SIDDHARTH GROUP OF INSTITUTIONS :: PUTTUR
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QUESTION BANK (DESCRIPTIVE)

Subject with Code : HHM (16CE113) **Course & Branch**: B.Tech - CE

Year & Sem: II-B.Tech & II-Sem **Regulation:** R16

UNIT - I

OPEN CHANNEL FLOW (Uniform & Non-uniform Flow)

1. What is meant by most economical section? Also derive the condition for a trapezoidal channel to be most economical. 12M
2. Explain specific force curve in detail. Also obtain the condition for maximum discharge for a given value of specific force 12M
3. Determine the expression for the most economical depth of water in terms of the diameter of a channel of circular cross-section for maximum discharge. 12M
4. A concrete lined circular channel of diameter 3m has abed slope of 1 in 500. Find out velocity and flow rate for conditions of a) Max.Velocity b) Max. Discharge. Assume chezys constant C=50 12M
5. In a rectangular channel 3.5m wide laid at a slope of 0.0036, uniform flow occurs at a depth of 2m. Find how high can the hump be raised without causing afflux? If the upstream depth of flow is to be raised to 2.5m. What should be the height of hump? Take n= 0.015 in manning's formula 12M
6. a) Derive an expression for discharge through the open channel flow by chezy's constant. 8M
   b)Find the diameter of a circular sewer pipe which is laid at a slope of 1 in 8000 and carries a discharge of 800 lit/sec when flowing half full. Take the value of manning's N=0.020. 4M
7. The discharge of water through a rectangular channel of width 8m, is $15m^{3/sec}$. When the 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. 12M
8. a) Derive an expression for maximum velocity of flow through a circular section. 6M
   b)Determine the expression for the most economical trapezoidal section in terms of side slope.6M
9. a) Derive the condition for a rectangular channel to be most efficient. 4M
   b) Explain the terms specific energy of a flowing liquid, minimum specific energy, critical depth, critical velocity and alternate depth applied to non-uniform flow. 8M

10. a) Write a brief note on channel transition with reduction in width of a rectangular channel with neat sketch. .6M

    b)Write a brief note on channel transition with raise in bottom in a rectangular channel with neat sketch. 6M

UNIT - II

GRADUALLY VARIED FLOW & RAPIDLY VARIED FLOW

1. a) What is hydraulic jump and what are the assumptions of hydraulic jump. 6M

   b) What are the different types of hydraulic jump and explain with neat sketches? 6M.

2. What are assumptions of gradually varied flow? Derive the Dynamic equation of gradually varied flow. 12M

3. Show that the head loss in a hydraulic jump formed in a rectangular channel may be expressed as $\Delta E = \frac{(V_1 - V_2)^3}{2g(V_1 + V_2)}$ 12M.

4. a)What is back water curve and afflux .Derive the expression for length of back water curve. 6M

   b)What are the classifications of channel bottom slopes and briefly explain charactestics of surface profiles. 6M

5. a) Derive an expression for depth of hydraulic jump in terms of upstream Froude number. 4M

   b) Find the rate of change of depth of water in a rectangular channel of 10m wide and 1.5m deep ,when the water is flowing with a velocity of 1 m/s. The flow of water through the channel of bed slop 1 in 4000, is regulated in such a way that energy line is having a slope of 0.00004. 8M

6. Determine the length of back water curve caused by an afflux of 2m in a rectangular channel of width 40m and depth 2.5 m.The slope of bed is given as 1 in11000.Take manning's N=0.03. 12M

7. What is hydraulic jump and derive the expression for depth of hydraulic jump. 12M

8. a) Derive an expression for hydraulic jump in rectangular channel. 6M.

   b) What are the applications of hydraulic jump? 6M.

9. a) A hydraulic jump forms at the downstream end of spillway carrying 17.93 m^3/s discharge. If depth before jump is 0.80 m, determine the depth after the jump and energy loss. 6M

   b) Write about the classification of bottom channel slope . 6M

10. a)A rectangular channel 7.5 m wide has a uniform depth of flow of 2m ,and has a bed slope of 1 in 3000.If due to weir constructed at the down stream end of the channel , water surface at a

section is raised by0.75 m . Determine the water surface slope w.r.to horizontal at this section. Assume manning's n=0.02. 8M

b) Derive an expression for loss of energy due to hydraulic jump. 4M

UNIT - III

IMPACT OF JETS

11. (a) Derive the equation for force exerted by a jet on stationary inclined flat plate. 6M

    (b) Find the force exerted by a jet of water of diameter 75mm on a stationary flat plate, when th jet strikes the plate normally with velocity of 20m/s. 6M

2. A jet of water having a velocity of 30m/s strikes a series of radial curved vanes mounted on a wheel which is rotating at 200r.p.m. The jet makes an angle of 20 degrees with the tangent to the wheel at inlet and leaves the wheel with a velocity of 5m/s at an angle of 130 degrees to the tangent to the wheel at outlet. Water is flowing from outward in a radial direction. The outer and inner radii of the wheel are 0.5m and 0.25m respectively. Find vane angles at inlet and outlet. Work done per unit weight of water and efficiency of the wheel. 12M
3. Derive the expression for force exerted by a jet on stationary curved plate if jet strikes the curved plate at the Centre and at one end. 12M
4. A jet of water moving at 12 m/s impinges on a vane shaped to deflect the jet through 120 degres when stationary. If the vane is moving at 5 m/s, find the angle of jet so that there is no shock at inlet. What is the absolute velocity of jet at exit in magnitude and direction and the work done per second per unit weight of water striking per second? Assume that the vane is smooth and moving in the same direction as that of the jet. 12M
5. 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 degrees to the direction of motion of vanes when entering and leaves at an angle of 120 degrees. Draw the triangles of velocities at inlet and outlet and find the angles of vanes tips so that water enters and leaves without shock, the work done per unit weight of water entering the vanes and the efficiency. 12M
6. A jet of water of diameter 50 mm strikes a curved plate having a velocity of 20 m/s. The curved plate is moving with a velocity of 10 m/s in the direction of the jet. The jet is deflected through an angle of 60^0. Assuming the plate smooth, find: (i) Force exerted by the jet on the vane in the direction of the motion. (ii) work done per second by the jet . 12M

7. A 7.5 cm diameter jet having a velocity of 30 m/s strikes a flat plate, the normal of which is inclined at 45 degrees to the axis of the jet. Calculate the normal pressure on the plate.
   (i) When the plate is stationary and
   (ii) When the plate is moving with a velocity of 15 m/s and away from the jet. Also determine the power and efficiency of the jet when the plate is moving. 12M
8. A jet of water of diameter 7.5 cm strikes a curved plate at its center with a velocity of 20 m/sec. The curved plate is moving with a velocity of 8m/sec in the direction of the jet. The jet is deflected through an angle of 165 degree. Assuming the plate smooth find
   a) force exerted on the plate in the direction of jet b) power of the jet c) efficiency of the jet . 12M
9. The jet of water having a velocity of 40 m/s strikes a curved vane, which is moving with a velocity of 20m/s. the jet makes an angle of 30 degree with the direction of motion of vane at inlet and leaves at an angle of 90 degree to the direction of motion of vane at outlet. Draw the velocity triangles at inlet and outlet and determine the vane angles at inlet and outlet so that the water enters and leaves the vane without shock . 12M
10. Derive th expression for force exerted by a jet of water on an unsymmetrical moving curved plate when jet strikes tangentially at one of the tips and explain the velocity triangles at inlet &oulet and also efficiency of the jet. 12M

UNIT - IV

HYDRAULIC TURBINES – I & II

12. a) What is a turbine and give the classification in detail? Give the various efficiencies. 6M
    b) Explain Radial flow reaction turbine with a neat diagram. 6M
2. a)A Pelton wheel is to be designed for a head of 60m when running at 200r.p.m.The pelton wheel develops 95.6475kW shaft power. The velocity of the buckets =0.45 times the velocity of the jet, overall efficiency=0.85and co-efficient of the velocity=0.98. 6M
   b)A jet strikes the buckets of Pelton wheel, which is having shaft power as 15450kW. The diameter of each jet is given as 200mm.If the net head on the turbine is 400m.Find the overall efficiency of the turbine, take C_v=1.0 . 6M
3. a) Draw the velocity triangles, work done and maximum hydraulic efficiency of a pelton wheel turbine 5M
   (b) An inward flow reaction turbine has external and internal diameters as 1m &0.6 m.The hydraulic efficiency of the turbine is 90% when the head on the turbine is 36m.The velocity of

flow at outlet is 2.5m/s and discharge at outlet is radial. If the vane angle @ outlet is 15 degrees &width of the wheel is 100mm at inlet and outlet , Determine (i)The guide blade angle (ii) speed of the turbine (iii) vane angle of the runner at inlet (iv) volume flow rate of turbine (v) power developed. 7M

4. The three-jet Pelton turbine is required to generate 1000 kW under a net head of 400 m. The blade angle at outlet is 15 degrees and the reduction in the relative velocity while passing over the blade is 5%. If the overall efficiency of the wheel is 80%, Cv=0.98 and speed ratio =0.46, then find (i) The diameter of jet (ii) Total flow in m3/sec and the force exerted by a jet on the buckets.

   If the jet ratio is not less than 10, find the speed of the wheel for a frequency of 50 hertz/sec and the corresponding wheel diameter. 12M

6. A Francis turbine working under a head of 30 m has a wheel diameter of 1.2 m at the entrance and 0.6 m at the exit. The vane angle at the entrance is 90 degres and guide blade angle is 150 degrees. The water at the exit leaves the vane without any tangential velocity and the velocity of flow in the runner is constant. Neglecting the effect of draft tube and losses in the guide and runner passages, determine the speed of wheel in r.p.m. and vane angle at exit. State whether the speed calculated is synchronous or not. If not, what speed would you recommend to couple the turbine with an alternator of 50 cycles? 12M

7. The following data is given for a Francis turbine.

   Net head=60 m ; Speed= 700r.p.m ; shaft power =294.3KW ; Overall efficiency=84% ;Hydraulic efficiency=93%;flow ratio=0.20; breadth ratio=0.1; Outer diameter of the runner=2x inner diameter of runner. The thickness of vanes occupy 5% of circumferential area of the runner, velocity of flow is constant at inlet and discharge is radial at outlet. Determine: (i) Guide blade angle (ii) Runner vane angles at inlet and outlet (iii) Diameters of runner at inlet and outlet and (iv) Width of wheel at inlet. 12M

8. A Kaplan turbine runner is to be designed to develop9100KW.Th net available head is5.6 m, If the speed ratio =2.09 , Flow ratio =0.68, overall efficiency=86%& diameter of th boss is1/3 the diameter of the runner. Find the diameter of the runner and its speed and the specific speed of the turbine. 12M

9. (a) Define (i)speed ratio (ii) Flow ratio (iii) Diameter of turbine (iv)Radial discharge. 6M

   (b) Define the term unit power, unit speed and unit discharge with reference to a hydraulic turbine. And also derive the expression for these terms. 6M

10. (a) What are the uses of draft tube? Describe with neat sketches different types of draft tube. 6M

(b)What is specific speed, derive the equation for specific speed. 6M

UNIT - V

HYDRAULIC PUMPS &

DIMENSIONAL ANALYSIS AND SIMILITUDE

1. What is centrifugal pump? Explain the parts of centrifugal pump and derive the condition for work done. 12M
2. A centrifugal pump discharges 0.15 m3/sec of water against a head of 12.5 m, the speed of impeller being 600 r.p.m. The outer and inner diameter of impeller are 500 mm and 250 mm respectively and the vanes are bent back at 350 to the tangent at exist. If the area of flow remains 0.07 m2 from inlet to outlet, calculate (i) Manometric efficiency of pump (ii) Vane angle at inlet (iii) Loss of head at inlet to impeller when the discharge is reduced by 40% without changing the speed. 12M
3. The internal and external diameter of an impeller of a centrifugal pump which is running at 1000 r.p.m. are 200 mm and 400 mm respectively. The discharge through pump is 0.04m3 /sec and velocity of flow is constant and equal to 2 m/sec. The diameters of suction and delivery pipes are 150 mm and 100 mm respectively and suction and delivery heads are 36 m and 30 m of water respectively. If the outlet vane angle is 450 and power required to drive the pump is 16.186 KW, determine: (i) Vane angle of impeller at inlet (ii) Overall efficiency of the pump and (iii) Manometric efficiency of pump. 12M
4. A three stage centrifugal pump has impeller 40 cm in diameter and 2 cm wide at outlet. The vanes are curved back at the outlet at 450 and reduce the circumferential area by 10%.The manometric efficiency is 90% and overall efficiency is 80%. Determine the head generated by the pump when running at 1000r.p.m. delivering 50 litres per second. What should be the shaft horse power? 12M
5. (a) What it is meant by priming? 5M

   (b) The diameters of an impeller of a centrifugal pump at inlet and outlet are 30 cm and 60 cm respectively. Determine the minimum starting speed of the pump if it works against a head of 30 m. 7M
6. (a) What are similarity laws? 6M

   (b) What is meant by dimensional analysis? What are the uses? 6M
7. (a) A 1.0 m long model of a ship is towed in a towing tank at a speed of 81 cm/s. To what speed of the ship of 64 m long does this correspond. 6M

(b) For laminar flow in a pipe the drop in pressure ΔP is a function of the pipe length L, its diameter D, mean velocity of flow V and the dynamic viscosity. Using Rayleigh's method, develop an expression for ΔP. 6M

8. (a) What is the difference between single-stage and multistage pumps? Describe multistage pump with: (i) Impellers in parallel. (ii) Impellers in series. 6M

   (b) The diameter of an impeller of a centrifugal pump at inlet and outlet are 20 cm and 40 cm respectively. Determine the minimum speed for starting the pump if it works against a head of 25 m. 6M

9. (a) What are different types of dimensionless numbers? Explain them. 5M

   (b) What is meant by cavitation in the case of centrifugal pumps? What are the effects and precautions against cavitation? How do you calculate cavitation in centrifugal pumps? 7M

10. (a) State the Buckingham – Pi theorem and mention the advantages of dimensional analysis.

    (b) A model 1/10 of prototype of a flying boat is towed in fresh water (ρm = 1000 kg/m3). The prototype is moving in a sea water (ρp = 1030 kg/m3) with a speed of 72 km/hr. Find the corresponding speed of themodel. Also find out the resistance due to waves on model if the wave resistance experienced by prototype is 750 N. 12M