Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

VI SEMESTER B.TECH. (AERONAUTICAL ENGINEERING)
END SEMESTER EXAMINATIONS, JUNE 2024

HIGH SPEED AERODYNAMICS [AAE 4083]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 00 June 2024** **Max. Marks: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

Q.NO	Questions	Marks	CO	BTL
1A.	What is the reason behind that the Newtonian theory is only applicable in hypersonic regimes? Also determine the values for following in Newtonian theory a) Coefficients of pressure on upper and lower surface of an airfoil b) Coefficients of lift and drag c) Lift to drag ratio d) Graphical representation of Newtonian theory on a flat plate with C_P, L/D, C_L and C_D.	(05)	CO3	4
1B.	Draw and explain the Velocity-Altitude map of hypersonic vehicle. Write down the importance of lifting entry and ballistic entry from this map	(03)	CO1	3
1C.	Evaluate the basic differences in conventional hypersonic vehicles with surface reentry vehicles and explain their design features	(02)	CO1	3
2A.	Describe the followings: a) Cold wall and hot wall b) Knudsen number c) Stanton number d) Self-similar solutions e) Similarity parameter	(05)	CO1	2
2B.	Consider the flat plate at an angle of attack 10deg in a Mach 8 inviscid flow. Calculate the pressure coefficients on the top and bottom surface of the plate, the lift and drag coefficients and the lift-to-drag ratio by using a) Exact shock – wave and expansion wave theory b) Newtonian theory c) Compare the both results	(03)	CO3	3
2C.	Define Mach number independence and write down one example	(02)	CO1	2
3A.	Write down the procedures of Maslen's method and what are the constant parameters using in this method.	(05)	CO2	3

3B.	Draw the schematic diagrams of gas dynamic laser and electric discharge laser. Explain their functions and operations	**(03)**	**CO4**	**3**
3C.	Analyze different design methods to increase aero-dynamical efficiency of a hypersonic vehicle	**(02)**	**CO5**	**3**
4A.	What is numerical technique of Method of characteristics? Explain in detail with limiting characteristics, unit process, initial data line and limitations of method of characteristics	**(05)**	**CO2**	**4**
4B.	What are the uses of non-dimesionalized parameters in inviscid hypersonic flows? Prove with an example that in high speed hypersonic, the properties become independent of Mach number	**(03)**	**CO2**	**3**
4C.	Why hypersonic boundary layer is thicker than subsonic and supersonic boundary layers?	**(02)**	**CO1**	**3**
5A.	Consider a flat plate at zero angle of attack in an airflow at standard sea level condition and the chord length of the plate is 3.2m with $38m^2$ planform area. Calculate the shear stress on the body by using reference temperature method. ($T_w=T_{aw}=6350K$, $T_e=T_\infty$, $M_e=M_\infty$, $u_e=4400m/s$)	**(05)**	**CO5**	**4**
5B.	Evaluate the basic hypersonic expansion wave relation and conclude the merits and demerits of expansion waves on hypersonic bodies	**(03)**	**CO3**	**4**
5C.	Define wave rider and how its design is different from other conventional hypersonic vehicle?	**(02)**	**CO5**	**3**