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Question Paper Code: ME305PC

ACE-R20

Semester Supplementary Examination
II B. Tech- I Semester- SEPTEMBER-2022
THERMODYNAMICS
(Mechanical Engineering)

Time: 3 Hours **Max. Marks: 70**

H. T. No										

Answer any 5 Questions out of 8 Questions from the following

Q.No	Question	Marks
1. a)	Explain the working of constant volume gas thermometer.	4
b)	A three process cycle operating with nitrogen as the working substance has constant temperature compression at 34°C with initial pressure 100 kPa. Then the gas undergoes a constant volume heating and then polytropic expansion with 1.35 as index of expansion. The isothermal compression requires - 67 kJ/kg of work. Determine i) pressure, volume and temperature around the cycle ii) Heat in and out iii) Net work For Nitrogen gas CV=0.7431 kJ/kg-K.	10
2. a)	Write the Kelvin-Planck and Clausius statements and explain with sketches?	5
b)	Two blocks of metal, each having a mass of 10 kg and having a specific heat of 0.4 kJ/kg.K, are at a temperature of 40°C. A reversible refrigerator receives heat from one block and rejects heat to the other. Calculate the work required to cause a temperature difference of 100°C between the two blocks.	9
3. a)	Define dryness fraction? What are the different methods of measurement of dryness fraction?	5
b)	A vessel of volume 0.04m³ contains a mixture of saturated water and saturated steam at a temperature of 250°C. The mass of the liquid present is 9kg.Find the pressure, mass, specific volume, enthalpy, entropy and internal energy?	9
4. a)	Derive the Clausius Claperon equation?	5
b)	The following is the volumetric analysis of a producer gas: CO=28%, H_2=13%, CH_4=4%, CO_2=4%, N_2=51%. The values of Cp for the constituent CO, H_2, CH_4,CO_2,N_2 are 29.27kJ/mol.K, 28.89 kJ/mol.K, 35.8kJ/mol.K, 37.22kJ/mol.K, 29.14kJ/ mol.K respectively. Calculate the values of Cp, Cv for the mixture.	9
5. a)	In an Otto cycle, the pressure at the beginning of the compression is 1 bar and pressure at the end of compression is 15 bar. Calculate the pressure ratio and the air standard efficiency of engine.	7

5. b)	The swept volume of a Diesel engine working on Dual cycle is 0.0053m³ and clearance volume is 0.00035 m³. The maximum pressure is 65bar. Fuel injection ends at 5% of stroke. The temperature and pressure of the start of the compression are 80^0C and 0.9 bar. Determine air standard efficiency of cycle? Take γ of air is 1.4.	7
6. a)	Explain the Zeroth law of thermodynamics. What is its physical significance?	5
b)	A mass of 1.5kg and volume of 0.14m³ of certain gas at 40 bar is expanded isentropically such that temperature falls to 500 K. Determine 1. Initial temperature of gas 2. Work done during the process 3. Pressure at end of expansion. Take R=0.287 kJ/kgK , and Cv=0.718 kJ/kgK	9
7. a)	Apply the first law of thermodynamics to a closed system undergoing a change state and show that energy is a property of the system.	5
b)	In a steady flow process, a substance flows at the rate of 300 kg/min. It enters at a pressure of 6 bar ,a velocity of 300 m/s internal energy2000kJ/kg and specific volume 0.4 m³/kg. It leaves the system at a pressure of 0.1 MPa , a velocity of 150m/s, the internal energy1600 kJ/kg and specific volume 1.2 m³ . The inlet is 10 m above the outlet. During its passage through the system the substance has a work transfer of 3 MW to the surroundings. Determine the heat transfer in kJ /s. Stating whether it is from or to the system.	9
8. a)	Two engines are to operate on otto and diesel cycle with the following data: Maximum temperature=1500K; Exhaust temperature=700K; Ambient conditions= 1 bar and 300K.Compare the compression ratios and maximum pressures and efficiencies of two engines.	7
b)	Explain the vapour compression refrigeration cycle with neat diagram	7