Reg.No.									

INTERNATIONAL CENTRE FOR APPLIED SCIENCES

(Manipal University)

III SEMESTER B.S. DEGREE EXAMINATION – NOV. / DEC. 2016

SUBJECT: PRINCIPLES OF THERMODYNAMICS (ME 231)

(BRANCH: MECHANICAL)

Friday, 25 November 2016

Time: 3 Hours **Max. Marks: 100**

- ✓ **Answer ANY FIVE full Questions.**
- ✓ **Missing data, if any, may be suitably assumed**
- ✓ **Use of thermodynamic data hand book is permitted**

1A Differentiate between 05

a. Macroscopic and Microscopic point of view

b. Closed system and Open system

c. Isolated system and Adiabatic system

d. Intensive and Extensive property of a system

e. Point function and Path function of a system.

1B What are similarities and dissimilarities between work and heat transfer of a system. 05

1C The pressure-volume relation for a non-flow reversible process is P= (8 - 4V) bar, where V is in m^3. If 130 kJ of work is supplied to the system, calculate final pressure and volume of the system. Take initial volume = 0.5 m^3. 10

2A Explain the state of thermodynamic equilibrium of a system. 04

2B With help of P-V diagram, derive an expression for work in the following cases. 06

a. Constant volume process

b. constant pressure process

c. Isothermal process

d. Adiabatic and polytropic process

2C An engine cylinder of diameter 22.5 cms has a stroke of 37.5 cm. The swept volume is 4 times the clearance volume. The pressure of gases at the beginning of expansion stroke is 1570 kPa. Find the work done during expansion stroke assuming the process as reversible adiabatic. Assume $\gamma = 1.4$. 10

3A Express assumptions made & derive an expression of a steady flow energy equation applied to an open thermodynamics system. 06

3B Show that the energy is the property of a thermodynamic system. 06

3C In a nozzle, the ideal gas expands from a pressure of 20 bar to 3 bar and the process is reversible adiabatic. The inlet conditions are 500^0C and 35 m/s. Determine area and velocity at the outlet of the nozzle, if the flow rate is 5 kg/s. Take R= 190 J/kg.K and $\gamma = 1.35$. 08

4A Define the first law of thermodynamics applied to a close system execute a cycle and Explain Joule's experiment of first law of thermodynamics. 06

4B State statements of the second law of thermodynamics and Explain the concept of PMM-I and PMM-II. 04

4C A source at temperature T_1 K supplies heat to a reversible heat engine which rejects heat to a low temperature sink at 780 K. The sink acts as a source for second reversible engine which rejects heat to a cold reservoir at 280 K. Determine T_1, (i) for equal thermal efficiencies of the two engines and (ii) when two engines deliver the same amount of work. 10

5A Prove that the efficiency of a reversible heat engine is always greater than the efficiency of an irreversible heat engine. 06

5B Define thermodynamic temperature scale and derive $Q_1/Q_2 = T_1/T_2$. 06

5C A reversible heat engine takes 900 kJ of heat from a source at 700 K. The engine develops 350 kJ of net work and rejects heat to two low temperature reservoirs at 600 K and 500 K. Determine engine thermal efficiency and heat rejected to each low temperature reservoir. 08

6A Explain Clausius inequality of the second law of thermodynamics. 06

6B During the polytropic expansion of 1 kg of air the pressure reduces from 8 bar to 1 bar. The temperature of air is 350 K. Determine (i) The specific volume and temperature after expansion (ii) change of internal energy, work done and heat interaction, (iii) Increase in entropy. Take R= 287 J/kg.k, γ =1.4 and n=1.2 08

6C Explain the working principle of combined separating & throttling calorimeter 06

7A Define the following terms: 06

a. Sensible heat

b. Latent heat of vaporization

c. Dryness fraction

d. Triple point

e. Critical pressure and temperature

f. Super heat.

7B Explain PVT diagram for water indicating clearly solid, liquid and vapour regions 06

7C A vessel of 0.04 m^3 contains a mixture of saturated water and saturated steam at a temperature of 240^0C. The mass of liquid present in the mixture is 8 kg. Find the pressure, mass, the specific volume, enthalpy, entropy and internal energy of the mixture 08

8A Define the following terms applied to a mixture of ideal gases. 04

i) Mole fraction
ii) Volume fraction
iii) Mass fraction
iv) Partial pressure ratio.

8B Explain Gibb's Dalton law and derive expression for gas constant R and molecular weight M of mixture of gases. 06

8C 0.25 kg of air at a pressure of 1.5 bar and volume 0.12 m^3, is compressed to 10 bar according to the law $PV^{1.35} = C$. Determine: 10

(i) Change in internal energy of the air

(ii) The work done on or by the air

(iii) The heat received or rejected by the air

Take Cp = 1.005 kJ/kg.K, Cv = 0.718 kJ/kg.K.