KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2017/2018 ACADEMIC YEAR

THIRD YEAR FIRST SEMESTER
SPECIAL/SUPPLIMENTARY EXAMINATIONS

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

COURSE CODE: PRD 371

COURSE TITLE: THERMODYNAMICS II

DURATION: 2 HOURS

DATE: 9/10/18 **2017** **TIME:**

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 **3** printed pages. Please Turn Over

KIBU observes ZERO tolerance to examination cheating

QUESTION ONE (COMPULSORY) – 30 MARKS

a) Use a P-V diagram to explain the processes in an Atkinson

(5 Marks)

b) Define a heat engine

(3 Marks)

c) Use a P-V diagram to explain the processes in a Joule-Brayton cycle

(5 Marks)

d) Define Work ratio

(2 Marks)

e) Explain, with the help of a P-V diagram, the processes in an Otto cycle

(5 Marks)

f) Briefly explain the following terms

(i) Impulse turbines

(3 Marks)

(ii) Impulse-Reaction turbines

(2 Marks)

g) A steam power plant operates between a boiler pressure of $4.2MN/m^2$ and a condenser pressure of $6kN/m^2$. For a Carnot cycle using wet steam for these limits, calculate the cycle efficiency

(5 Marks)

QUESTION TWO – 20 MARKS

Calculate the change in entropy per kg of air expanding polytropically in a cylinder behind a piston from a pressure of 6.5×10^4 N/m^2 and a temperature of 660^0C to a pressure of 1.0×10^4 N/m^2. The index of expansion is 1.3

(20 Marks)

QUESTION THREE – 20 MARKS

During an adiabatic compression of air in an engine, the volume is reduced to 0.0625 of its initial value. Heat is then added at constant pressure until the temperature is 1400^0C. The stroke is followed by an adiabatic expansion until the initial volume is attained again. The cycle is completed by a constant volume process. At the beginning of adiabatic compression, the pressure is 0.9bar and the temperature is 40^0C.

a) Sketch the p-v diagram for the engine

(6 Marks)

b) Calculate the thermal efficiency of the cycle

(14 Marks)

QUESTION FOUR – 20 MARKS

a) Show from first principles that the indicated work of an air compressor is expressed as:

$$W = \left(\frac{n}{n-1}\right) mR(T_2 - T_1)$$

(8 Marks)

b) A single-acting single-cylinder air compressor running at 290 rpm takes $1m^3$ of air per minute at a pressure of 1 bar and 18^0C. The compression process which takes place in a single stage follows the law $pv^{1.32}$ = constant. Air is then delivered at a pressure of 8 bar.

Assuming negligible clearance volume, calculate:

(i) Indicated power

(6 Marks)

(ii) Isothermal efficiency

(6 Marks)

QUESTION FIVE – 20 MARKS

Steam is supplied to a steam engine at a pressure of 7×10^5 N/m^2 and a dryness fraction of 0.95. It expands in the engine according to a law $pv^{1.1}$ = constant to attain a pressure 0f 3.4×10^4 N/m^2.

a) Calculate the change in entropy per kg of steam during expansion.

(16 Marks)

b) Show the process on a T-S diagram.

(4 Marks)