Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER– V • EXAMINATION – WINTER 2016

Subject Code: 151903 Date: 19/11/2016
Subject Name: FLUID POWER ENGINEERING
Time: 10:30AM – 01:00PM Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary and mention them clearly.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** At a sudden enlargement of a water main from 240mm to 480mm diameter if hydraulic gradient rises by 10 mm calculate rate of flow. **07**

(b) Derive the equation for efficiency of propulsion for ship when orifices face the direction of motion of ship. Calculate the value of efficiency when Velocity of ship and absolute velocity of jet are equal. **07**

Q.2 **(a)** Define specific speed for turbine. Derive its equation for hydraulic turbine. Give classification of hydraulic turbines based on value of specific speed. **07**

(b) A Pelton wheel is designed for the following specifications: **07**
Shaft power = 9.56MW , Head = 350 m, speed = 750 rpm, Overall efficiency of turbine = 85% . Condition is imposed that jet diameter should not exceed $1/6^{th}$ of wheel diameter.
Calculate : The wheel diameter, Jet diameter and the number of jet required.
Take : Speed ratio = 0.45 and co-efficient of velocity = 0.985.

OR

(b) A Kaplan turbine develops 22 MW at an average head of 35 m. Calculate diameter of runner, speed and specific speed of the turbine. **07**
Use following data for Kaplan turbine:
Speed ratio = 2, Flow ratio = 6, Diameter of boss = 0.35* Diameter of runner, Overall efficiency = 0.88 .

Q.3 **(a)** Define and derive equation of NPSH in centrifugal pump ? How its value significantly affects efficiency of centrifugal pump. **07**

(b) A centrifugal pump impeller runs at 80 rpm and has an outlet vane angle is of 60^0. The velocity of flow is 2.5 m/s throughout and diameter of the impeller at exit is twice that at inlet. If manometric head is 20 m and manometric efficiency is 75%, Calculate : **07**
1) Diameter of impeller at exit
2) Inlet vane angle and
3) Tangential velocity of impeller at inlet.

OR

Q.3 **(a)** Draw an indicator diagram for single acting reciprocating pump by considering effect of acceleration and friction in suction and delivery pipes. Find an expression for the work done per second for it. **07**

(b) A single acting reciprocating pump has a diameter of piston is 100 mm and stroke length is 200 mm. The length and diameter of suction pipe is 6.5 m and 50 mm respectively. If the suction lift is of the pump is 3.2 m and the separation occurs when the pressure in the pump falls below 2.5 m of water absolute. Find the maximum speed in rpm at which the pump can be run without separation in the suction pipe. Take atmospheric pressure is 763 mm of Hg. **07**

Q.4 **(a)** Derive an expression of work done per cycle for reciprocating compressor by considering clearance volume. **07**

(b) Free air delivered by a centrifugal compressor is 20 kg/min. The inlet conditions are 1 bar and 20^0C static. The velocity of air at inlet is 60 m/s. The isentropic efficiency of the compressor is 0.7. The total head pressure ratio is 3. Calculate a) The total head temperature at exit and b) Power required by the compressor if mechanical efficiency is 95%. **07**

OR

Q.4 **(a)** Discuss salient features of radial, backward and forward curved vanes in a centrifugal compressor using velocity triangles and head-capacity curves **07**

(b) The mass flow rate of multi stage axial flow compressor is 20 kg/s of air. The stage efficiency is 0.9. the inlet conditions are 1 bar and 300K. The stage pressure ratio is constant and the temperature rise in the first stage is 20^0 C. The temperature at the end of isentropic compression is 500 K. Calculate i) The delivery pressure at the end of last stage, ii) The total pressure ratio and iii) The number of stages. **07**

Q.5 **(a)** Write working principle of hydraulic press. Derive equation for 'leverage of press' and state uses of hydraulic press. **07**

(b) Draw p → V diagram for two stage reciprocating air compressor. Write equation for indicated work per cycle and find out optimum intermediate pressure for minimum work supply. **07**

OR

Q.5 **(a)** Explain in brief working of hydraulic ram with neat sketch. Derive equation for efficiency. **07**

(b) Explain the phenomenon of surging and stalling in an axial flow compressor. **07**

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