

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

CLASS: MTECH  
BRANCH: SER

SEMESTER :II  
SESSION : SP/2023

SUBJECT: SR552 ROCKET COMBUSTION PROCESS

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.
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		CO	BL
Q.1(a)	Describe the various methods used for determining adiabatic flame temperature. What are the parameters which affect the adiabatic flame temperature?	[5] CO1	L3
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] CO1	L3
Q.2(a)	Illustrate the various methods of determining the flame front. Also comment on which method is most suitable for determining the non-stationary flame front and why.	[5] CO2	L5
Q.2(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] CO2	L4
Q.3(a)	Distinguish between the combustion wave structure in a composite solid propellant and a double base propellant. Explain how the various regions differ and associated reactants/ products of combustion and the reactions involved.	[5] CO3	L4
Q.3(b)	Demonstrate according to the two temperature postulate how does the binder effect the thermal layer in AP based composite solid propellant	[5] CO3	L5
Q.4(a)	What is the role of injectors in the liquid rocket engine? Discuss the various types of injectors used in the liquid rocket engine.	[5] CO4	L2
Q.4(b)	Explain clearly the different zones which occur in the combustion process of a liquid rocket engine with the help of a schematic diagram. Which zone has a pronounced effect on the combustion process?	[5] CO4	L4
Q.5(a)	Differentiate between the combustion process of a liquid droplet and the entrained bed combustion of a liquefying hybrid fuel. (Use schematic diagrams)	[5] CO5	L4
Q.5(b)	Describe the turbulent boundary layer theory for hybrid rocket combustion explaining how the oxidizer mass flux influences the regression rate. (Use schematic diagrams)	[5] CO5	L3

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