Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, July 2020

Programme Name: B.Tech/Mechanical **Semester : VIII**
Course Name : Gas Dynamics **Time : 03 hrs**
Course Code : MHEG421 **Max. Marks: 100**
Nos. of page(s) : 02
Instructions: Attempt all the questions as directed. Assume suitable data if required.

SECTION A

S. No.		Marks	CO
Q 1	Sum of enthalpy and kinetic energy remains a constant in _____ (a) Polytropic flow (b) Isentropic flow (c) Adiabatic flow (d) none	**5**	**CO1**
Q 2	All real fluids are (a) incompressible (b) compressible to some extent (c) compressible to any extent (d) none of the above.	**5**	**CO1**
Q 3	Which of the following is the basic equation of compressible fluid flow? (a) Continuity equation (b) Momentum equation (c) Energy equation (d) Equation of state (e) All of the above.	**5**	**CO1**
Q 4	The flow is said to be subsonic when Mach number is (a) equal to unity (b) less than unity (c) greater than unity (d) none of the above.	**5**	**CO2**
Q 5	A convergent-divergent nozzle is used when the discharge pressure is (a) less than the critical pressure (b) equal to the critical pressure (c) more than the critical pressure (d) none of the above.	**5**	**CO1**
Q 6	The sonic velocity in a fluid medium is directly proportional to (a) Mach number (b) pressure (c) square root of temperature (d) none of the above.	**5**	**CO2**

SECTION B			
Q 7	An aircraft cruises at 220 m/s at altitudes of 1800, 5500 and 12000 meters. Determine its Mach number at these altitudes.	**10**	**CO1**
Q 8	Describe the behavior of flow in a convergent-divergent nozzle when it is operated at (i) design pressure ratio (ii) pressure ratio higher than the design value; and (iii) pressure ratio lower than the design value.	**10**	**CO2**
Q 9	Define the second kind of Mach number M*. What is the advantage of using M* instead of M in some cases?	**10**	**CO2**
Q 10	Define is continuum? Under what conditions the assumptions of a continuum is valid? How is it used to define pressure and density in a medium?	**10**	**CO1**
Q 11	An aircraft flies at a velocity of 700 kmph in an atmosphere where the pressure is 75 kPa and temperature is 5^oC. Calculate the Mach number and stagnation properties. Take $\gamma = 1.4$, R = 287.43 J/kg K for air (OR) An air jet ($\gamma = 1.4$, R = 287.43 J/kgk) at 400k has sonic velocity. Determine: 1. Velocity of sound at 400K 2. Velocity of sound at the stagnation conditions 3. Maximum velocity of the jet 4. Stagnation enthalpy	**10**	**CO2**
SECTION-C			
Q 12	A nozzle in a wind tunnel gives a test-section Mach number of 2.0. Air enters the nozzle from a large reservoir at 0.69 bar and 310 K. The cross sectional area of the throat is 1000 cm2. Determine the following quantities for the tunnel for one dimensional isentropic flow. (i) Pressure, temperature and velocities at the throat and test-section. (ii) Area of cross section of the test section (iii) Mass flow rate (iv) Power required to drive the compressor. (OR) A jet of gas ($\gamma = 1.3$, R = 0.469 kJ/kg K) at 275 K and 2 bar has an initial Mach number of 2.5. If it passes through a normal shock wave, determine (i)Mach number, (ii) pressure (iii), temperature (iv) density (v) speed of sound, and (vi) jet velocity downstream of the shock.	**20**	**CO3**