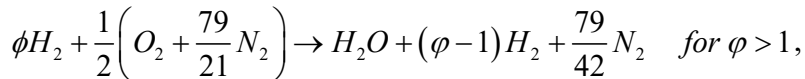
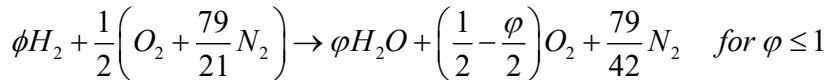


Assignment - 1
Combustion Explosion and Detonation (AS 5640)
 Department of aerospace Engineering, IIT Madras
 Due date: **04/02/2019**

assignment is to be submitted **latest by 4:30 pm** on the due date

1. Consider the combustion of a) hydrogen and air (consider only oxygen and nitrogen) and b) hydrogen and oxygen (no nitrogen), with initial reactants at temperature of 298K and total pressure of 1 atmosphere. Assuming constant pressure combustion and that there is no dissociation of products. Compute the adiabatic flame temperatures for the following reaction/s



where ϕ is the equivalence ratio (0.1, 0.3, 0.5, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.5, 2.0, 2.5)

Take heat of formation, $\Delta H_{f_{H_2O}}^0 = -241845 \text{ kJ} / \text{kmol}$ and constant specific heat,

$C_{P(H_2O)} = 40 \text{ kJ} / \text{kmolK}$, $C_{P(H_2)} = 30 \text{ kJ} / \text{kmolK}$, $C_{P(O_2)} = 35 \text{ kJ} / \text{kmolK}$ and $C_{P(N_2)} = 33 \text{ kJ} / \text{kmolK}$ (all are at 1000K).

If we relax the assumption of constant specific heat capacity calculate again the adiabatic temperature using CEA software. Compare the flame temperature for the two cases (air and pure oxygen) for both constant C_p and variable C_p .

Allow for dissociation of products and obtain flame temperature for the two cases (air and pure oxygen).

2. Consider combustion of a fuel (see the table below for your fuel) is air at initial temperature of 298.16K and at constant pressure of 1atm. Use Gordon-McBride chemical equilibrium program (CEA software) to carry out thermochemical calculations for equilibrium compositions and flame temperature for equivalence ratios of 0.5 to 2.5 (take increments of 0.1 in equivalence ratio). Plot adiabatic flame temperature (T_f) and mole fractions of CO, NO and NO_2 with equivalence ratio.

Discuss the following:

- a) What is the maximum adiabatic temperature and at what equivalence ratio. Explain your observations.
- b) What equivalence ratio would you suggest to minimize NO and NO_2 . Similarly what will be your strategy to reduce CO pollutants? Can you comment on challenge one is faced to reduce both NOx and CO simultaneously.

Sl. No	RollNo	First Name	
1	AE09B028	Vasireddy Saiashwin	CH ₄ (Methane)
2	AE14B041	Harshal Mankar	C ₂ H ₂ (Acetylene)
3	AE14B044	Pratik Sutar	C ₂ H ₄ (Ethene)
4	AE15B008	APOORVA BANERJEE	C ₂ H ₆ (Ethane)
5	AE15B031	RAJEEV KRISHNA S	1-Propanol(C ₃ H ₈ O)
6	AE15B055	RAPARTHI SAITEJA	Ethanol(C ₂ H ₆ O)
7	AE16B103	AKKHIL VANNAN M	Carbon Monoxide (CO)
8	AE16B109	RAKESH RAUSHAN	C ₃ H ₆
9	AE17D001	PINTO ROCKY SIMON	C ₃ H ₈
10	AE18D005	VIPIN KUMAR	C ₄ H ₈
11	AE18D012	SUMIT SARMA	C ₄ H ₁₀
12	AE18D014	ANUSAI R	C ₅ H ₁₀
13	AE18D409	CHAUN BRIJ JAYDEEPBHAI	C ₅ H ₁₂
14	AE18D410	GOMATHINAYAGAM N	C ₆ H ₆
15	AE18M007	VALLURI RAVI PRASAD	C ₆ H ₁₂
16	AE18M010	ADITYA WALIYA	C ₆ H ₁₄
17	AE18M011	ANKIT SAHAY	C ₇ H ₁₄
18	AE18M012	ARMAL NIKHIL DATTU	C ₇ H ₁₆
19	AE18M016	GAUTHAM KRISHNAN	C ₈ H ₁₆
20	AE18M027	SAURABH ROY	C ₈ H ₁₈
21	AE18M028	SIBANANDA PANIGRAHY	C ₉ H ₁₈
22	AE18M038	SHUBHAM KUMAR	C ₉ H ₂₀
23	AE18S021	ROHITH S K	C ₁₀ H ₂₀
24	AE18S025	KINGSHUK CHAKRABORTY	C ₁₀ H ₂₂
25	AE18S026	VISHAL SRIVASTAV	C ₁₁ H ₂₂
26	AE18S046	GAGANA S	C ₁₁ H ₂₄
27	ME16B067	RAGHAV KAKANI	Methanol(CH ₄ O)