INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

ASSIGNMENT QUESTIONS

Course Name	:	**HYDRAULICS & HYDRAULIC MACHINES**
Course Code	:	**A40111**
Regulaton	:	**R13**
Class	:	II B. Tech II Semester
Branch	:	Civil Engineering
Year	:	2016 – 2017
Course Faculty	:	Dr. Venkata Ramana Gedela, Professor, Civil Department

OBJECTIVES

This course is intended to introduce basic principles of fluid mechanics. It is further extended to cover the application of fluid mechanics by the inclusion of fluid machinery especially water turbine and water pumps. Now days the principles of fluid mechanics find wide applications in many situations directly or indirectly. The use of fluid machinery, turbines pumps in general and in power stations in getting as accelerated fill up. Thus there is a great relevance for this course for mechanical technicians. The Mechanical technicians have to deal with large variety of fluids like water, air, steam, ammonia and even plastics. The major emphasis is given for the study of water. However the principle dealt with in this course will be applicable to all incompressible fluids.

S. No	QUESTION	Blooms Taxonomy Level	Course Outcome
	UNIT - I		
1.	What do you understand by flow in open channel?	Understand	1
2	Explain the terms: i) specific energy of a flowing liquid ii) minimum specific energy iii) critical depth iv) critical velocity.	Evaluate	1
3	Define the terms : i) afflux ii) back water curve	Evaluate	1
4	Derive an expression for the discharge through a channel by chezy's formula.	Analyze	1
5	Derive an expression for the depth of hydraulic jump in terms of upstream Froude number	Analyze	1
6	Find the discharge of water through a trapezoidal channel of width 8mts and side slope as 1 Horizontal to 3 Vertical.The depth of flow of water is 2.4mts and value of Chezy's Constant,C=50.The slope of the bed of the Channel is given 1 in 4000.	Analyze	1
7	A rectangular channel 4mts wide has a depth of water 1.5mts.The slope of the bed of the channel is 1 in 1000 and value of Chezy's constant C=55 It is desired to increase the discharge to a maximum by changing the dimensions of the section for constant area of cross-section, slope of the bed and roughness of the channel .Find the new dimensions of the channel and increase in discharge.	Evaluate	1

S. No	QUESTION	Blooms Taxonomy Level	Course Outcome
8	The discharge of water through a rectangular channel of width 8mts is 15m3/sec When the depth of flow of water is 1.2mts.Calculate specific energy of the Flowing water; critical depth and critical velocity; value of minimum specific Energy	Apply	1
9	The depth of flow of water at certain section of a rectangular channel of 4mts width is 0.5mts.The discharge through the channel is $16m^3$/sec. If a hydraulic Jump takes place on downstream side. Find the depth of flow after the jump.	Apply	1
10	Find the diameter of a circular sewer pipe which is laid at a slope of 1 in 8000 and carries a discharge of 800 liters/sec when flowing half full. Take the value of Manning's N=0.020	Analyze	1
	UNIT - II		
1	Define the terms dimensional analysis and model analysis.	Remember	2
2	Explain the term "dimensionally homogeneous equation".	Analyze	2
3	Explain the terms : i) Geometric similarity ii) kinematic similarity iii) Dynamic similarity.	Remember	2
4	Explain the terms : i) Distorted ii) Undistorted model	Evaluate	2
5	What is the significance of the non-dimensional numbers: reynold's number, Froude number and mach number in the theory of similarity? What is dimensional analysis? How is this analysis related to the theory of similarity?	Analyse	2
6	Determine the dimensions of the quantities given below : i) angular velocity ii) angular acceleration iii) discharge iv) kinematic viscosity v) force vi) specific weight.	Analyse	2
7	The time period of a pendulum depends upon the length of the pendulum, Acceleration due to gravity. Determine expression for time period using Rayleigh's method	Understand	2
8	Efficiency of a fan depends upon density; dynamic viscosity; angular velocity; Diameter; discharge. Express efficiency in dimensionless parameters .using Rayleigh's method	Understand	2
9	A pipe of diameter 1.5mts is required to transport an oil of specific gravity 0.90 and viscosity $3X10^{-2}$ poise at a rate of 3000litres/sec .Tests were conducted on15cm diameter pipe using water at 20^0c.Find the velocity and rate of flow in the Model. Viscosity of water at 20^0c is 0.01 poise.	Apply	2
10	Determine the dimensions of the given quantities; Discharge, Force, Specific Weight, angular acceleration, dynamic viscosity, kinematic viscosity.	Remember	2
	UNIT-III		
1	Define the term impact of jets	Understand	5
2	Water is flowing through a pipe at the end of which a nozzle is fitted .the diameter of the nozzle 100mm and the head of water at the centre of nozzle is 100 m .find the force exerted by the jet of water on a fixed vertical plate .the coefficient of velocity is given as 0.95.	Evaluate	5
3	Show that the force exerted by a jet of water on an inclined fixed plate in the direction of the jet is given by :	Creating & analyze	5

S. No	QUESTION	Blooms Taxonomy Level	Course Outcome
	$F_x = \rho a V^2 \sin^2\theta$ Where a=area of jet , V=velocity of the jet		
4	Differentiate between: i) the force exerted by a jet of water on a fixed vertical plate and moving plate, and ii) the force exerted by a jet on a single curved moving plate and series of curved moving plate .	Analyse	5
5	Prove that the force exerted by a jet of water on a fixed semi –circular plate in the direction of jet when the plate strikes the centre of the semi – circular plate is two times the force exerted by the jet on an fixed vertical plate.	Evaluate	5
6	Find the force on the curved plate when the plate is moving in the direction of jet?	Evaluate	5
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 ^{0} to the axis of the jet . Find the normal pressure on the plate : i) When the plate is stationary When the plate is moving with a velocity of 15 m/s and away from the jet and also determines the power and efficiency of the jet when the plate is moving.	Analyze	5
8	A jet of water having a velocity of 30 m/s strikes a curved vane, which is moving with a velocity of 15 m/s. the jet makes an angle of 30^0 with the direction of motion of vane at inlet and leaves at an angle of 120^0 to the direction of vane at outlet. Calculate : 1.Vane angles , if the water enters and leaves the vane with out shock, 2.Work done per second per unit weight of water striking the vanes per second	Evaluate	5
9	A jet of water, having a velocity of 15m/sec strikes a curved vane which is moving with a velocity of 6m/sec in the same direction as that of the jet at the inlet. The vane is so shaped that the jet is deflected through 135^0, the diameter of the jet is 150mm. assuming the vane to be smooth: 1. Find the force exerted by the jet on the vane in direction of motion. 2.Power of the vane Efficiency of the vane	Apply	5
10.	A jet of water having a velocity of 30m/sec strikes a series of radial curved vanes mounted on a wheel which is rotating at 300 rpm the jet makes an angle of 30^0 with the tangent to the wheel at inlet and leaves the wheel with a velocity of 4m/sec at an angle of 120^0 to the tangent to the wheel at outlet. Water is flowing from outward in the radial direction. The outer and inner radii of the wheel are o.6m and 0.3 m respectively. Determine: Vane angles at inlet and outlet Work done per second per kg of water. Efficiency of the wheel	Apply	5
	UNIT - 1V		
1	A turbine is to operate under a head of 25 m at 200 r. p .m. The discharge is 9 cumec. If the efficiency is 90 % , determine : i) Specific speed of the turbine ii) Power generated and , Type of machine.	Analyse	7
2	A turbine develops 9000 kW when running at a speed of 140 r. p m and under a head of 30 m .Determine the specific speed of the turbine.	Understand	7
3	A water turbine has a velocity of 6 m/s at the entrance to the draft tube and a velocity of 1.2 m/s at the exit. For friction losses of 0.1 m and tail water 5 m below the entrance to the draft tube, find the pressure head at the entrance.	Evaluate	7
4	What do you understand by characteristic curves of a turbine? Name the	Apply	7

S. No	QUESTION	Blooms Taxonomy Level	Course Outcome
	important types of characteristic curves?		
5	Differentiate between an inward and out ward flow reaction turbine?	Evaluate	7
6	What do you understand by characteristic curves of a turbine? Name the important types of characteristic curves?	Apply	7
7	An inward flow reaction turbine has external and internal diameters as 1.2 m and 0.6 m respectively. The velocity of flow through the runner is constant and is equal to 1.8 m/s .Determine i)Discharge through the runner , ii) Width at outlet if width at inlet =200 mm.	Apply	7
8	An outward flow reaction turbine has internal and external diameters of the runner as 0.5 m and 1.0 m respectively. The guide blade angle is 15^0 and velocity of flow through the runner is constant and equal to 3 m/s. if the speed of the turbine is 250 r.p.m and head on turbine is 10 cm and discharge at out let is radial. Determine : i) Runner vane angles at inlet and out let ii) Work done by the water on the runner per sec per unit weight of water striking per sec and Hydraulic efficiency.	Analyze	7
9	A Francis turbine with an overall efficiency of 70% is required to produce 147.15 Kw. It is working under a head of 8 m .The peripheral velocity is 3.75 m/s and radial velocity of flow at inlet is 12.02 m/s .The wheel runs at 200 r.p.m and hydraulic losses in the turbine are 20 % of the available energy assume radial discharge , determine : i) The guide blade angle ii) The wheel vane angle at inlet , iii) Dia of wheel at inlet iv) Width of wheel at inlet.	Analyze	7
10	A conical draft tube having inlet and out let diameters 0.8m and 1.2 m discharges water at outlet with a velocity of 3 m/s .The total length of draft tube is 8 m and 2m of the length of draft tube is immersed in water .If the atmospheric pressure head 10.3 m of water and loss of head due to friction in the draft tube is equal to 0.25 times the velocity head at out let of the tube , find (i)pressure head at inlet and (ii) efficiency of draft tube	Analyze	7
	UNIT - V		
1	What is meant by pump and discuss about pump installation?	Evaluate	9
2	Define the following :i) suction head ii) delivery head iii)static head	Remember	9
3	Define the following : i) load factor ii)utilization factor iii)capacity factor	Remember	9
4	Differentiate between the volute casing and vortex casing for the centrifugal pump. obtain an expression for the work done by the impeller of a centrifugal pump on water per second per unit weight of water	Evaluate	9
5	What do you mean by manometric efficiency, mechanical efficiency and over all efficiency of a centrifugal pump ?	Evaluate	9
6	What is the difference between single stage and multi stage pump? Describe multi stage pump with a) impellers in parallel b) impellers in series.	Apply	9
7	Find the rise in pressure in the impeller of a centrifugal pump through which water is flowing at the rate of 15 liter/s. The internal and external diameters of the impeller are 20 cm and 40 cm respectively. The widths of impeller at inlet and out let are 1.6 cm and 0.8 cm. The pump is running at 1200 r .p. m. The water enters the impeller radially at inlet and impeller vane angle at out let is 30^0. Neglect losses through the impeller.	Apply	9
8	The diameter of an impeller of a centrifugal pump at inlet and out let are	Apply	9

S. No	QUESTION	Blooms Taxonomy Level	Course Outcome
	300 mm and 600 mm respectively .the velocity of flow at out let 2.5 m/s and vanes are set back at an angle of 45^0 at out let determine the minimum starting speed of the pump if the manometric efficiency 75%.		
9	A three stage centrifugal pump has impeller 40 cm in diameter and 2.5 cm wide at outlet .The vanes are set back at the outlet at 30^0 and reduce the circumferential area by15 %. The manometric efficiency is 85 % and overall efficiency is 75 % .determine the head generated by the pump when running at 12000 r.p .m and discharge is 0.06 m^3/s .Find the shaft power also.	Apply	9
10	A centrifugal pump rotating at 1000 rpm delivers 160 liters/sec of water against a head of 30 m the pump is installed at a place where atmospheric pressure is 1 $X10^5$ pa (abs) and vapour pressure of water is 3 k pa (abs) the head loss in suction pipe is equivalent to 0.2 m of water calculate Minimum NPSH, Maximum allowable height of pump from free surface of water in the sump.	Evaluate	9

PREPARED BY: Dr. Venkata Ramana Gedela, Professor, Civil Department

HOD, CIVIL ENGINEERING