INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

AERONAUTICAL ENGINEERING

DEFINITIONS AND TERMINOLOGY QUESTION BANK

Course Name	:	**HIGH SPEED AERODYNAMICS**	
Course Code	:	**AAE008**	
Program	:	**B.Tech**	
Semester	:	**V**	
Branch	:	**Aeronautical Engineering**	
Section	:	**A&B**	
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Course Faculty	:	**Mr. G Satya Dileep, Assistant Professor, AE** **Ms. D Anitha, Assistant Professor, AE**	

OBJECTIVES:

I	To help students to consider in depth the terminology and nomenclature used in the syllabus.
II	To focus on the meaning of new words / terminology/nomenclature

DEFINITIONS AND TERMINOLOGY QUESTION BANK

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
UNIT-I INTRODUCTION TO COMPRESSIBLE FLOWS						
1	Define Density?	Density is defined as mass per unit volume. Mass is a property and the SI unit for density is [kg/m^3].	Remember	CO 1	CLO 2	AAE008.02
2	Define compressibility?	In thermodynamics and fluid mechanics, compressibility (also known as the coefficient of compressibility or isothermal compressibility) is a measure of the relative volume change of a fluid or solid as a response to a pressure (or mean stress) change.	Remember	CO 1	CLO 2	AAE008.02
3	Define Continuity Equation?	The continuity equation would be derived based on the law of conservation of mass in a controlled volume 'V	Remember	CO 1	CLO 3	AAE008.03
4	Define Uniform Flow?	The flow is defined as uniform flow when in the flow field the velocity and other hydrodynamic parameters do not change from point to point at any instant of time	Remember	CO 1	CLO 2	AAE008.02
5	Define Non Uniform Flow?	Non-Uniform Flow When the velocity and other hydrodynamic parameters changes from one point to another the flow is defined as non-uniform.	Remember	CO 1	CLO 2	AAE008.02
6	What are Newtonian fluids?	Shear stress τ in a fluid is proportional to the time-rate-of-strain, i.e. velocity gradients. Such fluids are called Newtonian fluids	Remember	CO 1	CLO 2	AAE008.02

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
7	Define total energy?	The total energy of a moving fluid per unit mass is the sum of its internal energy per unit mass, e, and its kinetic energy per unit mass, $V^2/2$	Remember	CO 1	CLO 2	AAE008.02
8	What is internal Energy?	The internal energy of the gas system is simply the energy of each molecule or atom, summed over all the molecules and atoms in the system.	Remember	CO 1	CLO 2	AAE008.02
9	Define heat flux?	The heat transfer in a given direction, when expressed in dimensions of energy per unit time per unit area perpendicular to the direction, is called heat flux in that direction.	Understand	CO 1	CLO 2	AAE008.02
10	Define enthalpy?	A thermodynamic quantity equivalent to the total heat content of a system. It is equal to the internal energy of the system plus the product of pressure and volume.	Understand	CO 1	CLO 2	AAE008.02
11	What is kinetic energy?	Kinetic energy is the energy which a body possesses by virtue of being in motion. Kinetic energy can be transferred between objects and transformed into other kinds of energy. For example, a flying squirrel might collide with a stationary chipmunk. Following the collision, some of the initial kinetic energy of the squirrel might have been transferred into the chipmunk or transformed to some other form of energy.	Remember	CO 1	CLO 2	AAE008.02
12	What is free molecular flow	Free molecular flow describes the fluid dynamics of gas where the mean free path of the molecules is larger than the size of the chamber or of the object under test.	Remember	CO 1	CLO 1	AAE008.01
13	What is adiabatic process?	An adiabatic process occurs without transfer of heat or mass of substances between a thermodynamic system and its surroundings. In an adiabatic process, energy is transferred to the surroundings only as work.	Remember	CO 1	CLO 2	AAE008.02
14	What is reversible process?	In thermodynamics, a reversible process is a process whose direction can be "reversed" by inducing infinitesimal changes to some property of the system via its surroundings. Throughout the entire reversible process, the system is in thermodynamic equilibrium with its surroundings.	Remember	CO 1	CLO 2	AAE008.02
15	What is isentropic process?	In thermodynamics, an isentropic process is an idealized thermodynamic process that is both adiabatic and reversible. The work transfers of the system are frictionless, and there is no transfer of heat or matter.	Remember	CO 1	CLO 1	AAE008.01

UNIT-II
SHOCK AND EXPANSION WAVES

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
1	What is Mach wave?	In fluid dynamics, a Mach wave is a pressure wave traveling with the speed of sound caused by a slight change of pressure added to a compressible flow.	Remember	CO 2	CLO 4	AAE008.04
2	What are Shock waves?	Shock waves are highly localized irreversibilities in the flow. Within the distance of a mean free path, the flow	Remember	CO 2	CLO 4	AAE008.04

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
		passes from a supersonic to a subsonic state, the velocity decreases suddenly and the pressure rises sharply.				
3	What are normal shock waves?	Shock waves are very small regions in the gas where the gas properties change by a large amount. Across a shock wave, the static pressure, temperature, and gas density increases almost instantaneously. If the shock wave is perpendicular to the flow direction it is called a normal shock.	Remember	CO 2	CLO 4	AAE008.04
4	Define Mach angle.	A Mach wave propagates across the flow at the Mach angle μ, which is the angle, formed between the Mach wave wavefront and a vector that point opposite to the vector of motion. It is given by $\mu = arcsin\left(\frac{1}{M}\right)$	Remember	CO 2	CLO 4	AAE008.04
5	Define shock tube	The shock tube is an instrument used to replicate and direct blast waves at a sensor or a model in order to simulate actual explosions and their effects, usually on a smaller scale.	Understand	CO 2	CLO 5	AAE008.05
6	What is shock polar?	The term shock polar is generally used with the graphical representation of the Rankine–Hugoniot equations in either the hodograph plane or the pressure ratio-flow deflection angle plane. The polar itself is the locus of all possible states after an oblique shock.	Remember	CO 2	CLO 5	AAE008.05
7	What is pitot probe?	A pitot probe, also known as pitot tube, is a flow measurement device used to measure fluid flow velocity. The pitot tube was invented by the French engineer Henri Pitot in the early 18th century and was modified to its modern form in the mid-19th century by French scientist Henry Darcy.	Remember	CO 2	CLO 5	AAE008.05
8	Define oblique shock wave.	An oblique shock wave, unlike a normal shock, is inclined with respect to the incident upstream flow direction. It will occur when a supersonic flow encounters a corner that effectively turns the flow into itself and compresses.	Remember	CO 2	CLO 4	AAE008.04
9	Define expansion wave.	In supersonic flow, expansion waves occur when bodies begin to narrow, making more space available. In passing through an expansion wave, air velocity increases, while temperature and pressures are reduced. A simple wave or progressive disturbance in the isentropic flow of a compressible fluid, such that the pressure and density of a fluid particle decrease on crossing the wave in the direction of its motion. It is the opposite of a compression wave. Also called a rarefaction wave.	Understand	CO 2	CLO 4	AAE008.04
10	What is boundary layer interaction?	In high speed intakes there are potentially far-reaching consequences of the interaction of shock waves with boundary layer since in extreme cases the interaction	Remember	CO 2	CLO 6	AAE008.06

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
		can cause an unstart of the intake				
11	What is reflected shock wave?	The shock wave when strikes a solid wall and reflects from the wall generating a new shock. This new shock is called reflected shock wave.	Remember	CO 2	CLO 6	AAE008.06
12	What is sonic circle?	The circle drawn with radius $M^*=1$ in shock polar is called ass sonic circle.	Remember	CO 2	CLO 5	AAE008.05
13	Define slip line.	The dividing stream line which separates two regions in intersection of shock waves across which entropy changes discontinuously is called slip line.	Understand	CO 2	CLO 5	AAE008.05
14	Define boundary layer.	The thin viscous layer adjacent to a surface is called a boundary layer	Understand	CO 2	CLO 6	AAE008.06
15	What is Mach reflection?	When a shock wave, which is moving with a constant velocity, propagates over a solid wedge, the flow generated by the shock impinges on the wedge thus generating a second reflected shock, which ensures that the velocity of the flow is parallel to the wedge surface. Viewed in the frame of the reflection point, this flow is locally steady, and the flow is referred to as pseudo steady. When the angle between the wedge and the primary shock is sufficiently large, a single reflected shock is not able to turn the flow to a direction parallel to the wall and a transition to Mach reflection occurs	Remember	CO 2	CLO 5	AAE008.05
UNIT-III **ONE DIMENSIONAL AND QUASI ONE DIMENSINAL FLOW**					
1	What is one dimensional flow?	If all the flow parameters may be expressed as functions of time and one space coordinate only, then the flow is called one dimensional flow.	Remember	CO 3	CLO 7	AAE008.07
2	What is quasi one dimensional flow?	A quasi-one-dimensional flow is one in which all variables vary primarily along one direction, say x. A flow in a duct with slowly-varying area A(x) is the case of interest here.	Remember	CO 3	CLO 7	AAE008.07
3	What is chocked flow?	Choked flow is a limiting condition where the mass flow will not increase with a further decrease in the downstream pressure environment for a fixed upstream pressure and temperature.	Remember	CO 3	CLO 8	AAE008.08
4	What is over expanded flow?	When the external pressure is higher than the exit pressure, is referred to as over-expanded. When an over expanded flow passes through a nozzle, the higher atmospheric pressure causes it to squeeze back inward and separate from the walls of the nozzle. This "pinching" of the flow reduces efficiency because that extra nozzle wall is wasted and does nothing to generate any additional thrust	Remember	CO 3	CLO 8	AAE008.08
5	What is under expanded flow?	When the atmospheric pressure is lower than the exit pressure, is called under expanded. In this case, the flow continues to expand outward after it has exited the	Understand	CO 3	CLO 8	AAE008.08

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
		nozzle. This behavior also reduces efficiency because that external expansion does not exert any force on the nozzle wall. This energy can therefore not be converted into thrust and is lost.				
6	Define slipstream.	A slipstream is a region behind a moving object in which a wake of fluid (typically air or water) is moving at velocities comparable to the moving object, relative to the ambient fluid through which the object is moving.	Understand	CO 3	CLO 8	AAE008.08
7	Define diffuser.	Diffuser is a part of a jet engine air intake, especially when operated at supersonic speeds	Understand	CO 3	CLO 7	AAE008.07
8	Define Fanno flow.	Fanno flow is the adiabatic flow through a constant area duct where the effect of friction is considered. Compressibility effects often come into consideration, although the Fanno flow model certainly also applies to incompressible flow.	Remember	CO 3	CLO 9	AAE008.09
9	Define Rayleigh flow.	Rayleigh flow refers to frictionless, non-Adiabatic flow through a constant area duct where the effect of heat addition or rejection is considered. Compressibility effects often come into consideration, although the Rayleigh flow model certainly also applies to incompressible flow.	Remember	CO 3	CLO 9	AAE008.09
10	What is Fanning friction factor?	The Fanning friction factor, named after John Thomas Fanning, is a dimensionless number used as a local parameter in continuum mechanics calculations. It is defined as the ratio between the local shear stress and the local flow kinetic energy density	Remember	CO 3	CLO 9	AAE008.09
11	What is stagnation temperature?	Stagnation temperature is the temperature at a stagnation point in a fluid flow. At a stagnation point the speed of the fluid is zero and all of the kinetic energy has been converted to internal energy and is added to the local static enthalpy	Remember	CO 3	CLO 9	AAE008.09
12	What is Fanno line?	The line representing the locus of points with the same mass velocity and stagnation enthalpy is called a Fanno line. It is a one-dimensional model for adiabatic flow in a constant area duct with friction	Remember	CO 3	CLO 9	AAE008.09
13	What is Rayleigh line?	In thermodynamic coordinates, the Rayleigh flow process can be described by a curve known as Rayleigh line and is defined as the locus of quasi- static thermodynamic state points traced during the flow. The Rayleigh line satisfies the equation of state along with simple forms of continuity and momentum equation.	Understand	CO 3	CLO 9	AAE008.09
14	Define hydraulic diameter.	The hydraulic diameter, D_H, is a commonly used term when handling flow in non-circular tubes and channels. Using this term, one can calculate many things in the same way as for a round tube.	Understand	CO 3	CLO 9	AAE008.09

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
15	Define specific heat.	The specific heat capacity (or simply specific heat) of a substance is the heat capacity of a sample of the substance divided by the mass of the sample. Informally, it is the amount of energy that must be added, in the form of heat, to one unit of mass of the substance in order to cause an increase of one unit in its temperature.	Understand	CO 3	CLO 9	AAE008.09
UNIT-IV APPLICATIONS OF COMPRESSIBLE FLOWS AND NUMERICAL TECHNIQUES						
1	What is compatibility equation?	The equation involving dependent variables which holds only along the characteristic line. The advantage of this compatibility equation is that it is in one less dimension than the original partial differential equations.	Understand	CO 4	CLO 11	AAE008.11
2	Define characteristic lines?	The lines in the XY space along which the derivate of u an v are indeterminant are called the characteristic lines	Understand	CO 4	CLO 11	AAE008.11
3	What is perturbation?	Perturbation is a deviation of a system, moving object, or process from its regular or normal state or path, caused by an outside influence.	Remember	CO 4	CLO 10	AAE008.10
4	What is Cramer's rule?	In linear algebra, Cramer's rule is an explicit formula for the solution of a system of linear equations with as many equations as unknowns, valid whenever the system has a unique solution.	Remember	CO 4	CLO 11	AAE008.11
5	Define subsonic flow?	Subsonic Flow: When the fluid velocity is lower than the acoustic speed (M<1) then the fluid flow is called as subsonic. However Mach number of the flow changes while passing over an object or through a duct. Hence for simplicity, flow is considered as subsonic if Mach number is in the range of 0-0.8.	Remember	CO 4	CLO 10	AAE008.10
6	Define transonic flow?	Transonic flow is where air flows above, at, and below the speed of sound at the same time at different points on an object.	Remember	CO 4	CLO 10	AAE008.10
7	Define supersonic flow?	When the flow Mach number is more than everywhere in the domain then it is called as supersonic flow. This flow is not pre-warned since the fluid speed is more than the speed of sound.	Remember	CO 4	CLO 10	AAE008.10
8	Define hypersonic flow?	In aerodynamics, a hypersonic speed is one that greatly exceeds the speed of sound, often stated as starting at speeds of Mach 5 and above. The precise Mach number at which a craft can be said to be flying at hypersonic speed varies, since individual physical changes in the airflow (like molecular dissociation and ionization) occur at different speeds; these effects collectively become important around Mach 5-10. The hypersonic regime is often alternatively defined as speeds where Cp and Cv are no longer able to be reasonably	Remember	CO 4	CLO 10	AAE008.10

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
		considered constant.				
9	What is supercritical airfoil?	A supercritical airfoil is a special airfoil designed to reduce the drag when operating near supersonic speeds. When a plane flies near supersonic speeds, the air moving over the wing goes faster than the speed of sound before the plane does.	Remember	CO 4	CLO 11	AAE008.11
10	Define area rule.	The Whitcomb area rule, also called the transonic area rule, is a design technique used to reduce an aircraft's drag at transonic and supersonic speeds, particularly between Mach 0.75 and 1.2.	Remember	CO 4	CLO 11	AAE008.11
11	Define truncation error.	In numerical analysis and scientific computing, truncation error is the error made by truncating an infinite sum and approximating it by a finite sum.	Remember	CO 4	CLO 11	AAE008.11
12	Define round-off error	A round-off error, also called rounding error, is the difference between the result produced by a given algorithm using exact arithmetic and the result produced by the same algorithm using finite-precision, rounded arithmetic.	Remember	CO 4	CLO 11	AAE008.11
13	What is exact solution?	As used in physics, the term "exact" generally refers to a solution that captures the entire physics and mathematics of a problem as opposed to one that is approximate, perturbative, etc. Exact solutions therefore need not be closed-form.	Remember	CO 4	CLO 12	AAE008.12
14	What is unit process?	A "unit process" is one or more grouped operations in a manufacturing system that can be defined and separated from others.	Remember	CO 4	CLO 12	AAE008.12
15	Define airfoil?	Airfoil is a structure with curved surfaces designed to give the most favorable ratio of lift to drag in flight, used as the basic form of the wings, fins, and horizontal stabilizer of most aircraft	Remember	CO 4	CLO 10	AAE008.10

UNIT-V
EXPERIMENTAL METHODS IN COMPRESSIBLE FLOWS

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
1	What is wind tunnel?	A tunnel-like apparatus for producing an airstream of known velocity past models of aircraft, buildings, or other solid objects in order to investigate flow or the effect of wind on the full-size object.	Understand	CO 5	CLO 13	AAE008.13
2	What is shock tube?	The shock tube is an instrument used to replicate and direct blast waves at a sensor or a model in order to simulate actual explosions and their effects, usually on a smaller scale. Shock tubes (and related impulse facilities such as shock tunnels, expansion tubes, and expansion tunnels) can also be used to study aerodynamic flow under a wide range of temperatures and pressures that are difficult to obtain in other types of testing facilities	Remember	CO 5	CLO 14	AAE008.14
3	What is rupture disk?	A rupture disk, also known as a pressure safety disc, burst disc, bursting disc, or burst diaphragm, is a non-reclosing	Remember	CO 5	CLO 14	AAE008.14

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
		pressure relief safety device that, in most uses, protects a pressure vessel, equipment or system from over pressurization or potentially damaging vacuum conditions.				
4	What is settling chamber?	The Settling Chamber is at the very front of the wind tunnel, and is made up of screens and honeycomb-shaped mesh, which straighten out the air and reduce turbulence.	Remember	CO 5	CLO 13	AAE008.13
5	What is Contraction Cone?	The Contraction Cone forces a large volume of air through a small opening in order to increase the wind velocity in the tunnel	Remember	CO 5	CLO 13	AAE008.13
6	What is diffuser?	The Diffuser is at the end of the Test Section, and keeps the air running smoothly as it goes toward the back. It also increases in volume in order to slow the air down as it exits the tunnel	Remember	CO 5	CLO 13	AAE008.13
7	What is Drive Section?	The Drive Section is at the very back of the wind tunnel, and it is where the fan is housed. At first, it might seem odd that the fan is at the back of the tunnel, facing outward, instead of at the front; but this is actually the best placement, because it will draw air into the wind tunnel by blowing air out of it.	Remember	CO 5	CLO 13	AAE008.13
8	What is manometer?	A Manometer is a device to measure pressures. A common simple manometer consists of a U shaped tube of glass filled with some liquid. Typically the liquid is mercury because of its high density.	Remember	CO 5	CLO 13	AAE008.13
9	What is shadowgraph?	Shadowgraph is an optical method that reveals non-uniformities in transparent media like air, water, or glass. It is related to, but simpler than, the Schlieren and Schlieren photography methods that perform a similar function. Shadowgraph is a type of flow visualization.	Remember	CO 5	CLO 15	AAE008.15
10	What is Schlieren photography?	Schlieren photography (from German; singular "Schliere", meaning "streak") is a visual process that is used to photograph the flow of fluids of varying density. Invented by the German physicist August Toepler in 1864 to study supersonic motion, it is widely used in aeronautical engineering to photograph the flow of air around objects.	Remember	CO 5	CLO 15	AAE008.15
11	What is Interferometry?	Interferometry is a family of techniques in which waves, usually electromagnetic waves, are superimposed, causing the phenomenon of interference, which is used to extract information.	Remember	CO 5	CLO 15	AAE008.15
12	What is Expansion tunnel?	Expansion tunnel uses a dual-diaphragm system where the diaphragms act as rupture discs, or a pressure relief. The tunnel is separated into three sections: driver, driven, and acceleration. The driver section can be fired either by a high pressure gas or by a	Remember	CO 5	CLO 14	AAE008.14

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
		free piston driver.				
13	What is refractive index?	In optics, the refractive index or index of refraction of a material is a dimensionless number that describes how fast light propagates through the material.	Remember	CO 5	CLO 15	AAE008.15
14	What is texture advection?	In scientific visualization, texture advection is a family of methods to densely visualize vector fields or flows (like the wind movement of a tornado). Scientists can use the created images and animations to better understand these flows and reason about them	Remember	CO 5	CLO 15	AAE008.15
15	What is turning vane?	Turning vanes: In a closed circuit wind tunnel, the air has to circulate in a controlled manner. Typically, the corners of the wind tunnel are of two bends aligned 90 0 each other. These corners are provided with turning vanes for smooth passage of the flow.	Remember	CO 5	CLO 13	AAE008.13

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