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

CLASS: M.TECH **SEMESTER : III**
BRANCH: SER **SESSION : MO/19**

SUBJECT: SR601 PROPELLANT TECHNOLOGY

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) Examine the basis of classification of solid propellants. Distinguish the role of each ingredient in different types of solid propellants and give suitable examples to explain your answer. [5]

Q.1(b) Correlate the mechanical and ballistic properties of composite solid propellants (CSP). Predict the effect of ageing on ballistic properties of CSPs and advance your reasons for it. [5]

Q.2(a) Categorize various types of solid propellant grains based on burning surface area and approach of grain installation in the rocket motor through suitable schematic diagrams. [5]

Q.2(b) Evaluate the burning surface area and length of an end burning grain that uses a CSP with a burn rate of 25 mm/s at 70 Kgf/cm^2. The other parameters are: Combustion index=0.745, Density= 1.83 gm/cc, Discharge coefficient= 0.72 and throat area=2.230 cm^2. The motor must operate for 15 sec. Assume a loss of 1%. [5]

Q.3(a) Predict the fundamental properties of a radial burning grain with star shaped port in term of burning surface area, port area and effect of burning on cusp with time and correlate the change in geometrical features. [5]

Q.3(b) Estimate the change in burning perimeter with burn distance in the web for concave and convex cusps for a given value of apex angle ‘θ’. How does ‘θ’ influence the burning characteristic of the grain? [5]

Q.4(a) Assess the effect of physical properties of liquid rocket propellants on their ignition delay. Explain the role of injection pressure, equivalence ratio and additives on ignition delay of a propellant system. [5]

Q.4(b) Distinguish between a liquid and a gel propellant. Predict the methodology and changes that will be required for their effective use in a rocket engine. [5]

Q.5(a) What are the loading concepts used in cryogenic propellant loading in a missile tank? Which concept would you like to use in practice, validate your choice in terms of lesser ‘Outage’. [5]

Q.5(b) Explain the following terms in relation to propellant slosh: Sloshing frequency and Fluid height to tank radius ratio. How sloshing can be detrimental to performance of a flight rocket and what are the approaches to control it. [5]

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