Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

II SEMESTER M.TECH (ENERGY SYSTEMS & MANAGEMENT)

END SEMESTER EXAMINATIONS, APRIL / MAY 2019

SUBJECT: ENERGY AUDIT & MANAGEMENT [ELE 5203]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 24 April 2019** **Max. Marks: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. Define energy management, energy conservation and energy audit. Explain in brief, duties and responsibilities of energy manager. ***(05)***

1B. Define the following (i) Room Index, (ii) Installed Power Density.

Describe the methodology followed for carrying out a detailed lighting audit. Explain any three energy conservation measures aimed at lighting systems. ***(05)***

2A. Following are the data collected for a boiler using Furnace oil as the fuel. Determine the boiler efficiency by indirect method ignoring the radiation and convection losses.

Ultimate chemical analysis (% weight): Carbon: 84, hydrogen:12, Nitrogen:0.5, Oxygen :1.5, Sulphur:1.5, Moisture : 0.5, Calorific Value: 10000 Kcal/kg,

Humidity: 0.025 kg moisture/kg of dry air.

Flue Gas analysis: O_2: 7.4% by volume, Flue gas exit temperature:190°C

Ambient temperature: 30°C.

Mass flow rate of the fuel :2650 kg/h

Surface temperature of the boiler : 80°C

Wind speed: 3.8 m/s

Surface area of the boiler: 90 m^2 .

Take C_p of flue gas as 0.24 Kcal/kgK and C_p of steam as 0.43 Kcal/kgK ***(05)***

2B. Explain how an energy efficient induction motor reduces its intrinsic losses.

A 3 Phase, 4 pole, 34 kW/45 hp, 415 Volt delta connected Induction Motor has a full load current of 57 A at 1475 RPM. The No Load Test yielded the following result;-

Applied Voltage = 415 V; No load current = 16.1 A, Frequency = 50 HZ; Stator phase resistance at 30 °C = 0.264 Ohms & No Load power = 1063.74W. Assuming an operating temperature of 120 °C, determine the motor efficiency at full load and full load power factor. ***(05)***

3A. With relevant equations, discuss briefly how the efficiency of a furnace can be determined by indirect method. ***(05)***

3B. Explain the role of mass and energy balance in an Energy audit.

A food containing 80% water is to be dried at 100 °C, down to moisture content of 10%. If the initial temperature of food is 16 °C, calculate the quantity of heat energy required per unit weight of original material, for drying under atmospheric pressure. The latent heat of vapourization of water at 100°C at standard atmospheric pressure is 2257 kJ/kg. The specific heat capacity of the food is 3.8 kJ/kg °C and of water is 4.186 kJ/Kg °C. Find also the energy required/kg water removed. ***(05)***

4A. With a neat sketch, explain working principle of heat wheel. Discuss its advantages and its limitations. ***(03)***

4B. What is combined scheme of cogeneration system? Explain. ***(02)***

4C. An energy audit of electricity bills of a process plant was conducted. The plant has a contract demand of 3000 kVA with the power supply company. The average maximum demand of the plant is 2300 kVA/month at a power factor of 0.95. The maximum demand is billed, at the rate of Rs.500/kVA/month. The minimum billable maximum demand is 75 % of the contract demand. An incentive of 0.5 % reduction in energy charges component of electricity bill is provided for every 0.01 increase in power factor over and above 0.95. The average energy charge component of the electricity bill per month for the company is Rs.11 lakhs.

The plant decides to improve the power factor to unity. Determine the power factor capacitor kVAr required, annual reduction in maximum demand charges and energy charge component. What will be the simple payback period if the cost of power factor capacitors is Rs.800/kVAr. ***(05)***

5A. Derive an equation for the critical thickness of insulation for a sphere with usual notations ***(02)***

5B. A 2 cm diameter electrical cable at 45°C is covered by 0.5 mm thick plastic insulation (k =0.13W/mK). Wire is exposed to ambient at 10°C with h =12 W/m2K. Investigate if the plastic insulation on the cable will help or hurt the heat transfer from the wire? Also calculate, the value of maximum heat transfer rate? ***(03)***

5C. With a neat block diagram, explain the key component of Energy Action Planning.

Hence, conduct a Force Field Analysis for the goal 'Converting Hostel Block 10 into a Net Zero Energy Building by using Solar Photovoltaics by 2022" ***(05)***