

043

THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
BACHELOR OF INDUSTRIAL STUDIES (INDUSTRIAL MANAGEMENT)-LEVEL 05
FINAL EXAMINATION – 2006/2007
ENERGY MANAGEMENT – MEI 5158



DATE : 4th MARCH 2007
TIME : 1330 HRS – 1630 HRS
DURATION : THREE HOURS

ANSWER FIVE QUESTIONS ONLY. ALL QUESTIONS CARRY EQUAL MARKS.

- (1) (i) What is the concept of combined cycle Cogeneration?. Explain the benefits of Cogeneration. (07 marks)
- (ii) Explain the topping cycle and bottoming cycle with reference to cogeneration systems. (06 marks)
- (iii) What is the difference between an open cycle and a closed cycle in a gas turbine? What are the advantages of a closed cycle over an open cycle?. (07 marks)
- (2) (i) “The present energy crisis in Sri Lanka is due to heavy dependence of hydro power generation”. Comment on this statement and suggest suitable solutions, in which renewable energy concepts can be used. (10 marks)
- (ii) Explain three different types of drying systems giving examples of products that can be dried in these systems. (10 marks)
- (3) (i) There is no set methodology, which can be readily tailor-adopted for conducting energy audit, but energy audit is generally conducted in four phases. Discuss these phases in detail. (12 marks)
- (ii) “Safety is one of the important components of any energy audit”. Comment on this statement suggesting a safety checklist. (08 marks)
- (4) Discuss in detail any two of the following.
- (a) PDCA cycle
- (b) Six Sigma
- (c) Process of Bench Marking
- (d) Energy saving in transportation, air conditioning, cooking and steam distribution. (20 marks)

(5) (i) Gas turbines are suitable for use as peak load power plant. Explain why? (05 marks)

(ii) You are given following data for an open cycle gas turbine system consisting of a compressor, combustor and turbine as shown in the figure Q 5.

Lower Heating Value of Fuel (Light Oil) = 42.3 MJ/kg

Generator efficiency $\eta_G = 0.97$

Mechanical efficiency $\eta_m = 0.98$

$h_{1\text{air}} = 20.01 \text{ kJ/kg}$

$h_{2\text{air}} = 348.5 \text{ kJ/kg}$

$h_{3\text{gas}} = 1118.7 \text{ kJ/kg}$

$h_{4\text{gas}} = 556.5 \text{ kJ/kg}$

Determine,

- (a) Turbine work
- (b) Compressor work
- (c) Overall efficiency of the system

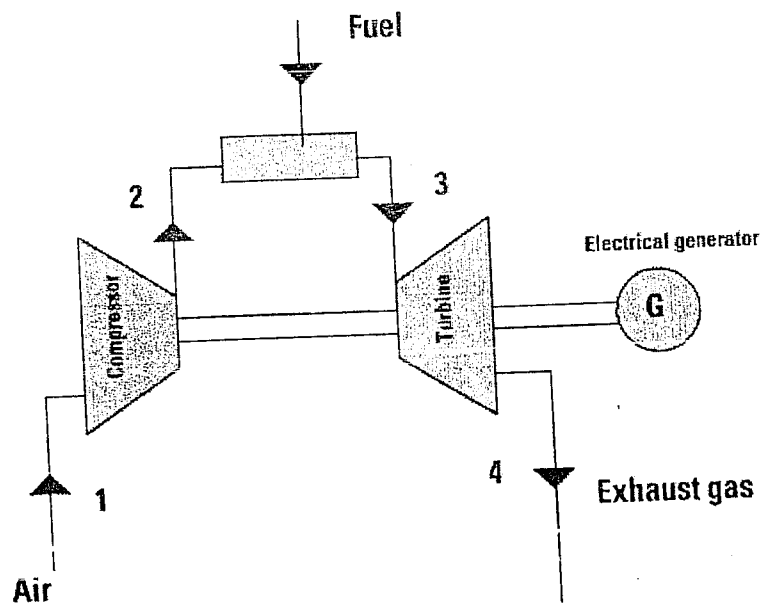


Figure Q.5

(15 marks)

- (6) (i) Discuss the difference between a fire tube boiler and water tube boiler in terms of construction and utilization. (08 marks)
- (ii) Discuss four major energy conservation opportunities in a boiler system. (07 marks)
- (iii) A furnace of 12 tonnes/ hr stock material output consumes 900 kg/hr of fuel oil when this material is heated from 90°C to 1250°C. Calculate the furnace efficiency by assuming specific heat of the stock material as 0.15 kcal/kg °C, and GCV of fuel oil as 11,500 kcal/kg. (05 marks)
- (7) (i) Explain briefly the “Position of Energy Manager” and “Energy Committee” in an organization. If you are an energy manager, explain what would you expect from the top management to discharge your duties satisfactorily?. (10 marks)
- (ii) What are the vital elements of a successful energy management programme? Explain your answer. (10 marks)
- (8) (i) What are the benefits of Waste Heat Recovery (WHR) devices to Industry in general? List down three WHR devices used in industry and briefly explain them. (15 marks)
- (ii) In a heat exchanger, steam is used to pre-heat furnace oil at the rate of 40 kg/ hour from 30° C to 90° C. The specific heat of furnace oil is 0.22 kcal/kg °C. The latent heat of steam is 540 kcal/ kg. How much steam per hour is needed?. (05 marks)
- (9) (i) A company expects to improve the lighting system of its office building and in this respect it identifies two project alternatives A and B. Relevant details of two projects are given below.
- (a) Calculate the discounted payback period (discount rate 7%).
- (b) Calculate NPV for the discount rate of 7% and IRR value for the projects.
- (c) What is the most economical alternative if the required rate of return is 8%?. Draw the graph of NPV vs Interest Rate and justify your answer.

- (ii) Among many others, lighting equipment too play a major role in energy management in office buildings. Identify three energy efficient components that can be introduced to manage electrical power consumption and explain how they reduce overall power consumption and the cost.

(20 marks)

Project A

Year	0	1	2	3	Total
Initial Investment (Rs)	6,000				6,000
Operating Cost (Rs)		250	400	800	1,750
Anticipated Savings (Rs)		3,250	2,750	2,500	8,750

Project B

Year	0	1	2	3	Total
Initial Investment (Rs)	20,000				20,000
Operating Cost (Rs)		2,000	3,500	5,000	10,500
Anticipated Savings (Rs)		15,000	10,000	8,500	33,500

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