MACHAKOS UNIVERSITY COLLEGE

(A Constituent College of Kenyatta University)
University Examinations for 2015/2016

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

SECOND SEMESTER EXAMINATION FOR DIPLOMA IN MECHANICAL ENGINEERING

2501/304A: THERMODYNAMICS

DATE: 1/8/2016 **TIME: 8:30 – 10:30 AM**

INSTRUCTIONS:

Answer all questions in section A and any other TWO questions in section B.

SECTION A

1. a) (i) Define entropy as used in applied thermodynamics. (2 marks)

(ii) Show that the change in entropy of a perfect gas is given by

$$\delta S = C_V Ln\frac{T_2}{T_1} + R \ Ln\frac{V_2}{V_1}$$ (6 marks)

b) An engine works on a constant volume cycle. It has a bore of 80mm and a stroke of 85mm. The clearance volume of the engine is 0.06litre. The actual thermal efficiency of the engine is 22%. Determine the relative efficiency of the engine. (Take γ=1.4) (5 marks)

c) A brick wall 250 mm thick is faced with concrete 50mm thick. The brick has a coefficient of thermal conductivity of 0.69w/mK while that of the concrete is 0.93 w/mK. If the temperature of the exposed brick face is 30^0c and that of the

concrete is 5^0c, determine the heat lost/h through a wall 10m long and 5m high. Determine also the interface temperature. (10 marks)

d) A quantity of gas has a pressure of 700kN/m^2 and it occupies a volume of 0.014m^3 at a temperature of 150^0c. The gas is expanded isothermally to a volume of 0.084m^3. Determine the change in entropy. (7 marks)

SECTION B

2. 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 (10 marks)

   b) The thermal efficiency of the cycle. (10 marks)

   (Take γ=1.4)

3. A 100mm diameter steam main is covered by two layers of lagging. The inside layer is 40mm thick and has a coefficient of thermal conductivity of 0.07w/mK. The outside layer is 25mm thick and has a thermal conductivity of 0.1w/mK. The main conveys steam at a pressure of 1.7MN/m^2 with 30K superheat. The outside temperature of lagging is 24^0c. If the steam main is 20 m long, determine;

   a) The heat lost/h (10 marks)

   b) The interface temperature of the lagging. (10 marks)

   Neglect the temperature drop across the steam main.

4. Calculate the stoichiometric air-fuel ratio for the combustion of a sample of dry anthracite of the following composition by mass. C=90%, H_2=3%, 0_2=2.5%, N_2=1%, S=0.5% and ash 3%. Determine the actual air- fuel ratio. Compute also the dry and wet analysis of the products of combustion by volume when 20% air is supplied in excess. (20 marks)