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# SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

**THIRD SEMESTER B.TECH DEGREE EXAMINATION (Regular), DECEMBER 2022**
**CIVIL ENGINEERING**
**(2020 SCHEME)**

**Course Code:** **20CET203**

**Course Name:** **Fluid Mechanics and Hydraulics**

**Max. Marks:** **100** **Duration: 3 Hours**

## PART A

***(Answer all questions. Each question carries 3 marks)***

1. Explain the working principle of a manometer.
2. Define the terms (i) Total Pressure (ii) Centre of Pressure
3. Illustrate the stability conditions of a floating body through neat sketches.
4. Differentiate between laminar and turbulent flow in pipes.
5. Explain the working principle of a pitot tube.
6. Explain Hydraulic gradient line and Energy gradient line with the help of a neat sketch.
7. Differentiate between open channel flow and pipe flow.
8. Relate Chezy's constant 'C' and Manning's roughness coefficient 'N'.
9. Sketch the specific energy diagram.
10. Show the flow profile variation through neat sketches in case of mild sloped and steep sloped channel in various zones.

## PART B

***(Answer one full question from each module, each question carries 14 marks)***

### MODULE I

11. a) An inverted differential manometer containing an oil of specific gravity 0.9 is connected to find the difference of pressure at two points of a pipe containing water. If the manometer reading is 400 mm, calculate the difference in pressures in meters of water (8)

    b) Show that the intensity of pressure at a point in a fluid at rest is equal in all directions. (6)

**OR**

12. a) Deduce the expression for total pressure and position of center of pressure for a plane surface immersed vertically in a fluid. (6)

b) A sector gate in the form of a circular arc of radius 5m retains water to a height of 4 m above its sill as shown in the Figure 1. Calculate the magnitude and direction of the resultant force per unit length of the gate. (8)

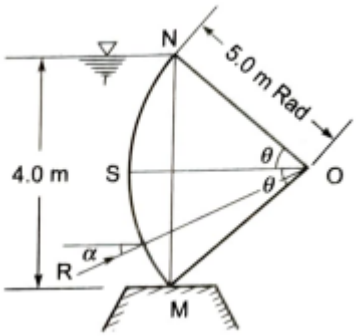


**Figure 1**

**MODULE II**

13. a) Determine the metacentric height of a cylinder having a diameter of 5m and a height of 5m given the specific gravity of cylinder material as 0.6 and also it is floating in water with its axis vertical. State whether equilibrium is stable or unstable. (9)

b) A pontoon has displacement of 20 MN whilst floating in sea water. When a load of 0.25 MN is moved through a distance of 8 m across the deck, there occurs a horizontal displacement of 0.15 m in a pendulum 3 m long. Compute the metacentric height of the pontoon. (5)

**OR**

14. a) Derive the continuity equation in three dimensions for steady and incompressible fluid flow. (9)

b) The velocity along the centreline of a nozzle of length $L$ is given by (5)

$$V = 2t\left(1 - \frac{x}{2L}\right)^2$$

Where V is the velocity in m/s, t is the time in seconds from commencement of flow and X is the distance from inlet to the nozzle. Calculate the local acceleration, convective acceleration and the total acceleration when $t$ =6s, $x$ = 1m and $L$ = 1.6m.

**MODULE III**

15. a) A venturimeter having a diameter of 7.5 cm at the throat and 15 cm at the enlarged end is installed in a horizontal pipeline of 15 cm diameter. Rate of flow of fluid in the pipe is 30 litres/sec. The difference of pressure head measured between the enlarged section and the throat section is 2.45 m. Find the coefficient of discharge of the venturimeter. (8)

b) The head of water over an orifice of diameter 100 mm is 12 m. The water coming out from the orifice is collected in a rectangular tank 2 m X 0.9 m. The rise of water level in this tank is 1.2 m in 30 seconds. Find the coefficient of discharge (6)

**OR**

16. Two reservoirs are connected by a pipeline consisting of two pipes, one of 15 cm diameter and length 6 m and the other of diameter 22.5 cm and 16 m length. If the difference of water levels in the two reservoirs is 6 m, calculate the discharge. (14)

**MODULE IV**

17. a) Determine the dimensions of a channel of rectangular cross-section so as to obtain a discharge of 600 l/sec with least cost. The slope of the bed is 1 in1800. Take Chezy's constant C as 50. (7)

b) Discuss the various geometric elements of an open channel. (7)

**OR**

18. a) A suppressed rectangular weir is constructed across a channel of 0.77 m width with a head of 0.39 m and crest 0.6 m above the bed of the channel. Estimate the discharge over it. Consider velocity of approach and take $C_d$=0.623. (10)

b) Differentiate Cipolletti weir from any other trapezoidal weirs. (4)

**MODULE V**

19. a) Determine specific energy and critical depth of a 10 m wide rectangular channel with discharge 20$m^3$/s and a depth of 800 mm. (4)

b) Derive the dynamic equation of gradually varied flow clearly stating the assumptions underlying it. (10)

**OR**

20. a) A sluice gate discharges water into a horizontal rectangular channel with a velocity of 10 m/s and depth of flow 1 m. Calculate the depth of flow of water after the jump and consequent loss in total head. (7)

b) Explain the procedure for computing the water surface profile by direct step method. (7)

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