

VISION INSTITUTE OF TECHNOLOGY, KANPUR
CIVIL ENGINEERING 2ND YEAR (4TH SEM)

HYDAULICS & HYDRAULIC MACHINES (RCE-401)

UNIT-1

Question bank

(LONG QUESTIONS)

- 1.** What between pipe flow and open channel flow? **[2014,2016]**
- 2.** Explain the classification of flow in open channel.**[2012,2013]**
- 3.** Draw the velocity distribution curve along the depth of the rectangular and circular channel. **[2012,2013, 2014,2015]**
- 4.** Show that the pressure distribution in curvilinear flow in vertical plane, an additional pressure will be imposed on the hydrostatic pressure distribution. **[2012,2014]**
- 5.** In a flow over a certain spillway crest the normal acceleration can be assumed to be constant. Show that the pressure on the crest is atmospheric when $a_n = g \cos \theta$, where θ = inclination of the normal to the surface with the vertical. **[2014]**
- 6.** What is continuity equation and derive an expression for spatially in an open channel?**[2014]**
- 7.** Derive the expression for specific force in a rectangular channel section.**[2013]**
- 8.** What is specific energy? Draw the specific energy diagram and describe its various characteristics.**[2012,2014, 2015,2016]**
- 9.** What is critical flow and critical depth? Also define subcritical and super critical flow conditions. Derive the condition for critical flow in rectangular channels.**[2012,2014, 2015,2016]**

10.Show that in rectangular channel maximum discharge occurs when the flow is critical for a given value of specific energy.[2016]

11.Show that for the rectangular channel carrying constant discharge, the specific force is minimum, when the depth is critical.

12.What is Chezy's formula? Derive an expression for the discharge through channel by Chezy's formula. [2013,2015,2016,2017]

13.Express chezy formula in terms of Darcy weibach friction factor.

14.Compare Chezy's formula and Manning's formula and give relation between friction factor and manning coefficient

15.Show by using manning formula that the average boundary shear stress is[2013]

$$\zeta_0 = \frac{\rho g n^2}{R^{1/3}} V^2$$

16.Define conveyance of channel. [2015]

17.Prove that for triangular channel of side slope m horizontal: 1 vertical the Froude number is given by [2012]

$$F_r = \frac{v\sqrt{2}}{\sqrt{gy}}$$

18.On which factors does the Manning's rugosity coefficient depends[2015]

19.What do you understand by most efficient channel section.

20.State the conditions under which the rectangular section of an open channel will be most economical. Derive these conditions. [2012,2015,2017]

21.What are the conditions for the trapezoidal channel of best section? Derive any two conditions.[2013,2017]

22.Explain the compound open channel. How would you calculate the total discharge of compound channel? Explain with example.[2012,2014]

SHORT QUESTIONS

1. What is continuity equation and derive an expression for unsteady in an open channel? [2012]
2. Define open channel flow with example. [2016]
3. Describe specific energy? [2016]
4. Write down the manning's equation for uniform flow in open channel. [2017]
5. State the relation b/w manning's constant and chezy's constant. [2016]
6. What do you understand by uniform and non-uniform flow.
7. What do you understand by specific force?
8. What is specific energy curve?
9. What is critical slope?
10. What is hydraulic radius and how it is calculated?

UNIT-2

Question bank

(LONG QUESTIONS)

23. Explain the applications of specific energy principle for the interpretation of open channel flow through

- a) Horizontal contractions
- b) Vertical contractions

24. What do you mean by gradually varied flow (GVF)? Write down the assumptions and limitations of GVF. [2014, 2015, 2016, 2017]

25. Derive the dynamic equation of GVF. [2014, 2015, 2016, 2017]

26. Show that the differential equation of gradually varied flow in a rectangular channel of variable width B can be expressed

$$\frac{dy}{dx} = \frac{S_0 - S_f + \left(\frac{Q^2 y dB}{g A^3 dx}\right)}{1 - \frac{Q^2 B}{g A^3}}$$

27. Show that for horizontal, frictionless rectangular channel of varying width B₁

$$(1 - Fr^2) \frac{dy}{dx} - Fr^2 \left(\frac{y}{B}\right) \frac{dB}{dx} = 0$$

28. Prove that for a wide rectangular channel, if the Manning's formula is used, the differential equation of GVF becomes.

$$\frac{dy}{dx} = S_0 \left[\frac{1 - (y_0/y)^{10/3}}{1 - (y_c/y)^3} \right]$$

29. Show that a wide rectangular channel if chezy's formula is used, the differential equation of GVF is given by

$$\frac{dy}{dx} = S_0 \left[\frac{1 - (y_0/y)^3}{1 - (y_c/y)^3} \right]$$

30. If the flow depth of the entrance to the constant width rectangular transition with bottom slope S_0 is equal to the critical depth y_c , then prove that the flow depth y in the transition is given by the equation. **[2013]**

$$S_0 x = y + \frac{y_c^3}{2y^2} - \frac{3}{2} y_c$$

31. Classify the following open channel flow situations **[2016]**

- a) Flow from a sluice gate
- b) Flow in a main irrigation canal
- c) A river during flood

32. Classify various profile with the help of neat sketches **[2013, 2015, 2016, 2017]**

- a) Mild slope
- b) Steep slope
- c) Critical slope

33. For a wide rectangular channel, derive expression for the channel bottom slope to be mild, steep and critical. **[2013]**

34. Sketch the gradually varied flow profile in the following arrangement of channel and controls. The flow is from left to right. **[2014]**

- a) Steep horizontal mild slope
- b) Steep steeper mild milder slope
- c) Free intake steep sluice gate mild slope

35. Define the terms **[2013, 2018]**

- a) Afflux
- b) Back water curve
- c) Drawdown curve

- 36.** Derive an expression for the length of the back water curve in case of GVF. **[2013]**
- 37.** Explain the various methods of computation for GVF profile.

SHORT QUESTIONS

- 11.** List the assumptions made in the derivation of dynamic equation of gradually varied flow. **[2016,17]**
- 12.** Briefly explain gradually varied flow. **[2017]**
- 13.** Discuss the characteristics of surface profiles. **[2017]**
- 14.** Explain the limitations of gradually varied flow?
- 15.** Give the classification of channel slopes.

UNIT-3

Question bank

(LONG QUESTIONS)

- 38.**What is hydraulic jump? Discuss the classifications of hydraulic jump and applications of hydraulic jump. **[2012,2013,2014,2015]**
- 39.**Why momentum equation is used in analysis of hydraulic jump? Deduce the relation between depth of hydraulic jump and froude's number. **[2014]**
- 40.**Derive the momentum equation formulation for the jump.
- 41.**Derive the equation of energy loss in hydraulic jump for a horizontal rectangular channel.
- 42.**For a hydraulic jump in a horizontal triangular channel **[2017]**

$$3F_{r1}^2 = \frac{\gamma^2 (\gamma^3 - 1)}{\gamma^2 - 1}$$

- 43.**Show that Froude number Fr_1 and Fr_2 in a hydraulic jump occurring in a rectangular channel are related by. **[2012,2014]**

$$F_{r2}^2 = \frac{8F_{r1}^2}{(-1 + \sqrt{1 + 8F_{r1}^2})^2}$$

- 44.**Deduce the relation of sequent depth and energy loss in hydraulic jump occurring in horizontal non rectangular channel.
- 45.**Explain the use of hydraulic jump as an energy dissipator below a hydraulic structure.
- 46.**What do you understand by surge? Give classifications of surge. **[2014,2018]**
- 47.**Evaluate all the elements of hydraulic jump in sloping beds.
- 48.**Derive the expression for the following
- a) Negative surge moving downstream
 - b) Negative surge moving upstream
- 49.**Define the celerity of gravity wave, shallow wave and deep wave. **[2014,2016]**
- 50.**Write short notes on free overfall through rectangular channel.

UNIT-4

Question bank

(LONG QUESTIONS)

- 51.** Derive linear momentum and impulse momentum equations.
- 52.** Derive the formula for dynamic force exerted by fluid jet on moving plate for the following cases
- a) When plate is normal to jet
 - b) Flat plate inclined to jet
 - c) When plate is curved and jet impinges at the center of plate
 - d) When plate is curved and jet impinges at one end
- 53.** Derive the formula for dynamic force exerted by fluid jet on stationary plate for the following cases
- a) When plate is normal to jet
 - b) Flat plate inclined to jet
 - c) When plate is curved and jet impinges at the center of plate
 - d) When plate is curved and jet impinges at one end
- 54.** Explain the working principle of a reciprocating pump with construction detail. What are the various types of reciprocating pumps? **[2017]**
- 55.** Derive the expression for discharge of single acting and double acting reciprocating pump. Also derive the expression for work done.
- 56.** What is rotodynamic pump? Explain the classifications of the rotodynamic pump. **[2013, 2016, 2017]**
- 57.** Differentiate volute casing and vortex casing of pump. **[2013]**
- 58.** Discuss the various efficiencies for the centrifugal pump.
- 59.** What do you understand by characteristics curve of a reciprocating pump? **[2013, 2017]**
- 60.** Define cavitation. What are the effects of cavitation? Give necessary precaution against cavitation. **[2016, 2018]**
- 61.** Define indication diagram and also explain the ideal indication diagram.
- 62.** What do you understand by separation of reciprocating pump?
- 63.** Explain briefly multistage centrifugal pump.
- 64.** What is air vessel? Describe the working of the air vessel for reciprocating pump with neat sketch.

65. Define centrifugal pump. Explain the classifications of centrifugal pump. **[2017]**

66. Differentiate between centrifugal pump and reciprocating pump.

67. Explain the velocity triangle of rotodynamic pump.

68. Show that maximum inertia head in a reciprocating pump without air vessel is

[2017]

$$H_a = \frac{lAw_0^2r}{ga}$$

SHORT QUESTIONS

16. What is meant by cavitation? **[2016]**

17. Differentiate between single acting and double acting reciprocating pump.

18. Define followings

- a) Suction head
- b) Delivery head
- c) Static head
- d) Manometric head

UNIT-5

Question bank

(LONG QUESTIONS)

- 69.** Give a brief introduction of roto dynamic machines and characteristics curves.[2013]
- 70.** What is hydraulic turbine? Discuss its classifications.
- 71.** Define hydraulic efficiency, mechanical efficiency and overall efficiency in case of turbines. Derive relationship among them.[2013,2018]
- 72.** Draw neat sketch of various shapes of draft tubes. Also explain the theory of draft tube.[2015,2016]
- 73.** Differentiate between impulse and reaction turbine , radial and axial flow turbine.[2015]
- 74.** Explain with neat diagram the working and components of pelton turbine.
- 75.** Write down the equation for jet and rotor size of pelton wheel.
- 76.** Explain reaction turbine and classify them. [2016]
- 77.** Explain with neat diagram the working and components of reaction turbine.
- 78.** Explain with neat diagram the working and components of francis turbine.
- 79.** Explain with neat diagram the working and components of kaplan turbine.
- 80.** Explain various heads in turbine.
- 81.** Define the specific speed of turbine. Derive an expression for the specific speed. What is the significance of the specific speed?[2012]
- 82.** Explain the cavitation in turbines. Also give its preventives measures
- 83.** What are the three characteristics of a water turbine? Define unit power, unit discharge and unit speed. Also sketch constant head curves for pelton wheel.[2014]
- 84.** Prove that the work done per second per unit weight of water in a reaction turbine is[2012]

$$w = \frac{v_{w1}u_1 + v_{w2}u_2}{g}$$

- 85.** Explain the working and diagram of following devices[2012]

- a) Hydraulic lift
- b) Hydraulic coupling
- c) Hydraulic crane

d) Hydraulic torque converter

86. Define the terms unit power, unit speed and unit discharge. Obtain an expression for unit speed. **[2013]**

87. Derive an expression for condition for maximum hydraulic efficiency of a pelton wheel turbine equation for maximum efficiency. **[2013]**

SHORT QUESTIONS

19. Give the range of specific speed of Kaplan, Francis and pelton turbine. **[2016]**

20. Explain the functions of air vessel in a reciprocating pump. **[2017]**

21. What is the use of draft tube? **[2017]**

22. Describe the surge tank and a forebay and what are their functions. **[2017]**

23. What are the main parts of Kaplan turbine. **[2018]**