



UNIVERSITY OF RUHUNA

Faculty of Engineering

Mid-Semester 4 Examination in Engineering: October 2015

Module Number: ME 4310

Module Name: Applied Thermodynamics (O.C.)

[Two Hours]

[Answer all questions. Each question carries five marks. Provide sketches and diagrams where appropriate. Make reasonable assumptions wherever necessary and state them clearly. Tables of thermodynamics and transport properties will be provided.]

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- Q1. a) Discuss practical limitations associated with the Carnot vapor power cycle. [02 marks]
- b) What advantages does reheating has when incorporated into a simple Rankine cycle? [01 mark]
- c) What are the advantages and disadvantages associated with the closed feed water heaters over the open feed water heaters? [02 marks]
- Q2. A steam power plant operates on a simple ideal Rankine cycle between the pressure limits of 3 MPa and 50 kPa. The temperature of the steam at the turbine inlet is 300 °C.
- a) Draw the cycle on a T-s diagram. [01 mark]
- b) Determine the thermal efficiency of the cycle. [02 marks]
- c) Determine the thermal efficiency of a Carnot cycle operating between the above same operating pressures. [02 marks]
- Q3. A gas-turbine power plant operating on an ideal Brayton cycle has a pressure ratio of 8. The gas temperatures at the inlet and the outlet of the compressor are 27 °C and 1227 °C, respectively. By using the air-standard assumptions (specific heat varies with the temperature), determine:
- a) i. Gas temperature at the outlet of the compressor.
ii. Gas temperature at the outlet of the turbine.
iii. The back work ratio.
iv. The thermal efficiency of the cycle. [04 marks]
- b) Determine the thermal efficiency of the above gas turbine, if a regenerator having 80% effectiveness is installed. [01 mark]

Q4. A steam power plant operates on an ideal regenerative Rankine cycle. Steam enters the turbine at 15 MPa and 600 °C, and is fully condensed in to liquid phase in the condenser at 20 kPa. Some portion of the steam is extracted from the turbine at a pressure of 1.5 MPa and fed to the open feed water heater of the cycle. Water leaves the feed water heater as a saturated liquid.

- a) Draw the cycle on a T-s diagram. [01 mark]
- b) Determine the fraction of mass of steam extracted from the turbine. [03 marks]
- c) Determine the thermal efficiency of the cycle. [01 mark]