Ref. No.: Ex/PG/EST/T/114A/2024

Name of the Examination : M.Tech. Energy Science and Technology First Year
First Semester - 2024
Subject : Energy Management

Time: Three hours **PART - I (60 Marks)** **Full Marks:100**

Use separate answer script for each Part

Answer **any three** questions.

1. Determine the flue gas analysis and the air-fuel ratio by weight when a coal of the following composition burns with 20% excess air. Assume complete combustion.

   Date given:
   i) **Proximate analysis of the coal,** % air-dried basis : moisture 8.0, ash 20.0, volatile matter 28.5, fixed carbon 43.5.
   ii) **Ultimate analysis of the coal,** % air-dried basis : carbon 58.40, hydrogen 3.30, nitrogen 1.30, sulphur 0.40, oxygen 8.60, moisture 8.0. and ash 20.0. 20

2. a) How do you evaluate boiler efficiency using 'Direct Method'? 8

   b) Find out the efficiency of the boiler by direct method with the data given below.

   Data given:
   i) Type of boiler: Coal fired
   ii) Quantity of steam (dry) generated: 6 ton per hour
   iii) Steam pressure (gauge) / Temperature: 10 kg/cm^2 (g) / 180^0C
   iv) Quantity of coal consumed: 1.2 ton per hour
   v) Feed water temperature: 80^0C
   vi) Gross calorific value (GCV) of coal: 3300 kCal / kg
   vii) Enthalpy of steam at 10 kg/cm^2 (g) pressure: 665 kCal/kg (saturated)
   viii) Enthalpy of the feed water: 80 kCal/kg 12

3. What is supply-side energy management and what is demand-side energy management? Discuss on energy management programme in India. 20

4. Describe the method of evaluating boiler efficiency by 'Indirect Method'. What are the advantages of this method? 20

5. Describe energy conservation techniques in oil-fired industrial boilers. 20

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M.TECH. ENERGY SCIENCE AND TECHNOLOGY

FIRST YEAR FIRST SEMESTER - 2024

Subject: ENERGY MANAGEMENT

Time: Three hours (Part I + Part II) **Full Marks: 100**

Part -II **(40 Marks)**

Use separate answer script for each Part

Answer ***any two*** from the following questions.

1(a) Discuss the concept of degree days and the key factors influencing the base temperature of a building. [8]

(b) Temperature variation of a building over a period of 24 hours is shown in Table 1. Considering cooling base temperature of 22°C and heating base temperature of 18°C, calculate the degree days. If electricity consumption for HVAC operation is 115 kWh per degree day, and cost of electricity is ₹ 8.50 per kWh, calculate annual cost of HVAC operation. Implementing improvement measures, for the next year, costs around 12% of annual HVAC bill. This will result in 4% reduction in HVAC consumption. Estimate projected financial savings (if any), return on investment and payback period. [12]

Table 1: Temperature variation data

Time of Day	00:00 – 05:00	05:00 – 07:00	07:00 – 09:00	09:00 – 11:00	11:00 – 01:00	01:00 – 03:00	03:00 – 05:00	05:00 – 07:00	07:00 – 09:00	09:00 – 11:00	11:00 – 12:00
Temp (°C)	15	17	23	28	34	33	30	26	22	20	18

2(a) What are the different categories in which a building may be classified? [4]

(b) What are the different ways in which heat gain may occur in a building? [4]

(c) Derive the relationship between sundry gains, internal temperature, base temperature and outside temperature of a building. [5]

(d) A building has an exposed area of 9820 m^2 and enclosed volume of 40000 m^3. Number of heating hours per year is 8760. For heating purpose 273760 units of electricity is used. Apart from this 5682201 kWh of energy is also supplied to the boiler from oil and gas. Inside, outside and base temperatures of the building are 21°C, 9.84°C, and 19°C respectively. Calculate the number of air changes needed per hour. Consider boiler efficiency to be 75% and U value to be 3 $W/m^2/K$. [7]

3. With the help of an example discuss in details, how you will conduct an energy audit of a building of your choice. Feel free to take necessary assumptions if needed. [20]