Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 20940

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2023.

Fifth Semester

Electrical and Electronics Engineering

EE 3005 — ENERGY MANAGEMENT AND AUDITING

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is Energy Management?

2. Define Energy Audit.

3. How is Energy Efficiency calculated in indirect method, using energy balance?

4. Define IRR in terms of bank's discount rate and NPV.

5. Justify the name of FBC boilers.

6. What is the common desirable property of insulation and refractories and why?

7. Justify the name given to vapour absorption refrigeration system.

8. Justify the name given to vapour compression refrigeration system.

9. Name two factors affecting motor performance.

10. What is flash steam and why should it be recovered?

PART B — (5 × 13 = 65 marks)

11. (a) How much hard coal is required at a power plant with an overall efficiency of 36% to run an auxiliary 6 kW electric motor at 90% efficiency constantly for 4 weeks (672 hours)? (One tonne of hard coal contains 25 GJ of heat). What will be the Heat Rate of the power plant? (13)

Or

(b) State the four laws of thermodynamics. Give one example or application or take-away from each. (13)

12. (a) An autoclave contains 1000 cans of pea soup. It is heated to an overall temperature of 100 °C. If the cans are to be cooled to 40 °C before leaving the autoclave, how much cooling water is required if it enters at 15°C and leaves at 35°C?

The specific heats of the pea soup and the can metal are respectively 4.1 kJ/ kg °C and 0.50 kJ/ kg °C. The weight of each can is 60 g and it contains 0.45 kg of pea soup. Assume that the heat content of the autoclave walls above 40 °C is 1.6 x Hf kJ and that there is no heat loss through the walls. (13)

Or

(b) Suppose you were to compare the economics of LED compared to T12 (Fluorescent Lamps). Considering differences in their initial investments, life (burning hours) and efficacy (lumen/W), how would you make use of relevant financial factors to make your economic analysis more robust? Give clear steps to be followed to arrive at the solution. (13)

13. (a) (i) Discuss with relevant diagrams in detail, about any one type of temperature control mechanism in furnaces. (7)

(ii) Write a detailed technical role on the selection and application of refractories. (6)

Or

(b) What is steam? Explain the following events in a steam system: (i) Water hammer and its remedy (ii) Water carry over and its control (iii) Condensate in pipelines and its recovery. (13)

14. (a) In a compressor capacity trial in a plant, following were the observations:

Receiver capacity: 10 m

Initial pressure : 0.2 kg / cm^2 g

Final pressure : 6.0 kg / cm^2 g

Additional hold-up volume: 1.2 m^3

Atmospheric pressure: 1.026 kg / cm^2

A Compressor pump-up time : 4.26 minutes

Motor power consumption (avg.): 98.6 kW

Calculate the operational capacity of compressor and specific power consumption (neglect temperature correction)? (13)

Or

(b) Why are central air compressors costly machines? How can you prevent oversizing of an air compressors? (13)

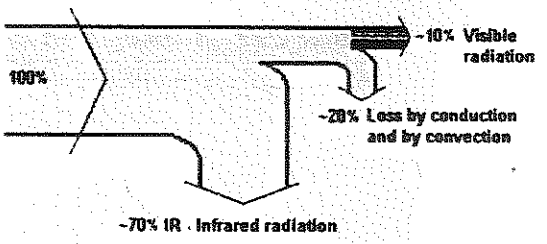
15. (a) A 3.7 kW, 4-pole motor in frame NDII2M has standard motor efficiency 85% and energy-efficient motor efficiency of 88.3%. Cost of the standard motor is INR 7215 and that of energy efficient motor is INR 9380. Calculate the simple payback for 4000 working hours per year at an electricity cost of INR 10/kWh. Assume the motor runs on 80% of the rated capacity. (13)

Or

(b) How the synchronous speed of motors is calculated? Classify electric motors with example of its application in each class. (13)

PART C — (1 × 15 = 15 marks)

16. (a)



The above is the Sankey Diagram of which lighting system? What is the efficiency of this system? Comment on this value and propose a modern replacement of this system. Name the proposed system and state its advantages and disadvantages with compared to the above, in terms of efficiency, efficacy, cost, working or burning hours (life), CRI, etc. What is the trend and future of lighting systems at home, streets and industries? (15)

Or

(b) An existing chiller with a capacity of 800 kW and an average seasonal COP of 3.5 is to be replaced by a new chiller with the same capacity but with an average seasonal COP of 4.5. Determine the simple payback period of the chiller replacement if the cost of electricity is INR 10/ kWh and the cost differential of the new chiller is INR 7,50,000. Assume that the number of equivalent full-load hours for the chiller is 1000 per year, both before and after the replacement. Can you guess how this improvement in COP was possible? (15)