Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
A Constituent Institution of Manipal University

III SEMESTER B.TECH. (AERONAUTICAL/ AUTOMOBILE ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2016

SUBJECT: THERMODYNAMICS [AAE 2104]

REVISED CREDIT SYSTEM
(02/12/2016)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.
- Use of thermodynamic data hand book is permitted.

1A. Define the term "Heat" and discuss its sign convention. **(02)**

1B. Explain the working of a constant-volume gas thermometer with a neat sketch. **(04)**

1C. Air inside a balloon behaves such that $P = C_2V^{1/3}$ where P is the pressure in kPa, 'V' is the balloon volume in m^3 and constant C_2 = 100 kPa/m. The air inside the balloon at 45°C expands from an initial volume of 1 m^3 to a final volume of 3 m^3. Determine the work done by air during this process and the final temperature of air. **(04)**

2A. A 5-kg cannon ball acts as a piston in a cylinder with a diameter of 0.15 m. As the gunpowder is burned, a pressure of 7 MPa is created in the gas behind the ball. What is the acceleration of the ball if the cylinder (of cannon) is pointing horizontally? **(02)**

2B. Explain the following terms: **(03)**

i. Thermal energy reservoir
ii. Spontaneous process
iii. Perpetual motion machine of second kind

2C. State and prove the Carnot's theorem applied to heat engines. **(05)**

3A. A domestic refrigerator maintains food at a temperature of -10°C. The ambient air temperature is 27°C. If heat leaks into the freezer at the continuous rate of 2.5 kW, determine the least power necessary to pump this heat out continuously. **(02)**

3B. For a closed system, derive the expression for the entropy change during the following processes: **(04)**

i. Polytropic process
ii. Isothermal process

3C. A heat engine receives 500 kW of heat from a source at 1200 K and rejects the waste heat to a medium at 300 K. The power generated by the heat engine is 480 MJ/hr. Determine the following: **(04)**

i. Exergy
ii. Anergy
iii. Heat engine efficiency
iv. Rate of irreversibility

4A. Derive the Clausius-Claperyon equation. **(03)**

4B. Two tanks A and B containing water are connected with a valve and pipe arrangement with the valve initially closed. Tank A is at 300 kPa, specific volume of water, v_A =0.5 m^3 /kg, tank volume V_A = 1 m^3. Tank B contains 3.5 kg of water at 0.6 MPa and 400° C. The valve is now opened and the two tanks come to a uniform state. Neglecting the volume of the joining pipe between the tanks, Calculate the final specific volume and the final specific enthalpy. **(05)**

4C. Explain the Dalton's law of partial pressures. **(02)**

5A. Illustrate the working of an ideal dual combustion cycle and derive its thermal efficiency. **(06)**

5B. Define the following terms: **(04)**

i. Specific humidity
ii. Dew-point temperature
iii. Intercooling
iv. Mole fraction