TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology
Department of Mechanical & Automotive Engineering
UNIVERSITY EXAMINATION FOR:
Diploma in Mechanical Engineering
EME 2207 : Thermodynamics II
END OF SEMESTER EXAMINATION
SERIES: AUGUST 2019
TIME: 2 HOURS
DATE: Pick Date **Aug 2019**

Instruction to Candidates:
You should have the following for this examination
- *Student I.D. Card & Examination Pass*
- *Answer booklet*
- *Non-Programmable scientific calculator*
- *Thermodynamic and Transport Properties of Fluids by G. F. C. Rogers and Y. R. Mayhew*

This paper consists of **FIVE** questions. Attempt any **THREE** questions.
Maximum marks for each part of a question are as shown.
Do not write on the question paper.

Question ONE
a. i)   Briefly describe the Air standard Diesel cycle using both p-v and t-s diagrams.
   ii)   Show that the thermal efficiency of the of the cycle in a. i) is given by;

$$\eta_{Diesel} = \frac{\beta^{\gamma}-1}{(\beta-1)r_v^{\gamma-1}-\gamma}$$

Where $r_v = Compression\ ratio$
         β = Cut off ratio

(15 marks)

b.   Determine the thermal efficiency based on the diesel cycle for an engine whose inlet temperature and pressure are 25°C and 1.325 bar respectively. The compression ratio for the engine is 12.5/1 and the maximum cycle temperature is 1200°C.   **(5marks)**

Question TWO

   a. Show that when 1kg of perfect gas undergoes a non-flow reversible adiabatic process it obeys the law;

$$pv^\gamma = constant$$

Where $p = pressure$
$v = specific\ volume$

(10 marks)

   b. The initial conditions of pressure and temperature of 0.2 m³ of air are 4 bar and 130°C. The air undergoes a reversible non-flow adiabatic expansion until the pressure falls to 1.02 bar. The gas is then heated at constant pressure until the enthalpy increases by 72.5 kJ. Calculate the work done. **(10 marks)**

Question THREE

   a. Define the following terms as applied to combustion.

      (i)   Calorific value

      (ii)   Mixture strength   **(4marks)**

   b. A sample of dry coal has the following composition by mass

   C – 88%, H_2 – 4%, O_2 – 3.5%, N_2 – 1%, S – 0.5%, Ash – 3%. If the fuel is burnt with 30% excess air, determine;

      (i)   Air fuel ratio

      (ii)   Dry analysis of the products of combustion   **(16 marks)**

Question FOUR

   a. Explain the stages in the formation of steam with the help of well-labelled T-s diagram showing all the key parts. **(13 marks)**

   b. Steam at a pressure of 20bar and 250°C is expanded isentropically to 3.6 bar and it is then further expanded according to the law PV=C to a pressure of 0.6 bar. Determine;-

      (i)   Final condition of the steam

      (ii)   Change of entropy during the two processes   **(7 marks)**

Question FIVE

(a) Derive an expression for the logarithmic mean radius of a sphere. **(8 marks)**

(b) A spherical container of negligible thickness holding a hot fluid at 140^0C and having an outer diameter of 0.4 m is insulated with three layers of each 50 mm thick insulation of $k_1 = 0.02$: $k_2 = 0.06$ and $k_3 = 0.16$ W/m.K. (Starting from inside). If the outside surface temperature is 30 ^{0}C, determine;
  (i)   The heat loss, and
  (ii)   Interface temperatures of insulating layers.   **(12 marks)**