Name: Enrolment No:	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 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	In a one-dimensional flow, the gas flows through one spatial dimension, namely its length. a) True b) False	**5**	
Q 2	The fluid speed through the nozzle is altered with_____ a) Acceleration b) Deceleration c) Constant speed d) Zero	**5**	
Q 3	What happens to velocity in the converging duct? a) Increases b) Decreases c) Same d) Independent	**5**	
Q 4	In an isentropic flow, the area of the duct is either maximum or minimum when the_____ a) Mach number = 1 b) Mach > 1 c) Mach = 0 d) Mach < 0	**5**	
Q 5	Normal shock waves are_____ to the local flow. a) Parallel b) Perpendicular c) Same d) Independent	**5**	
Q 6	The flow characteristics of a channel does not change with time at any point. What type of flow is it? a) Steady flow b) Uniform flow c) Laminar flow d) Turbulent flow	**5**	

SECTION B			
Q 7	Explain the following terms (i) Stagnation Temperature (ii) Stagnation Pressure (iii) Stagnation velocity of sound (iv) Stagnation enthalpy (v) Stagnation density	**10**	
Q 8	Explain the following terms: (i) Mach number (ii) Critical velocity (iii) Maximum Velocity (iv) Transonic flow (v) Hypersonic flow		
Q 9	An aircraft cruises at 1080km/hr at altitudes of 2000, 7000 and 15000 meters. Determine its Mach number at these altitudes.	**10**	
Q 10	Define the second kind of Mach number M*. What is the advantage of using M* instead of M in some cases?	**10**	
Q 11	The pressure, temperature, and Mach number at the entry of a flow passage are 2.45 bar, 26.5^{o}C, and 1.4, respectively. If the exit Mach number is 2.5 determine for the adiabatic flow of a perfect gas (γ = 1.3, R = 0.469 kJ/kg K) (i) Stagnation temperature (ii) Temperature and velocity of the gas at the exit, and (iii) The flow rate per square meter of the inlet cross-section (OR) Describe the behavior of flow in a convergent and convergent-divergent nozzle when it is operated at (i) design pressure ratio and (ii) pressure ratio lower than the design value. Discuss the change of Mach number in convergent-divergent nozzle under various backpressure.	**10**	
SECTION-C			
Q 12	A gas is isentropically expanded from p = 10 bar and t = 525^{o}C in a nozzle to a pressure of 7.6 bar. If the rate of flow of the gas is 1.5 kg/s, determine (i) pressure, temperature, and velocity at the nozzle throat and exit: (ii) maximum possible velocity attainable by the gas and (iii) the type of nozzle and its throat area. Take γ = 1.3, R = 0.464 kJ/kg K. (OR) A jet of air at 275 K and 0.69 bar has an initial Mach number of 2.0. 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. Take γ = 1.4, R = 287.43 J/kg K for air.	**20**	