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Question Paper Code : 41037

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Fifth Semester

Civil Engineering

OME 551 — ENERGY CONSERVATION AND MANAGEMENT

(Common to : Aeronautical Engineering/Aerospace Engineering/
Agriculture Engineering/Automobile Engineering/Biomedical Engineering/
Civil Engineering/Computer Science and Engineering/Computer and
Communication Engineering/Electronics and Communication
Engineering/Electronics and Telecommunication Engineering/Environmental
Engineering/Industrial Engineering/ Industrial Engineering and
Management/Manufacturing Engineering/Marine Engineering/Material Science and
Engineering/Mechanical Automation Engineering/Mechatronics
Engineering/Medical Electronics/Petrochemical Engineering/Production
Engineering/Robotics and Automation/Bio Technology/Chemical
Engineering/Chemical Electrochemical Engineering/Fashion Technology/
Food Technology/Handloom and Textile Technology/Information
Technology/Petrochemical Technology/ Petroleum Engineering/Pharmaceutical
Technology/
Textile Chemistry/Textile Technology)

(Regulations 2017)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define the term 'Ton of Oil Equivalent (TOE) related with any country energy consumption.
2. What do you understand by greenhouse gas effect?
3. Define harmonics.
4. What do you understand by load factor?
5. Define critical thickness of insulation. Write its equation for a cylindrical pipe carrying steam.
6. Write the stoichiometric equation for furnace oil.
7. Define coefficient of performance and energy efficiency ratio of a refrigeration system. Mention the units of each.

8. Write the steps involved in estimating compressed air leak test.
9. State two main functions of energy management information system.
10. Write the two main disadvantages with simple payback period.

PART B — (5 × 13 = 65 marks)

11. (a) Explain the need of energy conservation with respect to environment, financial and political aspects of any country.

Or

- (b) What is the need for energy audit and list out various barriers for the same? Summarise different steps involved in energy auditing and their importance.
12. (a) The contract demand of plant is 1500 kVA. The minimum billing demand is 80% of the contract demand. The tariff structure of the plant is demand charges are Rs. 180 per kVA per month; unit charges are Rs. 4.5 for the first one lakh units per month and Rs. 3.75 above one lakh units per month; fuel surcharge is Rs. 0.25 per unit per month; service tax is Rs. 0.3 per unit per month and meter rent is Rs. 600 per month. The energy consumption is 5,15,000 units and the maximum demand recorded is 700 kVA. Calculate the cost of monthly electricity consumption?

Or

- (b) A distribution company has taken initiatives to reduce Aggregate Technical and Commercial (AT & C) loss in their network. The energy supplied, received and revenue details are given. Input energy, 60 million units metered billed energy 43 million units average billed 3 million units; amount billed, Rs. 54,00,00,000; arrears collected, Rs. 8,00,00,000; amount received, Rs. 47,00,00,000. Estimate the following (i) AT & C loss in % and revenue realized in Rs/kWh. (ii) Revenue loss kWh and monthly loss, if the purchased energy cost is Rs. 8.10/kWh
13. (a) (i) Mention any 5 major losses in furnace operation and their control methods. (10)
 - (ii) What is the need of blowdown in boiler operating process? (3)

Or

- (b) (i) Explain the adverse effects of excess air in combustion phenomena. (5)
- (ii) What are the uses of steam traps, classify them. Discuss the working of an inverted bucket type steam trap with a neat sketch. (8)

14. (a) A company has installed 5×110 TR reciprocating refrigerant compressors of which four compressors are in use and fully loaded for 14 hours per day. The specific power consumption of reciprocating compressor is 0.8 kW/TR. Due to higher energy cost, the company management has decided to replace reciprocating compressors with screw compressors having specific power consumption of 0.65 kW/TR. The management needs following input from energy consultant: (i) Comparison of electricity consumption of both reciprocating and screw compressors? (ii) Annual energy bill savings (for 320 days operation). Present unit cost is Rs 6.00 per kWh

Or

- (b) A 5 MW diesel generator set is operating at 70 % load, it equipped with a waste heat recovery boiler to generate steam at 10 bar from exhaust gas heat. Find the quantity of steam generated annually after installing the waste heat recovery boiler for the following conditions. Flue gas exit temperature, 500 °C; flue gas temperature after waste heat recovery boiler, 250 °C, specific heat of flue gases, 1.045 kJ/kg K, specific gravity of diesel oil, 0.85; air-fuel ratio, 30 kg of air per kg of fuel; specific fuel consumption, 4 litre/kWh; enthalpy of steam at 10 bar, 2761.5 kJ/kg; feed water temperature, 30 °C, operating hours per year, 6000 hours.

15. (a) (i) Explain the role of ESCO in implementing energy conservation measures. (5)
- (ii) What are the advantages with Discounted Cash Flow method of estimating the value of an investment? (5)
- (iii) Discuss various types of performance contracting. (3)

Or

- (b) An industry has identified four potential energy saving projects all with an initial cost of Rs. 20,00,000. The capital budget for the current financial year will allow them to install only one of the three proposed projects. The future cash flows and discount rates of each project are given in below table.

Cash Flows	Project A	Project B	Project C
I Year	Rs.5,00,000	Rs.6,00,000	Rs.10,00,000
II Year	Rs.5,00,000	Rs.6,00,000	Rs.8,00,000
III Year	Rs.5,00,000	Rs.6,00,000	Rs.6,00,000
IV Year	Rs.5,00,000	Rs.6,00,000	Rs.4,00,000
V Year	Rs.5,00,000	Rs.6,00,000	Rs.2,00,000
Discount Rate	6%	9%	15%

- (i) Given the discount rates and the future cash flows of each project, which project should they select?
- (ii) Calculate the Internal Rate of Return (IRR) of the selected project?

PART C — (1 × 15 = 15 marks)

16. (a) A coal fired Fluidized Bed Combustion boiler is installed in a chemical processing unit for steam generation with the following specifications. Boiler capacity, 80 tonnes/hr; boiler pressure, 65 bar; steam temperature, 550°C; percentage of ash in the coal is 35%; gross calorific value (GCV) of coal, 18,000 kJ/kg; theoretical air required for combustion, 5.6 kg/kg of coal; hydrogen in fuel, 4%; specific heat of flue gas, 1 kJ/kg°C; specific heat of superheated water vapor in the flue gas, 1.89 kJ/kg°C. Operating parameters are as follows: flue gas exhaust temperature, 160°C; oxygen percentage in flue gas is 6%; feed water temperature, 105°C; radiation and other losses, 4%; ambient temperature, 30°C; (i) Estimate the boiler efficiency using indirect method on GCV basis, (ii) What will be the hourly coal consumption for these operating conditions. Take total heat value of steam at 65 bar and 550 °C is 3630 kJ/kg.

Or

- (b) Discuss the following terms :

- (i) ESCO concept
- (ii) Life cycle costing
- (iii) Discount rate
- (iv) Net present value.