Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – II • EXAMINATION – WINTER • 2013

Subject code: 1722102 **Date: 27-12-2013**

Subject Name: Thermal Power Plant Engineering

Time: 10.30 am – 01.00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Define: average load, peak load, load factor, use factor, capacity factor, demand factor, diversity factor. **07**

(b) What factors are mainly considered in the design of boiler used in power plant? Discuss the significance of each with details. **07**

Q.2 **(a)** Explain the principle of fluidized Bed Combustion systems with diagram. What are main problems with such system? How such problems are overcome? **07**

(b) Give the layout of modern thermal power station including major circuits/paths of flow of coal, air & flue gases, condensate & steam and cooling water. Label the major equipment. **07**

OR

(b) Explain clearly sinking fund method. With usual notations show that annual deposit in reserved fund is given by **07**

$$A = (P - S)\left[\frac{r}{(1+r)^n - 1}\right]$$

Q.3 **(a)** Derive an expression for the optimum pressure ratio giving maximum specific output in simple cycle gas turbine. **07**

(b) A power plant has the following annual factors. The load factor = 70%, capacity factor = 50%, use factor = 60%. The maximum demand is 20 MW. Find: **07**

(i) Annual energy production

(ii) Reserve capacity over and above peak load

(iii) Hours during which the plant is not in service per year.

OR

Q.3 **(a)** Explain the main features of supercharging with the help of p – V diagram. What do you mean by mechanical supercharging and turbo charging? **07**

(b) Draw a neat diagram of CANDU reactor and give advantages and disadvantages over other types. Under what circumstances this reactor is more preferable than PWR and BWR? **07**

Q.4 **(a)** Write short note on compressed air storage plant. **07**

(b) Elaborate with an example of any one thermal system to justify the importance and relevance of energy conservation and management in considering the overall economics of a typical thermal system. **07**

OR

Q.4 **(a)** Explain with line diagram a binary vapour cycle for steam power plant and analysis for such a plant. **07**

(b) In a cogeneration plant, the power load is 5.6 MW and the heating load is 1.163 MW. Steam is generated at 40bar and 500^0C and is expanded isentropically through a turbine to a condenser at 0.06bar. The heating load is **07**

supplied by extracting steam from the turbine at 2bar, which is condensed in the process heater to saturated liquid at 2bar and then pumped back to the boiler. Compute:

(i) The steam generation capacity of the boiler in t/hr.

(ii) The heat input to the boiler in kW

(iii) The fuel burning rate of the boiler in t/hr. if a coal of calorific value 25MJ/kg is burned and the boiler efficiency is 88%.

(iv) The heat rejected to the condenser

The rate of flow of cooling water in the condenser if the temperature rise of water is 6^0C. Neglect pump work.

Q.5 (a) What is the function of an economiser? What are steaming and non-steaming economizers? Why are the economiser tubes often finned or gilled on the gas-side? **07**

(b) Explain the principle of economic scheduling. Show that for two units running in parallel, the combined energy input will be minimum if the incremental heat rate of unit 1 is equal to that of unit 2. **07**

OR

Q.5 (a) What are the requirements of peak load plants? Name power plant which are commonly used as peak load plant. With neat sketch explain the working of pump storage peak load plant. **07**

(b) A single unit open cycle gas turbine plant is designed to generate 2MW power. The inlet temperature and pressure are 27^0C and 1bar. The pressure ratio of the cycle is 5. Air coming out of compressor absorbs heat from the exhaust gases in a regenerator at a rate of 80 kJ/kg of air. The air is further heated at a constant pressure by the combustion of 0.01 kg of fuel per kg of air, the fuel having a calorific value of 40000 kJ/kg. The products of combustion are expanded in the turbine to 1bar and exhausted with negligible velocity after yielding some of the heat to the air leaving the compressor. **07**

Estimate the theoretical thermal efficiency of the plant. Compare this efficiency with that of a normal constant pressure cycle.

Also find the fuel consumption per hour.

Take C_p = 1kJ/kg-K and γ= 1.4 both for air and gases.

Neglect the pressure and heat losses of the plant and take the isentropic efficiency of 85% both for compressor and turbine.

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