B.Tech. 5th Semester Exam., 2013

STEAM POWER SYSTEM

Time : 3 hours   akubihar.com   *Full Marks* : 70

Instructions :

(i) *The marks are indicated in the right-hand margin.*

(ii) *There are **NINE** questions in this paper.*

(iii) *Attempt any **FIVE** questions.*

(iv) *Question No. **1** is compulsory.*

(v) *Use of steam table allowed.*

1. Answer any *seven* questions by writing True or False :   2×7=14

    (a) Once through boilers operate at supercritical pressure.

    (b) Steam trap drains off water collected by partial condensation of steam in pipes.

    (c) Supersonic nozzle is a converging passage.

    (d) The compounding of steam turbines is done to increase blade speed ratio.

    (e) Curtis turbine is a two-stage velocity compounded turbine.

(f) La Mont boiler is a high pressure water-tube boiler.

(g) The effect of friction in a steam nozzle is to decrease the velocity.

(h) Reheat factor is zero if efficiency of the turbine is close to unity.

(i) The sequence superheater, economizer, air preheater is the correct order for flue gas flow in the steam power plant layout.

(j) In a shell and tube surface condenser for a power plant, cooling water passes through the tubes and steam surrounds them.

2. (a) What is the mean temperature of heat addition? What is its effect on cycle efficiency?   5

(b) How is the maximum pressure of a steam cycle fixed up?   4

(c) Explain the function of the deaerator. Why is it installed at a large height from the basement?   5

3. (a) Differentiate between fire-tube and water-tube boilers.   6

(b) From the data given below, estimate the power of a motor required to drive an induced draft (ID) fan :

     Draft to be maintained—50 mm of water

     Temperature of boiler house— 310 K

     Temperature of flue gases—475 K

     Coal consumption—1600 kg/hr

     A/F—15

     Efficiency of fan—75%

If the ID fan is replaced by an FD fan of the same efficiency, what would be the power consumption in this case? Comment on your result.   8

4. (a) Derive the condition for maximum discharge through the chimney.   5

(b) Explain the functions of economizer, superheater and air preheater.   9

5. (a) Explain the effect of supersaturation phenomenon in the steam nozzle with the help of T-S and H-S diagrams.   7

(b) Steam initially at 12·5 bar and 250 °C is expanded in a nozzle to 2 bar. The condensation does not take place while the steam is in the nozzle due to super-saturation phenomenon. Determine for the mass flow rate of 2 kg/s degree of under cooling, degree of supersaturation and throat area.   7

6. (a) Differentiate between surface condenser and jet condenser.   5

(b) A surface condenser deals with 5000 kg of steam per hour. The air leakage into the condenser is 0·5 kg per 1000 kg of steam. The vacuum in the air pump suction is 670 mm of mercury and temperature 34 °C. Barometer reading is 755 mm of mercury. Find the volumetric efficiency of a single-acting air pump required to remove the condensate and air having a cylinder diameter of 24 cm and a stroke of 40 cm. The speed of the pump is 60 r.p.m.   9

7. (a) Find the condition for maximum diagram efficiency of a simple impulse turbine.   7

(b) Differentiate between the impulse turbine and reaction turbine with the help of diagrams.   7

8. Steam at a pressure of 11 bar and 260 °C expands in a five-stage turbine to a pressure of 0·07 bar. The steam pressure in five stages are 5, 2, 0·8, 0·2 and 0·07 bar. Tabulate the entropy and total heat data, and also find the reheat factor. The stage efficiency is 60%.   14

9. Write short notes on any *two* of the following :   7×2=14

(a) Coal furnace

(b) Governing of steam turbine

(c) Spray pond

(d) Instrumentation in steam turbine plant

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