GUJARAT TECHNOLOGICAL UNIVERSITY
M.E –IIst SEMESTER–EXAMINATION – JULY- 2012

Subject code: 1722102   **Date: 09/07/2012**
Subject Name: Thermal Power Plant Engineering
Time: 10:30 am – 13:00 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)** What is regeneration? Draw the schematic and T-s diagrams of Thermal **07** Power Plant cycle with Regeneration & Reheating for 300 MW Thermal Power Plant.

(b) In a cogeneration binary cycle, superheated steam enters the turbine with **07** a mass flow rate of 5 kg/s at 40 bar, 440 C and expands isentropically to 1.5 bar. Half of the flow is extracted at 1.5 bar and used for industrial process heating. The remaining steam passes through a heat exchanger which serves as the condensate leaves the heat exchanger as saturated liquid at 1 bar, where it is combined with the return flow from the industrial process at 60 C and 1 bar, before being pumped isentropically to the steam generator. The Regrigerant-12 cycle is an ideal Ranking cycle with refrigerant entering the turbine at 16 bar,100 C and saturated liquid leaving the condenser at 9 bar. Determine:
    a. The rate of heat transfer in the steam generator
    b. The net power output of the binary cycle
    c. The rate of heat transfer to the industrial process.

Q.2 **(a)** Explain the dual-pressure steam cycle in combined plant. What are its **07** thermodynamic advantage?

(b) Explain with a sketch the characteristics of a circulating fluidized bed **07** boiler.

OR

(b) What are the different methods of controlling the superheat and reheat **07** temperature of steam?

Q.3 **(a)** Explain with a neat sketch the combustion chamber of a gas turbine **07** plant. What are dilution holes? How is flame stabilization secured by (a) a swirler (b) a bluff body?

(b) A gas turbine employs a heat exchanger with a thermal ratio of 72%. The **07** turbine operates between the pressures of 1.01 bar and 4.04 bar and ambient temperature is 20 C. Isentropic efficiency of compressor and turbine are 80 % and 85% respectively. The pressure drop on each side of the heat exchanger is 0.05 bar and in the combustion chamber 0.14 bar. Assume combustion efficiency to be unity and calorific value of the fuel to be 41800 kJ/kg. Calculate the increase in efficiency due to heat exchanger over that for simple cycle. Assume C_p is constant throughout and is equal to 1.024 kJ/kg K, and γ =1.4. For simple cycle the air-fuel ratio is 90 : 1 and for the heat exchange cycle the turbine entry temperature is the same as for a simple cycle.

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Q.3 **(a)** Explain the main features of supercharging with the help of P-V diagram. What do you mean by turbocharging? What is the effect of intercooling in turbocharging? **07**

(b) In closed cycle gas turbine there is two-stage compressor and a two stage turbine. All the components are mounted on the same shaft. The pressure and temperature at the inlet of the first-stage compressor are 1.5 bar and 20 °C. The maximum cycle temperature and pressure are limited to 750 ^{0}C and 6 bar. A perfect intercooler is used between the two-stage compressors and a reheater is used between the two turbines. Gases are heated in the reheater to 750 ^{0}C before entering into L.P. turbine. Assuming the compressor and turbine efficiencies as 82% calculate the efficiency of the cycle with a regenerator whose effectiveness is 0.7. The working fluid used in the cycle is air. **07**

Q.4 **(a)** What is HTGR? Explain with a sketch its main features. **07**

(b) What are the three stages in India's nuclear power programme? **07**

OR

Q.4 **(a)** With the help of neat sketch explain a simple adiabatic compressed air energy storage system. **07**

(b) How does the pumped hydro system operate? Show the main components in a neat sketch of the system. **07**

Q.5 **(a)** The loads on a power plant with respect to time for 24 hours are given as follows: **07**

Time (hours)	0-6	6-12	12-14	14-18	18-24
Load (KW)	30000	90000	60000	100000	50000

    a. Draw the load curve
    b. Draw the load duration curve
    c. Select suitable generating units to supply the load
    d. Calculate the load factor
    e. Calculate the capacity of the plant and plant capacity factor.

(b) Enlist the advantages and disadvantages of diesel power plants. **07**

OR

Q.5 **(a)** 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**

(b) Define turnaround efficiency. Enlist the various losses in a pumped hydro system. **07**

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