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M.Tech.
(SEM II) EVEN SEMESTER EXAMINATION, 2015-16
COMBUSTION ENGINES & POLLUTION

[Time: 3 hrs.] **[Max. Marks: 100]**

Note: - Attempt any ***Five*** questions. All questions carry ***equal marks***. Assume suitably missing data, if any. Use of Steam table is permitted.

1. Calculate the adiabatic flame temperature when ethane is burned with air 125 percent theoretical air. The fuel and air enters the burner at 1 bar and 298 K and the combustion products leave the burner at 1 bar. The molar heat capacities of CO_2, H_2O, O_2 and N_2 are constant and are given by 53.1 J/molK, 41 J/molK, 34.3 J/molK and 32.2 J/molK respectively. Also find the dew point temperature of combustion products. The standard enthalpy of formation of $\Delta H^o_{f298}CO_2$ = -393.98 kJ/mol, ΔH^o_{f298} H_2O = -241.99 kJ/mol, $\Delta H^o_{f298}C_2H6$= -84.573 kJ/mol.

2. Answer the following:-

(a) Discuss the effect of pressure, effect of inert gas addition and effect of excess reactants on degree of conversion of reactants into products.

(b) Discuss the combustion stages and instantaneous heat release in CI engine with the help of p-θ diagram.

3. Answer the following:-

(a) A diesel engine having compression ratio 14, operates on A/F ratio of 50:1. The temperature and pressure of air at the beginning of compression is 60 ºC and 1 bar. Find the efficiency and mean effective pressure of engine, assume engine works on air standard cycle, C.V. of fuel is 42 MJ/kg, $Cp_{,air}$ = 1.004 kJ/kg.

(b) An old car has a engine with a carburetor adjusted to supply stoichiometric air-fuel supply at normal condition using gasoline (C8H15) as fuel. Calculate the actual equivalence ratio the carburetor is supplying to the engine when it is supplied with the M20 (20% blend of methanol in petrol) fuel.

4. Answer the following:-

(a) Discuss the major causes for the formation of HC emissions in SI engine.

(b) In diesel engine with compression ratio (CR)=16, N=2400 rpm, ignition delay is given by ID (ms) = 0.44 $P^{(-1.19)}$ exp [4650/T], where T is temperature in K, P=pressure in atm. Ambient air temperature and pressure is 20 C and 1 atm. It is desired for combustion to start at 10 btdc, find the crank angle at which fuel injection should start.

5. Discuss the working of three way catalytic converter. Also describe the working principle of FID gas analyzer with the help of schematic diagram.

6. Compare SI & CI engine on the basis of volumetric, mechanical and thermal efficiency. A six cylinder square four stroke 5 litre engine is tested at 2500 rpm on dynamometer which has 50 cm arm. The dynamometer scale reading was 500 N. The air consumption is measured by Air box method. The following readings were observed:-

Ambient pressure and temperature = 1 bar and 27 ºC, Orifice dia = 30 mm, pressure drop across orifice = 14 cm of Hg, C_d of orifice = 0.6, For fuel, C/H ratio by mass = 83/17, density = 780 kg/m3, time taken for 100 ml fuel consumption = 18 s. Find bore of the engine, bsfc, equivalence ratio, volumetric efficiency and bmep.

7. Answer the **two** of the following:-

(a) Describe the effect of compression ratio, turbulence, engine speed, spark timing and combustion chamber wall temperature on detonation in SI Engine.

(b) Describe the following group of additives used for lubricants:-
Detergent-dispersant, extreme pressure additives, viscosity index improvers

(c) Discuss the EGR (Exhaust gas Recirculation) technique to Reduce NOx emissions in Diesel engine.