UNIVERSITY OF RUHUNA

Faculty of Engineering

End- Semester 8 Examination in Engineering: November 2016

Module Number: ME8312 **Module Name: Energy Management**

[Three Hours]

[Answer all questions, each question carries ten marks]

Q1. a) State three (03) options available to an Energy Manager when optimizing energy usage in an industry. Briefly discuss each option.

[3 Marks]

b) "The key to a successful energy management program is the dedication and commitment from top management". Discuss the significance of this statement and state three methods that you will use to get the attention and support of the Top Management.

[2 Marks]

c) Discuss in brief what the ISO 50001 Energy Management System enables organizations to do.

[2 Marks]

d) Explain how the PDCA Process is implemented in ISO 50001 (Use the Energy Management System Model in the explanation).

[3 Marks]

Q2. a) How do an Industry, Nation and Globe would benefit from energy efficiency programs?

[2 Marks]

b) What are the factors to be considered before procuring fuels for energy efficiency and economics?

[2 Marks]

c) Distinguish between "preliminary energy audit" and "detailed energy audit"?

[2 Marks]

d) List steps involved in "detailed energy audit".

[2 Marks]

e) What is Ozone layer depletion? What are the impacts of Ozone Layer depletion?

[2 Marks]

Q3. a) In an energy audit of a coal fired industrial boiler, below data have been recorded. Calculate the boiler efficiently using the direct method.

- Quantity of steam generated = 8 ton/hour
- Feed water temperature = 65 °C
- Gross calorific value of coal = 20,000 kJ/kg
- Temperature of steam = 190 °C
- Coal consumption = 2.0 ton / hour
- Steam pressure = 8 bar
- Enthalpy of superheated steam at 8 bar and 190°C = 2810 kJ/kg [4 Marks]
- Enthalpy of water at 65°C and atmospheric pressure = 272.1 kJ/kg

Question Q3 is continued on Page 2 .....

..... *Question Q3 is continued from Page 1*

b) Comment on the limitations of using the direct method to calculate the efficiency of a boiler compared with the indirect method.

[2 Marks]

c) Assume you are required to suggest how to improve the overall efficiency of this boiler. State and briefly explain four such suggestions and how to implement them.

[4 Marks]

Q4. a) Write short notes on the below.

(i) Different impeller types used in centrifugal pumps.
(ii) Positive displacement pumps and their applications.

[2 Marks]

b) There are different methods which can be used to improve energy efficiency of pumps and piping networks. State three of such methods for pumps and three **other** methods for pumping networks.

[3 Marks]

c) A water pump is used for an industrial application where a constant supply of water at 1.5 m^3 / min has to be pumped to a tank, which is 30 m above the water intake. The length of the pipe network is about 150 m and a 15 cm diameter cast iron pipe has been used for the piping network. The piping network also includes six 90^0 elbows, and three fully-open gate valves. By using the data given in **Table Q4.1**, **Table Q4.2**, **Figure Q4.1** and **Figure Q4.2**, do the relevant calculations and select the appropriate pump and the electric drive motor for the pump. You may take the temperature of water as 20 °C, where its density is 1000 kg m^{-3} and viscosity is 0.001 N s m^{-2}.

[5 Marks]

Q5. a) Briefly explain the below statements related with steam generation, distribution and end use.

(i) Steam to be generated at high pressure, distributed at high pressure and used at lowest possible pressure.
(ii) Inappropriate insulation of boiler surface and piping can increase heat losses.
(iii) Thermo compressor is an energy saving device.

[3 Marks]

b) Sketch and briefly describe two techniques used for boiler feed water treatment.

[2 Marks]

c) Explain the importance of air venting and feed water de-aeration for the reliable and efficient operation of a given steam system.

[2 Marks]

d) Explain what is meant by a recuperator and briefly explain with suitable sketches, three of such recuperators used in the industry.

[3 Marks]

Table Q 4.1. Relative roughness factors for pipes

Material	Roughness factor (ε)
Riveted steel	0.001- 0.01
Concrete	0.0003 - 0.003
Wood staves	0.0002 - 0.003
Cast iron	0.0003
Material	**Roughness factor (ε)**
Galvanized iron	0.0002
Asphalted cast iron	0.001
Commercial steel	0.00005
Drawn tubing	Smooth

Table Q 4.2. Friction loss factors in fittings

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Valves, fully open:	
gate	0.13
globe	6.0
angle	3.0
Elbows:	
90° standard	0.74
medium sweep	0.5
long radius	0.25
square	1.5
Tee, used as elbow	1.5
Tee, straight through	0.5
Entrance, large tank to pipe:	
sharp	0.5
rounded	0.05

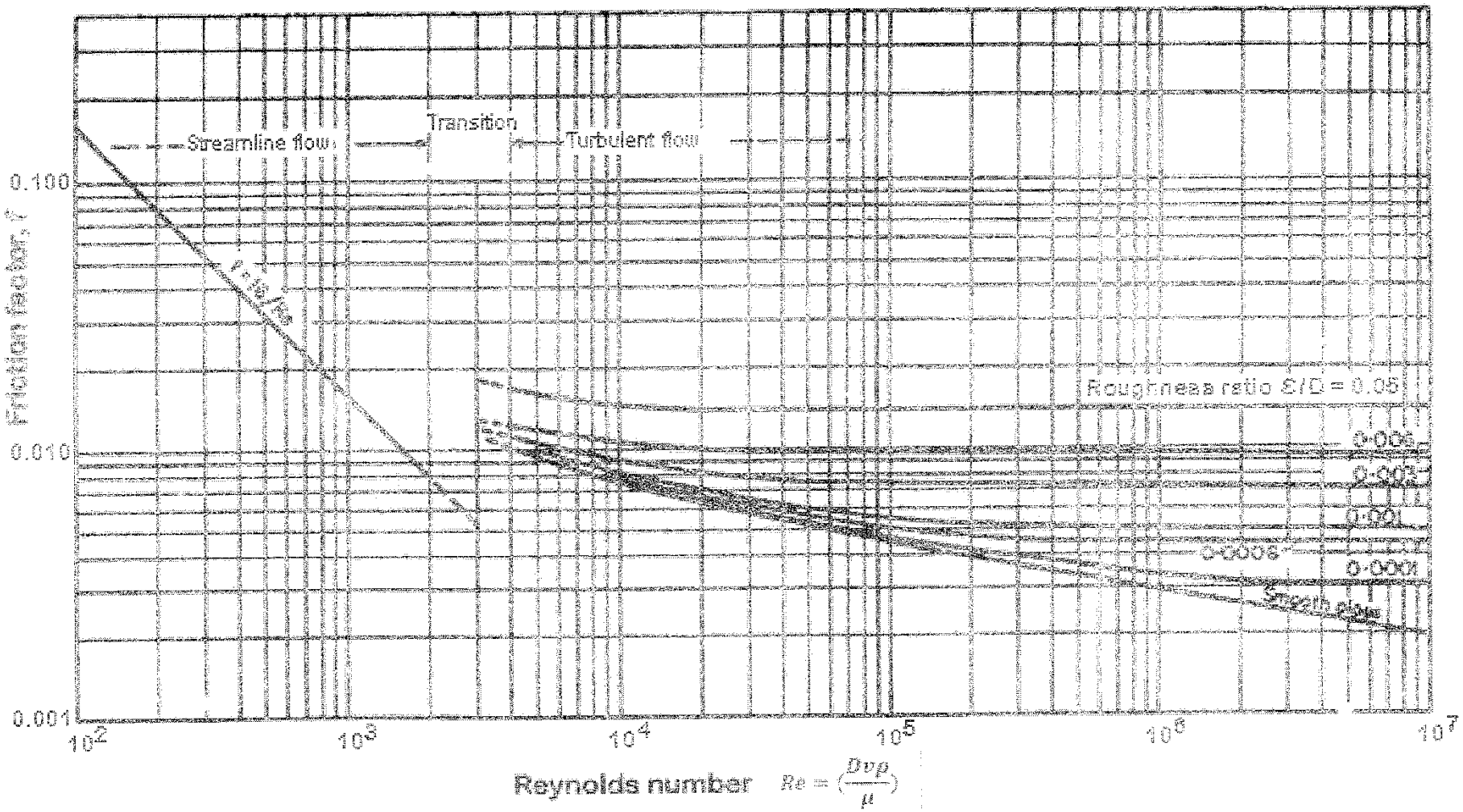

Figure Q 4.1. Friction factors in pipe

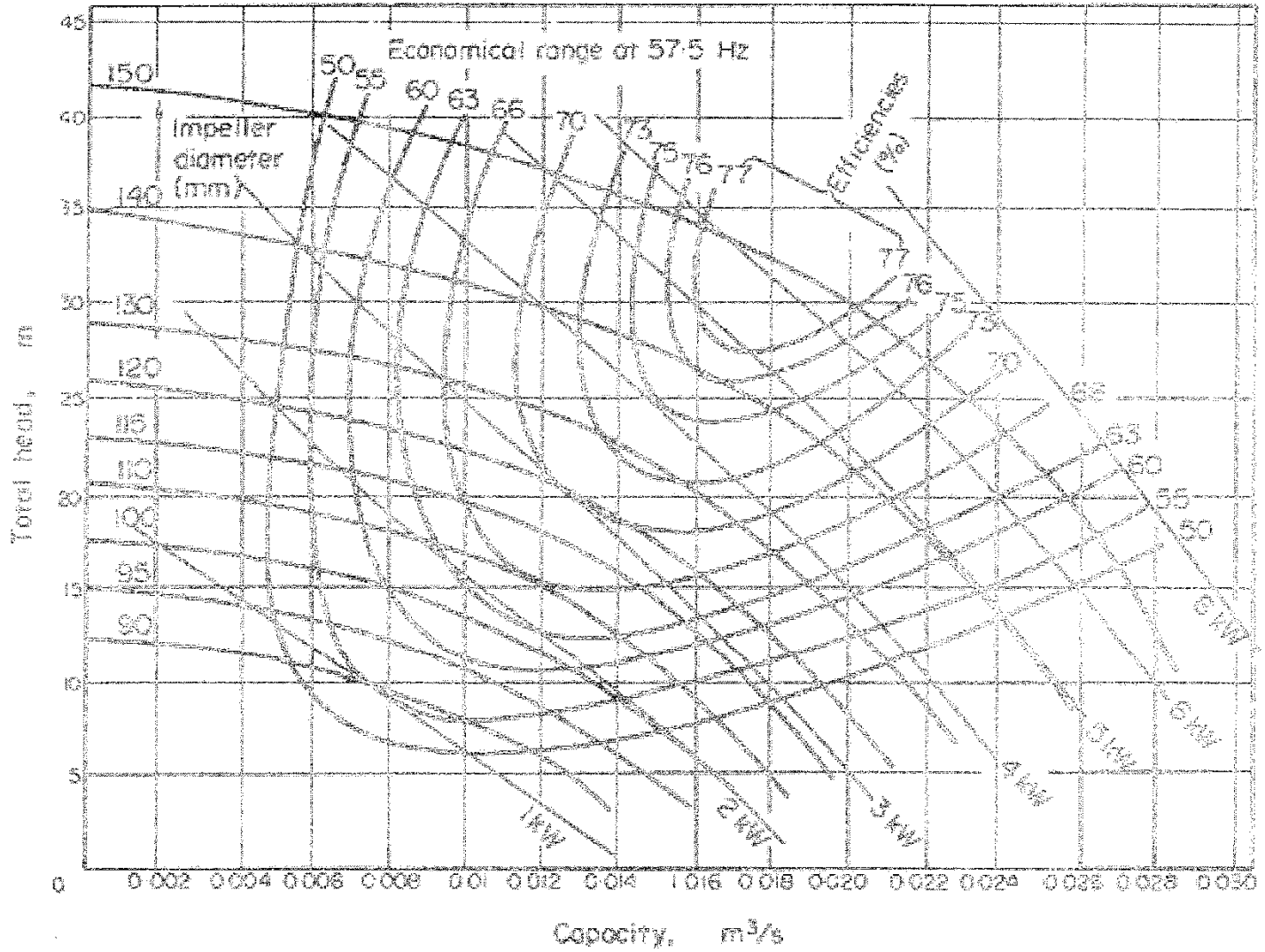

Figure Q 4.2. Characteristic curves for centrifugal pumps