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Total Number of Pages: 02

M.Tech
HTPE205

2nd Semester Back Examination 2016-17

Theory of Combustion & Emission

**BRANCH: HEAT POWER & THERMAL ENGG, HEAT POWER ENGG, THERMAL ENGG,
THERMAL POWER ENGG**

Time: 3 Hours

Max Marks: 70

Q.CODE: Z853

**Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.**

Q1 Answer the following questions: (2 x 10)

- a) What three conditions define the standard reference state ?
- b) Describe the effect of increasing pressure and temperature on the equilibrium composition of combustion products.
- c) Determine the mass fraction of O₂ and N₂ in air, assuming the molar composition is 21 percent O₂ and 79 percent N₂.
- d) Contrast combustion in compression ignition engines and spark ignition engines. What are the main differences in fuel requirements ?
- e) What is the difference between 'knock' in compression ignition and spark ignition engines ? How can 'knock' be eliminated in each case ?
- f) What is a thermal energy reservoir? Explain Kelvin–Planck expression of the second law of thermodynamics.
- g) Explain normal combustion and abnormal combustion.
- h) Draw the schematic sketch of solid fuel ramjet and scramjet engine.
- i) What is equivalence ratio? Mention its significance.
- j) Explain the differences between BS III and BS IV engines with respect to emission ?

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Q2 a) What is additive? What is the effect of additive on fuel economy? (2)

- b) A fuel oil has a composition by weight of 0.865 carbon, 0.133 hydrogen and 0.002 incombustibles. Find the stoichiometric gravimetric air/fuel ratio. (8)

When the fuel is burnt with excess air, the dry volumetric exhaust gas analysis is: CO₂ 0.121, N₂ 0.835, O₂ 0.044. Determine the actual air/Fuel ratio used and the wet volumetric exhaust gas analysis. Consider 1 kg of fuel, and convert the gravimetric data to molar data. Molar mass of carbon = 12, hydrogen = 1.

- Q3** a) Compare between laminar and turbulent flame fronts for pre-mixed combustion. (5)
b) Explain the Combustion in SI engines. Draw the pressure diagram for the same. (5)

- Q4** a) Briefly explain the sources and control of emissions in CI engines. (5)
b) Explain about air-breathing jet propulsion and non air-breathing jet propulsion with examples. (5)

- Q5** a) Briefly explain about the pulverized coal burning systems. (5)
b) Mention the differences between gas and liquid type burners with proper examples. (5)

- Q6** a) Differentiate between flame ignition and extinction. (4)
b) A liquid fuel has the composition: (6)
C 86.5%
H 13.0%
O 0.2%
S 0.3%

Its higher heating value is $HHV = 45 \times 10^6 \text{ J kg}^{-1}$. Determine an effective chemical formula and enthalpy of formation for this fuel.

- Q7** Briefly explain the flame propagation and structure of: (a) Bunsen burner flame; (b) spark ignition engine; (c) diffusion flame, with proper diagram. (10)

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- Q8** **Write short answer on any TWO:** (5 x 2)
a) Fluidized bed combustion
b) Vapour Compression Refrigeration cycle
c) Combined power cycle
d) Solid fuel propellant system