Course Code: 20CE0111 **R20**

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY:: PUTTUR

(AUTONOMOUS)

Siddharth Nagar, Narayanavanam Road – 517583

QUESTION BANK (DESCRIPTIVE)

Subject: Hydraulic Engineering (20CE0111) **Course & Branch: B.Tech & Civil**

Year & Sem: II-B.Tech –II Sem **Regulation: R20**

UNIT –I

UNIFORM FLOW & NON-UNIFORM FLOW

1	Derive the condition for a trapezoidal channel to be most economical.	**[L2] [CO1]**	**[12M]**
2	Prove that for a channel of circular section, the depth of flow d=0.81D for maximum velocity.	**[L3] [CO1]**	**[12M]**
3	A concrete lined circular channel of diameter 3m has a bed slope of 1 in 500. Find out velocity and flow rate for conditions of a) Maximum Velocity b) Maximum Discharge. Assume Chezy's constant C=50.	**[L3] [CO1]**	**[12M]**
4	Derive an expression for maximum velocity of flow through a circular section.	**[L2] [CO1]**	**[12M]**
5	Explain concept of specific energy force in detail and obtain the condition for specific energy curve.	**[L2] [CO1]**	**[12M]**
6	**a)** Derive an expression for discharge through the open channel flow by Chezy's constant.	**[L2] [CO1]**	**[6M]**
	b) Find the discharge though a circular pipe of diameter 3 m, if the depth of water in the pipe is 1m and the pipe is laid at the slope of 1 in 1000, Take C=70.	**[L3] [CO1]**	**[6M]**
7	The discharge of water through a rectangular channel of width 8 m is 15 m^3/sec. When the depth of flow of water is 1.2 m. Calculate: (i) specific energy of the flowing water (ii) critical depth and critical velocity (iii) value of minimum specific energy	**[L3] [CO1]**	**[12M]**
8	**a)** Derive the condition for a rectangular channel to be most efficient.	**[L2][CO1]**	**[6M]**
	b) Explain the term specific energy of a flowing liquid and derive the condition for critical depth	**[L2][CO1]**	**[6M]**
9	In a rectangular channel 3.5 m wide laid at a slope of 0.0036, uniform flow occurs at a depth of 2 m. Find how high can the hump be raised without causing afflux? If the upstream depth of flow is to be raised to 2.5 m. What should be the height of hump? Take n = 0.015 in Manning's formula.	**[L3][CO1]**	**[12M]**
10	**a)** Write a brief note on channel transition with reduction in width of a rectangular channel with neat sketch.	**[L1] [CO1]**	**[6M]**
	b) Write a brief note on channel transition with raise in bottom in a rectangular channel with neat sketch.	**[L1] [CO1]**	**[6M]**

Course Code: 20CE0111 **R20**

UNIT –II

GRADUALLY VARIED FLOW & RAPIDLY VARIED FLOW

1	What are assumptions of gradually varied flow? Derive the Dynamic equation of gradually varied flow.	**[L2] [CO2]**	**[12M]**
2	What is hydraulic jump and derive the expression for depth of hydraulic jump.	**[L2] [CO2]**	**[12M]**
3	What are the classifications of channel bottom slopes and briefly explain various types of water surface profiles.	**[L2] [CO2]**	**[12M]**
4	What is back water curve and afflux? Derive the expression for length of back water curve?	**[L2] [CO2]**	**[12M]**
5	**a)** What is hydraulic jump and what are the assumptions of hydraulic jump.	**[L1][CO2]**	**[6M]**
	b) What are the different types of hydraulic jump and explain with neat sketches?	**[L1] [CO2]**	**[6M]**
6	The depth of flow of water, at a certain section of a rectangular channel of 2 m wide, is 0.3m. The discharge through the channel is 1.5 m^3/s. Determine whether a hydraulicjump will occur, and if so, find its height and loss of energy per kg of water.	**[L3] [CO2]**	**[12M]**
7	Derive dynamic equation for GVF in wide rectangular.	**[L2][CO2]**	**[12M]**
8	**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.	**[L3][CO2]**	**[6M]**
	b) Write about the classification of bottom channel slope.	**[L1][CO2]**	**[6M]**
9	**a)** A sluice gate discharges water into a horizontal rectangular channel with a velocity of 10 m/s and the depth of flow of 1m. Determine the depth of flow after jump and consequent loss in total head.	**[L3][CO2]**	**[5M]**
	b) Derive an expression for loss of energy due to hydraulic jump.	**[L2][CO2]**	**[7M]**
10	**a)** Derive an expression for depth of hydraulic jump in terms of upstream Froude number.	**[L2] [CO2]**	**[5M]**
	b) Find the rate of change of depth of water in a rectangular channel of 10m wideand 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.	**[L3] [CO2]**	**[7M]**

Course Code: 20CE0111 **R20**

UNIT –III

IMPACT OF JETS

1	**a)** Derive the equation for force exerted by a jet on stationary inclined flat plate.	**[L2][CO3]**	**[6M]**
	b) Find the force exerted by a jet of water of diameter 75mm on a stationary flat plate, when the jet strikes the plate normally with velocity of 20m/s.	**[L3] [CO3]**	**[6M]**
2	A jet of water of diameter 75mm moving with a velocity of 30m/s, strikes a curved fixed plate tangentially at one end at an angle of 30^o to the horizontal. The jet leaves the plate at an angle of 20 degrees to the horizontal. Find the force exerted by the jet on the plate in the horizontal and vertical direction.	**[L3] [CO3]**	**[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.	**[L2][CO3]**	**[12M]**
4	**a)**Derive the condition for force on the inclined plate moving in the direction of the jet	**[L2] [CO4]**	**[6M]**
	b) Derive the condition for force on the flat vertical plate moving in the direction of jet	**[L2][CO4]**	**[6M]**
5	Obtain the condition for the jet when it strikes the fixed curved plate at one end tangentiallywhen the plate is symmetrical.	**[L3][CO3]**	**[12M]**
6	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.	**[L3][CO4]**	**[12M]**
7	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.	**[L3][CO4]**	**[12M]**
8	Obtain the expression for the force exerted by jet of water on a fixed vertical plate in the direction of the jet.	**[L3] [CO3]**	**[12M]**
9	A jet of water of diameter 50mm strikes a fixed plate in such a way that the angle between the plate and the jet is 30^o. The force exerted in the direction of jet is 1417.5N. Determine the rate if flow of water.	**[L3] [CO3]**	**[12M]**
10	A nozzle of 50 mm diameter delivers a stream of water at 20m/s perpendicular to a plate that moves away from the jet at 5m/s Find (i) the force on the plate (ii) the work done (iii) the efficiency of jet.	**[L3][CO4]**	**[12M]**

Course Code: 20CE0111 **R20**

UNIT – IV

PUMPS & DIMENSIONAL ANALYSIS AND SIMILITUDE

1	What is centrifugal pump? Explain the parts of centrifugal pump with neat sketch.	**[L1] [CO5]**	**[12M]**
2	A centrifugal pump discharges 0.15 m^3/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.	**[L3] [CO5]**	**[12M]**
3	A centrifugal pump is to discharge 0.118m^3/sec at a speed of 1450r.p.m. against a head of 25m. The impeller diameter is250mm,its width at outlet is 50mm and manometric efficiency is 75%. Determine the vane angle at the outer periphery of the impeller.	**[L3] [CO5]**	**[12M]**
4	A three-stage centrifugal pump has impeller 40cm in diameter and 2cm 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?	**[L1] [CO5]**	**[12M]**
5	**a)** What it is meant by priming?	**[L2] [CO5]**	**[4M]**
	b) What is cavitation? What are the effects of cavitation and mention someprecautions against cavitation.	**[L1] [CO5]**	**[8M]**
6	Explain the different types of hydraulic similarities that must exist between a prototype and its model.	**[L2] [CO5]**	**[12M]**
7	**a)** Define and explain Reynolds's number, Froude number and Mach number. **b)** In 1 in 40 model of a spillway, the velocity and discharge are 2 m/s and2.5m^3/s. Find the corresponding velocity and discharge in the prototype.	**[L2] [CO5]** **[L3] [CO5]**	**[6M]** **[6M]**
8	A centrifugal pump delivers water against a net head of 14.5 meters and a design speed of 1000 r.p.m. The vanes are curved back to an angle of 30 degrees with the periphery. The impeller diameter is 300 mm and outlet width is 50 mm. Determine the discharge of the pump if manometric efficiency is 95 %.	**[L3 [CO5]**	**[12M]**
9	**a)** What are different types of dimensionless numbers? Explain them.	**[L2] [CO5]**	**[6M]**
	b) Define the terms: model, prototype, hydraulic similitude.	**[L1] [CO5]**	**[6M]**
10	**a)** State the Buckingham – Pi theorem	**[L1][CO5]**	**[6M]**
	b) The time period (t) of a pendulum depends upon the length (L) of the pendulum and acceleration due to gravity (g) . Derive an expression for time period.	**[L2][CO5]**	**[6M]**

Course Code: 20CE0111 **R20**

UNIT –V

HYDRAULIC TURBINES – I & HYDRAULIC TURBINES-II

1	**a)** What is a turbine and give the classification in detail? Give the various efficiencies.	**[L1] [CO6]**	**[6M]**
	b) Explain Radial flow reaction turbine with a neat diagram.	**[L2] [CO6]**	**[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 95.6475 kW shaft power. The velocity of the buckets =0.45 times the velocity of the jet, overall efficiency=0.85 and co-efficient of the velocity=0.98.	**[L3] CO6]**	**[6M]**
	b) A jet strikes the buckets of Pelton wheel, which is having shaft power as 15450 kW. 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.	**[L3][CO6]**	**[6M]**
3	**a)** Draw the velocity triangles, work done and maximum hydraulic efficiency of a Pelton wheel turbine	**[L1] [CO6]**	**[6M]**
	b) An inward flow reaction turbine has external and internal diameters as 1m &0.6m. The hydraulic efficiency of the turbine is 90% when the head on the turbine is36 m. The velocity of flow at outlet is 2.5 m/s and discharge at outlet is radial. If the vane angle at outlet is 15 degrees &width of the wheel is 100 mm at inlet and outlet, determine (i) 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.	**[L3] [CO6]**	**[6M]**
4	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?	**[L3][CO6]**	**[12M]**
5	The following data is given for a Francis turbine. Net head=60 m; Speed=700 r.p.m; shaft power =294.3 kW; 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 occupies 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.	**[L3] [CO6]**	**[12M]**
6	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 the boss is1/3 the diameter of the runner. Find the diameter of the runner and itsspeed and the specific speed of the turbine.	**[L3][CO6]**	**[12M]**
7	**a)** Define (i) Speed ratio (ii) Flow ratio (iii) Diameter of turbine (iv) Radial discharge.	**[L2] [CO6]**	**[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.	**[L2] [CO6]**	**[6M]**
8	**a)** What are the uses of draft tube? Describe with neat sketches different types of draft tube.	**[L1][CO6]**	**[6M]**
	b) What is specific speed, derive the equation for specific speed.	**[L1] [CO6]**	**[6M]**

9	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 %, C_v=0.98 and speed ratio = 0.46, then find (i) The diameter of jet (ii) Total flow in m^3/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.	**[L1][CO6]**	**[12M]**
10	**a)** Explain Radial flow reaction turbine with a neat diagram.	**[L2] [CO6]**	**[6M]**
	b) A jet strikes the buckets of Pelton wheel, which is having shaft power as 15450 kW. The diameter of each jet is given as 200mm.If the net head on the turbine is400m. Find the overall efficiency of the turbine, take C_v=1.0.	**[L3][CO6]**	**[6M]**

Prepared by: **C. SAILAJA, Assistant Professor, CE**