BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: M.TECH **SEMESTER : I**
BRANCH: SER **SESSION : MO/18**

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) What are the various methods of determining the adiabatic flame temperature? Explain the iterative method for determining the adiabatic flame temperature. [4]

Q.1(b) The gasoline (represented by C_8H_{18}) is burnt with dry air. The volumetric analysis of products on dry basis is CO2 = 10.02%, O2 = 5.62%, CO = 0.88% and N2 = 83.48%. Determine (a) A/F ratio (b) equivalence ratio (c) % stoichiometric air used. [6]

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) A first order reaction is 30% complete at the end of 140 s. Estimate the value of reaction rate constant in s-1. How much time will it take to complete 60% of reaction? [5]

Q.3(a) Determine the salient properties that influence the operational behavior of premixed flames and diffusion flames. Examine critically the mechanism of flame stabilization of a combustion wave using the concept of gas velocity and burning velocity in open atmosphere above the burner rim. What is flame quenching and important factors affecting it? [5]

Q.3(b) How interaction of flame and flow in burner effects the flame stabilization? Distinguish characteristic stability areas and condition of lift off and blow off with variation of fuel concentration and flow velocity for open flames. [5]

Q.4(a) Distinguish between deflagration, detonation and explosion phenomenon. Illustrate the mechanism of deflagration to detonation transition and the combustion waves associated with them. [5]

Q.4(b) Deduce an expression from the fundamental equations of continuity, momentum and energy to evaluate net energy change in a detonation wave and detonation velocity. [5]

Q.5(a) Predict various factors that can influence the combustion of a composite solid propellant in a rocket motor. Also assess the various flame zones one may observe during the combustion process. [5]

Q.5(b) Select the most critical physical/chemical process in combustion of a liquid rocket engine. Support your selection with arguments on its impact on various ballistic parameters. [5]

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