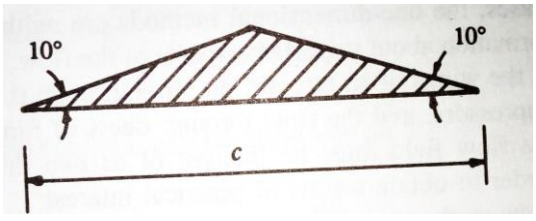
Enrolment No:

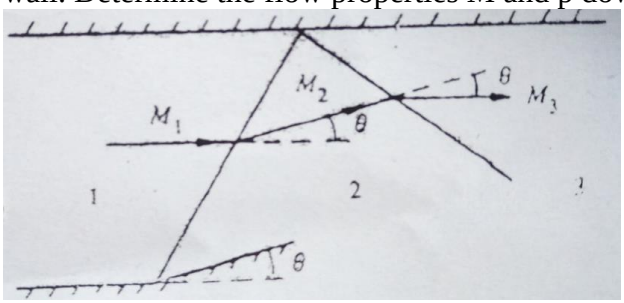
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, April/May 2018

Course: Supersonic Aerodynamics **Semester: VI**
Program: B. Tech ASE
Time: 03 hrs **Max. Marks: 100**

Instructions:

SECTION A

S. No.		Marks	CO
Q1	What is a *mach* wave? Derive relation for Mach angle.	**4**	**CO1**
Q2	Differentiate between Normal Shock and Expansion Fan.	**4**	**CO2**
Q3	What are simple and non-simple regions in supersonic flow?	**4**	**CO3**
Q4	Explain Prandlt-Glauert rule for subsonic and supersonic flow.	**4**	**CO5**
Q5	Define *recovery factor* term for measuring temperature in supersonic flow.	**4**	**CO6**
	SECTION B		
Q6	What do you mean by shock strength? Derive the relation of shock strength in supersonic flow.	**10**	**CO1**
Q7	A normal shock wave with pressure ratio 4.0 impinging on a plane wall. Determine the static pressure ratio for reflected normal shock wave. Air Temperature in front of the incident wave is 300 K.	**10**	**CO2**
Q8	Compute flow Mach nos. in a diverging channel with walls diverging by 20 deg and M_{inlet}=2.0. Divide the flow into three equal segments.	**10**	**CO3**
Q9	A two dimensional wedge shown below moves through the atmosphere at sea- level at zero angle of attack with mach no 3.5. Calculate C_L and C_D using shock expansion theory  **or**	**10**	**CO4**
Q10	What are different types of supersonic wind tunnels?	**10**	**CO6**

SECTION-C			
Q 11	A) Show that mach number behind normal shock is always subsonic.	**10**	**CO1**
	B) Find lift, drag coefficients and flow mach nos. on the Flat plate at 10 angle of attack. Compare the result's using Shock Expansion Theory and thin airfoil theory.	**10**	**CO3**
or			
Q12	A) Show that flow can be turned by an angel of ϕ_{max} where the pressure p will become zero, and $\phi_{max} = \sqrt{\frac{\gamma+1}{\gamma-1}}$ in expansion fan,	**10**	**CO2**
	B) Air flow at Mach 4.0 and Pressure 10^4 N/m^2 is tuned abruptly by a wall into the flow with a turning angle of 20 deg. If the shock is reflected by another wall. Determine the flow properties M and p downstream. 	**10**	**CO3**
Q13	A) Derive Crocco's Theorem for supersonic flow.	**10**	**CO4**
	B) What are pressure-measuring instruments in supersonic flow? Explain them briefly.	**10**	**CO6**