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

CLASS: M.TECH **SEMESTER : II**
BRANCH: SER **SESSION : SP/19**

SUBJECT: SR552 ROCKET COMBUSTION PROCESSES

TIME: 3.00 Hrs. **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) Sketch the combustion wave structure of a double base propellant and temperature profile. Demonstrate that combustion products of the preceding combustion zone form the reactants of the following stage. [5]

Q.1(b) Compare the essential elements of thermal layer theory of Chaiken and Anderson as applied to composite solid propellants containing AN and AP as oxidants. Demonstrate the applicability of two temperature postulate in this concept. [5]

Q.2(a) Select the suitable metal ingredients for incorporation in a composite solid propellant explain clearly the criteria of their selection. Examine the difficulties encountered in combustion of metallized propellants and their plausible solutions. [5]

Q.2(b) Explain the different stages in combustion of a single metal particle burning in gaseous oxidizer stream applying Fassel's model. How does particle size and mutual solubility of metal and its oxide influence metal combustion process? [5]

Q.3(a) Demonstrate with the help of suitable diagrams the existence of threshold velocity and negative erosion phenomenon. Draw a suitable experimental set-up to determine erosion function. [5]

Q.3(b) Critically evaluate the Lenoir and Robillard Theory of erosive burning and prove that erosive effect is very small for low values of 'x', coordinate in axial direction and for fast burning propellants. [5]

Q.4(a) Examine the various physio-chemical processes encountered in a liquid propellant rocket engine with a view to point out their individual importance. [5]

Q.4(b) Assuming a steady state transfer of heat and mass to and from a liquid droplet, select a suitable expression that can evaluate the mass burning rate of droplet. Explain the terms involved and their relative importance. [5]

Q.5(a) Draw a labelled simplified model of diffusion-controlled hybrid propellant combustion process in a cylindrical port burning grain. What are the critical operating parameters that influence the regression rate of a hybrid fuel in oxygen stream in a hybrid rocket engine? [5]

Q.5(b) Explain the key features of Marxman and Gilbert theory of hybrid combustion and show that regression rate of hybrid fuel is strongly related to heat flux and turbulent boundary layer condition. [5]

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