MEBS6000 Utility Services

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Assignment 02 – Steam Systems, Fuel Gas Supply, Telecommunication Systems, Extra Low Voltage Systems, Security Design & Planning (2025-2026)

1. Steam Systems

1.1 Describe the unique properties of steam which can provide many benefits for building and industrial applications. Explain the meaning of superheated steam. Discuss the disadvantages of using superheated steam as the heating medium in process heat exchangers and other heating processes.

(10 marks)

1.2 1000 $kg.h^{-1}$ of condensate at 10 bar gauge passes through a steam trap to 1 bar gauge. Calculate how much flash steam will be produced and the residual condensate. Discuss the different ways to reuse the condensate in a steam boiler system. What are the common methods to return the condensate to the boiler plant?

Given: Specific enthalpy of water at 10 bar gauge = 782 $kJ.kg^{-1}$
Specific enthalpy of water at 1 bar gauge = 505 $kJ.kg^{-1}$
Specific enthalpy of evaporation at 1 bar gauge = 2201 $kJ.kg^{-1}$

(10 marks)

1.3 For an indirect steam heating system, calculate the log mean temperature difference (LMTD) and the arithmetic mean temperature difference (AMTD) of the heat transfer process based on the following information.

- Steam temperature = 100 °C
- Product inlet temperature = 35 °C
- Product outlet temperature = 95 °C

Draw a conceptual diagram to show the basic principle and the inputs/outputs of a boiler plant. Clearly indicate the components and elements.

(10 marks)

1.4 A hospital building has a steam boiler plant operating at 700 kPa absolute pressure. Condensate is being discharged at saturation temperature from the plant with a flow rate of 2.5 $kg.s^{-1}$. Calculate the amount of saturated flash steam that would be produced at 200 kPa absolute pressure and the amount of residual condensate. The properties of the condensate and flash steam can be found in the following table.

Absolute pressure (kPa)	Specific enthalpy ($kJ.kg^{-1}$)		
	In saturated liquid (h_f)	Latent heat of evaporation (h_{fg})	In saturated vapour (h_g)
700	698	2066	2763
200	506	2201	2707

(4 marks)

2. Fuel Gas Supply

2.1 A gas pipework is supplying liquefied petroleum gas (LPG) to a kitchen appliance. Based on the following information, calculate the gas flow rate and pressure loss. If the pipe diameter is changed to 15 mm, determine the respective pressure loss and comment on whether this is acceptable or not.

Appliance heat output = 15 kW
Appliance efficiency = 75%
Gross calorific value of LPG = 116 $MJ.m^{-3}$
Specific gravity of LPG = 1.91
Pipe diameter = 22 mm
Actual length of the gas pipe = 10 m
Allowances for pipe fittings = 4 bends x 0.4 m each
Design tolerance for the pressure loss = 1 millibar

(10 marks)

2.2 Draw a schematic diagram to show the design arrangement of a LPG system with manifold cylinder installation. Clearly indicate and label the components

(4 marks)

3. Telecommunication Systems

3.1 Explain the meaning of structured cabling system (SCS) and describe the major sub-systems of SCS. What is the main purpose of a firewall system in a telecommunication network?

(10 marks)

3.2 Compare the system design options for in-building wireless systems. Discuss the pros and cons of the design options.

(7 marks)

4. Extra Low Voltage Systems

4.1 Define what is extra low voltage (ELV). Briefly describe the three types of ELV sources and illustrate with diagrams. Explain the principles of using ELV design to ensure safety of the electric circuit.

(9 marks)

4.2 Explain the meanings of monitored and unmonitored systems for the design of security systems. Discuss the common causes of false alarms.

(8 marks)

(Cont'd)

5. Security Design & Planning

5.1 Briefly explain the four layers of physical security and its ultimate goal. Describe the key concepts of crime prevention through environmental design (CPTED).

(10 marks)

5.2 Describe the risk-based approach to planning security for a commercial building. What are the major considerations for the risk assessment?

(8 marks)