Reg.No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

IV SEMESTERB.TECH(MECHANICAL ENGINEERING)

END EMESTEREXAMINATION –APRIL-2018

SUBJECT: THERMODYNAMICS–II(MME 2201)

REVISED CREDIT SYSTEM

Time: 3 Hours **Max. Marks: 50**

Note: Answer ALL the questions

Use of Thermodynamic data hand book permitted.

1A. With usual notions derive an expression for the air standard thermal efficiency of limited pressure cycle in terms of compression ratio, cut off ratio and pressure ratio. **05**

1B. A two cylinder C.I engine with a compression ratio 13:1 and cylinder works on an ideal two stroke cycle and consumes 14 kg/h of the fuel while running at 300 rpm. Bore and stroke of the cylinder are 200 mm and 250 mm respectively. Relative and mechanical efficiencies of the engine are 65% and 76% respectively. Fuel injection is continued up to 5% stoke. If the calorific value of the fuel used is 41800 kJ/kg, calculate IP, BP and indicated mean effective pressure. Take √ for working fluid as = 1.4. **05**

2A. With p-θ diagram explain the different stages of combustion in S.I engine **02**

2B. Why Carnot vapor cycle cannot be practically implemented for power production and how they have been overcome in Rankine cycle?

Explain with T-s diagrams reheating in Rankine cycle? **03**

2C. In a regenerative vapor power cycle steam enters the turbine at a pressure of 8 MPa and 500°C. It then expands to a pressure of 0.7 MPa till it becomes dry saturated. Some of steam is extracted to feed water heater operating at 0.7 MPa. Remaining steam expands in the second stage turbine to a condenser pressure of 0.008 MPa. Isentropic efficiency of each turbine is 85%, while each pump operates isentropic ally. If the net power output of the cycle is 105 MW, determine

(a) Thermal efficiency of the cycle.

(b) Mass flow rate of the steam entering the first turbine stage. **05**

3A. Derive an expression to determine the work of compression for a single stage compression with clearance in terms of pressure ratio and polytrophic index.Discuss the merits of multistage compression over single stage compression. **05**

3B. A two stage compressor compresses air from 15°C and 100 kPa to 6000 kPa. Air is cooled in the intercooler to 30°C and the intermediate pressure

is steady at 733 kPa. Low pressure cylinder is 10 cm in diameter and the stroke for both the cylinders is 11.25 cm. Assuming a compression law of $pV^{1.35}$ =C and that the volume of the air drawn in at atmospheric conditions is equal to the low pressure cylinder swept volume, find the power of the compressor running at 250 rpm. Find also the diameter of the high pressure cylinder. **05**

4A. Explain the working of Bell-coleman refrigeration cycle and derive an expression for the COP with usual notations. **05**

4B. A food storage locker requires a refrigeration capacity of 50 kW. Refrigerant ammonia works between a condenser temperature of 34°C and an evaporator temperature of −10°C. It is sub-cooled by 5°C before entering the expansion valve.Vapor is dry saturated before leaving the evaporator. Assuming single cylinder, single acting compressor operating at 1000 rpm with stroke equal to 1.2 times bore, find

(a) COP

(b) Cylinder dimensions

Take specific heat of the refrigerant vapor as 2.903 kJ/kgK. **05**

5A. For a compressible flow obtain a relation between area and velocity of flow and hence discuss the effect of variation of area for subsonic, sonic and supersonic flows. **05**

5B. In a gas turbine the compressor takes in air at a temperature of 15°C and compresses it four times the initial pressure with an isentropic efficiency of 82%. Air then passes through a heat exchanger heated by theturbine exhaust before reaching the combustion chamber. In the heat exchanger 78% of the available heat is given to the air. Maximum temperature after constant pressure combustion is 600°C and the efficiency of the turbine is 70%. Neglecting the losses, and assuming working fluid throughout the cycle to have the characteristics of air find the efficiency of the cycle.Assume R =0.287kJ/kgK and $\sqrt{}$ = 1.4 for air. **05**