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

CLASS: B TECH | **SEMESTER : VI**
BRANCH: MECHANICAL ENGG. | **SESSION : SP/2024**

SUBJECT: ME369 GAS DYNAMICS

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. Use Gas Table wherever it is required.

			CO	BL
Q.1(a)	Derive an expression for Area- Velocity relationship for a compressible flow in the form $\frac{dV}{V}\left(M^2-1\right)=\frac{dA}{A}$. Where this relation is applied while designing a system comprises of compressible flow.	[5]	1	L
Q.1(b)	A projectile is travelling in air having pressure and temperature as 8.829 x 10^4 N/sq.m. and 271 Kelvin respectively. If the Mach angle is 40 degrees, determine the velocity of the projectile. Take gama=1.4 and R=287 J/kg K.	[5]	1	M
Q.2(a)	Explain the phenomena of formation of a normal shock wave in compressible flow field.	[5]	2	L
Q.2(b)	Gas while flowing through a nozzle encounters a shock. The Mach number UPSTREAM of the shock is 1.6 and static temperature DOWNSTREAM of the shock is 470 K. Determine the change in velocity of the gas across the shock. Take gama=1.4 and R=287 J/kg K.	[5]	2	M
Q.3(a)	Prove that the point of maximum entropy on the Fanno line corresponds to the sonic velocity.	[5]	3	L
Q.3(b)	Air enters a circular duct having a constant diameter of 0.61 m. The Mach number of air at inlet to the duct is 3 and its absolute temperature is 310 K and its static pressure is 0.7 bar. At a section of the duct, where the local Mach number is 2.5, a normal shock occurs. The Mach number at the duct exit is 0.8. assume the coefficient of friction($4\bar{f}$ = 0.02). Determine (i) the distance from the inlet to the location of the normal shock, (ii) the total length of the duct and (iii) stagnation pressure at the exit of the duct. Take gama=1.4 and R=287 J/kg K.	[5]	3	M
Q.4(a)	Explain with neat sketch the principle of operation of Ramjet and Pulse jet engine.	[5]	4	L
Q.4(b)	A turbo jet engine flies at 920 km/hour at an altitude of 5500 m where atmospheric pressure P = 0.61 bar and the temperature is 260 K. the compressor pressure ratio is 8 and the maximum temperature at the combustor is 1000 deg C. Assuming ideal conditions. Determine (i) the compressor work, (ii) the pressures(P), (iii) exit jet velocity. Use this following Air table:	[5]	4	M

Temp[K]	Enthalpy[KJ/kg]	Pressure(P_r)[bar]
260	260.28	0.8368
292.55	292.95	1.2651
525	531.10	10.121
674.2	685.87	24.94
1069.3	1125.65	148.32
1273	1363.80	301.69

Q.5(a)	Classify various propellants used in Rocket engines. Specify various properties of liquid propellants and solid propellants.	[5]	5	L
Q.5(b)	Explain with neat sketch a liquid propelled rocket engine. What are its merits as compared to solid propelled systems.	[5]	5	L

::::::29/04/2024::::::M