http://www.makaut.com

Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.TECH(EE)/SEM-1/PEM-104(D)/2011-12

2011

ENERGY MANAGEMENT & AUDIT

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer any ***five*** questions. 5 × 14 = 70

1. a) Name some greenhouse gases responsible for global warming.

   b) An electric heater of 230 V, 3 k W rating is used for hot water generation in an industry. Find electricity consumption per day (i) at the rated voltage, (ii) at 190V.

   c) What is NPV ? Calculate the Net Present Value of a project at a discount rate of 16% with an investment of Rs. 50,000 at the beginning of the first year, and savings of Rs. 15,000, Rs. 18,000 and Rs. 20,000 respectively at the end of the first, second and third year. 3 + 5 + 6

2. a) Explain briefly PERT.

b) An energy auditor is trying to establish the operating power factor of a 15 HP / 11·2 k W induction motor with full load efficiency of 90%. The motor is not connected with any PF correction capacitors at motor terminals. The instrument to measure input electric parameters to the motor displays the three numbers 5 kW, 2 kVAr and 0·928 PF. As an Energy Manager / Energy Auditor, do you fully agree with the instrument display of Power Factor reading and its correctness ?

c) Briefly mention about primary sources of energy. What are the immediate term energy strategies recommended ? 3 + 6 + 5

3. Write explanatory notes on any *three* of the following : 14

a) Energy Management

b) Energy audit (as defined in EC Act, 2001)

c) Production factor

d) Energy Strategy for the Future

e) Industrial Electricity Billing.

4. a) The details of activities for implementation of an energy efficient project is given below :

The contracted demand of a chemical plant is 1000 kVA. The average monthly MD recorded is 800 kVA only. The average monthly energy consumption is 1·6 lakhs unit. The utility bill analysis provides the following billing components. Minimum monthly billing demand is 80% of contracted MD or the actual recorded MD whichever is higher. Minimum power factor may be maintained is 0·9. 0·5% of unit charge for every 0·01 point below the 0·90 PF will be charged additionally as penalty. 0·5% of unit charge for every 0·01 point above the 0·95 PF will be given as incentive for maintaining higher power factor. MD charge is Rs. 300 per kVA. Energy charges is Rs. 4 per kWh. Energy manager of the plant has proposed to improve the power factor from 0·86 to 0·96 by adding capacitors in the distribution system.

Determine : (i) MD reduction in kVA, (ii) Monthly cost saving.

b) How benchmarking of energy consumption internally and externally may be useful ? Explain. 10 + 4

5. a) The Avg. PF of an engineering industry is 0·8 with electrical load of 400 kW. Determine the kVAR required if PF is improved to 0·9 to avoid PF penalty and MD reduction.

   b) Explain the importance of time of day tariff (TOD).

   c) A maximum demand recorder for a plant will record the following loads over a period of 30 minutes. Compute the MD as the recorder would do. 700 kVA for 5 minutes, 300 kVA for 5 minutes, 600 kVA for 10 minutes, 700 kVA for 8 minutes, 300 kVA for 2 minutes.

   d) The energy consumed by a plant was 24,000 kWh over a day. The maximum load recorded during this time was 1400 kW. Calculate the load factor on that day.

5 + 2 + 3½ + 3½

6. a) What is meant by luminous efficacy, Lux and CRI ?

   b) Highlight the advantages of high frequency (HF) electronic ballasts in place of conventional ballasts.

c) Highlight the advantages of CFL (compact fluorescent lamp) over GLS lamp.

d) Calculate fixed energy consumption for a rolling mill consuming 3,00,000 units electricity to produce 500 MT product per month and having specific energy consumption of 500 kWh/MT. 4 + 3 + 3 + 4

7. a) For any electrical distribution system, list any 5 options for distribution loss optimization and explain.

b) Draw a typical curve for efficiency and power factor *vs* load for a 3-phase induction motor between 0% and 100%.

c) 7·5 kW, 3-phase, 415 V induction motor draws 10·5 A and 5 kW input power at 410 V. What is the Apparent and Reactive Power drawn by the motor at the operating load ? 5 + 4 + 5

8. A plant has 2 identical 500 kVA transformers, each with a no load loss of 0·80 kW and full load copper loss of 5·7 kW. The plant average load is 420 kVA and has never exceeded 460 kVA in the past. An energy auditor while conducting the energy audit founds that only single transformer is kept in operation and second transformer is switched off. The plant management was of the view that since the plant load is well within the reach of the one transformer, therefore there is no need of keeping the second transformer in parallel operation. As claimed by the management, plant would be saving no load loss of transformer, which is 0·80 kW.

   a) In your opinion, whether energy auditor would agree with the stand taken by the management.

   b) If not, what he would like to advise to the plant's management on transformers operation keeping in view the energy saving potential, reliability and safety of the system ? 14

9. An energy auditor works out the percentage loading of a particular induction motor as a ratio of current drawn to the rated current of the motor.

   a) Do you agree with the above methodology adopted by the consultant ? Justify your answer with reasons.

   b) In your opinion what is the right approach for working out the motor loading ?

   c) List any other method, which is also an indicator for motor loading. 6 + 4 + 4

OR

   a) Explain the benefit of reducing maximum demand. Explain step-by-step approach in controlling the maximum demand.

   b) Explain in detail the methodology for conducting a detailed energy audit. 7 + 7

==========