SV - 80

Total No. of Pages : 4

Seat No.	

S.E. (Mechanical Engineering) (Part - II) (Semester - IV) (Revised) Examination, May - 2018
FLUID AND TURBO MACHINERY
Sub. Code: 63362

Day and Date : Friday, 11 - 05 - 2018 **Total Marks : 100**

Time : 10.00 a.m. to 1.00 p.m.

Instructions :
1) **All questions are compulsory.**
2) **Figures to the right side indicate full marks.**
3) **Assume suitable data, if necessary and indicate clearly.**
4) **Use non programmable calcualtor is allowed.**

Q1) a) Explain different efficiencies of hydraulic turbine. **[8]**

b) A Pelton wheel is to be designed for following specifications **[8]**

i) Shaft Power = 13250 kW

ii) Head = 800 m

iii) Speed = 600 rpm

iv) Peripheral velocity = $0.46\sqrt{2gH}$

v) Overall efficiency = 85%

vi) The diameter of the jet is not exceeding one sixteenth the wheel diameter.

Take coefficient of velocity 0.97 and determine,

1) Discharge through turbine
2) Diameter of wheel
3) Diameter of jet
4) Number of jet required

OR

c) A Pelton wheel is revolving at a speed of 190 rpm and develops 5150.25 kW when working under head of 220 m with an overall efficiency of 80%. The speed ratio for turbine is given as 0.47. Determine unit speed, unit discharge and unit power. Also find speed when this turbine is working under a head of 140 m. **[8]**

P.T.O.

Q2) a) State working principle of Reaction turbine and explain working of any one reaction turbine. **[8]**

b) A Francis turbine with overall efficiency of 75% is required to produce 148.25 kW power. It is working under a head of 7.62 m. The peripheral velocity = $0.26\sqrt{2gH}$ and radial velocity of flow at inlet is $0.96\sqrt{2gH}$. The wheels runs at 150 rpm and hydraulic losses in turbine are 22% of available energy. Assuming radial discharge. **[8]**

Derermine:

i) Guide blade angle,

ii) Wheel vane angle,

iii) Diameter of wheel,

iv) Width of wheel at inlet.

OR

c) A conical draft tube having diameter at the top as 2 m and pressure head of 7 m of water (vacuum), discharges water at the outlet with a velocity of 1.2 m/s at the rate of 25 m^3/s. If atmospheric pressure head is 10.3 m of water and losses between the inlet and outlet of the draft tube are negligible, find the length of draft tube immersed in water. Total lenght of tube is 5m. **[8]**

Q3) a) Explain construction of centrifugal pump and define different heads available for pump. **[8]**

b) Write a short note (any two): **[10]**

i) Explain multistage of pump.

ii) What is Cavitation and also comments on effects, precautions.

iii) Explain performance curves of pump.

OR

c) Solve following problems. **[10]**

i) A centrifugal pump is used to discharge 0.118 m^3/s of water at a speed of 1450 rpm against a head of 25m. The impeller diameter is 250 mm, its width at outlet is 50 mm and manometric efficiency is 75%. Determine the vane angle at outer periphery of impeller.

ii) Find the number of pumps required to take water from a deep well under a total head of 89m. All pumps are identical and are running at 800 rpm. The specific speed of each pump is given as 25 rpm while the rated capacity of each pump is 0.16 m^3/s.

Q4) a) Why the clearance volume is provided in reciprocating air compressor. Explain its effect on the work required to drive the compressor. **[8]**

b) Write a short note (any two): **[10]**

i) Explain root blower and vane blower compressor.

ii) Different efficiencies of reciprocating air compressor.

ii) Different applications of compressed air.

OR

c) Solve following problems. **[10]**

i) A two stage single acting reciprocating air compressor draws in air at a pressure of 1 bar and 17°C and compresses it to a pressure of 60 bar. After compression in the low pressure cylinder, the air is cooled at constant pressure of 8 bar to a temperature of 37°C. The low pressure cylinder has a diameter of 150 mm and both cylinders have 200 mm stroke. If law of compression is PV^{135}= constant, find the power of the compressor, when it runs at 200 rpm. Take R = 287 J/kg K.

ii) A single stage reciprocating air compressor takes in 7.5 m^3/min of air at 1 bar and 30°C and delivers it at 5 bar. The clearance is 5 percent of the stroke. The expansion and compression follows $PV^{1.3}$ = constant. Calculate Temperature of delivered air volumetric efficiency & power of the compressor.

Q5) a) Explain terms Surging, Chocking, and Stalling for centrigual air compressor. **[8]**

b) A centrifugal compressor running at 10000 rpm delivers 660 m^3/min of free air. The air is compressed from 1 bar and 20°C to pressure ratio of 4 with isentropic efficiency of 82%. Blades are radial at outlet of impeller and flow velocity of 62 m/s may be assumed throughout constant. The outer radius of impeller is twice the inner and the slip factor may be assumed as 0.9. The blade area co-efficient may be assumed 0.9 at inlet. Calculate:

i) Theoretical power

ii) Impeller diameters at inlet and outlet. Also find breadth of impeller at inlet. **[8]**

OR

c) An axial flow compressor having eight stages with 50% reaction design compresses air in the pressure ratio of 4:1. The air enters the compressor at 20°C and flows at a constant speed of 90 m/s. The rotating blades of compressor rotate with a mean speed of 180 m/s. Isentropic efficiency of the compressor taken as 82%. Calculate,

i) Work done by machine

ii) Blade angles

Take $\gamma = 1.4$ and $c_p = 1.005$ kJ/kg K. **[8]**

Q6) a) Compare gas turbine with reheating and intercooling. **[8]**

d) A gas turbine unit has a pressure ratio of 6:1 and maximum cycle temperature of 610°C. The isentropic efficiencies of the compressor and turbine are 80% and 82% respectively. Calculate the power output in kW of an electric generator geared to the turbine when air enters the compressor at 15°C at the rate of 16 kg/s.

Take $\gamma = 1.4$ and $c_p = 1.005$ kJ/kg K for the compression process and $\gamma = 1.333$ and cp = 1.11 kJ/kg K for the expansion process. **[8]**

OR

c) In an oil-gas turbine installation, it is taken at pressure of 1 bar and 27°C and compressed to a pressure of 4 bar. The oil with calorific value of 42000 kJ/kg is burnt in the combustion chamber to raise the temperature of air 550°C. If the air flows at the rate of 1.2 kg/s, find the net power of installation and air fuel ratio. **[8]**

Take $c_p = 1.05$ kJ/kg K and $c_v = 0.714$ kJ/kg K.

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