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SE-8300

B. E. III (Sem. V) (Mech.) Examination

May / June – 2011

Fluid Power Engineering

(New Course)

Time : **3** Hours] [Total Marks : **100**

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી. **Fillup strictly the details of ☛ signs on your answer book.** Name of the Examination : ☛ **B. E. 3 (Sem. 5) (Mech.)** Name of the Subject : ☛ **Fluid Power Engineering** ☛ Subject Code No. : **8 3 0 0** ☛ Section No. (1, 2,.....) : **Nil**	Seat No. : Student's Signature

(2) Attempt all questions.

(3) Use of calculate is permitted.

(4) Figures to the right side indicate full marks.

(5) Assume suitable data if required.

1 Answer the following : **10**

(i) The power which appears in the expression for the specific speed :

(a) Shaft power

(b) Water power

(c) Power inflow turbine

(d) None of above

(ii) Muschel curve means

(a) Curves at constant head

(b) Curves at constant speed

(c) Curves at constant efficiency

(d) All of above

(iii) The runner passage of reaction turbine are _____ filled with water (partially, fully)

(iv) _____ turbine is also known as propeller turbine. (Kaplan, Fransis, Pelton)

(v) The runner of tank is used to avoid reversal of flow. (True or False)

(vi) Define peak load
(vii) Define unit discharge of turbine
(viii) Define Mechanical efficiency
(ix) Define degree of reaction of turbine.
(x) The area of casing of reaction turbine _____ in order to flow over the periphery. (increased, reduced, remain same)

2 Answer the following questions : **20**

(i) A pelton wheel is to be designed for the following specifications. Shaft power = 11772 kW, Head = 380 meters, Speed = 750 rpm, overall efficiency = 86%, Jet diameter is not exceed one sixth of wheel diameter. Determine
   (a) the wheel diameter
   (b) the number of jet required
   (c) diameter of jet
   Take KV_1 = 0.985 and Ku_1 = 0.45.

(ii) A jet of water diameter 75 mm moving with a velocity of 25 m/sec strikes a fixed plate in such a way that the angle between the jet and the plate 60°. Find the force exerted by the jet on the plate
   (a) in the direction normal to the plane
   (b) in the direction of jet.

(iii) A reaction turbine works at 450 rpm under a head of 120 m. Its diameter at inlet is 120 cm and flow area is 0.4 m^2. The angles made by absolute and relative velocity are 20° and 60° respectively. With the tangential velocity determine :
   (a) The volume flow rate
   (b) the power developed
   (c) efficiency

(iv) A Kaplan turbine develops 24647.6 kw power at an average head of 39 meters. Assuming a speed ratio of 2, flow ratio of 0.6, diameter of boss equal to 0.35 times the diameter of runner and an overall efficiency of 90% calculate the diameter speed and specific speed of the turbine.

3 Answer the following questions : (any **three**) **20**

(i) Explain with neat sketch working of Kaplan Turbine
(ii) Explain with neat sketch working of hydroelectric power plant.
(iii) Write a short note on Draft Tube.
   - Function of draft tube
   - Classification on draft tube
   - Draft tube theory
(iv) What do you mean by priming ? Discuss different methods of priming

4 (a) Define any five from the following : **5**

(i) Hydraulic Gradient Line (H.G.L)
(ii) Prewhirl
(iii) Water hammer
(iv) Syphon
(v) Volumetric efficiency
(vi) Surging

(b) Match part 'A' with part 'B' for following : **5**

A		B	
(i)	Chocking	(a)	Represents sum of kinetic, pressure and potential head
(ii)	Air-vessel	(b)	Total discharge is same in each pipe
(iii)	Slip	(c)	Total head loss is same in each pipe
(iv)	Total Energy line	(d)	Limiting maximum mass flow rate
(v)	Pipes in parallel	(e)	Reciprocating pump
		(f)	Non-radial flow exit from the compressor tip

5 (a) Attempt any **two** : **15**

(i) In a two stage air compressor, the L.P. cylinder draws in 0.15 m^3 of air at temperature of 15°C and a pressure of 1 bar absolute. It is compressed adiabatically to 2.0 bar absolute and then delivered to a receiver where the air is cooled under constant pressure to 15°C. The air is then drawn into H.P. cylinder and compressed abiabatically to 4 bar absolute. Find the I.P. required when running single acting at 100 r.p.m.

(ii) Determine the power required to compress the air from following particulars which relate to a single acting two stage reciprocating compressor.
L.P. cylinder dia = 30 cm, stroke = 20 cm
N = 240 r.p.m.
Delivery presure = 25 bar
Intermediate pressure = 5 bar, temperature of air entering the H.P. cylinder = 35°C,
law of compression $PV^{1.3}$ = constant, volume sucked = 3/4 of the swept volume of L.P. cylinder at 1 bar and 15°C.

(iii) An accumulator is loaded with 300 kN weight. The ram has a diameter of 250 mm and stroke of 5m. Its friction may be taken as 5 per cent. It takes two minutes to fall through its full stroke. Find the total work supplied and power delivered to the hydraulic appliance by the accumulator when 0.0070 m^3/s of liquid is being delivered by a pump, while the accumulator descends9 with the stated velocity.

(b) Attempt any **two** : **10**

(i) Write short note with neat sketch on hydraulic ram. Also describe parameters affecting efficiency of hydraulic ram.

(ii) Derive condition for maximum power transmission through pipes and derive maximum efficiency of power transmission corresponding to that.

(iii) Write short note on

(a) Screw compressor

(b) Scroll compressor

6 Attempt any **two** : **15**

(i) Two reservoirs have a difference of water levels of 60 m and are connected through a piping system consisting 40 cm diameter, 500 m long single pipe, branching two pipes of 20 cm diameter and 600 m long each. A pump installed at lower reservoir and single pipe base. A pump delivers 0.25 m^3/s water to higher reservoir. Calculate the input power for the pump using with and without concept of equivalent pipe. Assume for all pipes $f = 0.008$ and efficiency of pump $\eta_{pump} = 0.68$.

(ii) Determine the number of radial impeller vanes using stanitz formulae for a centrifugal compresor which requires 180 kJ of power input per unit mass flow rate and is running at 15000 rpm. Guide vanes at inlet give the air a prewhirl of 25° to the axial direction at all radial and the mean diameter of the eye is 250 mm. The impeller tip diameter is 600 mm. The absolute air velocity at inlet is 150 m/s.

(iii) An axial flow 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° and 1.35 respectively. Determine :

(a) power required to drive the compressor while delivering 57 kg/s of air, if mechanical efficiency is 86% and inlet temperature is 35°C.

(b) The stage loading coefficient

(c) The stage efficiency and

(d) The degree of reaction if the temperature at the rotor exit is 55°C.