Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
A Constituent Institute of Manipal University, Manipal

IV SEMESTER B.TECH (MECHANICAL) – Grade improvement EXAMINATIONS

Wednesday August 4, 2021 (9.30 – 11.30)

THERMODYNAMICS II [MME 2254]

REVISED CREDIT SYSTEM

Time: 2 Hours MAX. MARKS: 40

Instructions to Candidates:

- Answer **any four full** questions out of **six** questions.
- Missing data if any, may be suitably assumed.
- Use of Thermodynamics data hand book is permitted

1A. Explain the concept and purpose of reheating as well as regeneration used in gas turbine power plants. **5**

1B. A petrol engine operating on an air standard Otto cycle has maximum and minimum temperatures respectively 1200^0C and 27^0C. The energy addition to the cycle at constant volume is 600kJ/kg. Find (i) thermal efficiency (ii) MEP (iii) work output per kg of the working fluid. Determine the temperature and pressure at all salient points taking lowest pressure of the cycle as 1 bar. **5**

2A. Derive an expression for mean effective pressure for a Diesel cycle in terms of relevant parameters. Write neatly the necessary PV and Ts diagrams. **5**

2B. In a regenerative cycle having open feed water heater, dry saturated steam is supplied from the boiler at a pressure of 30 bar and condenser pressure is 95.82 kPa. The steam is bled at a pressure of 2.5 bar. Determine the amount of bled steam per kg of steam supplied and the efficiency of the cycle. What would be the efficiency without regenerative feed heating? **5**

3A. What are the desirable properties for ideal working substances in vapor power cycles?
List the two most important undesirable property of the water as the working substance in steam power plant. **5**

3B. A six cylinder, gasoline engine operates on the four-stroke cycle. The bore of each cylinder is 80 mm and the stroke is 100 mm. The clearance volume of each cylinder is 70 cc. At a speed of 4000 rpm, the fuel consumption is 20 kg/h. The torque developed is 150 N-m. Calculate (i) the brake power, (ii) the brake mean effective pressure, (iii) brake thermal efficiency if the calorific value of the fuel is 43MJ/kg and (iv) the relative efficiency if the ideal cycle for the engine is Otto cycle **5**

4A List the different methods available to determine the FP of IC engines. Explain a method to determine the friction power of a single cylinder four-stroke diesel engine. **5**

4B. The pressure ratio of an open cycle gas turbine cycle is 6. The compressor inlet conditions are 1 bar and 15^{o} C. The maximum temperature in the cycle is 800 ^{o} C. The isentropic efficiency of compressor is 85% and that of the turbine is 90%. The combustion efficiency is 95%. There is a pressure drop of 2% of the inlet pressure in the combustion chamber. The calorific value of the fuel used is 42 MJ/kg. Assume that the values of γ and C_p remain same throughout the cycle and equal to 1.4 and 1.005 kJ/(kg-K) respectively. Determine (i) net-work output per unit mass of air (ii) air-fuel ratio, (iii) thermal efficiency of the plant, (iv) specific fuel combustion in kg/kWh, and (v) power output from the plant for a mass flow rate of air of 1.0 kg/s. **5**

5A. Compare the first stage of combustion in SI and CI engines. Clearly discuss how they are different. **5**

5B. A two- stage compressor compresses air from 15°C and 1.01325 bar to 61 bar. The air is cooled in the inter cooer to 30°C and the intermediate pressure is 7.5 bar. The diameter of low-pressure cylinder is 11.5cm and stroke is 12 cm. If the law of compression is $PV^{1.35} = C$ and volume of air at the atmospheric conditions drawn in per stroke is equal to low-pressure swept volume. Calculate the power of the compressor when running at 250rpm. Calculate also diameter of high- pressure cylinder. **5**

6A What are the dis-advantages of single stage compression? Derive an expression for intermediate pressure of a two stage reciprocating air compressor for minimum work input condition. **5**

6B Compare the vapor compression and vapor absorption refrigeration cycles using flow diagrams, explain clearly the differences in the equipment's used. **5**