Model Question Paper-1 with effect from 2020-21 (CBCS Scheme)

USN | | | | | | | | | |

Fifth Semester B.E. Degree Examination
Aerodynamics - II

TIME: 03 Hours **Max. Marks: 100**

Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.

Module – 1			
Q.1	**(a)**	Derive continuity, momentum, and energy equations for one dimensional compressible flow	8
	(b)	Draw a neat sketch showing the variation of pressure along the convergent-divergent duct for various back pressure & explain.	6
	(c)	Briefly explain the significance of speed of sound. Also, derive the expression for the same.	6
OR			
Q.2	**(a)**	Derive the adiabatic state energy equations	4
	(b)	*Air flowing in a duct has a velocity of 300m/s, pressure 1bar and temperature 290k.Taking γ=1.4 and R=287j/kg-k, determine 1)stagnation pressure and temperature.2)velocity of sound in the dynamic and stagnation condition.3)stagnation pressure assuming constant density.*	8
	(c)	A nozzle in a wind tunnel gives a test section Mach number 2.Air enters the nozzle from a large reservoir at 0.69 bar and 310k.the cross sectional area of the throat is 1000cm^2.Determine the following quantities for the tunnel for one dimensional isentropic flow.1.) Pressures, temperatures, velocities at the throat and test sections 2.) Area of cross section of the test section 3.) Mass flow rate 4.) Power required to drive the compressor.	8
Module – 2			
Q.3	**(a)**	Derive the expression for static pressure ratio across the shock in terms of upstream Mach number.	6
	(b)	Derive the expression for temperature ratio across the shock in terms of upstream Mach number.	6
	(c)	Derive the expression for Mach number downstream of the normal shock wave	8
OR			
Q.4	**(a)**	Derive the Prandtl-Meyer equations for normal shock wave in perfect gas	8
	(b)	Derive the expression for Rankine-Hugoniot equations of a normal shock wave	6
	(c)	Derive the normal shock wave equations	6
Module – 3			
Q.5	**(a)**	Demonstrate the moving normal shock waves for stagnant gas and other relations.	6

	(b)	Write the Prandtl Mayer equation for oblique shock wave	6
	(c)	Write the density ratio and pressure ration across the oblique shock wave (Rankine-Hugoniot Equation)	8
OR			
Q.6	**(a)**	Illustrate shock interactions and reflections for oblique shock waves.	6
	(b)	Air approaches a symmetrical wedge ($\delta=15^0$) at a Mach number of 2.0. analyze for the strong and weak waves (a) wave angle (b) pressure ratio (c) density ratio (d) temperature ratio and (e) downstream Mach number.	6
	(c)	The velocity of a normal shock wave moving into stagnant air (p = 1.0 bar, t = 17^0) is 500 m/s. If the area of cross section of the duct is constant calculate (a) pressure (b) temperature (c) velocity of air (d) stagnation temperature and (e) the Mach number imparted upstream of the wave-front.	8
Module – 4			
Q.7	**(a)**	Write the basic potential equation for compressible flow	6
	(b)	Derive Von-Karman rule for transonic flow	6
	(c)	Explain Ackert's supersonic airfoil theory (Linearized supersonic flow)	8
OR			
Q.8	**(a)**	Derive the velocity potential equation	6
	(b)	Derive the linearized pressure coefficient	6
	(c)	Explain the improved compressibility corrections	8
Module – 5			
Q.9	**(a)**	Explain the wind tunnel measurements for low speed subsonic wind tunnel	6
	(b)	Explain the difference between intermittent and continuous wind tunnel	6
	(c)	With a neat sketch explain the shock tube and shock tube wave diagram	8
OR			
Q.10	**(a)**	With a neat sketch explain the following a) Open circuit supersonic wind tunnel b) Closed circuit continuous type supersonic wind tunnel	6
	(b)	Explain the following optical methods of flow visualization a) Shadow technique b) Schlieren technique	6
	(c)	Explain the conventional hypersonic wind tunnel	8

Table showing the Bloom's Taxonomy Level, Course Outcome and Programme Outcome				
Question		**Bloom's Taxonomy Level attached**	**Course Outcome**	**Programme Outcome**
Q.1	(a)	L4	CO1	PO1
	(b)	L5	CO1	PO2
	(c)	L6	CO1	PO4
Q.2	(a)	L4	CO1	PO2
	(b)	L6	CO1	PO3
	(c)	L3	CO1	PO2
Q.3	(a)	L3	CO1	PO3
	(b)	L4	CO1	PO2
	(c)	L4	CO2	PO3
Q.4	(a)	L3	CO2	PO2
	(b)	L1	CO2	PO1
	(c)	L2	CO2	PO1
Q.5	(a)	L2	CO1	PO2
	(b)	L2	CO1	PO2
	(c)	L2	CO1	PO1
Q.6	(a)	L2	CO1	PO5
	(b)	L1	CO3	PO1
	(c)	L1	CO3	PO1
Q.7	(a)	L1	CO3	PO1
	(b)	L1	CO3	PO2
	(c)	L2	CO3	PO2
Q.8	(a)	L2	CO2	PO1
	(b)	L2	CO1	PO2
	(c)	L2	CO1	PO2
Q.9	(a)	L2	CO1	PO1
	(b)	L2	CO1	PO5
	(c)	L1	CO3	PO1
Q.10	(a)	L1	CO3	PO1
	(b)	L1	CO3	PO1
	(c)	L1	CO3	PO2

Bloom's Taxonomy Levels	**Lower order thinking skills**		
	Remembering(knowledge): L_1	Understanding Comprehension): L_2	Applying (Application): L_3
	Higher order thinking skills		
	Analyzing (Analysis): L_4	Valuating (Evaluation): L_5	Creating (Synthesis): L_6

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Fifth Semester B.E. Degree Examination

AERODYNAMICS - II

TIME: 03 Hours **Max. Marks: 100**

Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.
02. Use of Gas Tables is permitted

Module – 1			
Q.1	**(a)**	Draw a neat showing the variation of pressure along the convergent- divergent duct for various back pressure and explain.	10
	(b)	The pressure, temperature and mach number at the entry of a flow passage are 2.45bar, 26.5^0C and 1.4 respectively. If the exit mach number is 2.5, determine for adiabatic flow of a perfect gas. (γ=1.3, R=0.469KJ/Kg K) i. Stagnation temperature ii. Temperature and velocity of gas at exit iii. The flow rate per square meter of the inlet cross section	10
OR			
Q.2	**(a)**	Derive impulse function for compressible flow problems is $$\frac{F}{F^*} = \frac{1+\gamma M^2}{M\sqrt{2(1+\gamma)\left[1+\frac{\gamma-1}{2}M^2\right]}}$$	10
	(b)	A nozzle in a wind tunnel gives a test section Mach number of 2. Air enters the nozzle from a large reservoir at 0.69bar and 310K. The cross sectional area of the throat is $1000cm^2$. Determine the following quantities for the tunnel for one dimensional isentropic flow. i) Pressure, temperature and velocities at the throat and test sections ii) area of cross section of the test section iii) mass flow rate iv) Power required to drive the compressor.	10
Module – 2			
Q.3	**(a)**	Show that, the gas velocities before and after the normal shock by using Prandtl-Meyer relationship is expressed by $C_x.C_y=a^*$, $M_x^*. M_y^*=1$	10
	(b)	A gas (γ=1.4, R=0.469KJ/Kg K) at a mach number of 1.8, P=0.8bar and T=373K passes through a normal shock. Determine its density after the shock. Compare this value in an isentropic compression through the same pressure ratio	10
OR			
Q.4	**(a)**	Derive the expression for Rankine-Hugonoit of a moving normal shock.	10
	(b)	The state of a gas (γ=1.3, R=0.469KJ/Kg K) upstream of a normal shock wave is given by the following data. M_X=2.5, P_X=2bar, T_X=275K. Calculate the mach number, pressure, temperature and velocity of the gas downstream of the shock, check the calculated values with those given in the tables.	10

Module – 3			
Q.5	**(a)**	Starting from the general energy equation for flow through an oblique shock obtain the prandtl's equation	10
	(b)	A gas (γ=1.3) at P_1=345bar T_1=350K and M_1=1.5 is to be isentropically expanded to 138bar. Determine i. The deflection angle ii. Final mach number iii. The temperature of the gas	10
OR			
Q.6	**(a)**	What is Expansion waves and how it is formed in the flow? Derive relation for Prandtl Meyer function.	10
	(b)	Explain with neat sketch about intersection of shocks of same family and opposite families with different and equal strength	10
Module – 4			
Q.7	**(a)**	Derive small Perturbation theory using linearized velocity potential equation. Also write the conclusion.	12
	(b)	Derive the expression for pressure co-efficient for linearized flow.	08
OR			
Q.8	**(a)**	Derive Prandtl-Glavert rule compressibility correction from small perturbation theory for supersonic flow.	10
	(b)	Write about uses of Karman rule and obtain an expression for lift and drag co-efficient using Von-Karman rule.	10
Module – 5			
Q.9	**(a)**	Write about the types of subsonic and supersonic wind tunnel, with sketch.	08
	(b)	Write the pressure measuring instruments used in wind tunnel. Explain any two with neat sketch.	08
	(c)	Write about the flow visualization techniques used for subsonic flow	04
OR			
Q.10	**(a)**	Explain about Schlieren techniques and shadow graph techniques and write its advantages and disadvantages.	12
	(b)	Explain about shock tube with neat sketch and write its application	08

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Q.3	(a)	L6	CO1	PO3
	(b)	L3	CO1	PO2
Q.4	(a)	L3	CO1	PO3
	(b)	L4	CO1	PO2
Q.5	(a)	L4	CO2	PO3
	(b)	L3	CO2	PO2
Q.6	(a)	L1 L3	CO2	PO1
	(b)	L2	CO2	PO1
Q.7	(a)	L2 L3	CO1	PO2
	(b)	L2 L3	CO1	PO2
Q.8	(a)	L2 L3	CO1	PO1
	(b)	L2 L3	CO1	PO5
Q.9	(a)	L1	CO3	PO1
	(b)	L1 L2	CO3	PO1
	(c)	L1	CO3	PO1
Q.10	(a)	L1 L2	CO3	PO2
	(b)	L2	CO3	PO2

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