University of Lincoln Assessment Briefing 2024-2025

Module Code & Title: EGR3030, Energy Systems and Conversion

Contribution to Final Module Mark: 25

Coursework Title: Coursework 1

Description of Assessment Task and Purpose:

The purpose of the assessment is to test your understanding of the fundamental principles of energy conversion modes using a practical activity on an energy conversion system. In this assessment, a vapour-compression refrigeration system is used. You will be guided in using the experimental set up and provided with a user manual. In addition, there is Useful Data at the end of this brief that may help during calculations.

Introduction

The vapour-compression refrigeration cycle in which the refrigerant undergoes phase changes is the most widely used method for air conditioning of buildings, vehicles, domestic and commercial refrigerators, large-scale warehouses, and a host of other commercial and industrial settings.

In this exercise, you are expected to examine the relationship between pressure and temperature, and visually observe this relationship in the both the evaporator and condenser. Please refer to the user manual for detailed instructions on operating the refrigeration equipment.

The condenser contains refrigerant in all stages from superheated vapour through to sub-cooled liquid, the thermometer pocket only records temperatures close to saturation when the pocket is showing signs of condensed liquid. Therefore, the pressure-temperature relationship in the condenser is investigated as the condenser pressure increases.

Procedure

Firstly, set the water flow rate to 20 g/s:

1. Record the condenser pressure, Pc, evaporator pressure Pe, the condensing temperature t_6, evaporating temperature t_5. Record other temperatures as they may be useful to checking your calculations.

After taking these temperatures,

2. reduce the cooling water flow by a small increment so that the condenser pressure increases by about 10-20 kN/m^2. This amount will vary depending on the cooling water inlet temperature. After the unit stabilises for a few minutes, repeat recording the above parameters, up to a maximum condenser pressure of 150 kN/m^2. Make at 5-7 flow rate changes and take corresponding readings.

Question 1

a. Calculate the heat transferred in the evaporator and condenser (in Watts) for each of the water flow rates above **[10 marks]**
b. Appropriately tabulate your results. **[10 marks]**

Question 2

a. For each flow rate in your table, determine the COP of the system. **[10 marks]**
b. Plot the COP against the saturation or condensing temperature. **[10 marks]**

Question 3

a. Plot the pressure vs temperature for the evaporator and condenser at the different water flow rates. **[10 marks]**
b. Discuss the trend and any other observations. **[10 marks]**

Question 4

a. Plot the evaporator and condenser heat transferred against temperature **[10 marks]**
b. Discuss the trend and any other observations. **[10 marks]**

Question 5

Explain what happens if the water supplied into the unit is cooled or warmed below and above those used in tasks 1-4 above? How will the heat transferred, and COP be affected? **[5 marks]**

Question 6

It is proposed that water should be used as the refrigerant instead of R-134a in an air conditioner where the minimum temperature never goes below the freezing point. Would you support this proposal or not? Kindly explain. **[5 marks]**

Pay particular attention to detail, appropriately formatting your report with a good introduction, procedure, diagrams of experimental with appropriate labelling, discussion accompanying your answers, and uncertainty analysis. **[10 marks]**

[Total: 100 marks]

You may carry out your calculations and plots in a spreadsheet or script it using MATLAB. The spreadsheet or code should accompany your Turnitin submission. Marks will be given for your observations (in pictures and description). Note that the pressures you plot on the pressure-enthalpy chart and pressure-temperature chart should be absolute values.

Learning Outcomes (LO) Assessed:

- LO3 Develop a detailed knowledge of chemical energy conversion and make informed judgements
- LO4 Adopt a systems approach to the solution of engineering problems, find technical information and acquire experimental data
- LO5 Use engineering software for the analysis of machines and systems, and critically evaluate the results to identify where design improvements can be made

Knowledge & Skills Assessed:

The coursework element of this module's summative assessment will require each student to individually submit a technical report relating to a laboratory experiment on a refrigeration unit. They are expected to present and analyse their data and draw conclusions from them.

Assessment Submission Instructions:

This submission is: ☒ individual work.
☐ group work.

All work should be submitted by the deadline stated above. Any late submissions will be subject to a lateness penalty in line with the University policy.

The method of submission described above should be used in the first instance however, in cases of technical issues please email your assessment to: soesubmissions@lincoln.ac.uk by the above deadline. Please include the module code and coursework title in the email subject.

Format for Assessment:

Experimental report showing introduction, experimental method, results and calculations, discussion, conclusions.

Marking Criteria for Assessment:

You are expected to produce a well-structured laboratory report on your findings. Marks will be distributed as shown beside each question but more detail you provide ensures you get full marks, for example, stating any assumptions, giving reasons for an observation, and calculating statistics/estimating uncertainty from triplicates of measurements.

COURSEWORK WILL BE SCORED ACCORDING TO THE FOLLOWING UNIVERSITY CRITERIA.

90-100%: a range of marks consistent with a first where the work is exceptional in all areas; 80-89%: a range of marks consistent with a first where the work is exceptional in most areas.

70-79%: a range of marks consistent with a first. Work which shows excellent content, organisation and presentation, reasoning and originality; evidence of independent reading and thinking and a clear and authoritative grasp of theoretical positions; ability to sustain an argument, to think analytically and/or critically and to synthesise material effectively.

60-69%: a range of marks consistent with an upper second. Well-organised and lucid coverage of the main points in an answer; intelligent interpretation and confident use of evidence, examples and references; clear evidence of critical judgement in selecting, ordering and analysing content; demonstrates some ability to synthesise material and to construct responses, which reveal insight and may offer some originality.

50-59%: a range of marks consistent with lower second; shows a grasp of the main issues and uses relevant materials in a generally business-like approach, restricted evidence of additional reading; possible unevenness in structure of answers and failure to understand the more subtle points: some critical analysis and a modest degree of insight should be present.

40-49%: a range of marks which is consistent with third class; demonstrates limited understanding with no enrichment of the basic course material presented in classes; superficial lines of argument and muddled presentation; little or no attempt to relate issues to a broader framework; lower end of the range equates to a minimum or threshold pass.

35-39%: achieves many of the learning outcomes required for a mark of 40% but falls short in one or more areas.

30-34%: a fail; may achieve some learning outcomes but falls short in most areas; shows considerable lack of understanding of basic course material and little evidence of research. 0-29%: a fail; basic factual errors of considerable magnitude showing little understanding of basic course material; falls substantially short of the learning outcomes for compensation.

0-29%: a fail; basic factual errors of considerable magnitude showing little understanding of basic course material; falls substantially short of the learning outcomes for compensation. ***Please note that all work is assessed according to the University of Lincoln Management of Assessment Policy and that marks awarded are provisional on Examination Board decisions (which take place at the end of the Academic Year)***
Feedback Format: Feedback will be given within the submitted work and accessible on Turnitin. This will be broken down per sub question and why the marks awarded were given in full or in part.
Additional Information for Completion of Assessment: An operating manual will be provided for the experimental rig. Please read and refer to it throughout the experiments and for your analysis.
Assessment Support Information: Please email any questions to AAliyu@lincoln.ac.uk
Important Information on Academic Integrity: The use of AI tools is: Not Permitted. All work will be subject to plagiarism and academic integrity checks. In submitting your assessment, you are certifying that this is entirely your own work, without input from either commercial or non-commercial writers or editors or advanced technologies such as artificial intelligence services unless explicitly allowed and referenced. If standard checks suggest otherwise, Academic Misconduct Regulations will be applied. For further information, see www.plagiarism.org

Useful data:

Condenser and evaporator water coil surface area: 0.032 m^2

Specific heat capacity of water Cp = 4.18 kJ/kgK

Refrigerant: Solkatherm SES36

Quantity: approximately 800 cm3 (~1 kg)