MECH/CBGS/VI/T&FPE /14-12-16

Thermal & Fluid Power Engg.

QP Code :601302

(3 Hours) [Total Marks: 80]

N.B. 1. Question No.1 is compulsory.
2. Attempt any three questions from remaining five questions.
3. Assume suitable data if required.
4. Use of steam table is permitted.

Q.1 Solve any five (20)

a. Explain the principle of working of an impulse turbine.
b. How are hydraulic turbine classified?
c. Define specific speed and state its significance.
d. How is a gas turbine plant modeled as air standard Brayton cycle? Write the assumptions clearly.
e. What is the role of fusible plug in Boiler?
f. Explain working of turbojet Engine?

Q.2 a) Explain the construction and working of Babcock Wilcox boiler. (08)

b) The nozzles of a turbine are supplied with saturated steam at 10 bar, 523K. The steam leaves the nozzle at a pressure of 1.0 bar. The steam consumption for turbine is 16 kg/kWh, when it develops 225 kW. If the throat diameter is 0.8 cm, determine the number of nozzle required and exit diameter of nozzles, assuming that 10% of the total heat drop is lost in overcoming the friction in the divergent part only. Neglect the velocity of approach. (12)

Q.3 a) The following observations were made on a boiler plant during one hour test: (10)

Steam Pressure = 20 bar
Steam Temperature = 260°C
Steam generated = 37500 Kg
Temperature of water entering the economizer = 15°C
Temperature of water leaving the economizer = 90°C
Fuel used = 4400 Kg
Calorific value of fuel = 33000 KJ / Kg
Calculate:
i. The equivalent evaporation per kg of fuel.
ii. Thermal efficiency of plant.
iii. The percentage heat energy of the fuel energy utilized by the economiser.

b) A pelton wheel is receiving water from a penstock with a gross head of 510 m. One third of gross head is lost in friction in the penstock. The rate of flow through the nozzle fitted at the end of the penstock is 2.2 m^3/s. The angle of deflection of the jet is 165^0. (10)
Determine: i) The power given by water to the runner, ii) Hydraulic efficiency of the Pelton wheel. Take $C_v = 1.0$ and speed ratio = 0.45

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Q.4 a) Parson reaction turbine running at 400 rpm with 50% reaction develops 75 kW per kg of the steam. The exit angle of the blade is 20^0 and the steam velocity is 1.4 times the blade velocity. Determine blade velocity and blade inlet angle. (10)

b) Derive an expression for maximum hydraulic efficiency of a pelton wheel. (10)

Q.5 a) A hydro-turbine is required to give 25 MW at 50 m head 90 r.p.m. runner speed. The laboratory facilities available, permit testing of 20 kW model at 5 m head. What should be the model runner speed and model to prototype scale ratio? (10)

b) In a gas turbine plant the intake pressure and temperature are 1 bar and 18^0C respectively. The air is compressed to the pressure of 4.1 bar by a compressor, whose isentropic efficiency is 80%. The temperature of the gas, whose properties may assumed to resemble with those of air, is raised to 645^0C in the combustion chamber where there is a pressure drop of 0.1 bar. Expansion to atmospheric pressure then occurs. If the thermal efficiency of the plant is to be 19%, what must be the isentropic efficiency of turbine? The mass of the fuel may be neglected. (10)

Q.6 Solve any four (20)

a. Distinguish between water tube boiler and Fire tube boiler.
b. What is cavitation? How can it be avoided in reaction turbine?
c. Write merits and demerits of Gas turbine.
d. Explain the working of reheat gas turbine plant with the help of a T-s diagram.
e. Draw the velocity triangle for 50% reaction turbine and write the expression for maximum work done and blade efficiency.
