Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent Institution of MAHE, Manipal)

VII SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, NOVEMBER 2018

SUBJECT: ENERGY AUDITING [ELE 4006]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 27, November 2018** **Max. Marks: 50**

Instructions to Candidates:

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

1A. 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)***

1B. Explain the ten step detailed energy audit methodology by clearly bringing out the scope and purpose of each step. ***(05)***

2A. A centrifugal water pump operates at 30 m^3/hr and at 1440 RPM. The pump operating efficiency is 65% and motor efficiency is 89%. The discharge pressure gauge shows 3.4 kg/cm^2. The suction is 3 m below the pump centerline. If the speed of the pump is reduced by 25 %, estimate the following:

a) pump flow,
b) pump head
c) motor power.

Assume motor and pump efficiency remains same at the reduced speed ***(04)***

2B. An energy auditor audits a 75 kW four pole 3 phase induction motor operating at 50 Hz and rated for 415 V, 100 A at 1440 RPM. The actual measured speed was 1470 RPM and the power analyser recorded the applied voltage to be 428 V and drawing a current of 30 A.

a) The auditor works out the percentage loading of the induction motor as a ratio of line current drawn to the rated current of the motor. Do you agree with the above methodology adopted by the auditor? Justify your answer with reasons.
b) Determine the percentage loading of the motor for the given operating conditions. ***(03)***

2C. Explain, any three salient features of the Electricity Act, 2003 by clearly bringing out its merits. ***(03)***

3A. A community has 500 people. The Source of water to the community are borewells & supply of water from borewell is through handpumps. Six handpumps 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
- Depth of borewell – 20 m
- Cost of digging the borewell – INR 250 per meter.
- Life span of a hand pump = 10 years
- Annual Maintenance Cost – INR 1250/- per handpump
- Rate of interest = 10%
- Inflation Rate - 7% ***(05)***

3B. A four pole 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 Test yielded the following result; - V = 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

Determine

a) Calculate the Core + Friction & Windage losses
b) Stator copper losses if the operating temperature is 120 °C.
c) Full load slip & rotor input; Motor input assuming IEC standard for stray losses
d) Motor efficiency at full load & full load power factor. ***(05)***

4A. An industrial process requires a water discharge of 68 m^3/hr. The demand is being met using a centrifugal pump A, which is connected to an Industrial 3 Phase Induction Motor, having an efficiency of 85%. The pump is operated for 12 hours daily throughout the year. **[Refer the pump characteristic curves & related data given below]**

a) Compute the total power drawn by the motor, driving pump A.
b) Suggest the best possible recommendation to suit the flow demand.
c) Compute the payback period for the recommendation given. [**Assume energy cost to be INR 6/- per unit]**

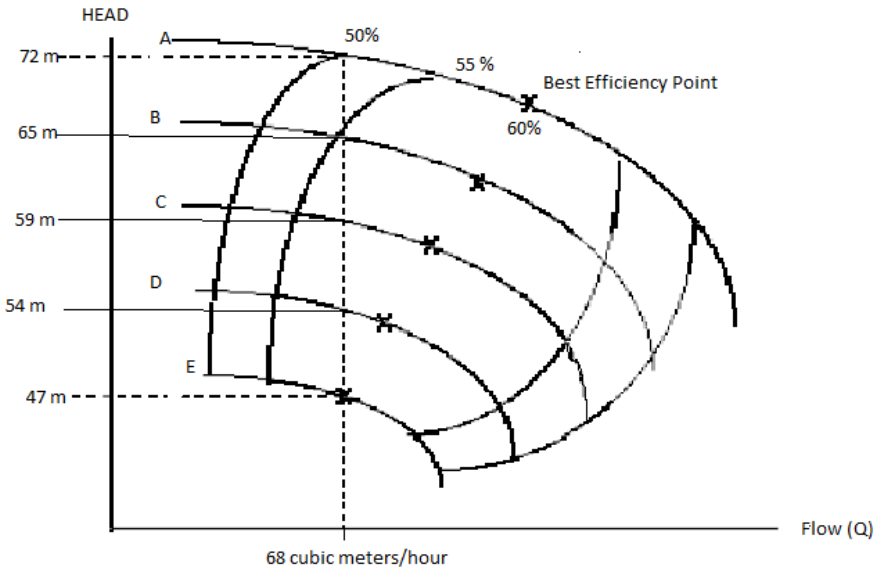

Figure 1: Head vs Flow of Pumps (Q 4A)

(05)

Pump	Motor Efficiency	Cost of the Pump
B	88%	INR 60000
C	88%	INR 62000
D	86%	INR 64000
E	85%	INR 64000

Table 1: Motor cost and efficiency (Q 4A)

4B.. Explain the six-step methodology followed for a lighting audit. Hence, discuss how reduction of feeder voltage and use of occupancy sensors can help reduce the energy consumption in an office space. ***(05)***

5A. The energy monitoring program at a food processing factory yielded the data, as shown in the table below. Its energy consumption and production data was collected for the duration November, 2016 till April, 2018. During the month of July 2017, energy efficient motors and waste heat recovery systems were installed.

Energy Consumption vs Production Details				
Month	**Monthly Energy Consumption**			**Monthly Production**
	(toe/month)			**(Tonnes/month)**
	HSD	**Electricity**	**Coal**	
Nov, 2016	130	190	20	380
Dec, 2016	110	210	20	440
Jan, 2017	100	270	10	460
Feb, 2017	100	270	10	520
Mar, 2017	120	175	05	320
Apr, 2017	120	360	20	520
May, 2017	80	200	00	240
June, 2017	100	300	24	620
July, 2017	100	300	20	600
Aug, 2017	120	270	10	560
Sept, 2017	100	255	05	440
Oct, 2017	105	210	15	360
Nov, 2017	110	225	05	420
Dec, 2017	88	240	12	420
Jan, 2018	136	200	36	480
Feb, 2018	90	258	32	540
Mar, 2018	80	190	10	280
Apr, 2018	100	270	10	500

- Using Linear Regression Analysis, derive the equation for standard energy consumption.
- Perform CUSUM analysis to calculate the energy savings due to installation of energy efficient motors & waste heat recovery systems. ***(07)***

5B. Explain the role of the top management in energy action planning. ***(03)***