Reg. No.

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MANIPAL INSTITUTE OF TECHNOLOGY

I SEMESTER M.TECH. (AUTOMOBILE ENGINEERING) END SEMESTER EXAMINATIONS, FEBRUARY-MARCH 2021 SUBJECT: COMBUSTION AND EMISSION [AAE 5173] REVISED CREDIT SYSTEM (01/03/2021)

Time: 3 Hours

Constituent Institution of Manipal University

MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions, Missing data if any may be suitably assumed.
- Use of Combustion data hand book is permitted.
- 1A. Derive an expression for equilibrium constant (K_p) in terms of mole fraction and pressure. (05)
- 1B. A gas stream at 1 atm contains a mixture of CO, CO₂, and N₂ in which the CO (05) mole fraction is 0.10 and CO₂ mole fraction is 0.20. The gas stream temperature is 1200 K. Determine the absolute enthalpy of the mixture on both mole and mass basis. Also determine the mass fractions of the three component gases.
- 2A. List the methods that can be employed to control emission in I C Engines. (05) With a neat sketch explain EGR and its limitations
- 2B. A closed chamber initially contains 1000 ppm of CO, $3\% O_2$ and the reminder (05) N₂ at 1500 K and 1 atmosphere pressure. Determine the time for 90% of the CO to react assuming only elementary reaction: Given, the kinetic rate constant k=2.5×10⁶exp(-24060/T) gmol⁻¹.m⁻³.s⁻¹, where T is the absolute temperature.
- 3A. Explain in detail classification of fuels.
- 3B. A closed system initially containing 1.000×10^{-3} moles of H₂ and 2.000×10^{-3} (05) moles of I₂ at 448 °C is allowed to reach equilibrium, and at equilibrium the HI concentration is 1.87×10^{-3} moles. Calculate K_c at 448 °C for the reaction taking place, which is H_{2(g)}+ I_{2(g)} \rightarrow 2 HI_(g).
- 4A. Explain competitive and consecutive reactions with suitable examples. (05)
- 4B. Explain in detail various sources of pollution in IC Engines. (05)
- 5A. With a neat sketch explain construction and working of thermal conductivity (05) detector and ionization detectors used in gas chromatography.
- 5B. Find the adiabatic flame temperature of Bituminous coal burned with 50% (05) excess air at 25 degree Celsius and 1 atm. The as-received ultimate analysis of the coal is 70% (wt) carbon, 5% hydrogen, 15% oxygen, 5% moisture and 5% ash. Neglect dissociation and neglect the ash. Enthalpy of formation of Bituminous coal is -1081 kJ/kg.

(05)