

B.E. DEGREE EXAMINATIONS: APRIL / MAY 2010

Fourth Semester

CIVIL ENGINEERING

U07CE403: Applied Hydraulics & Hydraulic Machinery

Time: Three Hours

Maximum Marks: 100

Answer ALL the Questions:- PART A (10 x 1 = 10 Marks)

1. Channel having same section shape and constant slope along its length is called as
 - a) Uniform channel
 - b) Open channel
 - c) Prismatic channel
 - d) Economic channel section
2. Assertion, A: Velocity of flow at any channel is not uniform distributed in its depth as well as width directions.
Reason, R: Variation in velocity of flow is due to the presence of free surface and frictional resistance at the channel boundary.
 - a) Both A and R are true. R is correct explanation to A
 - b) Both A and R are true. R is not correct explanation to a.
 - c) A is true. R is false
 - d) A is false. R is true.
3. At alternate depths, _____ remains same in an open channel
 - a) total energy
 - b) specific energy
 - c) discharge
 - d) Froude number
4. Identify the incorrect one with regard to critical flow condition
 - a) Froude number is equal to 1
 - b) Specific energy is minimum
 - c) Rate of change of energy with respect to flow depth is equal to zero
 - d) Hydraulic mean depth is maximum
5. Channel with mild slope is the one having
 - a) channel bottom rising in the flow direction
 - b) critical depth greater than normal depth
 - c) normal depth greater than critical depth
 - d) same critical and normal depths
6. The most essential condition for a hydraulic jump to form is the
 - a) existence of subcritical flow before the jump
 - b) existence of critical flow before the jump
 - c) existence of supercritical flow before the jump
 - d) constancy of specific energy
7. To achieve maximum efficiency in the case of a series of curved vanes, the tangential velocity of vanes must be _____ the jet velocity
 - a) equal to
 - b) $\frac{3}{4}$ of
 - c) $\frac{1}{2}$ of
 - d) $\frac{1}{3}$ of
8. A Kaplan turbine is
 - a) an inward flow impulse turbine
 - b) low head axial flow turbine
 - b) high head axial flow turbine
 - d) high head mixed flow turbine

9. The specific speed of a pump is defined as the speed of unit of such a size that it
- a) produces unit power with unit head available
 - b) delivers unit discharge at unit head
 - c) requires unit power to develop unit head
 - d) delivers unit discharge at unit power
10. Air vessel is provided to
- a) reduce the slip
 - b) increase the discharge
 - c) maintain constant discharge
 - d) maintain constant head

PART B (10 x 2 = 20 Marks)

11. What do you mean by Reynolds's number? State its significance.
12. Define the term "most economical section"
13. State specific energy values for rectangular and triangular sections at critical flow conditions.
14. What is called as open channel transition?
15. State the assumptions made in deriving dynamic equation for gradually varied flow.
16. On what basis the hydraulic jumps are classified. Name any two types.
17. Derive the force exerted by a jet with velocity 'v' on a flat plate moving at a velocity 'u'
18. What is draft tube? State its purpose.
19. Define centrifugal pump.
20. What do you mean by "cavitation" in a pump?

PART C (5 x 14 = 70 Marks)

21. a) An open channel of most economical section, having the form of a half hexagon with horizontal bottom is required to give a maximum discharge of $20.2 \text{ m}^3/\text{sec}$ of water. Taking slope as 1 in 2500 and C as 60, determine the dimensions of the section

(OR)

- b) Derive the most economical section condition for a trapezoidal channel having side slope 1: m and bottom width b.
22. a) An 8m wide rectangular channel conveys $15 \text{ m}^3/\text{s}$ of water at a depth of 1.2m. Calculate
- (i) Specific energy of the flowing water;
 - (ii) Critical depth, critical velocity and minimum specific energy;
 - (iii) Froude number and state whether flow is subcritical or supercritical

(OR)

- b) Water flows at a velocity of 1 m/s and a depth of 2m in an open channel of rectangular cross-section, 3m wide. At a certain section the width is reduced to 1.8m and the bed is raised by 0.65m. Will the upstream depth be affected? If so, to what extent?

23. a) Derive the dynamic equation of GVF. **(OR)**

b) A 3.6m wide rectangular channel conveys $9.0 \text{ m}^3/\text{s}$ of water with a velocity of 6 m/s.

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

24. a) A jet of water having a velocity of 35 m/s impinges on a series of vanes moving with a velocity of 20 m/s. The jet makes an angle of 30° to the direction of motion of vanes when entering and leaves at an angle of 120° . Draw the triangles of velocities at inlet and outlet and find:

(i) the angles of vanes tips so that water enters and leaves without shock,

(ii) the work done per N of water entering the vanes, and

(iii) the efficiency.

(OR)

b) A pelton wheel is to be designed for the following specifications:

Power (brake or shaft)	- 9560 kW
Head	- 350 meters
Speed of turbine	- 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 and iii) the number of jets required.

Take $C_v = 0.985$ and speed ratio = 0.45.

25. a) A centrifugal pump is to discharge $0.118 \text{ m}^3/\text{s}$ at a speed of 1450 rpm against a head of 25 m. The impeller diameter is 250 mm, its width at outlet is 50 mm and manometric efficiency is 75 percent. Determine the vane angle at the outer periphery of the impeller.

(OR)

b) A single acting reciprocating pump has a piston diameter of 150 mm and stroke length of 350 mm. The center of the pump is 3.5m above the water surface in the sump and 22m below the delivery water level. Both the suction and delivery pipes have the same diameter of 100 mm and are 5 m and 30m long respectively. If the pump is working at 30 rpm, determine:

(i) the pressure heads on the piston at the beginning, middle and end of both suction and delivery strokes.

(ii) the power required to drive the pump.
