1000 rpm. The velocity of flow at the outlet is 3 m/s and the vane angle at outlet is 30^0. Determine the diameter and width of the impeller at outlet if the hydraulic efficiency is 80%. (7M) CO4

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CE223(R20)

Hall Ticket Number: file -2

CE223(R20)

B.TECH. DEGREE EXAMINATION, OCTOBER-2022

Semester IV [Second Year] (Regular)

HYDRAULICS AND HYDRAULIC MACHINES

Time: Three hours Maximum Marks: 70

Answer Question No.1 compulsorily. (14 x 1 = 14)
Answer One Question from each unit. (4 x 14 = 56)

1. Answer the following in brief:
   (a) Calculate the critical depth of the water flowing through a rectangular channel of width 5 m when discharge is 15 m^3/s. CO1
   (b) What are alternate depths? CO1
   (c) Define momentum correction factor. CO1
   (d) What is a hydraulic jump? CO2
   (e) Define specific force. CO2
   (f) Draw S1-profile. CO2
   (g) What is dimensional homogeneity? CO3
   (h) Define Weber number. CO3
   (i) What is angular momentum principle? CO3
   (j) What are the functions of draft tube? CO4
   (k) What is priming? CO4
   (l) Differentiate between inward radial flow and outward radial flow turbines. CO4
   (m) What are the efficiencies of hydraulic turbines? CO4
   (n) Explain the function of diffuser vanes in a centrifugal pump. CO4

UNIT – I

2. (a) Derive Chezy's equation. (7M) CO1
   (b) A rectangular channel has a width of 2.0 m and carriers a discharge of 4.80 m^3/s with a depth of 1.60 m at a certain section a small, smooth

hump with a flat top and of height 0.10 m is proposed to be built. Calculate the likely change in the water surface. Neglect the energy loss. (7M) CO1

(OR)

3. (a) Define specific energy. Explain the specific energy curve with a neat sketch. (7M) CO1
   (b) A trapezoidal channel carries a discharge of 2.5 m^3 /s. Design the section if the slope is 1 in 1200 and the side slopes are 1 in 1. Use Chezy's formula, C = 55. (7M) CO1

UNIT – II

4. (a) Explain different types of hydraulic jumps. (7M) CO2
   (b) Explain the computation of length of surface profiles by single step method. (7M) CO2

(OR)

5. (a) Explain type M water surface profiles. (7M) CO2
   (b) A wide channel of uniform rectangular section with a slope of 1/95 has a flow rate of 3.75 m^3/s/m. The manning constant is 0.013. Suddenly the slope changes to 1/1420. Determine the normal depths for each case. Show that a hydraulic jump has to occur and calculate the downstream flow height. Also calculate the loss of energy. (7M) CO2

UNIT – III

6. (a) Explain scale effect in model testing. How is it found? (7M) CO3
   (b) A Jet of water moving at 20 m/s impinges on a symmetrical curved vane shaped to deflect the jet through 120^0 when stationary. If the vane is moving at 5 m/s, find the angle of jet so that

there is no shock at inlet. Also compute the absolute velocity of jet at exit both in magnitude and direction, and the work done per second per N of water. Assume the vane is smooth. (7M) CO3

(OR)

7. (a) What are repeating variables? How are these selected by dimensional analysis? (7M) CO3
   (b) An oil of specific gravity 0.92 and viscosity 0.03 poise is to be transported at the rate of 2500 litres/sec, through a 1.2 m diameter pipe. Tests were conducted on a 12 cm diameter pipe using water at 20^0C. If the viscosity of water at 20^0C is 0.01 poise, find velocity of flow in the model and rate of flow in the model. (7M) CO3

UNIT – IV

8. (a) Explain the working of Pelton wheel with a neat sketch. (7M) CO4
   (b) Design a Francis turbine runner with the following data. Net head = 68 m, speed = 750 rpm, output power = 330 kW, hydraulic efficiency = 94%, overall efficiency = 85%, flow ratio = 0.15, breadth ratio = 0.1, inner dia of runner is 0.5 outer dia. Also assume 6% of circumferential area of the runner to be occupied by the thickness of the vanes. Velocity of flow remains constant throughout the flow and is radial at exit. (7M) CO4

(OR)

9. (a) Explain the main characteristic curves of turbine. (7M) CO4
   (b) A centrifugal pump works against a head of 30 m and discharges 0.25 m^3/s while running at

= 2 x inner diameter of the runner. The thickness of the vanes occupies 5% of circumferential area of the runner, velocity of flow is constant at inlet and outlet. Discharge is radial at outlet. Determine (i) Guide blade angle at inlet (ii) Vane angles at inlet and outlet (iii) Diameters of the runner at inlet and outlet (iv) Width of wheel at inlet. (7M) CO4

(OR)

9. (a) Explain the main and operating characteristic curves of a centrifugal pump with neat sketches. (7M) CO4
   (b) The internal and external diameters of the impeller of a centrifugal pump are 200 mm and 400 mm respectively. The pump is running at 1000 rpm. The vane angles of the impeller at inlet and outlet are 20^0 and 30^0 respectively. The water enters the impeller radially and velocity of flow is constant. Determine the work done by the impeller per unit weight of water. (7M) CO4

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file-2

Hall Ticket Number:

CE223 (R20)

B.TECH. DEGREE EXAMINATION, JANUARY-2023

Semester IV [Second Year] (Supplementary)

HYDRAULICS AND HYDRAULIC MACHINES

Time: Three hours Maximum Marks: 70

Answer Question No.1 compulsorily. (14 x 1 = 14)
Answer One Question from each unit. (4 x 14 = 56)

1. Answer the following:
   (a) Write the relationship between Chezy's and Manning's coefficients. CO1
   (b) Write the expression for critical velocity in open channel. CO1
   (c) What is specific energy? CO1
   (d) Name the bed slope of channel, if normal depth is 1 m and critical depth is 2 m. CO2
   (e) Write the dynamic equation of GVF. CO2
   (f) What is hydraulic jump? CO2
   (g) What do you mean by Dimensional Homogeneity? CO3
   (h) Define Froude's number. CO3
   (i) What is distorted model? CO3
   (j) Define Impulse-Momentum principle. CO3
   (k) Distinguish between impulse and reaction turbines. CO4
   (l) Write the functions of draft tube. CO4
   (m) Why priming is necessary in centrifugal pump? CO4
   (n) Express the specific speed of the centrifugal pump. CO4

UNIT – I

2. (a) Derive the relationship between alternate depths and critical depth for a given specific energy and discharge intensity in a rectangular open channel. (7M) CO1

(b) Find the required longitudinal slope of a rectangular open channel of width 2 m when the depth of flow is 1.5 m discharging at a rate of flow of 3 m^3/s. Take Chezy's constant as 40. (7M) CO1

(OR)

3. (a) Define critical flow and derive the condition for critical flow in open channel. (7M) CO1

(b) A rectangular channel of width 4 m carrying water at a rate of 8 m^3/s with a depth of flow of 1.5 m. Find the specific energy of the flow. Also find the minimum specific energy needed for a possible flow for the same discharge. (7M) CO1

UNIT – II

4. (a) Derive the dynamic equation of Gradually Varied Flow in an open channel flow. List the assumptions made while deriving the equation. (7M) CO2

(b) A rectangular channel is 20 m wide and carries a discharge of 65 m^3/s. It is laid at a slope of 0.0001. At a certain section along the channel length, the depth of flow is 2 m. Name the water surface profile. How far upstream/downstream will the depth be 2.6 m? Take Manning's n as 0.02. (7M) CO2

(OR)

5. (a) Derive the relationship between sequent depths of hydraulic jump in a horizontal rectangular channel. (7M) CO2

(b) A spillway discharges a flood flow at a rate of 8 m^3/s per metre width. At the downstream of spillway, the depth of flow was found to be 0.5 m. Check whether hydraulic jump takes place. If so, determine its sequent depth and loss of head due to hydraulic jump. (7M) CO2

UNIT – III

6. (a) Derive the expression for work done by the jet per sec when the jet is striking a series of radial curved vanes mounted on a wheel. (7M) CO3

(b) A jet of water having a velocity of 30 m/s strikes a cured vane, which is moving with a velocity of 10 m/s. The jet makes an angle of 20° with the direction of motion of vane at inlet and leaves at an angle of 120° to the direction of motion of vane at outlet. Determine (i) vane angles, if the water enters and leaves the vane without shock (ii) work done per second per unit weight of water striking the vanes per second. (7M) CO3

(OR)

7. (a) Define and derive different dimensionless numbers involved in fluid motion. (7M) CO3

(b) Assuming that the rate of flow Q of a centrifugal pump is dependent upon the mass density ρ of fluid, pump speed N in rpm, the diameter of impeller D, the pressure p and viscosity of fluid μ, show that $\frac{Q}{ND^3} = \emptyset\left[\left(\frac{P}{\rho N^2 D^2}\right)\left(\frac{\mu}{\rho N D^2}\right)\right]$. (7M) CO3

UNIT – IV

8. (a) What do you mean by gross head, net head of turbine? Explain the different types of the efficiencies of a turbine. (7M) CO4

(b) The following data is given for a Francis turbine:
Net head = 40 m, speed = 500 rpm, shaft power = 400 kW, overall efficiency = 85%, hydraulic efficiency = 90%, flow ratio = 0.2, breadth ratio = 0.1, outer diameter of the runner

(OR)

9. (a) Which points should be considered while selecting right type of hydraulic turbines for hydroelectric power plant? (7M) CO4

(b) The diameter and width of a centrifugal pump impeller are 50 cm and 2.5 cm. The pump runs at 1200 rpm. The suction head is 6 m and the delivery head is 40 m. The frictional drop in suction is 2 m and in the delivery 8 m. The blade angle at outlet is 30^0. The manometric efficiency is 80% and the overall efficiency is 75%. Determine the power required to drive the pump. Also calculate the pressures at the suction and delivery side of the pump. (7M) CO4

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Hall Ticket Number:

File-2

CE223 (R20)

B.TECH. DEGREE EXAMINATION, JULY-2023

Semester IV [Second Year] (Regular & Supplementary)

HYDRAULICS AND HYDRAULIC MACHINES

Time: Three hours Maximum Marks: 70

Answer Question No.1 compulsorily. (14 x 1 = 14)
Answer One Question from each unit. (4 x 14 = 56)

1. Answer the following:
   (a) Explain pressure distribution in open channels. CO1
   (b) What is the relation between Chezy's constant and Manning's constant? CO1
   (c) What do you understand by hydraulically efficient channel section? CO1
   (d) Define the terms: (i) Afflux and (ii) Back water curve. CO2
   (e) What are sequent depths? CO2
   (f) Mention the assumptions made in the derivation of dynamic equation of GVF. CO2
   (g) What is the use of dimensional analysis in the study of fluid mechanics? CO3
   (h) What is the importance of velocity triangles? CO3
   (i) What are distorted models? CO3
   (j) What is the use of multistage centrifugal pump? CO4
   (k) Define unit power and unit speed. CO4
   (l) Define manometric head. CO4
   (m) What is cavitation in pumps? CO4
   (n) What is the significance of specific speed? CO4

UNIT – I

2. (a) For a given specific energy, show that maximum discharge in a rectangular channel occurs at the critical depth. (7M) CO1

(b) A 2.5 m wide rectangular channel carries 6.0 m^3/s of flow at a depth of 0.5 m. Calculate the minimum height of a streamlined, flat-topped hump required to be placed at a section to cause critical flow over the hump. The energy loss over the hump can be taken as 10% of the upstream velocity head. (7M) CO1

(OR)

3. (a) State the conditions under which the trapezoidal section of an open channel will be most economical. Derive these conditions. (7M) CO1
   (b) A channel has a cross section given by the relationship $A = y^{2.5}$. For a critical depth of 0.5 m in this channel, estimate the (i) discharge and (ii) specific energy. (7M) CO1

UNIT – II

4. (a) Derive the dynamic equation of gradually varied flow. (7M) CO2
   (b) A spillway discharges a flood flow at a rate of 7.75 m^3/s per metre width. At the downstream horizontal apron the depth of flow was found to be 0.50 m. What tailwater depth is needed to form a hydraulic jump? If a jump is formed, find its (i) type (ii) length (iii) head loss (iv) energy loss as a percentage of the initial energy. (7M) CO2

(OR)

5. (a) Explain type S water surface profiles. (7M) CO2
   (b) Derive an expression for loss of energy head for a hydraulic jump. (7M) CO2

UNIT – III

6. (a) Derive the expression for force exerted by a jet, work done and efficiency on a moving inclined flat plate. (7M) CO3
   (b) Assuming that the rate of discharge Q of a centrifugal pump is dependent upon the mass density ρ of the fluid, pump speed N (rpm), the diameter of impeller D, the pressure p and the viscosity of fluid μ, show using the Buckingham's π-theorem that it can be represented by $Q = (ND^3)\ \phi[(\frac{gH}{N^2D^2}), (\frac{\upsilon}{ND^2})]$ where H = head and υ = kinematic viscosity of the fluid. (7M) CO3

(OR)

7. (a) Explain different model laws. (7M) CO3
   (b) A jet of water 100 mm diameter and having a velocity of 15 m/s impinges at the centre of a hemispherical vane. The linear velocity of vane is 5 m/s in the direction of the jet. Find the force exerted on the vane. How this force would change if the jet impinges on a series of vanes attached to the circumference of a wheel? (7M) CO3

UNIT – IV

8. (a) What is specific speed of a pump? Derive the expression for specific speed of a pump. (7M) CO4
   (b) A Pelton wheel has to develop 13230 kW under a net head of 80 m running at a speed of 600 rpm. If the C_v = 0.97, speed ratio = 0.46, ratio for jet diameter is 1/6 of wheel diameter, calculate the number of jets required for the Pelton wheel. Assume overall efficiency 85%. Also calculate diameter of jet and the diameter of pitch circle. (7M) CO4

(OR)

9. (a) Obtain an expression for the work done by impeller of a centrifugal pump on water per second per unit weight of water. (7M) CO4

   (b) A three-stage centrifugal pump has impeller 50 cm in diameter and 2.5 cm wide at outlet. The vanes are curved back at outlet at 30^0 and reduce circumferential area by 15%. The manometric efficiency is 85% and overall efficiency is 75%. Determine the head generated by the pump when running at 1000 rpm and discharge is 0.05 m^3/sec. Find the shaft power also. (7M) CO4

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Hall Ticket Number:

CE223 (R20)

B.TECH. DEGREE EXAMINATION, NOVEMBER-2023

Semester IV [Second Year] (Supplementary)

HYDRAULICS AND HYDRAULIC MACHINES

Time: Three hours Maximum Marks: 70

Answer Question No.1 compulsorily. (14 x 1 = 14)
Answer One Question from each unit. (4 x 14 = 56)

1. Answer the following:
   (a) If the slope of the cannel is doubled, what will be the new velocity keeping the other parameters constant. CO1
   (b) Find the velocity of flow in the rectangular channel, if a discharge of 10 m^3/s is flowing in the channel of bed width 5 m with a depth of flow of 1 m. CO1
   (c) Find the minimum specific energy corresponding to a critical depth of 2 m in a rectangular channel. CO1
   (d) Give one example where back water curve can be observed. CO2
   (e) Write the expression for determining the length of back water curve. CO2
   (f) When hydraulic jump takes place in an open channel? CO2
   (g) What are the limitations of Rayleigh's method of dimensional analysis? CO3
   (h) What is the maximum efficiency of jet, when jet is striking series of flat plates mounted on a wheel? CO3
   (i) Write the expression for force exerted by jet of water along the jet direction when it is striking a fixed curved vane at its centre. CO3
   (j) Define angular momentum principle. CO3
   (k) When do you select Francis turbine? CO4
   (l) Define hydraulic efficiency of the turbine. CO4
   (m) What is forced vortex flow? CO4
   (n) What is the manometric efficiency of the centrifugal pump? CO4

UNIT – I

2. (a) Define specific energy of an open channel flow and explain the specific energy curve with a neat sketch. (7M) CO1

   (b) Find the possible maximum discharge in a rectangular channel of width 3 m for a specific energy of 5 m. (7M) CO1

(OR)

3. (a) Derive the conditions for maximum discharge in a circular open channel. (7M) CO1

   (b) Uniform flow occurs in a 5 m wide rectangular channel at a depth of 2 m. The channel is concrete lined (n = 0.015) and is laid at a bed slope of 0.0009. Determine how much rise can be provided in the channel bed in order to obtain critical flow. (7M) CO1

UNIT – II

4. (a) Explain various gradually varied flow profiles according to the bed slope of the channel with neat sketches. (7M) CO2

   (b) GVF is taking place in a rectangular channel of bed with 5 m at a rate of 10 m^3/s. At a particular section, the depth of flow is 1.5 m. Find the slope of water surface elevation if the channel is laid at a slope of 0.0001. Take Manning's n as 0.012. (7M) CO2

(OR)

5. (a) Derive the equation of energy loss while hydraulic jump takes place in a rectangular channel. (7M) CO2

   (b) A sluice gate discharges water into a horizontal rectangular channel with a velocity of 6 m/s and depth of flow is 0.4 m. The width of the channel is 8 m. Find height of the jump and energy loss per kg of water. (7M) CO2

UNIT – III

6. (a) Derive the expression for work done per sec when jet is striking the series of flat plates mounted on a wheel. (7M) CO3

   (b) A jet of water of the diameter 100 mm strikes a curved plate at its centre with a velocity of 15 m/s. The curved plate is moving with a velocity of 7 m/s in the direction of the jet. The jet is deflected through an angle of 150°. Assume the plate is smooth find (i) force exerted on the plate in the direction of the jet (ii) power of the jet and (iii) efficiency. (7M) CO3

(OR)

7. (a) A pipe of diameter 1.5 m is required to transport an oil of specific gravity 0.9 and viscosity 0.03 poise at the rate of 3000 litre/s. Tests were conducted on a 15 cm diameter pipe using water at 20^0 C. Determine the velocity and rate of flow in the model. Viscosity of water at 20^0 C is 0.01 poise. (7M) CO3

   (b) Derive the below expression by method of dimensional analysis. The resisting force 'R' of a supersonic plane during flight which depends on length of air craft L, velocity V, air viscosity μ, air density ρ, and bulk density K, can be expressed as,

$$R = \rho L^2 V^2 \phi\left[\left(\frac{\mu}{LV\rho}\right),\left(\frac{K}{\rho V^2}\right)\right].$$ (7M) CO3

UNIT – IV

8. (a) Discuss about classification of Turbines. (7M) CO4

   (b) A Pelton wheel has a mean bucket speed of 35 m/s with a jet of water flown at the rate of 1 m^3/s under a head of 270 m. The buckets deflect the jet through an angle of 170°. Estimate the power delivered to the runner and hydraulic efficiency of the turbine. Assume coefficient of velocity as 0.98. (7M) CO4

9. (a) What is specific speed of a pump? Derive the equation for specific speed of a pump. (7M) CO4

(b) Design a Pelton turbine to develop 103 KW shaft power at 300 r.p.m. when net head available is 80 m. Take Cv = 0.95, Overall efficiency η_o = 80% and speed ratio = 0.45. (7M) CO4

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CE223 (R20)

Hall Ticket Number:

CE223 (R20)

B.TECH. DEGREE EXAMINATION, MAY-2024

Semester IV [Second Year] (Regular & Supplementary)

HYDRAULICS AND HYDRAULIC MACHINES

Time: Three hours Maximum Marks: 70

Answer Question No.1 compulsorily. (14 x 1 = 14)
Answer One Question from each unit. (4 x 14 = 56)

1. Answer the following:
   (a) What are different types of channels? CO1
   (b) Write the relation between Chezy's and Manning's coefficients. CO1
   (c) Define critical depth and critical velocity. CO1
   (d) What is a back water curve? CO2
   (e) Write an example for M1 type of water surface profile. CO2
   (f) Define specific force. CO2
   (g) What are distorted models? CO3
   (h) Explain the angular momentum principle. CO3
   (i) What is dimensional homogeneity? CO3
   (j) Write any two differences between impulse and reaction turbines. CO4
   (k) What is the use of unit quantities? CO4
   (l) What is priming? CO4
   (m) Define cavitation in centrifugal pumps. CO4
   (n) What are the different heads of turbines? CO4

UNIT – I

2. (a) Derive the conditions for a hydraulically efficient trapezoidal channel section. (7M) CO1

   (b) A 2.5 m wide rectangular channel has a specific energy of 1.50 m when carrying a discharge of 6.48 m^3/s. Calculate the alternate depths and corresponding Froude numbers. (7M) CO1

(OR)

3. (a) Explain the velocity and pressure distribution in Open channel flows. (7M) CO1
   (b) A rectangular channel has a width of 2.0 m and carries a discharge of 4.80 m^3/s with a depth of 1.60 m. At a certain section, a small smooth hump with a flat top and of height 0.10 m is proposed to be built. Calculate the likely change in the water surface. Neglect the energy loss. (7M) CO1

UNIT – II

4. (a) Derive the dynamic equation of gradually varied flow. (7M) CO2
   (b) A hydraulic jump takes place in a rectangular channel with sequent depths of 0.25 m and 1.50 m at the beginning and end of the jump respectively. Estimate the (i) discharge per unit width of the channel and (ii) energy loss. (7M) CO2

(OR)

5. (a) Explain different types of hydraulic jumps. (7M) CO2
   (b) Explain the different types of water surface profiles. (7M) CO2

UNIT – III

6. (a) Prove that the force exerted by a jet of water on a fixed semi-circular plate in the direction of the jet when the jet strikes at the center of the semi-circular plate is two times the force exerted by the jet on a fixed vertical plate. (7M) CO3
   (b) Assuming that the rate of discharge Q of a centrifugal pump is dependent upon the mass density ρ of the fluid, pump speed N (rpm), the diameter of impeller D, the pressure p and the viscosity of fluid μ, show using the

Buckingham's π-theorem that it can be represented by $Q = (ND^3)\ \phi[(\frac{gH}{N^2D^2}), (\frac{\upsilon}{ND^2})]$ where H = head and υ = kinematic viscosity of the fluid. (7M) CO3

(OR)

7. (a) What is similitude? Explain different types of hydraulic similarities that must exist between a prototype and its model. (7M) CO3
   (b) A 25 m/s velocity jet having a cross-sectional area of 40 cm^2 strikes a series of flat plates mounted on the periphery of a wheel such that each plate appears successively before the jet. Determine: (7M) CO3
   (i) The total force exerted by the jet on the plate
   (ii) The torque on the wheel
   (iii) The work done per second on the plate
   (iv) The efficiency of jet

UNIT – IV

8. (a) Explain the characteristic curves of turbines. (7M) CO4
   (b) A centrifugal pump having outer diameter equal to two times the inner diameter and running at 1000 rpm works against a total head of 40 m. The velocity of flow through the impeller is constant and equal to 2.5 m/s. The vanes are set back at an angle of 40° at outlet. If the outer diameter of the impeller is 500 mm and width at outlet is 50 mm, determine: (7M) CO4
   (i) Vane angle at inlet
   (ii) Work done by impeller on water per second
   (iii) Manometric efficiency

(OR)

F-2

UNIT – IV

8. (a) Explain the working of a single stage centrifugal pump with neat sketch. (7M) CO4
   (b) Design a Francis turbine runner with the following data: Net head = 68 m, speed = 750 rpm, output power = 330 kW, hydraulic efficiency = 94%, overall efficiency = 85%, flow ratio = 0.15, breadth ratio = 0.1, inner dia of runner is 0.5 outer dia. Also assume 6% of circumferential area of the runner to be occupied by the thickness of the vanes. Velocity of flow remains constant throughout the flow and is radial at exit. (7M) CO4

(OR)

9. (a) Explain the heads and efficiencies of turbines. (7M) CO4
   (b) A centrifugal pump has the following characteristics: outer diameter of impeller = 800 mm, width of impeller vane at outlet = 100 mm, angle of impeller vanes at outlet = 40^0. The impeller runs at 550 rpm and delivers 0.98 m^3/s of water under an effective head of 35 m. A 500 kW motor is used to drive the pump. Determine the manometric, mechanical and overall efficiencies of the pump. Assume water enters the impeller vanes radially at inlet. (7M) CO4

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CE223 (R20)

Hall Ticket Number:

CE223 (R20)

B.TECH. DEGREE EXAMINATION, SEPTEMBER-2024

Semester IV [Second Year] (Supplementary)

HYDRAULICS AND HYDRAULIC MACHINES

Time: Three hours Maximum Marks: 70

Answer Question No.1 compulsorily. (14 x 1 = 14)
Answer One Question from each unit. (4 x 14 = 56)

1. Answer the following:
   (a) Differentiate between critical, sub critical and super critical flows. CO1
   (b) Mention the conditions for a most economical rectangular channel section. CO1
   (c) Define energy correction factor. CO1
   (d) What are sequent depths? CO2
   (e) Draw M1 and M2 type of profiles. CO2
   (f) What is a draw down curve? CO2
   (g) Define Froude model law. CO3
   (h) What is scale effect? CO3
   (i) What are the advantages of Buckingham's π-method over Rayleigh's method? CO3
   (j) What are the functions of draft tube? CO4
   (k) Classify the turbines based on the specific speed of the turbine. CO4
   (l) Differentiate between Francis and Kaplan turbines. CO4
   (m) What are the losses in centrifugal pumps? CO4
   (n) What are the precautions for cavitation in centrifugal pumps? CO4

UNIT – I

2. (a) What is specific energy? Explain specific energy curve with a neat sketch. Derive the expression for critical depth and critical velocity. (7M) CO1

(b) A most efficient trapezoidal section is required to give a maximum discharge of 21.5 m^3/s of water. The slope of the channel bottom is 1 in 2500 and the side slope of the channel is $\frac{1}{\sqrt{3}}$. Taking C = 70 in Chezy's equation, determine the dimensions of the channel. Also determine the value of Manning's n, taking the value of velocity of flow as obtained for the channel by Chezy's equation. (7M) CO1

(OR)

3. (a) Derive the condition for a most efficient circular channel section subjected to maximum discharge. (7M) CO1

(b) A rectangular channel has a width of 2 m and carries a discharge of 1.6 m. At a certain section a small, smooth hump with a flat top and of height 0.1 m is proposed to be built. Calculate the likely change in the water surface. Neglect the energy loss. (7M) CO1

UNIT – II

4. (a) Explain the procedure for computation of length of surface profile by single step method. (7M) CO2

(b) A wide channel of uniform rectangular section with a slope of 1/95 has a flow rate of 3.75 $m^3/s/m$. The manning constant is 0.013. Suddenly the slope changes to 1/1420. Determine the normal depths for each case. Show that a hydraulic jump has to occur and calculate the downstream flow height. Also calculate the loss of energy. (7M) CO2

(OR)

5. (a) Derive the relation between sequent depths. (7M) CO2

(b) In a rectangular channel 12 m wide and 3.6 m deep water is flowing with a velocity of 1.2 m/s. The bed slope of the channel is 1 in 4000. If flow of water through the channel is regulated in such a way that energy line is having a slope of 0.00004, find the rate of change of depth of water in the channel. (7M) CO2

UNIT – III

6. (a) Derive the expression for force exerted by a jet on moving flat inclined plate. (7M) CO3

(b) A ship 250 m long moves in a sea water whose density is 1030 kg/m^3. A 1:125 model of this ship is to be tested in wind tunnel. The velocity of air in the wind tunnel around the model is 20 m/s and the resistance of the model is 50 N. Determine the velocity of ship in sea water and also the resistance of the ship in sea water. The density of air is given as 1.24 kg/m^3. Take the kinematic viscosity of sea water and air as 0.012 stokes and 0.018 stokes respectively. (7M) CO3

(OR)

7. (a) What are repeating variables? How are they selected? (7M) CO3

(b) A jet of water 75 mm diameter strikes a curved plate at its centre with a velocity of 20 m/s. The curved plate is moving with a velocity of 8 m/s in the direction of jet, the jet is deflected through an angle of 165^0. Assuming the plate to be smooth, find (7M) CO3

(i) force exerted on the plate in the direction of jet
(ii) power of the jet and
(iii) Efficiency of the jet.