KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2019/2020 ACADEMIC YEAR

THIRD YEAR SECONDSEMESTER
SPECIAL/SUPPLIMENTARY EXAMINATIONS

FOR THE DEGREE OF
B.SC RENEWABLE ENERGY AND BIOFUELS TECHNOLOGY

COURSE CODE: PRD 372

COURSE TITLE: THERMODYNAMICS III

DURATION: 2 HOURS

DATE: 11/02/21   2020   **TIME:**   11 – 1 Pm

INSTRUCTIONS TO CANDIDATES
   (i) Answer **Question 1 (Compulsory)** and any other **TWO** questions
   (ii) All symbols have their usual meaning
   (iii) Use steam tables provided

This paper consists of 4 printed pages. Please Turn Over ▶

QUESTION ONE (Compulsory) – 30 Marks

a) Define the following terms:

    (i)   Mixture strength.

                                    (3 Marks)

    (ii)   Proximate analysis.

                                      (3 Marks)

    (iii)   Dehumidification.

                                      (2 Marks)

    (iv)   Sensible cooling.

                                      (2 Marks)

b) Show that the specific humidity of an air mixture can be expressed as:

$$\omega = 0.622 \frac{p_s}{p_a}$$

                                      (5 Marks)

c) State Leduc's law.

                                      (2 Marks)

d) Explain the following terms as applied to air conditioning engineering:

    (i)   Specific humidity.

                                      (2 Marks)

    (ii)   Relative humidity.

                                      (2 Marks)

e) Give the firing order for the following engines:
    (i)   V6

                                      (2 Marks)

    (ii)   V8

                                      (3 Marks)

f) Give two differences between a spark-ignition engine and a compression-ignition engine.

                                      (4 Marks)

QUESTION TWO (20 Marks)

A vessel of $1m^3$ capacity contains O_2 at 6 bar and 35^0C. The vessel is connected to another vessel of $2m^3$ capacity containing CO at 1.5 bar and 12^0C. A connecting valve is opened and the gases mix adiabatically. Take the c_v values (in kJ/kmol K) for O_2 and CO as 21.07 and 20.86 respectively.

Calculatefor this mixture:

a) The final temperature.

(13 Marks)

b) The final pressure.

(7 Marks)

QUESTION THREE (20 Marks)

Air at 10^0C DBT and90% RH is tobe heated and humidified to 35^0C DBT and 22.5^0C WBT. The air is pre-heated sensibly before passing to the air washer in which water is re-circulated. The RH of air coming out of the air washer is 90%. Air is again re-heated sensibly to obtain the final desired condition.

a) Outline the procedure for plotting points, and sketch the processes on the psychrometric chart.

(5 Marks)

b) Determine the temperature to which air should be pre-heated.

(1 Mark)

c) Find the total heating that is required.

(4 Marks)

d) Determine the make-up water that is added to the air washer.

(4 Marks)

e) Calculate the humidifying efficiency of the air washer.

(6 Marks)

QUESTION FOUR (20 Marks)

Ethyl alcohol (C_2H_6O) is burned in a petrol engine with extreme mixture strengths of 130%.

a) Calculate the:
   i) Stoichiometric air/fuel ratio.

(4 Marks)

   ii) Actual air/fuel ratio.

(2 Marks)

3