Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

IV SEMESTER B.TECH (MECHANICAL ENGINEERING)

END SEMESTER EXAMINATIONS, MAY 2016

SUBJECT: THERMODYNAMICS - II [MME 2201]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

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

1A. Define (i) Cut off ratio (ii) Explosion ratio
Derive an expression for air standard efficiency of a limited pressure cycle in terms of compression ratio, cut off ratio, explosion ratio and specific heats ratio. **05**

1B. An air standard Brayton cycle has air entering the compressor at 100kPa and 27 ^{0}C. The pressure ratio is 10 and the maximum allowable temperature in the cycle is 1350 K. Determine (i) temperatures at salient points of the cycle, (ii) compressor and turbine work per unit mass of air, (iii) net work output and work ratio, (iv) thermal efficiency of the cycle, (v) specific air consumption in kg/kWh, and (vi) improvement in the thermal efficiency of the cycle if a regenerator with 100 % effectiveness is incorporated in the cycle. **05**

2A. Explain the influence of following parameters on the performance of Rankine cycle (i) boiler pressure (ii) Condenser pressure **05**

2B. The airflow to a 4-cylinder four-stroke petrol engine is measured by means of a 7.5 cm diameter sharp edged orifice, with C_d =0.6. During a test on the engine following data were recorded: Bore= 11 cm, stroke = 13 cm, engine speed = 2250 rpm, brake power =36 kW, fuel consumption = 10.5 kg/hour, the calorific value = 42000 kJ/kg, pressure drop across the orifice =4.1 cm of water. Atmospheric temperature and pressure are 15^{0}C and 1.03bar. Calculate the following;

(a) Thermal efficiency based on brake power.
(b) Brake mean effective pressure. (iii) Volumetric efficiency. **05**

3A. What do you mean by perfect intercooling?
Obtain an expression for minimum work of compression with perfect intercooling for a two stage reciprocating air compressor with usual notations. **05**

3B. In an engine working on diesel cycle inlet pressure and temperature are 1 bar and 17^{0}C respectively; pressure at the end of adiabatic compression is 35bar. The expansion ratio (r_e) is 5. Calculate the heat addition, heat rejection, air standard efficiency and mean effective pressure of the cycle. **05**

4A. List the different methods available to determine the friction power in internal combustion engines. Explain how Morse test is used in multi cylinder engines to determine the friction power. **05**

4B. An ammonia ice plant operates between a condenser temperature of 30^0C and an evaporator temperature of -14^0C. It produces 10 tons of ice per day from water at 30^0C and ice at -5^0C. Assume that the state of the refrigerant entering the compressor is dry-saturated. Determine (i) power required to drive the compressor if the mechanical efficiency is 80% (ii) Capacity in tons of refrigeration (iii) COP (iv) size of the compressor if it runs at 600rpm. Assume that the compressor used in the refrigeration system is of two cylinder, single acting type with stroke equal to bore and the volumetric efficiency is 85%.

Given: Cp of water= 4.187kJ/kg, Cp of solid ice = 1.94kJ/kg, Latent heat of water = 333.5kJ/kg **05**

5A. Define: Static state, Stagnation state, Critical state and Nozzle efficiency. Derive an expression relating the stagnation and static properties of an ideal gas in terms of specific heat ratio and Mach number **05**

5B. A steam power plant operates on an ideal reheat Rankine cycle between the pressure limits of 9MPa and 10kPa.The mass flow rate of steam through the cycle is 1500 kg/min. The steam enters both the stages of the turbine at 500^0C.If the moisture content of the steam exiting the low pressure turbine should not exceed 9.58%, determine (i) Reheat pressure (ii) Cycle efficiency (iii) Percentage of sensible heat added compared to latent heat. **05**