M. Tech. (Energy Science & Technology) First Year Second Semester Examination – 2019

Subject: ADVANCED ENERGY MANAGEMENT

Time: Three hours   Full marks: 100

<div align="center">Answer any five questions.</div>

1. Calculate the unit cost of electricity generation from a coal fired thermal power plant, if the capital cost of a coal-fired thermal power plant is Rs. 5.0 crore per MW and the cost of coal and oil are Rs. 2.50 per kg and Rs. 40 per litre respectively. Assume a 9% yearly interest rate on the capital investment. 650 gm coal and 4ml oil are required to generate one unit of electricity in a thermal power plant. Assume standard data if required.

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2. Describe with neat sketches the four-stroke and two-stroke operating cycle of the I.C. engines.

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3. a) Write a short note on energy conservation techniques in road transport.

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   b) Assume that 70% of all freight is currently carried by small trucks (less than 8 ton capacity) and that 30% is carried by large trucks (greater than 8 ton capacity). Restructure the truck dispatching system so that substantial reduction in energy consumption is achieved.

Data given:
i)   Average specific energy consumption for the small trucks (less than 8 ton capacity) is 5.2 MJ / ton /km.

ii)   Average specific energy consumption for the large trucks (greater than 8 ton capacity) is 2.7 MJ / ton/km.

iii) A total freight of 1000 ton is transported per day to a distance of 100 km.

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4. Discuss energy conservation techniques in boilers with special reference to excess air control and load balancing.   20

5.a) A plant is using 4 ton/day of coal to generate steam. The calorific value of steam is 4000 kCal / kg. The cost of coal is Rs. 2500 / ton. The plant substitutes coal with rice husk, as a boiler fuel, which has a calorific value of 3000 kCal / kg and cost of Rs.800 / ton. Calculate the annual cost savings (if any) at 300 days of operation, assuming that the boiler efficiency decreases from 78% on coal to 72% on rice husk.

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b) A furnace of 12 ton / hour output consumes 900 kg / hour of fuel oil. Calculate the furnace efficiency by assuming specific heat of stock material as 0.15 kCal/kg°C, stock material heated from 90°C to 1250°C and GCV (gross calorific value) of fuel oil as 10,000 kCal/kg.

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6. a) What is refrigeration? With the help of a schematic diagram show the refrigeration process. What do you understand by Coefficient of Performance? State the difference between heat pump and refrigerator.

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b) Discuss the salient points on energy conservation in domestic refrigerators.

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7. a) Briefly describe the electric vehicle technology for road transportation.

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b) Describe the implementation strategy of electric vehicles in road transport sector in view of energy efficiency with the help of a case study.

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8. a) What measures may be opted to meet variable load demand in an electric power system? Describe the role of pump storage scheme in view of load management and its benefits.

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b) What are the criteria for selection of pumped storage sites?

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9. a) An evaluation needs to be made to replace all 65 Watt fluorescent lamps with a new lamp that saves 50% or 32.5 Watt and gives 30% more output. The cost of each lamp is Rs. 400/-. Hours of operation are 5800 and lamp warranty is 3 years. Electricity cost is Rs. 7(kWh. Rate of interest on borrowed capital is 11% per annum. Calculate the payback period.

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b) Given the empirical relation between load factor 'f' and loss factor 'F' as follows:

$$F = 0.2\,f + 0.8\,f^2$$

Estimate the economic size of a feeder using 3½ core cable required to supply a three--phase, 11 kV, 50 Hz load maximum demand is 750 kW and the average load required to be supplied per annum is 270 kW at unity power factor.

Assume, annual interest & depreciation : 6%

Cost of energy = Rs. 7 / kWh

Specific resistance of copper = 0.7 X 10⁻⁸ Ω / sq. inch.

Cost of cable per meter = Rs. (20 + 240 a), where 'a' is area of core in square inch.

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