15. (a) (i) State Buckingham's π-theorem. Why this theorem is considered superior over the rayleigh's method for dimensional analysis? (8)

(ii) Explain the different types of hydraulic similarities that must exist between a prototype and its model. (8)

Or

(b) A 7.2m high and 15m long spillway discharges $94 m^3/s$ discharge under a head of 2.0m. If a 1:9 scale model of this spillway is to be constructed, determine model dimensions, head over spillway model and the model discharge. If model experiences a force of 7500N, determine force on the prototype. (16)

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B.E./B.TECH. DEGREE EXAMINATIONS, NOV/DEC—2011

REGULATIONS 2008

THIRD SEMESTER

CE 35 – MECHANICS OF FLUIDS

CIVIL ENGINEERING

Time: Three Hours Maximum: 100 marks

ANSWER ALL QUESTIONS

PART—A (10×2=20 marks)

1. Define Kinematic Viscosity.
2. Define Surface Tension.
3. Define Meta centre.
4. Define stream function.
5. Define Bernoulli's equation and list its applications.
6. Define momentum principle.
7. What is meant by Displacement thickness?
8. Define hydraulic gradient line and total energy line.
9. Define the terms dimensional analysis and model analysis.
10. What do you mean by dimensionless numbers? Name any four dimensionless numbers.

PART–B (5×16=80 marks)

11. (a) (i) A plate, 0.035mm distant from a fixed plate, moves at 75cm/s and requires a force of 5N/m² to maintain this speed. Determine the fluid viscosity between the plates. (4)

(ii) Discuss in detail the properties of fluids. (12)

Or

If the velocity profile of a fluid over a plate is a parabolic with the vertex 20cm from the plate, where the velocity is 120cm/sec. Calculate the velocity gradients and shear stresses at a distance of 0, 10 and 20cm from the plate, if the viscosity of the fluid is 8.5 poise. (16)

12. (a) A trapezoidal channel 2m wide at the bottom and 1m deep has side slopes 1:1.Determine:

(i) The total pressure (6)

(ii) The center of pressure on the vertical gate closing the channel when it is full of water. (10)

Or

(b) If for a two dimensional potential flow, the velocity potential is given by $\Phi=x(2y-1)$, determine the velocity at the point P(4,5). Determine also the value of stream function ψ at the point P. (16)

13. (a) The water is flowing through a taper pipe of length 100m having diameters 60cm at the upper end and 30cm at the lower end, at the rate of 50litres/s. The pipe has a slope of 1 in 30. Find the pressure at the lower end if the pressure at the higher level is 2.0kgf/cm². (16)

Or

(b) A pipe of 30cm diameter conveying 0.30m³/s of water has a right angled bend in a horizontal plane. Find the resultant force exerted on the bend if the pressure at inlet and outlet of the bend are 24.525N/cm² and 23.544N/cm². (16)

14. (a) A plate of 60cm length and 40cm wide is immersed in a fluid of specific gravity 0.9 and kinematic viscosity 10^{-4}m²/s. The fluid is moving with a velocity of 6m/s. Determine

(i) Boundary layer thickness (4)

(ii) Shear stress at the end of the plate (6)

(iii) Drag force on one side of the plate. (6)

Or

(b) A horizontal pipe line 40m long is connected to a water tank at one end and discharges freely in to the atmosphere at the other end. For the first 25m of its length from the tank, the pipe is 15cm diameter and its diameter is suddenly enlarged to 30cm. The height of water level in the tank is 8m above the centre of the pipe. Considering all losses of head which occur, determine the rate of flow. Take f=0.01 for both sections of the pipe. (16)