CLASS: M.TECH   SEMESTER : I
BRANCH: ET   SESSION : MO/19

SUBJECT: SR504 FUNDAMENTALS OF COMBUSTION

TIME: 3 HOURS   FULL MARKS: 50

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

Q.1(a)	Describe the various methods for determining adiabatic flame temperature. Illustrate the iterative method for determining the adiabatic flame temperature in detail.	[5]
Q.1(b)	A gas turbine engine operates at an equivalence ratio of 0.286 with an air flow rate of 15.9Kg/s. The equivalent composition of the fuel (natural gas) is $C_{1.16}H_{4.32}$. Determine the fuel mass flow rate and the operating air-fuel ratio for the engine. MW_{air}=28.85gms.	[5]
Q.2(a)	What is a Second order reaction? Explain with example. Derive the equation for rate constant and half-life of a second order reaction.	[5]
Q.2(b)	How does change in temperature affect the rate of reaction? Derive the Arrhenius relation for the same. How does the activation energy differ for different types of reaction?	[5]
Q.3(a)	What are the factors that govern the shape and size of a laminar flame?Explain in detail the combustion wave structure in a laminar flame with suitable schematic diagram relative to the temperature profile and concentration of intermediate products in different zones.	[5]
Q.3(b)	Calculate the limits of inflammability of a gas mixture containing 40% methane, 20% butane and 40% hydrogen. Limits of inflammability for methane (5.3 and 14), butane (1.9 & 8.5) and hydrogen (4.0 & 75).	[5]
Q.4(a)	Demonstrate the process of transition of deflagration wave to a detonation wave. What are the experimental methods for determination of detonation velocity? Discuss in detail.	[5]
Q.4(b)	Explain the various parts of a Hugoniot curve using a suitable diagram. Prove that at point j the detonation velocity is the sum of particle velocity and velocity of sound?	[5]
Q.5(a)	What are the different types of liquid propellants used? Discuss in detail the various zones which are observed during the combustion process in a liquid rocket engine using suitable diagram.	[5]
Q.5(b)	What are various types of igniters used in a solid rocket motor?Describe the working of a pyrotechnic igniter, explaining the components involved with a suitable diagram.	[5]

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