3 hours **80 Marks**

N. B. :

1. Question No. 1 is compulsory
2. Attempt any **THREE from Q2 to Q6** questions
3. Use illustrative diagrams wherever required

Q1) Attempt any **FOUR** questions

a) In a double pipe heat exchanger, flow rates of hot and cold water streams are 50 and 60kg/min. Hot and cold streams inlet temperatures are 100°C and 35°C. The exit temperature of the cold stream is 55°C. The specific heat of the water is 4.18 kJ/kg K. The overall heat transfer coefficient is 800 W/m2 K. Calculate LMTD for parallel flow. **05**

b) State any five factors on which capacity of chiller decides? **05**

c) Illustrate the significance of Installed Load Efficacy Ratio (ILER) towards performance assessment of Lighting System **05**

d) State any five benefits of Power Factor (PF) improvement? **05**

e) Illustrate the purpose of using insulation in thermal systems. What are the benefits of providing insulation? **05**

Q2) **a)** The energy consumption and production patterns in a chemical plant over an 8 month period is provided in the table below. Using CUSUM technique, estimate the cumulative energy savings at end of the 8th month and give your inference on the result? (consider 8 month data for evaluation for predicted energy consumption) **10**

Where,

Estimated energy consumption in MWh = E_{est} = 0.021X + 66.1

Month	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Production in Tonnes/Month	400	300	375	475	575	450	225	250
Energy consumption MWh/Month	80.2	77.7	81.3	83.1	85.1	79.7	73.7	75.7

X = Production in tones

b) Define Energy Monitoring and Targeting. State the elements of Energy Monitoring and Targeting. Illustrate the role of Monitoring and Targeting towards achieving energy efficiency. **10**

Q3) **a)** A 3 phase, 415 V, 75 kW induction motor is drawing 48 kW at a 0.7 PF. Calculate the capacitor rating requirements at motor terminals for improving PF to 0.95. Also, calculate the reduction in current drawn and kVA reduction, from the point of installation back to the generating side due to the improved PF at operating voltage of 415 V. **07**

b) An economizer was installed in the furnace-oil fired boiler. The following are the data monitored after commissioning the economizer. **07**

Air to fuel ratio = 18

Evaporation ratio (Steam generated per kg of fuel) of the boiler = 12.5

Specific heat of flue gas = 0.25 kcal/ kg°C

Condensate recovery in the plant = Nil.

Calculate the drop in the flue gas temperature for the rise in temperature of feed water in an economizer by 34.2°C.

c) List the steps to evaluate performance of lighting system. **06**

Q4) a) Illustrate the main features of Energy Conservation Act-2001. **10**

b) A foundry unit draws power to the tune of 2500 kW. The demand observed during furnace operation is given below: **05**

5 minutes : 2940 kVA

7 minutes : 2550 kVA

3 minutes : 2777 kVA

If the billing meter is monitoring demand every 15 minutes, calculate the maximum demand registered and also the average PF, during the demand interval.

c) Define benchmarking. Illustrate the external benchmarking used in Energy Audit Process in brief. **05**

Q5) a) Define energy audit. What are the types of Energy Audit? Discuss the steps involved to conduct detailed Energy Audit. **10**

b) State the special desirable properties that energy audit instruments should have in comparison to conventional measuring instruments. **05**

c) Define Green building. Discuss the main features of green building. **05**

Q6) a) State the factors which affects the performance of boiler. **10**

b) An energy audit was conducted in a large machine shop and the audit report suggested replacing 20 machine motors with energy efficient motors. Assume motor loading in both cases remains same. Operating hours= 4000 hours per year. **10**

Additional cost of energy efficient motor in comparison to standard motor = 60000 Rs./ Motor

Energy charge = 7.5 Rs./kWh

Calculate the simple payback period for this replacement,

The loading details of old and new motors are given below:

Motor Rating in kW	Operating load %	Old motor efficiency %	New Motor Efficiency %	No of Motors
7.5	75	86	89	12
11.5	85	88	91	08

----------x----------x----------