Roll No.									

B.E. (Full Time) DEGREE END SEMESTER EXAMINATIONS, APRIL/MAY 2012

MECHANICAL ENGINEERING BRANCH

37

THIRD SEMESTER

ME 271 ENGINEERING THERMODYNAMICS

(REGULATIONS 2004)

Time : 3 hr Max Mark : 100

(Use of Thermodynamic Tables, Steam Tables and Psychrometric chart is permitted)

Answer ALL Questions

PART - A (10 x 2 = 20 Marks)

1. What are point and path functions?
2. What do you understand by constant pressure and constant volume processes? Show the processes on p-V diagrams.
3. State the Clausius and Kelvin Planck's second law of thermodynamics.
4. Define efficiency and COP.
5. Define wet steam and dryness fraction of steam.
6. Define dry bulb temperature and wet bulb temperature.
7. What are virial expressions and virial coefficients?
8. Give the Clayperon equation and indicate its importance.
9. What do you understand by enthalpy of combustion?
10. Calculate the stoichiometric air fuel ratio of methane.

PART – B (5 x 16 = 80 Marks)

11 i). A stationary fluid system goes through a cycle comprising the following processes:

(i) Process 1-2 isochoric heat addition of 235 kJ/kg

(ii) Process 2-3 adiabatic expansion to its original pressure with loss of 70 kJ/kg in internal energy

(iii) Process 3-1 isobaric compression to its original volume with heat rejection of 200 kJ/kg

Determine the total heat and work transfer during the cycle. **(8)**

ii). Apply the first law of thermodynamics to steam turbine, boiler and condenser and obtain the final expression. **(8)**

12 a i). Establish the equivalence of Kelvin-Planck and Clausius statements. **(8)**

ii). A reversible engine is supplied with heat from two constant temperature sources at 900 K and 600 K and rejects heat to a constant temperature sink at 300 K. If the engine executes a number of complete cycles while developing 100 kW and rejecting 3600 kJ of heat per minute, determine the heat supplied by each source per minute and efficiency of the engine. **(8)**

(OR)

b i). 300 kJ/s of heat is supplied at a constant fixed temperature of 290^{o}C to a heat engine. The heat rejection takes place at 8.5^{o}C. The following results were obtained:
(i) 215 kJ/s are rejected (ii) 150 kJ/s are rejected (iii) 75 kJ/s are rejected
Classify which of the result report a reversible cycle or irreversible cycle or impossible results. **(8)**

ii). An iron cube at a temperature of 400^{o}C is dropped into an insulated bath containing 10 kg water at 25^{o}C. The water finally reaches a temperature of 50^{o}C at steady state. Given that the specific of water is equal to 4186 kJ/kgK. Find the entropy changes for the iron cube and the water. **(8)**

13 a.i). Find the saturation temperature, the changes in specific volume and entropy during evaporation and the latent heat of vapourisation of steam at 1 MPa. **(8)**

ii). Discuss any one method of measuring the dryness fraction with a neat sketch. **(8)**

(OR)

b i). Draw a skeleton psychrometric chart indicating clearly all the properties. **(4)**

ii). One kg of air at 35^{o}C DBT and 60 % RH is mixed with 2 kg of air at 20^{o}C DBT and 13^{o}C dew point temperature. Calculate the specific humidity of the mixture. **(12)**

14 a i). Explain the principle of corresponding states. **(8)**

ii). Determine the specific volume of nitrogen at 100 atm and 145 K. Given for nitrogen ; P_c = 3390 kPa and T_c = 126.2 K. Calculate the pressure and compare it with the one obtained by using van der Walls equation. **(8)**

(OR)

b i). Derive the Maxwell's relations. **(10)**

ii). What do you understand by Joule Thomson coefficient? Explain. **(6)**

15 a i). Methane is combusted with 100 % theoretical dry air (298 K/1 atm). Determine the (i) enthalpy of reaction, (ii) enthalpy of combustion, (iii) heat of combustion, (iv) LHV and (v) HHV. **(10)**

ii). Explain the steps involved in the calculation of adiabatic flame temperature. **(6)**

(OR)

b i). Describe the working of the apparatus that is commonly used for the analysis of dry exhaust gases with a neat sketch. **(10)**

ii). The petrol used in an engine may be approximated to hexane(C_6H_{14}). The percentages of dry exhaust gases by volume at particular load and speed of the engine are observed to be

$CO_2 = 8.5$, $CO = 7.8$ and $N_2 = 83.7$

Find the air fuel ratio required for complete combustion and estimate the mixture strength in the test as a percentage of the chemically correct mixture. **(6)**

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