**NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY**
FACULTY OF INDUSTRIAL TECHNOLOGY
BACHELOR OF ENGINEERING (HONS) DEGREE
Part One Examination May 2011

**TCE1204 ENGINEERING THERMODYNAMICS**

Duration of Examination: 3Hours

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Instructions to Candidates

1. Answer any **FIVE** questions.
2. Show all your steps clearly in your calculation.
3. Start the answers for each question on a new page.
4. Additional materials: Steam Tables

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**1.** The laws of thermodynamics are really statements of thermodynamic behavior. They are natural laws, which are based on observable phenomena. These are considered as law because they have never been shown to be contradicted. The world is experiencing its most torrid time. There are earthquakes, floods, energy shortages, wars, drought global warming. All this can be attributed to the field of thermodynamics. Discuss. **[20]**

**2.** **(a)** Assume a compression according to the law ***PV = CONSTANT***,

**i)** Calculate the final volume when $2m^3$ of gas at 20 $kN/m^2$ is compressed to a pressure of 60 k N $/m^2$. **[3]**

**ii)** Calculate the initial volume of gas at a pressure of 1.0bar, which will occupy a volume of $6m^3$ when it is compressed to a pressure of 50bar. **[4]**

**iii)** $0.2m^3$ of gas at a temperature of $30^0$C is heated at constant pressure to a temperature of $300^0$C. Calculate the final volume. **[4]**

**(b)**Describe the principle of operation of:

**(i)** the constant temperature process. **[3]**

**(ii)** the constant pressure process. **[3]**

**(iii)** the constant volume process. **[3]**

**3.** **(a)**Determine the specific enthalpy of steam at a pressure of $2.5MN/m^2$ and with a temperature of 340 $^oC$ using two different methods. **[8]**

**(b)**Derive the expression for the relationship between the two specific heats. **[6]**

**(c)**Define the following terms:

**(i)** isothermal process. **[2]**

**(ii)** isobaric process. **[2]**

**(iii)**isochoric process. **[2]**

**4.** 0.5kg of air is taken through a constant pressure cycle. The pressure and temperature at the beginning of the adiabatic compression are 96.5kN/$m^2$ and $15^0$C respectively. The pressure ratio of the compression is 6:1. Constant pressure heat addition occurs after the adiabatic compression until the volume is doubled. Determine for the cycle,

**(a)** the thermal efficiency. **[4]**

**(b)**the heat received. **[4]**

**(c)**the net work done. **[4]**

**(d)**the work ratio. **[4]**

**(e)**the mean effective pressure. **[4]**

**5.** **(a)** With the aid of a diagram describe the major components of an electrical power plant. **[10]**

**(b)**With the aid of a graph and mathematical equations explain the four stage process which takes place in the refrigeration cycle **[10]**

**6.** **(a)**Write short notes on:

**i)** Conduction **[2]**

**ii)** Convection **[3]**

**iii)**Radiation **[3]**

**b)** A wall is made up of two layers of brick each 100mm thick with 50mm airspace between them. The coefficients of thermal conductivity are as follows:

| | |
|---|---|
| Inside brick | 0.8W/mK |
| Air | 0.025W/mK |
| Outside brick | 0.9W/mK |

The wall is 8m long and 5mm high.

**i)** Determine the heat loss per hour through the wall if the inside face temperature is $30^oC$ and the outside face temperature is $10^oC$. **[6]**

**ii)** Determine, also the interface temperatures. **[6]**

**END OF QUESTION PAPER!!!**