



KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

THIRD YEAR FIRST SEMESTER
SUPPLEMENTARY EXAMINATIONS

FOR THE DEGREE OF RENEWABLE ENERGY

COURSE CODE: REN 315

COURSE TITLE: THERMODYNAMICS II

DATE: 18/11/2022

TIME: 8:00AM-10:00AM

INSTRUCTIONS TO CANDIDATES

TIME: 2 Hours

Answer question ONE and any TWO of the remaining

KIBU observes ZERO tolerance to examination cheating

Section A-Compulsory (30 marks)

QUESTION ONE

- a. Define the following terms
- i. Heat engine. (2mks)
 - ii. Moist air (1mk)
 - iii. Refrigerant (1mk)
 - iv. Air conditioning (2mks)
- b. State the second law of thermodynamics? (2mks)
- c. Give the correct order of steps in which a working substance (gas) goes through in a refrigerator. (4mks)
- d. An engine works between 2 reservoirs of temperature 500K and 300K. A company claims that this engine of theirs takes 200J of energy from the hot reservoir and rejects 110J of energy. Is this True or False? (5mks)
- e. Differentiate between reversible and irreversible processes. (4mks)
- f. A car engine with a power output of 50 kW has a thermal efficiency of 24 percent. Determine the fuel consumption rate of this car if the fuel has a heating value of 44000kg/Kj (5mks)
- g. A heat engine absorbs 2500J of heat and discards 2100J of heat. Calculate, the work performed by this engine and its thermal efficiency? (4mks)

SECTION B: ANSWER ANY TWO QUESTIONS IN THIS SECTION (40MKS)

QUESTION 2

- a. Using a well labelled diagram, describe the refrigeration process (8mks)
- b. Jet engine releases 5000J of energy per cycle and performs 800J of work.
- i. How much heat is absorbed by this engine per cycle? (3mks)
 - ii. What is the thermal efficiency? (2mks)
 - iii. How much work can the engine perform in 50 cycles? (3mks)
 - iv. If the engine completes each cycle in 0.2s, what is the power rating of this engine? (4mks)

QUESTION 3

- a. Define a Carnot engine and represent its operation on a PV diagram (6mks)
- b. An engine has a heat input of 175kw and work of 21kw.
- What is the thermal efficiency? (2mks)
 - At what rate is heat discarded into the environment? (2mks)
 - How much heat is released into the environment if this machine were to operate continuously for one day? (4mks)
- c. 800J of heat energy is absorbed per cycle of a diesel engine that is 15% efficient.
- How much work does it perform per cycle? (3mks)
 - How much energy does it expel to the environment per cycle? (3mks)

QUESTION 4

At steady state, 100m³/min of dry air at 328C and 1 bar is mixed adiabatically with a stream of oxygen (O₂) at 1278C and 1 bar to form a mixed stream at 478C and 1 bar. Kinetic and potential energy effects can be ignored.

Determine

- (a) The mass flow rates of the dry air and oxygen, in kg/min (12mks)
- (b) The mole fractions of the dry air and oxygen in the exiting mixture (8mks)