Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

III SEMESTER B.TECH. (MECHANICAL ENGINEERING)

END SEMESTER MAKE UP EXAMINATIONS, DEC 2016/JAN 2017

SUBJECT: THERMODYNAMICS - I [MME 2101]

REVISED CREDIT SYSTEM
(28 /12 /2016)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.
- Use of thermodynamics data hand book and steam tables permitted.

1A. With the help of p-v and T-s diagrams, derive an expression for work transfer and heat transfer for an ideal gas undergoing a polytropic process in a closed cycle. **(05)**

1B. During flight, the air speed of a turbojet engine is 250 m/s. Ambient air temperature is -14°C. Gas temperature at outlet of nozzle is 610°C. Corresponding enthalpy values for air and gas are respectively 250 and 900 kJ/kg. Fuel air ratio is 0.0180. Chemical energy of fuel is 45 MJ/kg. Owing to incomplete combustion 6% of chemical energy is not released in the reaction. Heat loss from the engine is 21 kJ/kg of air. Find the exhaust gas velocity. **(05)**

2A. With necessary diagram, explain the difference between:

(a) Mechanical work and thermodynamic work
(b) Reversible process and irreversible process
(c) Extensive property and intensive property **(05)**

2B. A heat pump is to be used to heat a house in winter and then reversed to cool the house in summer. The interior temperature is to be maintained at 20°C. Heat transfer through the walls and roof is estimated to be 0.525 kJ/s per degree temperature difference between the inside and outside.

(a) If the outside temperature in winter is 5°C, what is the minimum power required to drive the heat pump?

(b) If the power output is the same as in part (a), what is the maximum outer temperature for which the inside can be maintained at 20°C? **(05)**

3A. Define:

(a) Internal energy
(b) PMM1 **(02)**

3B. With neat sketch and h-s diagram explain the working principle of combined calorimeter. **(03)**

3C. One kg of ice at -5°C is exposed to the atmosphere which is at 20°C. The ice melts and comes into thermal equilibrium with the atmosphere.

(a) Determine the entropy increase of the universe.

(b) What is the minimum amount of work necessary to convert the water back into ice at -5°C?

C_p of ice is 2.093 kJ/kg°C and the latent heat of fusion of ice is 333.3 kJ/kg. **(05)**

4A. Explain:

(a) Dalton law of partial pressure

(b) Amagat's law of partial volume **(02)**

4B. Show that the thermal efficiency of Carnot cycle is dependent only on the temperatures of thermal source and sink. **(03)**

4C. A vessel having a volume of 5 m^3 contains 0.05 m^3 of saturated liquid water and the rest water vapor at a pressure of 0.1Mpa. Heat is transferred to the tank until the vessel is filled with saturated vapor. Determine the final pressure and the heat added to water. **(05)**

5A. Prove that entropy is a property of the system. **(02)**

5B Define:

(a) Dead State

(b) Available and unavailable energy

(c) High grade and low grade energy **(03)**

5C. 0.5 kg of Helium and 0.5 kg of Nitrogen are mixed at 20°C and at a total pressure of 100 kPa. Find:

(a) The volume of the mixture

(b) Partial volumes of the components

(c) Partial pressures of the components

(d) Mole fractions of the components **(05)**