BTS(C) – IV – 09 – 015 - O

B. Tech Degree IV Semester Examination, April 2009

ME 404 APPLIED THERMO DYNAMICS

(*2006 Scheme*)

Time: 3 Hours Maximum Marks: 100

PART A

(Answer all questions)

(8 x 5 = 40)

I. a. Explain briefly the limitations of first law of thermodynamics.
b. State and illustrate Carnot's theorem.
c. Explain (i) Triple point (ii) Critical state.
d. Explain Reheat cycle.
e. Explain (i) Dalton's Law of partial pressures
(ii) Amagat's law of partial volume.
f. A perfect gas at pressure of 750 kpa and 600k is expanded to 2 bar presence. Determine final temperature of gas if initial and final volume of gas are $0.2m^3$ and $0.5m^3$ respectively.
g. Explain Enthalpy of Formation.
h. Explain briefly the working of Junker's gas calorimeter.

PART B

(4 x 15 = 60)

II. a. Derive Clausius inequality. (8)
b. Derive Entropy change in an irreversible process. (7)

OR

III. (i) A reversible heat pump is used to maintain a temperature of 0^0C in a refrigerator when it rejects the heat to the surroundings at 25^0C. If the heat removal rate from the refrigerator is 1440 KJ/min, determine the C.O.P. of the machine and work input required.
(ii) If the required input to run the pump is developed by a reversible engine which receives heat at 380^0C and rejects heat to atmosphere, then determine the over all C.O.P. of the system. (15)

IV. a. Explain the Modified Rankine cycle with PV and T-S diagram. (6)
b. Steam at 20 bar, 360^0C is expanded in a steam turbine 0.08 bar. It then enters a condenser, where it is condensed to a saturated liquid water. The pump feeds back the water into the boiler.
(i) Assuming ideal processes, find per Kg. of steam, the net work and the cycle efficiency.
(ii) If the turbine and pump have each 80% efficiency. Find the percentage reduction in the net work and cycle efficiency. (9)

OR

V. a. With the help of a neat sketch explain the working of a simple vertical boiler. (6)
b. A boiler generates 7.5 Kg. of steam per Kg. of coal burnt at a pressure of 11 bar, from feed water having a temperature of 70^0C. The efficiency of boiler is 75% and factor of evaporation 1.15, specific heat of steam at constant pressure is 2.3. Calculate
(i) Degree of superheat and temperature of steam generated;
(ii) Calorific value of coal in kJ/Kg.
(iii) Equivalent evaporation in kg. of steam per kg. of coal. (9)

(Turn over)

VI. a. Explain Adiabatic mixing of perfect gases. (7)

b. A vessel of 0.35 m^3 capacity contains 0.4 kg. of carbon monoxide (molecular weight = 28) and 1 Kg. of air at 20^0C. Calculate

(i) the total pressure of each constituent

(ii) the total pressure in the vessel,

The gravimetric analysis of air is to be taken as 23.3% oxygen (molecular weight = 32) and 76.7% nitrogen (molecular weight = 28). (8)

OR

VII. a. Derive the expressions for work done by a single stage reciprocating air compressor with and without clearance volume. (8)

b. An air compressor takes in air at 1 bar and 20^0C and compresses it according to law $PV^{1.2}$ = constant. It is then delivered to a receiver at a constant pressure of 10 bar. Take R=0.287 kJ/Kg.K

Determine (i) Temperature at the end of compression

(ii) Work done and heat transferred during compression per kg. of air. (7)

VIII. a. Explain how the calorific value of solid and liquid fuels can be determined in the laboratory. (7)

b. Following results were obtained when a sample of gas was tested by Junker's gas calorimeter:

Gas burnt in the calorimeter	= 0.08 m^3
Pressure of gas supply	= 5.2 cm of water
Barometer	= 75.5 cm of Hg.
Temperature of gas	= 13^0C
Weight of water heated by gas	= 28kg.
Temperature of water at inlet	= 10^0C
Temperature of water at outlet	= 23.5^0C
Steam condensed	= 0.06 kg.

Determine the higher and lower calorific values per m^3 of the gas at a temperature of 15^0C and barometric pressure of 76cm. of Hg. (8)

OR

IX. a. What are combustion equations? Obtain the combustion equations for the following:

(i) Combustion of hydrogen

(ii) Complete and incomplete combustion of carbon. (7)

b. A sample of fuel has the following percentage composition:

Carbon	=	86 percent
Hydrogen	=	8 percent
Sulphur	=	3 percent
Oxygen	=	2 percent
Ash	=	1 percent.

For an air-fuel ratio of 12:1, Calculate

(i) Mixture strength as a percentage rich or weak.

(ii) Volumetric analysis of the dry products of combustion. (8)

***