NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

Bachelor of Engineering Honours Degree Industrial & Manufacturing Engineering

SUPPLEMENTARY EXAMINATIONS OCTOBER 2009

THERMODYNAMICS – TIE 2101

INSTRUCTIONS TO CANDIDATES
ANSWER ANY FIVE (5) QUESTIONS
TIME ALLOWED: 3 HRS
ADDITIONAL MATERIAL – STEAM TABLES

Question 1

A perfect gas is compressed in a cylinder according to the law $PV^{1.,34} = C$. The initial condition of the gas is 2.07 Bars , $0.41\,m^3$ and $23\,^oC$. If the final pressure is 6.35 Bars and Cp=1.005kJ/kgK [3]
calculate:
(a) the mass of the gas in the cylinder [3]
(b) the final volume [3]
© the final temperature [3]
(d)the work done to compress the gas [3]
(e) the change in the internal energy [4]
(f) the transfer of heat between the gas and the cylinder [4]

Question 2

(a) Show from the first law of thermodynamics that the change of entropy for a gas is given by $s_2 - s_1 = c_p \ln(T_2 / T_1) + R \ln(P_2 / P_1)$ [8]

(b) Describe with the aid of a diagram the stages in the formation of superheated steam. [8]
(c) A perpetual motion machine of its own kind is impossible. Discuss [4]

Question 3

Air at 2.04 Bars, $25\,^oC$ initially occupying a cylinder volume of $0.3\,m^3$ is compressed reversibly and adiabatically by a piston to a pressure of 7.3 bars. Calculate:
(a) the final temperature [6]

(b) the final volume [6]
(c)work done on the mass of air in the cylinder. [8]

Question 4

A mass of 5kg of air initially at 3bar and *98o/c* undergoes a cycle consisting of the following processes

(a) Constant pressure expansion until the volume is tripled

(b) Constant volume cooling

© Reversible adiabatic compression to the initial state

Calculate

(i) the pressure after constant volume cooling process [10]
(ii) the net work done in the cycle [10]

Question 5

(a) Describe the major components of a refrigerator [10]

(b) A petrol engine cylinder has diameter of 10 cm and stroke 17 cm, clearance volume 250 cm^3. If the temperature at the beginning of the compression is 67^0C, Find the temperature at the end of compression and the work done during the compression stroke if the law of compression is $pV^{1.3}$ = c. Take the initial pressure as 200 kN/m^2. [10]

Question 6

(a) Derive from first principles the transfer of heat through a composite thick cylinder. [10]

A wall is made up of two layers of bricks each 100mm thick with a 50mm air space between them. The coefficients of thermal conductivity are as follows: inside brick-0.6W/mK outside brick- 0.025W/mK air-0.8W/mK. The wall is 6.15m long and 5.5m wide.

(b) Determine the heat loss/h through the wall if the inside wall temperature is 24 and the outside face temperature is 7. [5]

(c) Determine, also, the interface temperatures. [5]