Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

KNOWLEDGE IS POWER

VII SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2015

SUBJECT: ENERGY AUDITING & MANAGEMENT [ELE 423]

REVISED CREDIT SYSTEM

Time: 3 Hours   03 DECEMBER 2015   MAX. MARKS: 50

Instructions to Candidates:

❖ Answer **ANY FIVE FULL** questions.
❖ Missing data may be suitably assumed.

1A.	Explain the three classification of energy, with examples.	**02**
1B.	With a neat flow chart, briefly explain the various steps of Energy Action Planning.	**04**
1C.	Explain the methodology followed for carrying out assessment of lighting systems employed in Industries. Also, explain any two ECON measures for Lighting Systems.	**04**
2A.	Explain in details, the ten steps of Detailed Energy Audit methodology.	**05**
2B.	With respect to the Electricity Act, 2003, explain the reforms brought in generation, transmission and distribution sector.	**03**
2C.	A sample of coal from the mine is found to contain 67.2% carbon and 22.3% ash. The refuse obtained at the end of combustion is analyzed to contain 7.1% carbon and the rest is ash. Using Mass Balance technique, compute the percentage of the original carbon unburnt in the refuse.	**02**
3A.	A plant which runs for 8000 hours a year has a boiler with an efficiency of 80%. The boiler produces steam at 15 kg/cm^2. Steam must travel via pipeline to the plant, located at some distance. The diameter of steam pipeline is 100mm and the total length of pipe from the boiler to the plant is 300m. The surface temperature of the non-insulated part of pipeline, which is 150m in length, is 195 °C. The energy manager proposes a project to properly insulate the non-insulated length of the pipeline with 70mm of glass wool with aluminum cladding, so as to reduce the surface temperature to 70 ° C. Find out the fuel and costs savings and the payback period for the project if the proposal were to be accepted. Assume fuel cost is Rs 15/kg with GCV= 14250 kCal/kg, ambient temperature of 25 °C and insulation material is available at Rs 4000 per sq. meter.	**06**

3B. During May-2015, a plant has recorded a maximum demand of 750 kVA and an average power factor of 0.66 lag is observed. The minimum average power factor to be maintained is 0.95 lag as per the independent utility supplier & every dip of 0.05 from minimum average power factor attracts a penalty of Rs 8,000/- in each month's electricity bill.

    a) Calculate the improvement in power factor for June 2015 by installing 150 kVAR capacitors.

    b) Calculate penalty to be paid, if any, for the month of June 2015. **02**

3C. List any two duties and two responsibilities of Energy manager. **02**

4A. A 34 kW/45 HP, 415 Volt Delta connected 3 Phase IM has a full load current of 57 A at 1475 RPM. The No Load data is, 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. Calculate

    a) Core + FW losses

    b) Stator copper losses if the operating temperature is 120 °C

    c) Motor input (assuming IEC standards)

    d) Motor efficiency at full load & full load power factor. **05**

4B. Write a short technical note on Energy Efficient Motors. **02**

4C. A 22 kW rated motor driving a lube oil pump is drawing a constant power of 19 kW at 90% efficiency. If the motor is replaced with an energy efficient motor which operates at 93 % efficiency, find out the annual energy savings at 8000 hours of operation/year. If the investment is Rs. 30,000/- find out the payback period at Rs.4/kWh energy charges. **03**

5A. A community has 500 people. The source of water to the community are borewells and supply of water from the borewell is through hand pump. The depth of the borewell is 20m. Six hand pumps are used to meet the water requirement. Using the following details, compute the cost of water per liter if the project life cycle is 20 years.

- Per capita water consumption – 40 lit/day
- Cost of each hand pump – INR 5000/-
- Cost of digging a borewell – INR 250 per meter
- Life span of a hand pump – 10 years
- Annual Maintenance Cost – INR 1250/- per hand pump
- Rate of interest – 10%
- Inflation rate – 7% **04**

5B. 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 specific heat capacity of the food is 3.8 kJ/kg °C. Also find the energy required per unit of water removed. **04**

5C. With respect to Energy Conservation Act, 2001, define (i) Building, and (ii) Energy Auditing. **02**

6A. Explain the Kaizen management principle. How is it implemented? What are the benefits of Kaizen management principle?

03

6B. Zenith Fibres, Gujarat is involved in the business of manufacturing Synthetic cotton which is then exported to different countries. Its energy consumption and production data was collected for the duration November, 2012 till April, 2014. During the month of July 2013, energy efficient motors and waste heat recovery systems were installed.

Energy Consumption vs Production Details – Star Sea Food Pvt Ltd				
Month	**Monthly Energy Consumption**			**Monthly Production**
	(toe/month)			(Tonnes/month)
	HSD	**Electricity**	**Coal**	
Nov, 2012	130	190	20	380
Dec, 2012	110	210	20	440
Jan, 2013	100	270	10	460
Feb, 2013	100	270	10	520
Mar, 2013	120	175	05	320
Apr, 2013	120	360	20	520
May, 2013	80	200	00	240
June, 2013	100	300	24	620
July, 2013	100	300	20	600
Aug, 2013	120	270	10	560
Sept, 2013	100	255	05	440
Oct, 2013	105	210	15	360
Nov, 2013	110	225	05	420
Dec, 2013	88	240	12	420
Jan, 2014	136	200	36	480
Feb, 2014	90	258	32	540
Mar, 2014	80	190	10	280
Apr, 2014	100	270	10	500

- Using Linear Regression Analysis, derive the equation for standard energy consumption.

- Compute the Pearson's Correlation Co-efficient.

- Perform CUSUM analysis to calculate the energy savings due to installation of energy efficient motors & waste heat recovery systems.

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