MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

### (A constituent unit of MAHE, Manipal)

# IV SEMESTER B. TECH (MECHANICAL) END SEMESTER EXAMINATIONS, MAKE UP 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.** Explain the concept and purpose of reheating as well as regeneration used in gas turbine power plants.

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1B. A petrol engine operating on an air standard Otto cycle has maximum and minimum temperatures respectively of 1200°C and 27°C. The energy addition to the cycle at constant volume is 600kJ/kg. Find the thermal efficiency of the cycle and work output per kg of the working fluid. Assume a constant specific heat.

- 2A. Derive an expression for air standard efficiency of a Diesel cycle in terms of compression ratio, cutoff ratio and specific heat ratio.
- **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?
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- **3A.** With the help of flow diagram and T-S diagram, explain the working principle of binary vapor cycle. Also derive an expression for its thermal efficiency and mass flow rate of working fluid.
- **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 in each cylinder is 70 CC. At a speed of 4000 rpm and 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 43000kJ/kg and (iv) the relative efficiency if the ideal cycle for the engine is Otto cycle
- **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.

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- 4B. An ideal air refrigeration cycle has the following specifications: Pressure of air at compressor inlet = 101 kPa; Pressure of air at turbine inlet = 404 kPa; Temperature of air at compressor inlet = -6 C; Temperature of air at turbine inlet = 27 C; Determine (i) The COP of the cycle, (ii) Power required to produce 1 ton of refrigeration, and (iii) air circulation rate per ton of refrigeration
- 5A. List the six important properties required for the good refrigerant
- **5B.** Obtain the relationship between stagnation and static properties in terms of Mach Number and specific heat ratio
- **5C** A single stage double acting compressor delivers air at 7 bar. The pressure and temperature at the end of suction are 1 bar and 27<sup>o</sup>C. It delivers 2m<sup>3</sup> of per minute when the compressor is running at 300rpm. The clearance volume is 5% of the stroke volume. The pressure and temperature of ambient air are 1bar and 20<sup>o</sup>C. Index of compression = 1.3 and index of expansion =1.35. Find (i) volumetric efficiency of the compressor (ii) Indicated power and brake power of the compressor if the mechanical efficiency = 80% (iii) Diameter and stroke of the cylinder if they are equal.

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