CS/B.Tech(PWE)/SEM-6/PWE-602/2012

2012

STEAM TURBINE & ITS AUXILIARIES

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer Question Nos. 1 & 2 and any *three* questions from the rest.

1. Choose the correct alternatives for the following : 10x1 = 10

i) Function of fixed blade of a reaction turbine is

a) to convert heat energy into kinetic energy

b) to guide the steam to the moving blade

c) to convert kinetic energy into mechanical energy

d) both (a) and (b).

ii) Impulse balding is used in large utility turbine

a) in 1st stage of IP turbine

b) in last stage of HP turbine

c) in last one or two stage of HP turbine

d) in 1st stage of LP turbine.

iii) Source of PRDS steam is

a) boiler drum b) auxiliary boiler

c) main steam line d) HP heater.

iv) Condenser vacuum is created by

a) ejectors

b) CEP

c) circulating water / cooling water

d) vacuum pump.

v) During normal running, oil supply to the governing system is from

a) auxiliary oil pump b) DC oil pump

c) main oil pump d) seal oil pump.

vi) All hydraulic tripping circuit passes through

a) starting device b) speeder gear

c) trimming device d) main trip valve.

vii) Function of a De-aerator is

a) to provide storage for BFP

b) to heat the feed water

c) to remove oxygen and other dissolved gasses

d) all of these.

viii) In reaction turbine the revolving motion of the rotor is produced by

a) kick back force developed by expansion of steam in moving blade

b) impulse force produced due to change in velocity

c) both (a) and (b)

d) it depends upon operating load.

ix) In 210 MW KWU turbine, the axial expansion of HP inner casing takes place towards

a) Generator side

b) front pedestal bearing

c) both sides

d) no expansion takes place.

x) Regenerative feed heating system improves cycle efficiency because

a) boiler outlet steam pararmeters are improved

b) internal turbine losses are reduced due to low flow

c) work output of the turbine increased

d) reduces heat loss to the condenser in a greater portion as compared to the reduction in work output.

2. Write short notes on any *three* of the following : 3 5

a) Reheat factor

b) Turbine protections

c) Compounding of turbine

d) Gland sealing

e) De-aerator

f) HP heaters.

3. a) What are the different minor losses occur during fluid flow through closed conduit ?

b) What is super-saturation ? Explain with *T*- diagram ?

c) Prove that for maximum discharge through nozzle $\left(\frac{p_2}{p_1}\right)^{(n-1)/n} = \frac{2}{n+1}$, where $\left(\frac{p_2}{p_1}\right)$ is critical pressure ratio and *n* is the index of expansion. 4 + 4 + 7

4. a) Explain the effectiveness of a curtis stage. Why is compounding necessary ?

b) A 2-row velocity compounded impulse turbine with mean dia 70 cm, N = 3000 rpm, = 16° and V_1 = 610 m/s, I_m = 6·5 kg/s, kinetic energy loss in moving blade is 24%. Outlet angles are as follows $_1$ $_2$ = 18°, $_2$ $_2$ = 38°. Guide blade outlet angle = 22°.

Find

i) blade inlet angles

ii) power developed

iii) efficiency of the wheel. 5 + 10

5. a) Draw a schematic diagram of PRDS system.

b) A surface condenser receives 250 T/hr steam at 40°C with 12% moisture. The cooling water inlet and outlet temperatures are 32°C and 38°C. Condenser pressure is 0·078 bar. Circulating water velocity = 1·8 m/s. Condenser tube outside diameter = 25·4 mm,

Thickness = 1·25 mm. Overall heat transfer co-efficient = 2600 W/m^{2}K. Determine —

i) rate of cooling water flow

ii) rate of air leakage into the condenser

iii) length and number of tubes. 5 + 10

6. a) Draw pressure and velocity distribution in 3-stage reaction turbine.

b) Why are reaction blades are aerofoiled shaped ?

c) The tangential force on one ring of a Parson's turbine is 1200 N, V_b = 100 m/s, I_n = 8 kg/s, the blade outlet angle = 20°. Determine the steam velocity at the outlet from the blades. If the frictional losses are 25° of K.E. corresponding to relative velocity at entry to each ring of blades and the expansion losses are 10% of heat drop in the blades, determine the heat drop per stage and the stage efficiency. 3 + 2 + 10

7. a) Explain the function of starting and load limiting device with sketch.

b) Steam at stagnation pressure of 800 kPa and a stagnation temp. of 350°C expands in a nozzle to 200 kPa. Determine the throat area and exit area required for a flow of 3 kg/s assuming reversible adiabatic flow. 8 + 7