Machakos University

(University Examinations 2018/2019)

SCHOOL OF ENGINEERING

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

SECOND SEMESTER EXAMINATION FOR DIPLOMA (II) IN MECHANICAL ENGINEERING

UNIT CODE: MED-PR 212 THERMODYNAMICS II

DATE: **TIME: 2HRS**

INSTRUCTIONS

Answer all questions in Section A and choose any other TWO in Section B

SECTION A

1. (a) From first principles show that the change in entropy of one kilogram of a gas is given by

$$S = C_V Ln\frac{P_2}{P_1} + C_P Ln\frac{V_2}{V_1}$$ (8mks)

(b) 0.3 kg of air at a pressure of 350 KN/m^2 and a temperature of 35^{o}c respectively receives heat energy at constant volume until its pressure becomes 700KN/m^2. It then receives heat energy at constant pressure until its volume becomes 0.2289m^3. Determine the change of entropy during each process.

(***Take C_p =1.006kJ/Kg K and C_v= 0.717 kJ/Kg K***). (12mks)

(c) An engine works on the constant volume cycle. It has a bore of 80mm and a stroke of 85mm. the clearance volume of the bore of the engine is 0.06 litre. The actual thermal efficiency of the engine is 22%. Determine the relative efficiency of the engine.

(Take γ =1.4) (10mks)

SECTION B

2. A quantity of gas has an initial pressure, volume and temperature of 140KN/m^2, 0.14m^3 and 25^{o}c respectively. It is compressed to a pressure of 1.4MN/m^2 according to the law PV$^{1.25}$= C. Determine

   a) The change of entropy (10mks)

b) The approximate change of entropy contained by dividing the heat transferred by the gas by the mean absolute temperature during the compression. (10mks)

(Take C_p=1.041kJ/kgK, C_v=0.743kJ/kgK)

3. A gas engine is supplied with coal gas of the following composition: 53.6% H_2; 9% CO; 25% CH_4; 3%C_4H_8; 0.4% O_2; 3%CO_2; 6% N_2. If the air fuel ratio is 6.5/1by volume, calculate the analysis of the dry products of combustion. It can be assumed that the stoichiometric air fuel ratio is less than 6.5/1 (20mks)

4. In an ideal diesel cycle the volume ratios of the adiabatic expansion and compression are 7.5:1 and 15:1, respectively. The pressure and temperature at the beginning of compression are 98kN/m^2 and 44^0c respectively. The pressure at the end of the adiabatic expansion is 258kN/m^2. Determine:
   a) The maximum temperature attained during the cycle (10mks)
   b) The thermal efficiency of the cycle. (10mks)

(***Take γ=1.4***)

5. The analysis of dry exhaust gas from a 4-stroke,4-cylinder internal combustion engine gave the following result;12%CO_2, 2%CO, 4%, CH_4,1%H_2,4.5%O_2 and the remainder nitrogen. The engine has a bore of 180mm and a stroke of 380mm, with a compression ratio of 18:1. The specific fuel consumption and brake mean effective pressure at an engine speed of 780rpm are 0.2064kg/kwh and 9.3 bar. The calorific value of fuel is 44.2Mj/kg and air inlet conditions are 25°C and 1.7 bar. If the mechanical efficiency of the engine is 85%, determine the ratio of carbon to hydrogen by mass in the fuel assuming it to be a pure hydrogen. (20mks)