Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

IV SEMESTER B. TECH (MECHANICAL) END SEMESTER EXAMINATIONS, APRIL 2019

SUBJECT: THERMODYNAMICS - II [MME 2201]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data if any may be suitably assumed.
- Use of Thermodynamics data hand book is permitted

1A. What are the desirable properties for ideal working substances in vapor power cycles?
What are the problems with water as working substance in vapor power cycle? **5**

1B. The compression ratio for a single cylinder engine operating on dual cycle is 8. The maximum pressure in the cycle is limited to 55 bar. The pressure and temperature of air at the beginning of compression are 1 bar and 27^0. Heat added at constant pressure up to 3% of the stroke. Assuming the cylinder diameter as 25cm and stroke to bore ratio as 1.2, find the (i) Work done per cycle (ii) air standard efficiency of the cycle (iii) MEP (iv) Power developed if the working cycles are 200 per minute **5**

2A. What are the assumptions made in air standard cycles? Show that thermal efficiency of an air standard Otto cycle is a function of compression ratio only. **5**

2B. In a reheat steam cycle, the boiler exit conditions are 25 bar and 300^0 C. The exit pressure of steam at the end of first stage is 5 bar. The steam is then reheated to 300^0C before expanding in the second turbine to 0.05 bar. Find (i) the thermal-energy input in the re-heater, (ii) the cycle efficiency, (iii) power output for a mass flow rate of 2 kg/s. **5**

3A. Derive an expression for intermediate pressure of a two stage reciprocating air compressor for minimum work input condition and then obtain the equation for the minimum work for Z number of stages. **5**

3B. Four cylinder four stroke SI engine has a compression ratio of 8 and bore of 100mm and stroke equal to bore. The volumetric efficiency of each cylinder is 75%. The engine operates at 4800rpm with an air fuel ratio of 15. The calorific value of the fuel is 42MJ/kg. The atmospheric air density is 1.12kg/$m^{3.}$ The mean effective pressure in the cylinder is 10 bar and the mechanical efficiency of the engine is 80%. Determine the indicated thermal efficiency and brake power. **5**

4A With the help of Pressure - crank angle diagram explain the stages of combustion in a S.I. engine **5**

4B. An Ammonia refrigeration plant produces 30 tons of ice at 0^0C from water at 20^0C in a day. The temperature range of the working cycle is 25^0C to -15^0C. The vapor is saturated at the exit of the evaporator. Assuming actual COP is 60% of the theoretical COP, calculate (i) power required to drive the compressor (ii) Capacity of the plant in tons of refrigeration (iii) theoretical piston displacement in m^3/hr if the volumetric efficiency the compressor is 80% **5**

5A. Briefly explain: Stagnation State, Static state and Critical states **3**

5B. Single stage air compressor is required to compress 72 m^3/min of air from 15^oC and 1 bar to 8 bar. Compare the temperature at the end of compression and power required if the compression is carried as (i) Polytropically with index of compression 1.35 (ii) adiabatically (iii) Isothermally. **3**

5C In a gas turbine plant working on the Brayton cycle the air at the inlet is at 27°C, 1 bar. The pressure ratio is 6.25 and the maximum temperature is 800°C. The turbine and compressor efficiencies are each 80%. Find (a) the compressor work per kg of air, (b) the turbine work per kg of air (c) the cycle efficiency. **4**