^2 - y^2$

i) Show that flow is possible

ii) Derive the relative stream function

OR

A 6 m long pipe is inclined at an angle of 20° with the horizontal. The smaller section of the pipe which is at lower level is of 100 mm diameter and the larger section of pipe is of 300 mm diameter. If the pipe is uniformly tapering and the velocity of water at the smaller section is 1.8 m. Determine the pressure difference between the two sections.

C In a 45° bend a rectangular air duct of 1 m^2 cross sectional area is gradually reduced to 0.5 m^2 area. Find the magnitude and direction of force required to hold the duct in position if the velocity of flow at 1 m^2 section is 10 m/s , and pressure is 30 kN/m^2. Take specific gravity of air is 0.0116 kN/ m^3. 6

4. A Explain briefly working of venturimeter with suitable sketch. 2

B Two sharp ended pipes of diameters 50 mm and 100 mm respectively, each of length 100 m respectively, are connected in parallel between two reservoirs which have a difference of level of 10 m. If the friction factor for each pipe is (4f=0.32 in Darcys equation)) , calculate 4

i) Rate of flow for each pipe

ii) The diameter of single pipe 100 m long which would give the same discharge if it were substituted for the original two pipes.

OR

A tank has two identical orifices in one of its vertical sides. The upper orifice is 1.5 m below the water surface and lower one is 3 m below the water surface . Find the point at which the two jets will intersects, if the coefficient of velocity is 0.92 for

Contd..

both the orifices.

C A 2500 m long pipeline is used for transmission of power is to be transmitted through the pipe in which water having a pressure of 4000KN/m2 at the inlet is flowing. If the pressure drop over a length pipe is 800kN/m^2 and f= 0.006, find: **6**

i)Diameter of pipe, and

ii)Efficiency of transmission.

A Differentiate between Stream line and Bluff bodies **2**

OR

Explain Moody diagram

B On a flat plate plate 2 m(length) x 1 m (width) , experiments were conducted in a wind tunnel with a wind speed of 50 km/h. The plate is kept at such angle that the coefficients of drug and lift are 0.18 and 0.9 respectively. Determine the lift force, drag force, resulting force and power exerted by air stream on plate. Take mass density of air is 1.15 kg/m^3. **4**

C A lubricating oil of viscosity 1 poise and specific gravity 0.9 is pumped through a 30 mm diameter pipe. If the pressure drop per meter length of is 20 KN/m^2, determine: **6**

I) the mass flow rate in kg/min

II) the shear stress at the pipe wall

III) the Reynolds number of flow, and

IV) the power required per 50 m length of the pipe to maintain the flow.

****