INTERNATIONAL CENTRE FOR APPLIED SCIENCES
MAHE, MANIPAL

B.Sc. (Applied Sciences) in Engg.

End – Semester Theory Examinations – Nov./ Dec. 2020

III SEMESTER - THERMAL ENGINEERING (IME 231)

(Branch: Mechanical)

Time: 3 Hours **Date: 19 November 2020** **Max. Marks: 100**

- ✓ **Answer any FIVE full questions.**
- ✓ **Missing data, if any, may be suitably assumed**
- ✓ **Use of thermodynamics data hand book and steam tables permitted.**

1A) Define: (a)Property of the system (b) Second law of thermodynamics (c)PMM-1 and PMM-2 **(06)**

1B) Define first law of thermodynamics. What are the limitation of this law? **(06)**

1C) Differentiate with examples (a)Macroscopic and microscopic study (b)Path and Point function **(08)**

2A) Explain the thermodynamic equilibrium. **(06)**

2B) A fluid enters a device with a steady flow rate of 3.7 kg/s and an initial pressure of 690kPa, An initial density of 3.2 kg/m^3 and an initial velocity of 60 m/s, and an initial specific internal energy 200 kJ/kg. It leaves at 172 kPa, with a density of 0.64 kg/m^3, velocity of 160 m/s and a final specific internal energy of 1950 kJ/kg. The heat lost is found to be 18.6 kJ/kg. Determine the magnitude and direction of the shaft work in kW. **(06)**

2C) Derive the steady flow energy equation and apply this for heat exchanger and heat engine. **(08)**

3A) Explain with the sketch the necessity of the multi-stage compression in the air compressor. **(06)**

3B) Define with respect to air compressor (a) Volumetric efficiency (b) Clearance volume (c) Minimum work for compression. **(06)**

3C) A single stage single acting reciprocating air compressor has a bore of 20 cm and stroke of 30 cm. The compressor runs at 600 rpm. The clearance volume is 4% of the swept volume and the index of expansion and compression is 1.3. The suction conditions are 0.97 bar and 27^0 C and delivery pressure is 5.6 bar. The atmospheric conditions are 1.01 bar and 17^{0}C. Determine (a) Free air delivery in m^3/min. (b) Volumetric efficiency referred to the free air condition (c) The indicated power. **(08)**

4A) Briley explain the methods of measurement of BP, IP, FP . **(06)**

4B) Explain the significance of (a) Mean effective pressure (b) Specific power output **(06)**

4C) The following observations were recorded during a trial on a 4-stroke diesel engine : **(08)**

Power absorbed by non-firing engine when driven by an electric motor (F.P) = 10 kW ;
Speed of the engine = 1750 rpm ;Brake torque = 327.4 Nm ;
Fuel used = 15 kg/hr ; Calorific value of fuel = 42000 kJ/kg ;
Air supplied = 4.75 kg/min ; Cooling water circulated = 16 kg/min ;
Outlet temperature of cooling water = 65.8°C ;Temperature of exhaust gas = 400°C ;
Room temperature = 20.8°C ; Specific heat of water = 4.19 kJ/kg K ;
Specific heat of exhaust gas = 1.25 kJ/kg K
Determine : (i) BP (ii) Mechanical efficiency (iii) BSFC
(iv) Draw heat balance sheet on kW basis.

5A) With the P-V and T-s diagram briefly explain the processes involved in Carnot Cycle. **(06)**

5B) Derive the thermal efficiency of an air standard Diesel cycle as a function of compression ratio and cut-off ratio. **(06)**

5C) An air standard Otto cycle has a compression ratio of 6 and swept volume of 0.15 m^3. The pressure and temperature at the beginning of compression are 98 kPa and 60ºC. Determine the pressure and temperature at all salient points if the heat supplied is 150kJ/kg, C_p=1 kJ/kgK and C_v= 0.71kJ/kgK. Also plot the cycle on T-s diagram. **(08)**

6A) Define modes of heat transfer with appropriate examples. **(06)**

6B) Define (a) Grey body and Black body (b) Nusselt number (c) Stephen-Boltzmann law **(06)**

6C) Briefly explain the vapour absorption refrigeration method. **(08)**

7A) Derive efficiency equation for Otto-cycle engine. **(06)**

7B) Write a note on Mollier chart. **(06)**

7C) A steam power plant operates on a Rankine cycle between 4 MPa and 10 kPa with 380 ^{0}C as a cycle maximum temperature. Turbine and pump isentropic efficiencies are 90 % and 85 % respectively. Calculate the thermal efficiency of the cycle. **(08)**

8A) Write the assumption made while deriving equation of **(06)**
(a)Carnot efficiency (b) Air standard efficiency

8B) Briefly explain the reheat Rankine cycle. **(06)**

8C) Write a note on (a) Entropy (b) Quasi-static process. **(08)**

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