Total No. of printed pages = 8

ME 131704

Roll No. of candidate | | | | | | | | | | |

2017

B.Tech. 7th Semester End-Term Examination

Mechanical

TURBO MACHINERY

Full Marks – 100 Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer question No. 1 and any six from the set.

1. Choose the correct answer : $(10 \times 1 = 10)$

   (a) De-Laval turbine is
   - (i) pressure compounded impulse turbine
   - (ii) velocity compounded impulse turbine
   - (iii) simple single wheel impulse turbine
   - (iv) simple single wheel reaction turbine

   (b) For maximum blade efficiency for single stage impulse turbine
   - (i) $\rho = \cos^2 \alpha$
   - (ii) $\rho = \cos \alpha$
   - (iii) $\rho = \frac{\cos \alpha}{2}$
   - (iv) $\rho = \frac{\cos^2 \alpha}{2}$

[Turn over

(c) In a surface condenser if air is removal, there is

(i) fall in absolute pressure maintained in condenser

(ii) rise in absolute pressure maintained in condenser

(iii) no change in absolute pressure in the condenser

(iv) rise in temperature of condensed steam

(d) Evaposative type of condenser has

(i) steam in pipes surrounded by water

(ii) water in pipes surrounded by steam

(iii) either (i) or (ii)

(iv) none of the above

(e) The specific speed of a hydraulic turbine is given by

(i) $\frac{N\sqrt{P}}{H^{5/4}}$

(ii) $\frac{P\sqrt{N}}{H^{5/4}}$

(iii) $\frac{NP}{H^{3/2}}$

(iv) $\frac{\sqrt{NP}}{H^{3/2}}$

(f) In a reaction turbine the draft tube is used to

(i) transport water to down stream without eddies

(ii) reconvert kinetic energy to flow energy by a gradual expansion of the flow cross-section

(iii) increase the effective head

(iv) prevent air from entering

(g) Francis turbine is best suited for

(i) medium head application

(ii) high head installation

(iii) low head installation

(iv) any types of heads

(h) The degree of reaction of a turbine is defined as the ratio of

(i) static pressure drop to total energy transfer

(ii) total energy transfer to static pressure drop

(iii) change of kinetic energy across the turbine to the total energy transfer

(iv) kinetic energy to pressure energy

(i) Specific speed of a pump is the speed at which a pump runs when

(i) head developed is unity and discharge is one cubic meter

(ii) head developed is unity and shaft horse power is also unity

(iii) discharge is one cubic meter and shaft horse power is unity

(iv) none of the above

(j) Cavitation will take place if the pressure of the following fluid at any point is

(i) more than vapour pressure of the fluid

(ii) equal to vapour pressure of the fluid

(iii) is less than vapour pressure of the fluid

(iv) none of the above

2. (a) Derive the expression for the minimum blade efficiency of an impulse steam turbine having equiangular blades and blade velocity coefficient as one. (7)

(b) In a De Laval turbine steam issues from the nozzle with a velocity of 1200 m/s. The nozzle angle is 20°, the mean blade velocity is 400 m/s and the inlet and outlet angles of blades are equal. The mass of the steam-flowing through the turbine per hour is 1000 kg. Draw the velocity diagram (using scale and protector) with suitable scale and calculate,

(i) Blade angles

(ii) Relative velocity of steam entering the blades

(iii) Tangential force on the blades

(iv) Power developed

(v) Blade efficiency.

Take blade velocity coefficient as 0.8. (8)

3. (a) What do you mean by compounding of steam turbine? (2)

(b) With neat diagram explain one compounding method for simple impulse turbine. (5)

(c) A simple impulse turbine has a mean blade speed of 200 m/s. The nozzle are inclined at 20° to the plane of rotation of blades. The steam velocity from nozzles is 600 m/s. The turbine uses 3500 kg/h of steam. The absolute velocity at exist is along the axes of the turbine. Determine.

(i) The inlet and exit angles of the blade (blades are equiangular)

(ii) The power output of the turbine

(iii) The diagram efficiency

(iv) The axial thrust (per kg steam per second). (8)

4. (a) Define :

(i) Condenser efficiency

(ii) Vacuum efficiency. (3)

(b) What is jet condenser? Describe low level jet condenser with neat diagram. (5)

(c) In a surface condenser a section of the tubes near to the air pump suction is screened of so that the air is cooled to a temperature below that of the condensate, separate extraction pumps being provided to deal with air and condensate respectively. 5448 kg of steam are condensed per hour and the air leakage is 4.54 kg/h. The temperature of the exhaust steam is 31°C, the temperature of the condensate is 27°C and the temperature at the air pump suction is 21.1°C. Assuming a constant vacuum through the condenser, find.

(i) the mass of steam condensed per hour in the air cooler

(ii) the volume of air in m^3/h to be dealt with by the air pump

(iii) the percentage reduction in necessary air pump capacity following the cooling of the air. (7)

5. (a) Define the following terms :

(i) Gross head

(ii) Net head

(iii) Hydraulic efficiency

(iv) coefficient of velocity

(v) Bucket ratio. (1 + 1 + 2 + 2 + 1 = 7)

(b) A reaction turbine works at 450 rpm under a nead of 120 meters. Its diameter at inlet is 120 cm and the flow area is 0.4 m^2. The angles made by absolute and relative velocities at inlet are 20° and 60° respectively with the tangential velocity. Determine

(i) the volume flow rate

(ii) the power developed

(iii) hydraulic efficiency.

Assume whirl at outlet to be zero. (8)

6. (a) Define the specific of a turbine. Derive an expression for the specific speed. (2 + 5 = 7)

(b) A Pelton wheel is resolving at a speed of 190 r.pm. and develops 5150. 25 kw when working under a head of 220 m. With an overall efficiency of 80%. Determine unit speed, unit discharge and unit power. The speed ratio for the turbine is given as 0.47. Find the speed, discharge and power when this turbine is working under a head of 140 m. (8)

7. (a) Derive an expression for the minimum speed of starting a centrifugal pump. (6)

(b) A centrifugal pump having outer diameter equal to two times the inner diameter and running at 1200 r.p.m against a total head of 75 m. The velocity of flow through the impeller is constant and equal to 3 m/s. The vanes are set back to an angle at 30° at outlet. If the out let diameter of the impeller is 60 cm and width at outlet is 5 cm, determine

(i) vane angle at inlet,

(ii) work done/sec by impelles and

(iii) man metric efficiency. (3 + 3 + 3 = 9)

8. (a) Define slip, percentage slip and negative slip of a reciprocating pump. (5)

(b) State three differences between centrifugal pumps and reciprocating pump. (3)

(c) A single-acting reciprocating pump, running at 50 r.p.m delivers 0.01 m^3/s of water. The diameter of the piston is 200 mm and stroke length 400 mm. Determine :

(i) the theoretical discharge of the pump

(ii) co-efficient of discharge

(iii) slip and the percentage slip of the pump.

(7)

9. Write short notes on any THREE of the following :

$(3 \times 5 = 15)$

(a) Cooling tower

(b) Reheat factor

(c) Cavitation of centrifugal pump

(d) Fluid coupling

(e) Gear pump

(f) Air vessels.
