# INSTITUTE OF AERONAUTICAL ENGINEERING

**(Autonomous)**

Dundigal, Hyderabad - 500 043

## AERONAUTICAL ENGINEERING

### DEFINITIONS AND TERMINOLOGY QUESTION BANK

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| **Course Name** | : | AEROSPACE STRUCTURAL DYNAMICS |
| **Course Code** | : | AAE015 |
| **Program** | : | B.Tech |
| **Semester** | : | VII |
| **Branch** | : | Aeronautical Engineering |
| **Section** | : | A&B |
| **Academic Year** | : | 2019 – 2020 |
| **Course Faculty** | : | Dr. Y B Sudhir Sastry, Professor<br>Mr. T. Mahesh Kumar, Assistant Professor |

**OBJECTIVES:**

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| 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 |
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| UNIT-I | | | | | | |
| 1 | Amplitude | The maximum displacement of a vibrating body from its equilibrium position is called the amplitude of vibration. | Remember | **CO 1** | CLO 1 | AAE015.01 |
| 2 | Displacement | Amount of movement from one point to another. E.g. I just walked 100 meters. | Remember | **CO 1** | CLO 1 | AAE015.01 |
| 3 | Velocity | The rate of movement, E.g. I moved the 100 meters in 10 seconds | Remember | **CO 1** | CLO 1 | AAE015.01 |
| 4 | Acceleration | The rate of change of velocity. E.g. The car has the capability to go from 0 mph to 100 mph in 8 Seconds. | Remember | **CO 1** | CLO 1 | AAE015.01 |
| 5 | Frequency: | Denoting how often something occurs, the same thing applies in vibration too. This denotes how frequently something occurs. For example, made to appear at regular intervals based on their relative motion. | Remember | **CO 1** | CLO 2 | AAE015.02 |
| 6 | What is Hertz | The Hz denotes Hertz, the unit for frequency | Remember | **CO 1** | CLO 2 | AAE015.02 |

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| 7 | Time Domain | To say in a graph with Time in the X – Axis and Amplitude in the Y – Axis. You can assume the amplitude to be for example the amount of height a body jumps due to vibration | Remember | **CO 1** | CLO2 | AAE015.02 |
| 8 | Cycle. | The movement of a vibrating body from its undisturbed or equilibrium position to its extreme position in one direction, then to the equilibrium position, then to its extreme position in the other direction, and back to equilibrium position is called a cycle of vibration. | Remember | **CO 1** | CLO 2 | AAE015.02 |
| 9 | Period of oscillation. | The time taken to complete one cycle of motion is known as the period of oscillation $\tau = 2\pi/\omega$<br>Time period and is denoted by $\tau$<br>Rotate through an angle of $2\pi$<br>The circular frequency $\omega$ | Understand | **CO 1** | CLO 3 | AAE015.03 |
| 10 | Frequency of oscillation. | The number of cycles per unit time is called the frequency of oscillation | Understand | **CO 1** | CLO 3 | AAE015.03 |
| 11 | synchronous | Consider two vibratory motions denoted by $x1 = A1 \sin \omega t$<br>$x2 = A2 \sin(\omega t + \varphi)$<br>The two harmonic motions given by above Eqs. are called synchronous | Understand | **CO 1** | CLO 3 | AAE015.03 |
| 12 | Phase angle | Consider two vibratory motions denoted by $x1 = A1 \sin \omega t$<br>$x2 = A2 \sin(\omega t + \varphi)$<br>The two harmonic motions given by above Eqs. are called synchronous Because they have the same frequency or angular velocity, Two synchronous oscillations need not have the same amplitude, and they need not attain their maximum values at the same time, the second vector leads the first one by an angle known as the phase angle. | Remember | **CO 1** | CLO 4 | AAE015.04 |
| 13 | Natural frequency. | If a system, after an initial disturbance, is left to vibrate on its own, the frequency with which it oscillates without external forces is known as its natural frequency. | Remember | **CO 1** | CLO 4 | AAE015.04 |

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| 14 | Octave | When the maximum value of a range of frequency is twice its minimum value, it is known as an octave band. | Remember | **CO 1** | CLO 4 | AAE015.04 |
| 15 | Decibel | The various quantities encountered in the field of vibration and sound (such as displacement, velocity, acceleration, pressure, and power) are often represented using the notation of decibel. | Remember | **CO 1** | CLO 4 | AAE015.04 |
| UNIT - II | | | | | | |
| 1 | Resonance | Whenever the natural frequency of vibration of a machine or structure coincides with the frequency of the external excitation, there occurs a phenomenon known as resonance | Remember | **CO 2** | CLO 5 | AAE015.05 |
| 2 | vibration or oscillation | Any motion that repeats itself after an interval of time is called vibration or oscillation | Remember | **CO 2** | CLO 5 | AAE015.05 |
| 3 | generalized coordinates | The coordinates necessary to describe the motion of a system constitute a set of generalized coordinates. These are usually denoted as and may represent Cartesian and/or non-Cartesian coordinates | Remember | **CO 2** | CLO 5 | AAE015.05 |
| 4 | discrete or lumped parameter systems | Systems with a finite number of degrees of freedom are called discrete or lumped parameter systems | Remember | **CO 2** | CLO 5 | AAE015.05 |
| 5 | continuous or distributed systems | Systems with a finite number of degrees of freedom are called discrete or lumped parameter systems, and those with an infinite number of degrees of freedom are called continuous or distributed systems | Remember | **CO 2** | CLO 6 | AAE015.06 |
| 6 | Free Vibration. | If a system, after an initial disturbance, is left to vibrate on its own, the ensuing vibration is known as free vibration. No external force acts on the system. The oscillation of a simple pendulum is an example of free vibration. | Remember | **CO 2** | CLO 6 | AAE015.06 |
| 7 | Forced Vibration. | If a system is subjected to an external force (often, a repeating type of force), the resulting vibration is known as forced vibration. | Remember | **CO 2** | CLO 6 | AAE015.06 |
| 8 | When resonance will occur | If the frequency of the external force coincides with one of the natural | Remember | **CO 2** | CLO 6 | AAE015.06 |

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| | | frequencies of the system, a condition known as resonance occurs. | | | | |
| 9 | undamped vibration | If no energy is lost or dissipated in friction or other resistance during oscillation, the vibration is known as undamped vibration. | Understand | **CO 2** | CLO 6 | AAE015.06 |
| 10 | Damped vibration. | If any energy is lost in this way, however, it is called damped vibration. | Remember | **CO 2** | CLO 7 | AAE015.07 |
| 11 | linear vibration | If all the basic components of a vibratory system the spring, the mass, and the damper behave linearly, the resulting vibration is known as linear vibration. | Remember | **CO 2** | CLO 7 | AAE015.07 |
| 12 | nonlinear vibration | . If, however, any of the basic components behave nonlinearly, the vibration is called nonlinear vibration. | Understand | **CO 2** | CLO 7 | AAE015.07 |
| 13 | deterministic | If the value or magnitude of the excitation (force or motion) acting on a vibratory system is known at any given time, the excitation is called deterministic. | Understand | **CO 2** | CLO 7 | AAE015.07 |
| 14 | deterministic vibration | If the value or magnitude of the excitation (force or motion) acting on a vibratory system is known at any given time, the excitation is called deterministic. The resulting vibration is known as deterministic vibration. | Remember | **CO 2** | CLO 8 | AAE015.08 |
| 15 | random vibration | If the excitation is random, the resulting vibration is called random vibration | Understand | **CO 2** | CLO 8 | AAE015.08 |
| | | | UNIT - III | | | |
| 1 | Spring constant or spring stiffness or spring rate. | A spring is said to be linear if the elongation or reduction in length x is related to the applied force F as F = kx Where k is a constant, known as the spring constant or spring stiffness or spring rate. | Remember | **CO 3** | CLO 9 | AAE015.09 |
| 2 | Damping | The mechanism by which the vibrational energy is gradually converted into heat or sound is known as damping. | Remember | **CO 3** | CLO 9 | AAE015.09 |
| 3 | Viscous damping | In viscous damping, the damping force is proportional to the velocity of the vibrating body. | Remember | **CO 3** | CLO 9 | AAE015.09 |

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| 4 | Coulomb or Dry-Friction Damping. | The damping force is constant in magnitude but opposite in direction to that of the motion of the vibrating body. It is caused by friction between rubbing surfaces that either are dry or have insufficient lubrication. | Remember | **CO 3** | CLO 10 | AAE015.10 |
| 5 | Material or Solid or Hysteretic Damping. | When a material is deformed, energy is absorbed and dissipated by the material. The effect is due to friction between the internal planes, which slip or slide as the deformations take place. | Remember | **CO 3** | CLO 10 | AAE015.10 |
| 6 | Periodic motion. | Oscillatory motion may repeat itself regularly, as in the case of a simple pendulum, or it may display considerable irregularity, as in the case of ground motion during an earthquake. If the motion is repeated after equal intervals of time, it is called periodic motion. | Remember | **CO 3** | CLO 10 | AAE015.10 |
| 7 | Harmonic motion | The simplest type of periodic motion is harmonic motion. | Remember | **CO 3** | CLO 10 | AAE015.10 |
| 8 | Simple harmonic motion | It can be seen that the acceleration is directly proportional to the displacement. Such a vibration, with the acceleration proportional to the displacement and directed toward the mean position, is known as simple harmonic motion. | Remember | **CO 3** | CLO 10 | AAE015.10 |
| 9 | Torsional vibration | If a rigid body oscillates about a specific reference axis, the resulting motion is called torsional vibration. | Remember | **CO 3** | CLO 11 | AAE015.11 |
| 10 | Orthogonality | As the number of degrees of freedom increases, the solution of the characteristic equation becomes more complex. The mode shapes exhibit a property known as orthogonality. | Remember | **CO 3** | CLO 11 | AAE015.11 |
| 11 | Proportional damping. | The solution of forced-vibration problems associated with viscously damped systems can also be found conveniently by using a concept called proportional damping. | Remember | **CO 3** | CLO 11 | AAE015.11 |
| 12 | lumped-parameter or lumped-mass or discrete-mass systems | The lumped masses are assumed to be connected by massless elastic and damping members. Linear (or angular) coordinates are used to describe the motion of the lumped masses (or rigid | Remember | **CO 3** | CLO 12 | AAE015.12 |

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| | | bodies). Such models are called lumped-parameter or lumped-mass or discrete-mass systems | | | | |
| 13 | Finite element method | Method of approximating a continuous system as a multi degree-of freedom system involves replacing the geometry of the system by a large number of small elements. By assuming a simple solution within each element, the principles of compatibility and equilibrium are used to find an approximate solution to the original system. This method, known as the finite element method. | Remember | **CO 3** | CLO 12 | AAE015.12 |
| 14 | Influence coefficients | The equations of motion of a multidegree-of-freedom system can also be written in terms of influence coefficients, which are extensively used in structural engineering. Basically, one set of influence coefficients can be associated with each of the matrices involved in the equations of motion. | Remember | **CO 3** | CLO 12 | AAE015.12 |
| 15 | Flexibility influence coefficients | The influence coefficients corresponding to the inverse stiffness matrix are called the flexibility influence coefficients. | Remember | **CO 3** | CLO 12 | AAE015.12 |
| UNIT - IV | | | | | | |
| 1 | Nodes | The points at which $w_n$=0for all times are called nodes. | Remember | **CO 4** | CLO 13 | AAE015.13 |
| 2 | Euler-Bernoulli or thin beam theory | From the elementary theory of bending of beams. | Remember | **CO 4** | CLO 13 | AAE015.13 |
| 3 | Thick beam theory or Timoshenko beam theory | If the cross-sectional dimensions are not small compared to the length of the beam, we need to consider the effects of rotary inertia and shear deformation. Is known as the thick beam theory or Timoshenko beam theory. | Remember | **CO 4** | CLO 13 | AAE015.13 |
| 4 | Timoshenko s shear coefficient | Where G denotes the modulus of rigidity of the material of the beam and k is a constant, also known as Timoshenko s shear coefficient. | Remember | **CO 4** | CLO 13 | AAE015.13 |
| 5 | Rayleigh-Ritz method | Based on Rayleigh s quotient, for finding the approximate fundamental | Remember | **CO 4** | CLO 13 | AAE015.13 |

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| | | frequencies of continuous systems is outlined. The extension of the method, known as the Rayleigh-Ritz method. | | | | |
| 6 | Distributed or continuous systems | Systems where mass, damping, and elasticity were assumed to be present only at certain discrete points in the system. In many cases, known as distributed or continuous systems. | Remember | **CO 4** | CLO 13 | AAE015.13 |
| 7 | System of infinite degrees of freedom | A continuous system is also called a system of infinite degrees of freedom. | Remember | **CO 4** | CLO 14 | AAE015.14 |
| 8 | Wave equation | The Equation $c^2\frac{\partial^2 w}{\partial x^2} = \frac{\partial^2 w}{\partial t^2}$ is also known as the wave equation. | Remember | **CO 4** | CLO 14 | AAE015.14 |
| 9 | Frequency or characteristic equation | Equation $\sin\frac{\omega l}{c} = 0$ is called the frequency or characteristic equation. | Remember | **CO 4** | CLO 14 | AAE015.14 |
| 10 | Eigenvalues | Equation $\sin\frac{\omega l}{c} = 0$ is called the frequency or characteristic equation and is satisfied by several values of ω The values of ω are called the eigenvalues (or natural frequencies or characteristic values) of the problem. | Remember | **CO 4** | CLO 15 | AAE015.15 |
| 11 | Fundamental mode | The mode corresponding to n = 1 is called the fundamental mode. | Remember | **CO 4** | CLO 15 | AAE015.15 |
| 12 | Fundamental frequency. | The mode corresponding to n = 1 is called the fundamental mode, and $\omega_1$ is called the fundamental frequency. | Remember | **CO 4** | CLO 16 | AAE015.16 |
| 13 | Mode superposition method | The solution given by Eq. $w(x,t) = \sum_{n=1}^{\infty} w_n(x,t) = \sum_{n=1}^{\infty} \sin\frac{n\pi x}{l}\left[C_n \cos\frac{nc\pi t}{l} + D_n \sin\frac{nc\pi t}{l}\right]$ can be identified as the mode superposition method. | Remember | **CO 4** | CLO 17 | AAE015.17 |
| 14 | Torsional stiffness | Where G is the shear modulus and GJ(x) is the torsional stiffness. | Remember | **CO 4** | CLO 17 | AAE015.17 |
| UNIT - V | | | | | | |
| 1 | Aeroelasticity | The term used to denote the field of study concerned with the interaction between the deformation of an elastic structure in an airstream and the resulting aerodynamic force | Remember | **CO 5** | CLO 19 | AAE015.19 |
| 2 | Classical aerodynamic theory | The theory provide a prediction of the forces acting on a body of a given shape | Remember | **CO 5** | CLO 19 | AAE015.19 |
| 3 | Elasticity in Aeroelasticity | Provides a prediction of the shape of an elastic body under a given load. | Remember | **CO 5** | CLO 19 | AAE015.19 |

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| 4 | Dynamics in Aeroelasticity | Introduces the effects of inertial forces | Remember | **CO 5** | CLO 19 | AAE015.19 |
| 5 | Structural dynamics deals with | Between elasticity and dynamics | Remember | **CO 5** | CLO 19 | AAE015.19 |
| 6 | Static aeroelasticity deals with | Between aerodynamics and elasticity | Understand | **CO 5** | CLO 19 | AAE015.19 |
| 7 | Dynamic aeroelasticity deals with | Among elasticity, dynamics and aerodynamics | Remember | **CO 5** | CLO 19 | AAE015.19 |
| 8 | Torsional divergence phenomena | A major factor in the predominance of the biplane design until the early 1930s when “stressed skin” metallic structural configurations were introduced to provide adequate torsional stiffness for monoplanes | Remember | **CO 5** | CLO 19 | AAE015.19 |
| 9 | Structural dynamics | To describe the dynamic behavior of conventional aircraft. | Understand | **CO 5** | CLO 20 | AAE015.20 |
| 10 | Aeroelastic flutter | Which is associated with dynamic aeroelastic instabilities due to the mutual interaction of aerodynamic, elastic and inertial forces. | Remember | **CO 5** | CLO 20 | AAE015.20 |

**Signature of the Faculty** **Signature of HOD**