Register Number.....

B.E. DEGREE EXAMINATIONS: APRIL / MAY 2009

Fourth Semester

CIVIL ENGINEERING

U07CE403 Applied Hydraulics and Hydraulic Machinery

Time: Three Hours **Maximum Marks: 100**

Answer ALL the Questions:-

PART A (20 x 1 = 20 Marks)

1. By using Chezy's formula discharge is calculated as,

   (a) $Q = Ai\sqrt{(mC)}$ (b) $Q = AC\sqrt{(mi)}$ (c) $Q = Am\sqrt{(Ci)}$ (d) $Q = mC\sqrt{(Ai)}$

2. The discharge through a rectangular channel is maximum, when_____.

   (a) $m = \frac{d}{3}$ (b) $m = \frac{d}{2}$ (c) $m = 2d$ (d) $m = \frac{3d}{2}$

3. The maximum velocity in open channels occurs

   (a) At the mid depth (b) At the free surface
   (c) a little below the free surface (d) Near the channel bottom

4. In case of wide open channel, the width is greater than ____times of the depth of flow.

   (a) 10 (b) 5 (c) 3 (d) 12

5. The depth of flow at which specific energy is minimum, is called

   (a) Normal depth (b) Critical depth (c) Alternate depth (d)Sequent depth

6. The critical depth is given by,

   (a) $(\frac{q^2}{g})^{1/2}$ (b) $(\frac{q}{g})^{1/3}$ (c) $(\frac{q^2}{g})^{1/3}$ (d) $(\frac{q^2}{g})^{2/3}$

7. The specific energy in a channel depends on,

   (a) Depth and discharge (b) Roughness and discharge
   (c) Channel slope and discharge (d) Depth and roughness coefficient

8. In a channel transition, the width is gradually reduced till the desired width is obtained. For a given sub-critical flow in the approach channel, the depth of flow in the contracted portion:

   (a) increases resulting in an elevated water surface
   (b) is always equal to the critical depth
   (c) decreases resulting in a depressed water surface
   (d) may be less than the critical depth.

9. The most economical condition for a hydraulic jump to form is:

   (a) the existence of sub-critical flow before the jump
   (b) the existence of critical flow before the jump.
   (c) the existence of supercritical flow before the jump.
   (d) the constancy of specific energy.

10. The energy loss in a hydraulic jump is expressed as:

(a) $(Y_2 - Y_1)^2 / 4Y_1Y_2$ (b) $(Y_2 - Y_1)^4 / Y_1Y_2$

(c) $(Y_2 - Y_1)^3 / 4Y_1Y_2$ (d) $6(Y_2 - Y_1)^3 / Y_1Y_2$

11. Gradually varied flow in open channels is caused when:

(a) There is equilibrium between the forces causing the flow and those oppos

(b) The pressure forces and the change of momentum are different from each o

(c) When the force causing the flow is not equal to the resistance force.

(d) The channel slope is equal to the normal slope.

12. Waves in open channels propagate with velocity equal to:

(a) $\sqrt{2gy}$ (b) $\sqrt{gy}$ (c) $\sqrt{gy+V}$ (d) $\sqrt{y}+\sqrt{\frac{E}{\rho}}$

13. The forces exerted by a jet of water on a stationary curved plate in the directio jet is equal to

(a) ρAV^2 (b) $\rho AV^2 Sin^2\theta$ (c) $\rho AV^2(1+Cos\,\theta)$ (d) $\rho AV^2(1+Sin\,\theta)$

14. Francis turbine is

(a) an impulse turbine (b) a radial flow impulse turbine

(c) an axial flow turbine (d) a radial flow reaction turbine

15. Speed ratio is given by,

(a) $\frac{u}{\sqrt{2gH}}$ (b) $\frac{V_f}{\sqrt{2gH}}$ (c) $\frac{\sqrt{2gH}}{V_f}$ (d) $\frac{V_w}{\sqrt{2gH}}$

16. The discharge through Kaplan turbine is given by,

(a) $Q = \Pi\, DBV_f$ (b) $Q = \frac{\Pi}{4} d^2\sqrt{2gH}$

(c) $Q = \frac{\Pi}{4}(D_o^2 - D_b^2)\, V_f$ (d) $Q = 0.9\,\Pi\, DBV_f$

17. The manometric efficiency (η_{mano}) of a centrifugal pump is given by,

(a) $\frac{H_m}{gV_{w2}u_2}$ (b) $\frac{gH_m}{V_{w2}u_2}$ (c) $\frac{V_{w2}u_2}{gH_m}$ (d) $\frac{gV_{w2}u_2}{H_m}$

18. Cavitations is caused by,

(a) High velocity (b) Low barometric pressure (c) Low pressure (d) High pressur

19. The discharge through a single acting reciprocating pump is,

(a) $Q = \frac{ALN}{60}$ (b) $Q = \frac{2ALN}{60}$ (c) $Q = ALN$ (d) $Q = 2ALN$

20. The work saved by fitting an air vessel to a double acting reciprocating pump is

(a) 39.2% (b) 84.8% (c) 48.8% (d) 92.3%

PART B (5 x 16 = 80 Marks)

21(a) A flow of water of 100 litres/s flows down in a rectangular flume of width 600mm and having adjustable bottom slope. If Chezy's constant C is 56, find the bottom slope necessary for uniform flow with a depth of 300mm. Also find the conveyance K of the flume.

(OR)

(b) A rectangular channel 4m wide has depth of water 1.5m. The slope of the bed of the channel is 1 in 1000 and value of Chezy's constant is 55. It is desired to increase the discharge to a maximum by changing the dimensions of the section for constant area of cross section, slope of the bed and roughness of the channel. Find the new dimensions of the channel and increase in discharge.

22. (a) A river is 30m wide and has a rectangular shape. At a bridge location the flow width is restricted to 25m by the piers of the bridge and the river bed is approximately horizontal. Describe the flow which obtains underneath the bridge with minimum upstream depth when a flood of $450 m^3/s$ flows in the river. Also determine the upstream depth.

(OR)

(b) The discharge of water through a rectangular channel of width 8m, is $15 m^3/s$ when depth of flow of water is 1.2m. Calculate, (i) Specific energy of the flowing water, (ii)Critical depth and critical velocity, (iii) Value of minimum specific energy.

23. (a) Derive the Dynamic equation of gradually varied flow.

(OR)

(b) A sluice gate discharges water into a horizontal rectangular channel with a velocity of 6m/s and depth of flow is 0.4m. The width of the channel is 8m. Determine whether a hydraulic jump will occur, and if so, find its height and loss of energy per kg of water. Also determine the power lost in the hydraulic jump.

24. (a) Design a Francis turbine runner with the following data: Net head H=68m; Speed N=750 rpm; output power P = 330 kW; overall efficiency = 85%; hydraulic efficiency = 94%; flow ratio = 0.15; breadth ratio n=0.1; Outer diameter of the runner = 2 x inner diameter of runner. The thickness of vanes occupies 6% of circumferential area of the runner. Velocity of flow is remains constant at inlet and outlet and discharge is radial at outlet.

(OR)

(b) A Kaplan turbine produces 60,000kW under a net head of 25m with an ove efficiency of 90%. Taking the value of speed ratio K_u as 1.6, flow ratio as 0.5, the hub diameter as 0.35 times the outer diameter; find the diameter and speed of turbine.

25. (a) A centrifugal pump has the following characteristics: Outer diameter of impelle 800mm; width of impeller vanes at outlet = 100mm; angle of impeller vanes outlet = 40°. The impeller runs at 550 rpm and delivers 0.98cumecs of water un an effective head of 35m. A 500kW motor is used to drive the pump. Determine manometric, mechanical and overall efficiencies of the pump. Assume water ent the impeller vanes radially at inlet.

(OR)

(b) A single acting reciprocating pump ahs a plunger of diameter 250mm and stroke 350mm. If the speed of the pump is 60rpm and delivers 16.5litres/s of water agai a suction head of 5m and delivery head of 20m, find the theoretical dischar coefficient of discharge, the slip, the percentage of slip of the pump and the pow required to drive the pump.

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