Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

III SEMESTER B.TECH (AUTOMOBILE/ AERONAUTICAL ENGINEERING)

END SEMESTER EXAMINATIONS, DEC 2015/JAN 2016

SUBJECT: THERMODYNAMICS [AAE 2104]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

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

1A. State the first law of thermodynamics and mention its limitation. **(02)**

1B. A fluid at a pressure of 3 bar, and with specific volume of 0.18 m^3/kg, contained in a cylinder behind a piston expands reversibly to a pressure of 0.6 bar according to a law, $p = C/v^2$ where 'C' is a constant. Calculate the work done by the fluid on the piston. **(03)**

1C. Derive the expression for work done and entropy change for a polytropic process. **(05)**

2A. State and prove the Kelvin Planck statement of Second law of thermodynamics. **(03)**

2B. A turbine operating on a steady flow of nitrogen is to produce 0.8 kW of power by expanding nitrogen from 300kPa, 350K (inlet specific volume of 0.346m^3/kg) to 120kPa. For design purpose, the inlet velocity is assumed to be 30 m/s and the exit velocity has to be 50 m/s. The expansion takes place through a quasi equilibrium process such that $pv^{1.4} = constant$. Determine required mass flow rate. **(04)**

2C. A large stationary engine working on carnot cycle produces 15 MW with a thermal efficiency of 40%. The exhaust gas, which we assume to be air, flows out at 800 K and the intake air is 290 K. If 'c_p' of air is 1.005 kJ/kgK, determine the mass flow rate. **(03)**

3A. Derive the Maxwell's relations. **(03)**

3B. Briefly describe the following terms: **(04)**

i. Clausius- Clapeyron Equation
ii. Dryness fraction
iii. Joule-Thomson coefficient
iv. Mollier diagram

3C. Consider a gas mixture that consists of 3 kg of O_2, 5 kg of N_2 and 12 kg of CH_4. Determine **(03)**

i. Mole fraction of each component
ii. Mass fraction of each component
iii. Average molar mass and gas constant of the mixture

4A. Compare Dalton's law of partial pressures and Amagat's law of additive volumes. **(04)**

4B. Steam in a closed system expands reversibly and isothermally from 180°C and dryness 65% to a final pressure of 500kPa. Sketch the process on P-v and T-s plots. Calculate the work done by steam. **(04)**

4C. Explain the concept of exergy. **(02)**

5A. Sketch the P-v and T-S diagram for an ideal Brayton cycle and derive the expression for its thermal efficiency. **(03)**

5B. Show the working of a vapor compression cycle using a neat P-h plot and derive an expression for its coefficient of performance. **(03)**

5C. In an air standard Diesel cycle, the compression ratio is 16 and at the beginning of isentropic process, the temperature is 15°C and pressure is 0.1MPa. Heat is added until the temperature at the end of constant pressure process is 1480°C. Calculate : **(04)**

i. Cut-off ratio
ii. Heat supplied per kg of air
iii. Cycle efficiency