

C.U.SHAH UNIVERSITY

Summer Examination-2017

Subject Name : Fluid Power Engineering

Subject Code : 4TE05FPE1

Branch : B.Tech (Mechanical)

Semester : 5

Date :22/03/2017

Time :2:30 To5:30

Marks :70

Instructions:

- (1) Use of Programmable calculator & any other electronic instrument is prohibited.
 - (2) Instructions written on main answer book are strictly to be obeyed.
 - (3) Draw neat diagrams and figures (if necessary) at right places.
 - (4) Assume suitable data if needed.
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Q-1

Attempt the following questions:

14

- a) The force of impingement of a jet on a vane increases if:
 - (a) the vane angle is increased
 - (b) the vane angle is decreased
 - (c) the pressure is reduced
 - (d) the vane is moved against the jet.
- b) Which one of the following is an example of a pure (100%) reaction machine?
 - (a) Pelton wheel, (b) Francis turbine
 - (c) Modern gas turbine, (d) Lawn sprinkler
- c) In the case of Francis turbine, velocity ratio is defined as $\frac{V_3}{\sqrt{2gh}}$ where H is the available head and V_3 is the
 - (a) absolute velocity at the draft tube inlet
 - (b) mean velocity of flow in the turbine
 - (c) absolute velocity at the guide vane inlet
 - (d) flow velocity at the rotor inlet
- d) Kaplan turbine is
 - (a) a high head mixed flow turbine
 - (b) a low axial flow turbine
 - (c) an outward flow reaction turbine
 - (d) an impulse inward flow turbine
- e) Which one of the following is not correct regarding both Kaplan and propeller turbines?
 - (a) The runner is axial
 - (b) The blades are wing type
 - (c) There are four to eight blades
 - (d) The blades can be adjusted
- f) What is the purpose of a surge tank in high head hydroelectric plants?
 - (a) To prevent water hammer due to sudden load changes
 - (b) To improve the hydraulic efficiency
 - (c) To prevent surges in generator shaft speed
 - (d) To act as a temporary storage during load changes



- g) In hydraulic power-generation systems, surge tanks are provided to prevent immediate damage to
 - (a) draft tube (b) turbine (c) tail race (d) penstocks
- h) Manometric efficiency of a centrifugal pump is defined as the ratio of
 - (a) Suction head to the head imparted by the impeller to water,
 - (b) head imparted by the impeller to water to the suction head,
 - (c) manometric head to the head imparted by the impeller to water,
 - (d) head imparted by the impeller to water to the manometric head
- i) Multistage centrifugal pumps are used to obtain
 - (a) high discharge (b) high head (c) pumping of viscous fluids (d) high head and high discharge (e) high efficiency.
- j) Which one of the following helps in avoiding cavitation in centrifugal pumps?
 - (a) Low suction pressure (b) High delivery pressure
 - (c) Low delivery pressure (d) High suction pressure
- k) hydraulic coupling belongs to the category of
 - (a) power absorbing machines
 - (b) power developing machines
 - (c) energy transfer machines
 - (d) energy generating machines
- l) To carry water under pressure from large reservoir to turbine is a function of
 - (a) Spill way (b) Penstock (c) Draft tube (d) Tail race
- m) The Bernoulli's equation refers to conservation of
 - (a) Mass (b) linear momentum (c) energy (d) angular momentum
- n) Cavitation in a hydraulic turbine is most likely to occur at the turbine
 - (a) entry (b) rotor exit (c) stator exit (d) all of above

Attempt any four questions from Q-2 to Q-8

Q-2

Attempt all questions

- a) 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 %. **07**
- b) A water jet of area 13cm^2 having a velocity of 25m/s strikes a flat plate normal to which is inclined at 40° to the axis of jet. Plate moves a velocity of 10m/s along its normal axis. Find (i) normal force exerted by jet on plate (ii) power produced (iii) efficiency. **07**

Q-3

Attempt all questions

- a) What is a draft tube? Why is it used in a reaction turbine? What are the various types of it? **07**
- b) A hydroelectric power plant developing 80MW brake power under the head 450m and at 450 rpm , determine (a) total quantity of water required, (b) diameter of jet, diameter of runner, (c) no. of nozzle required, (d) no. of buckets in runner. Assuming overall efficiency. Take $\eta_0 = 90\%$, jet ratio $D/d = 10$, co-efficient of velocity $C_v = 0.97$ and speed ratio $= 0.46$. **07**



- Q-4 Attempt all questions**
- a) How will you obtain an expression for the minimum speed for starting of a centrifugal pump? **07**
- b) A Kaplan turbine develops 15000kW power with a head of 30 m. hub diameter of runner is 0.35 times the outer diameter of the runner. Assuming a speed ratio of 2.0 and flow ration of 0.65 and overall efficiency of 90% calculate: (i) diameter of runner (ii)rotational speed of turbine. (iii) specific speed. **07**
- Q-5 Attempt all questions**
- a) What is pre-whirl? Sketch the velocity diagrams with and without pre whirl for a centrifugal compressor. **07**
- b) A centrifugal pump delivers 250 lps of water against a head of 50 m at a designed speed of 900 rpm. The internal and external diameter of impeller are 350 mm and 700 mm respectively. The vane angle at exit is 35° . The width of impeller at inlet is 70mm and at outlet is 35mm. determine the following :
Manometric efficiency (ii) inlet vane angle (iii) loss of head at inlet if discharge is reduced by 40% assume, radial entry **07**
- Q-6 Attempt all questions**
- a) Write short note on the following (Any two) **07**
(I) Hydraulic ram
(II) Screw compressor
(III) Roots blower
- b) Discuss Characteristic curves of Hydraulic turbines. **07**
- Q-7 Attempt all questions**
- a) Show that for a two stage reciprocating air compressor with complete intercooling the total work of compression becomes minimum when the pressure ratio in each stage is equal. **07**
- b) A hydraulic crane has a jigger of multiplication factor of 6. Other data is as follows: diameter of ram, $D = 0.2$ m, length of pipe, = 300m, pressure of water in pipe= 8830kPa, Friction factor = 0.01, load on crane to be lifted = 2000gN, velocity of load = 5m/s, mechanical efficiency of crane = 0.9 **07**
Calculate the required diameter of pipe. In case the pipe diameter is 8cm, find the load and its speed of raising if the same maximum power is available from the system.
- Q-8 Attempt all questions**
- a) A jet of water 10 cm diameter impinges normally on a fixed vertical plate with a velocity of 25 m/s. Calculate force exerted on the plate. **04**
- b) Derive expressions for work done for impact of jet on a moving inclined plate **05**
- c) Explain impulse turbine with neat sketch. **05**

