

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

CLASS: MTECH
BRANCH: AE

SEMESTER :II
SESSION : SP/2025

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?	[2+3]	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 experimental method of determining the inflammability limit of a gaseous mixture? What is the effect on the flame shape and size with the change in the direction of the flame propagation for flames in a tube? Use diagrams to explain.	[2+3]	CO2	L4
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?	[2+3]	CO2	L4
Q.3(a)	Explain the combustion mechanism of the composite solid propellant with the help of BDP model (use diagrams). What are the outcomes of the model?	[3+2]	CO3	L4
Q.3(b)	Demonstrate according to the GDF model the combustion mechanism of a composite solid propellant. (use diagram to explain)	[5]	CO3	L4
Q.4(a)	Analyze how the combustion of bipropellant droplet combustion is different from that of a monopropellant droplet.	[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)	Derive a relation of burn rate for the Maxman Gilbert model for the combustion process in a hybrid rocket motor.	[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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