NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

B-Eng Hons Industrial and Manufacturing Engineering

Main Examination

COURSE	**:**	**ENGINEERING THERMODYNAMICS**
CODE	**:**	**TIE 2101**
DATE	**:**	**JANUARY 2013**
DURATION	**:**	**3 HOURS**

INSTRUCTIONS AND INFORMATION TO CANDIDATE

1. Answer **Five (5) questions**.
2. This paper contains Six **(6)** questions.
3. There are three **(3)** printed pages.

Additional Material

Steam Tables

QUESTION 1

(a) Write short notes on:

(i) Work and the polytropic process [3]

(ii) Work and the hyperbolic process [3]

(iii) Internal energy [3]

(iv) Calorimetry [3]

(b) A gas is compressed hyperbolically from a pressure and volume of 250 kN/m^2 and $0.085m^3$, respectively, to a volume of $0.009m^3$. Determine the final pressure and the work done on the gas. [8]

QUESTION 2

A nozzle has the following entry conditions: area A_1, Velocity C_1, Pressure P_1, Specific volume V_1, Temperature T_1, Specific enthalpy h_1.
Exit conditions are as follows A_2, C_2, P_2, V_2, T_2, h_2. From first principles derive an expression for the general flow analysis. [20]

QUESTION 3

(a) Determine the specific enthalpy of steam at a pressure of $3MN/m^2$ and with a temperature of 350^oC. [15]

(b) Describe the principle of operation of the Rankine cycle. [5]

QUESTION 4

Air flows through a diffuser. At one section the temperature is 5^oC, pressure 180 kN/m^2 and the velocity is 1000m/s. Along the tube the velocity has fallen to 400m/s. Assuming that the adiabatic flow is frictionless,
Determine:

(a) The increase in pressure [7]

(b) Temperature increase or decrease [7]

(c) Internal energy [6]

QUESTION 5

The volume ratio of the adiabatic expansion and compression in a diesel cycle are 8:1 and 16:1 respectively. The pressure and temperature at the beginning of compression are 100 kN/m^2 and 50° C respectively. The pressure at the end of adiabatic expansion is 330 kN/m^2. Determine:

(a) the maximum temperature. [10]

(b) the thermal efficiency. [10]

QUESTION 6

A composite wall is made up of an external thickness of brickwork 100mm thick inside which is a layer of fibre –glass 100mm thick. The fibre – glass is faced internally by an insulating board 30mm thick. The coefficients of thermal conductivities for the three materials are as follows:

Insulating board	0.06W/mK
Brickwork	0.4W/mK
Fibre – glass	0.03W/mK

The surface transfer coefficient of the inside wall is 1.7W/m2K while that of the outside wall is 2.4W/m^{2}K.

i) Determine the overall transfer coefficient of the wall. [10]

ii) Using the coefficient, determine the heat loss per hour through such a wall 10m high and 16m long. Take internal and external temperatures as 35^oC and 11^oC respectively. [10]

End of examination