AJAYI CROWTHER UNIVERSITY, OYO
FACULTY OF NATURAL SCIENCES
DEPARTMENT OF PHYSICS

Course Code: PHY3107;   Course Title: Statistical & Thermal Physics

Unit: 3

FIRST SEMESTER EXAMINATION; SESSION: 2021/2022

Examiner's Name: Mr A. Olatunji   Duration: $2^1/_2$ hours

Date: 11th February, 2022.

Instruction: Answer any 4 questions

Question 1:
(a) Distinguish between macroscopic and microscopic systems. Give two examples each (8 marks)

(b) Explain what is meant by micro and macro states (6 marks)

(c) State the Maxwell—Boltzmann distribution function. Mention and distinguish between the other statistical distributions (6 marks)

Question 2:
(a) Define the term heat engine (5 marks).

(b) Show that the efficiency of a heat engine is: $e = 1 - Q_{L/Q_H}$ (7 marks)

(c) A heat engine exhausts 7800J of heat while performing 2600J of useful work. What is the efficiency of this engine and when does a heat engine have 100% efficiency .(8 marks)

Question 3:
(a) Describe briefly the working of a Carnot engine (7 marks)

(b) Explain the factors that keep real engines from reaching Carnot efficiency (7 marks).

(c) A Carnot engine performs work at the rate of 520 kW with an input of 950 kJ of heat per second. If the temperature of the heat source is 560 degree Celsius, at what temperature is the waste heat exhausted (6 marks).

Question 4:
(a) With the aid of appropriate diagram, state the differences between heat engine and heat pump (7 marks)

(b) Given that the COP of a refrigerator is defined as : $COP = \frac{Q_L}{W}$

Show that for an ideal (Carnot)refrigerator: $COP = \frac{T_L}{T_H} - T_L$ (8 marks)

(c) What is the COP for an ideal refrigerator that maintains a freezer compartment at −18 degree Celsius when the condenser temperature is 24 degree Celsius (5 marks)

Question 5:
(a) Define the term entropy (6 marks)
(b) State the Kelvin—Planck second law of thermodynamics (6 marks)
(c) The coefficient of performance of a refrigerator is 4.60.How much electrical energy is used in removing 4.10 kJ of heat from its contents.(8 marks)

Question 6:
(a) Explain the three modes of heat transfer. State the major differences between them (8 marks)
(b) Explain why a tile floor feels colder to the feet than does a rug in the same room (5 marks)
(c) A piece of brass is 5mm thick and has a cross-sectional area of 0.01squared metre.If the temperature on one side of the metal is 65 degree Celsius and the temperature on the other side is 25 degree Celsius.How much heat will be conducted through the metal in 30 seconds.The coefficient for thermal conductivity for brass is 120 W/m/K (7 marks).