

**THE OPEN UNIVERSITY OF SRI LANKA  
FACULTY OF ENGINEERING TECHNOLOGY  
MASTER OF TECHNOLOGY IN INDUSTRIAL ENGINEERING – LEVEL 07  
FINAL EXAMINATION – 2007  
MEX 7125 – ENERGY MANAGEMENT**

**DATE :** 15 May 2008  
**TIME :** 0930 hrs – 1230 hrs  
**DURATION :** Three (03) hours



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This paper consists of Part A and Part B. Answer only four (04) questions selecting one (01) question from Part A and three (03) questions from Part B.

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**PART A**

1. A rice mill uses a rice-husk fired boiler to produce process steam for parboiling of paddy. The parboiling process involves soaking the paddy in hot water at 80° C for 03 hours and then steaming it for 30 minutes.

The soaking tanks contain a combined total of 16,000 litres of water at 30° C and this has to be raised to the soaking temperature within one hour. This is done by passing steam at just above atmospheric pressure into the water. Thereafter, a further quantity of steam has to be passed into the water to maintain it at the required temperature for 3 hours.

The hot water is then completely drained and steam at just above atmospheric pressure is passed through the paddy for a period of 30 minutes.

Following data is available:

All the steam passed into the soaking tank is condensed during the heating process.

The steam required to maintain the soaking temperature for 3 hours is 10% of that required to raise the temperature of the water to the soaking temperature.

The quantity of dry steam required for the steaming process is 30% of the quantity required for heating the soaking water.

The calorific value of rice husk is 4 MJ/kg.

Feed water enters the boiler at 30° C

Boiler efficiency is 70%.

Enthalpy of saturated steam is 2,676 kJ/kg

Enthalpy of saturated water is 419 kJ/kg

And also assume that

All the steam passed into the soaking tank is condensed during the heating process.

Heat taken up by the paddy is neglected.

- (i) Calculate the quantity of rice husk required to process one batch of paddy.
- (ii) Suggest some simple measures that can be taken to improve the efficiency of the system.

(40 marks)

2. A building uses 250 nos. 100W incandescent bulbs for 16 hours per day. It has been proposed that these be replaced by 20W compact fluorescent lamps (CFLs) as an energy saving measure, employing funds already available in the company (no borrowing is required). Evaluate the feasibility of this proposal using the following data.

Cost of a 100W incandescent bulb - Rs. 50/-

Life of an incandescent bulb – 1500 hrs.

Cost of a 20W CFL – Rs. 350/-

Life of a CFL – 12,000 hrs.

Cost of electricity Rs. 22/kWh

Bank interest on fixed deposits 16% per annum

(40 marks)

### PART B

3. Discuss the growth of energy use from the pre-industrial revolution period to the present day, and its consequences for the environment. (20 marks)
4. Describe the Kyoto Protocol and its key provisions. Why has its impact on issues such as global warming been disappointing? (20 marks)
5. Discuss the environmental impacts of the transport sector. Describe in detail how their negative effects expected to be minimised. (20 marks)
6. You have been engaged as a consultant by a large manufacturing organisation to advise them on reducing their energy costs. The organisation has a substantial thermal load arising from the generation of process steam as well as the need to dry products, and an electrical load arising from the operation of motors, pumps, compressors, conveyors, cranes, lighting, heating, ventilation and air conditioning.

Describe in detail how you would collect data for your study, and advise the company by explaining the steps you are expected to propose. Assume that the company does not have an energy management department and has no energy saving plan currently in place. (20 marks)

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