ID No.:_____ Exam Seat No.:_____

Kadi Sarva Vishwavidyalaya
Mechanical Engineering
B. E. 6th Semester Final Examination 2015

Subject: Fluid Power Engineering (ME 604) **Total Marks: 70**

Time: 10:30 AM – 1:30 PM **Date: 04/05/2015**

Instructions:

1. **Attempt all questions as directed and answer each section in separate main answer sheets.**
2. **Figures to the right indicate full marks.**
3. **Make suitable assumptions.**
4. **Please don't carry any type of Communication Gadgets, Programmable Calculators, etc., with you during the examination except Scientific Calculators.**
5. **Please don't write anything on this question paper except your Enrollment and ID Number.**
6. **Please keep your Identity Cards and Hall Tickets on your desk during the examination.**
7. **Please follow all the instructions provided by authorized university and institute personnel.**

Section - I

Q. 1 ***Total: 15***

A.	Explain various losses in energy while fluid flows through pipe. Also, write Darcy-Weisbach equation and explain it with example.	*5*
B.	Show that the efficiency of a free jet striking normally on a series of flat plates mounted on the periphery of a wheel can never exceed 50 %.	*5*
C.	Show that when a jet of water impinges on a series of curved vanes, maximum efficiency is obtained when the vane is semi-circular and the velocity of jet is double the velocity of vane.	*5*
	OR	
C.	Find an expression for the propelling force and the work done per sec. on a tank which is provided with an orifice through which jet of water is coming out and the tank is free to move.	*5*

Q. 2 ***Total: 10***

A.	Sketch a hydro-power plant and explain its different elements.	*5*
B.	The following data relate to a Pelton wheel. Tangential velocity of bucket=25 m/s Head of water=65 m Deflection of jet on bucket=1650 Discharge through the nozzle=110 liters/s Co-efficient of nozzle=0.95 Determine the power developed by the runner and the efficiency	*5*
	OR	

Q. 2 **Total: 10**

A. Explain the governing of Francis turbine with neat sketch. **5**

B. A jet of water impinges on a symmetrically curved vane at its center. The velocity of the jet is 60 m/s and the diameter 120 mm. the jet is deflected through an angle of 120° Calculate the force on the vane if the vane is fixed. Also determine the force if the vane moves with a velocity of 25 m/s in the direction of the jet. What will be the power and efficiency? **5**

Q. 3 **Total: 10**

A. What are the ill effects of cavitations in turbine? Give causes and remedies to avoid cavitations in a hydraulic turbine. **5**

B. Francis turbine designed to develop 160 kW working under a head 10 m and running at 200 rpm. The hydraulic losses in turbine are 15% of available energy. The overall efficiency of turbine is 80%. Assume flow ratio=0.94 and speed ratio=0.25. Calculate: (1) guide blade angle and runner vane angle at inlet and (2) diameter and width at inlet. **5**

OR

Q. 3 **Total: 10**

A. What is a draft tube? Why is it used in a reaction turbine? What are the various types of it? Explain with neat sketch. **5**

B. Explain the following terms with reference to water turbines. Give expression of each efficiencies. **5**
(1) Hydraulic efficiency
(2) Mechanical efficiency
(3) Overall efficiency

Section - II

Q. 4 **Total: 15**

A. Discuss the various characteristic curves of a centrifugal pump. **5**

B. Derive an expression for the minimum speed for starting of a centrifugal pump. **5**

C. Find the power required to drive a centrifugal pump which delivers $0.04 m^3/s$ of water to a height of 20 m through a 15 cm diameter pipe and 100 m long. The overall efficiency of the pump is 70 % and co-efficient of friction f = 0.015 in the formulae $h_f = 4flv^2 / 2gd$. **5**

OR

C. A centrifugal pump has impeller of 25 cm diameter at inlet and 50 cm diameter at outlet and runs at 1600 rpm. The vanes are set back at an angle of 300 to the outer rim if velocity of flow through impeller is constant at 3 **5**

m/s and entry to the impeller is radial. Calculate the vane angle at inlet and work done on the wheel per kg of water.

Q. 5 **Total: 10**

A. Show that for a two stage reciprocating air compressor with complete inter cooling the total work of compression becomes minimum when the pressure ratio in each stage is equal. **5**

B. What is pre-whirl? Sketch the velocity diagrams with and without pre whirl for a centrifugal compressor. **5**

OR

Q. 5 **Total: 10**

A. Prove that the work done / kg of air in single stage reciprocating air compressor without clearance is given by **5**

$$W = \frac{n}{n-1} RT_1\{(\frac{P_2}{P_1})^{\frac{n-1}{n}} - 1\}$$

Where notations have their usual meaning.

B. Explain the phenomenon of surging and stalling in an axial flow air compressor. **5**

Q. 6 **Total: 10**

A. With a suitable sketch explain the working principle of an axial flow compressor. Draw the stage velocity triangles. **5**

B. A centrifugal air compressor has a pressure ratio of 4:1 with an isentropic efficiency 88% when running at 14000 rpm and including air at 25° C. Curved vanes at inlet give the air a pre-whirl of 18° to axial direction at all radii and the mean diameter of eye is 245 mm. The absolute air velocity at inlet is 120 m/s. Impeller tip diameter is 580 mm. Calculate slip factor. **5**

OR

Q. 6 **Total: 10**

A. Write a short note on hydraulic ram. **5**

B. An axial flow air compressor stage has a mean diameter of 60 cm. and runs at 15000 rpm if the actual temperature rise and pressure ratio developed are 30 °C and 1.35 respectively. Determine : **5**
(I) Power required driving the compressor while delivering 57 kg/s of air, if the mechanical efficiency is 86 percent and inlet temperature rise is 35 °C.
(II) The stage loading coefficient.
(III) The degree of reaction if the temp. at the rotor exit is 55 °C

Our best wishes are always with you...