NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

Bachelor of Engineering Honours Degree Industrial & Manufacturing Engineering

1st SEMESTER EXAMINATIONS - FEBRUARY 2010

THERMODYNAMICS – TIE 2101

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

QUESTION 1

(a) 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. Discuss. [5]

(b) 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 calculate:

(i) the mass of the gas in the cylinder [2]
(ii) the final volume [2]
(iii) the final temperature [2]
(iv) the work done to compress the gas [3]
(v) the change in the internal energy [3]
(vi) the transfer of heat between the gas and the cylinder [3]

QUESTION 2

Determine

(a) the saturation temperature [5]
(b) the specific liquid enthalpy [5]
(c) the specific enthalpy of evaporation and [5]
(d) the specific enthalpy of dry saturated steam at a pressure of 15.02 MN/m^2 . [5]

QUESTION 3

(a) Describe the principle of operation of the reheat cycle. [5]

(b) In a refrigerating plant using R12 the vapour leaves the evaporator dry saturated at 1.74 bar and is compressed to 8.44 bar. The temperature of the vapour leaving the compressor is 42ºC and the liquid leaves the condenser at 23ºC and is throttled to the evaporator pressure calculate:

(i) the refrigerating effect [5]

(ii) the specific work input [5]

(iii) the COP_{ref} [5]

QUESTION 4

(a) Entropy is defined as the multiplicity of the system, the disorder of the system or the energy which is unavailable to do work . Discuss [8]

(b) 0.5kg of air at a pressure of $40 \, {}^{MN}\!/_{m^2}$ and a temperature of $40\,^oC$ receives heat energy at constant volume until its pressure becomes $80 \, {}^{MN}\!/_{m^2}$. It then receives heat energy at constant pressure until its volume becomes $0.5\, m^3$.

Determine the change of entropy during each process. [12]

Take Cp=1.005kJ/kgK and Cv=0.717kJ/kgK

QUESTION 5

(a) Describe five major components of a steam power plant [10]

(b) A petrol engine cylinder has diameter of 10 cm and stroke 15 cm, clearance volume 300 cm^3. If the temperature at the beginning of the compression is 70^0C, Find the temperature at the end of compression and the work done during the compression stroke if the law of compression is $pV^{1.11} = c$. Take the initial pressure as 156 kN/m^2. [10]

QUESTION 6

A composite wall is made up of an external thickness of brickwork 200mm thick inside which is a layer of fibre –glass 80mm 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	0.07W/mK
Brickwork	0.5W/mK
Fibre – glass	0.05W/mK

The surface transfer coefficient of the inside wall is 2.7W/m2K while that of the outside wall is 3.4W/m2K.

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

(b) Using the coefficient , determine the heat loss per hour through such a wall 7m high and 10m long. Take internal and external temperatures as $30^{o}C$ and $15^{o}C$ respectively. [10]

End of examination