INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MECHANICAL ENGINEERING

DEFINITIONS AND TERMINOLOGY QUESTION BANK

Course Name	:	**MECHANICAL VIBRATIONS**
Course Code	:	AME524
Program	:	B.Tech
Semester	:	VI
Branch	:	Mechanical Engineering
Section	:	A&B
Academic Year	:	2019– 2020
Course Faculty	:	Mr. VVSH Prasad, Associate Professor.

COURSE OBJECTIVES:

I	Understand basic concepts of mechanical vibrations and phenomena of transmissibility.
II	Analyze mechanical systems with or without damping for single and multi degrees of freedom environment.
III	Application of vibration measuring instruments and machine monitoring systems.
IV	Develop competency in analytical methods in solving problems of vibrations along with mode shapes.

DEFINITIONS AND TERMINOLOGY WITH COs AND CLOs

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
		UNIT-I				
1	Amplitude	The maximum displacement of a vibrating body from its equilibrium position is called the amplitude of vibration.	Remember	CO1	CLO 1	AME524.01
2	Displacement	Amount of movement from one point to another. E.g. I just walked 100 meters.	Remember	CO1	CLO 1	AME524.01
3	Velocity	The rate of movement, E.g. I moved the 100 meters in 10 seconds	Remember	CO1	CLO 1	AME524.01
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	CO1	CLO 1	AME524.01
5	Frequency:	This denotes how frequently something occurs. For example, made to appear at regular intervals based on their relative motion.	Remember	CO1	CLO 2	AME524.02
6	Hertz	The Hz denotes Hertz, the unit for frequency	Remember	CO1	CLO 2	AME524.02
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	Remember	CO1	CLO2	AME524.02

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		jumps due to vibration				
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	CO1	CLO 2	AME524.02
9	Period of oscillation.	The time taken to complete one cycle of motion is known as the period of oscillation $\tau=2\pi/\omega$,Time period and is denoted by τ, Rotate through an angle of 2π, The circular frequency ω	Understand	CO1	CLO 3	AME524.03
10	Frequency of oscillation.	The number of cycles per unit time is called the frequency of oscillation	Understand	CO1	CLO 3	AME524.03
11	synchronous	Consider two vibratory motions denoted by $x1 = A1 \sin \omega t$ $x2 = A2 \sin(\omega t + \varphi)$, The two harmonic motions given by above Eqs. are called synchronous	Understand	CO1	CLO 3	AME524.03
12	Phase angle	Consider two vibratory motions denoted by $x1 = A1 \sin \omega t$ $x2 = A2 \sin(\omega t + \varphi)$, The two harmonic motions given by above Eqs. are called synchronous, Because they have the same frequency or angular velocity, Two synchronous oscillations neednot 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	CO1	CLO 4	AME524.04
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	CO1	CLO 4	AME524.04
14	Octave	When the maximum value of a range of frequency is twice its minimum value, it is known as an octave band.	Remember	CO1	CLO 4	AME524.04
15	Decibel	The various quantities encountered in the field of vibration and sound are often represented using the notation of decibel.	Remember	CO1	CLO 4	AME524.04
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	CO2	CLO 5	AME524.05

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2	vibration or oscillation	Any motion that repeats itself after an interval of time is called vibration or oscillation	Remember	CO2	CLO 5	AME524.05
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	CO2	CLO 5	AME524.05
4	discrete or lumped parameter systems	Systems with a finite number of degrees of freedom are called discrete or lumped parameter systems	Remember	CO2	CLO 5	AME524.05
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	CO2	CLO 6	AME524.06
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	CO2	CLO 6	AME524.06
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	CO2	CLO 6	AME524.06
8	When resonance will occur	If the frequency of the external force coincides with one of the natural frequencies ofthe system, a condition known as resonance occurs.	Remember	CO2	CLO 6	AME524.06
9	undamped vibration	If no energy is lost or dissipated in friction or other resistance during oscillation, the vibrationis known as undamped vibration.	Understand	CO2	CLO 6	AME524.06
10	Damped vibration.	If any energy is lost in this way, however, it is called damped vibration.	Remember	CO2	CLO 7	AME524.07
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	CO2	CLO 7	AME524.07
12	nonlinear vibration	If, however, any of the basic components behave nonlinearly, the vibration is called nonlinear vibration.	Understand	CO2	CLO 7	AME524.07
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	CO2	CLO 7	AME524.07

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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 vibrationis known as deterministic vibration.	Remember	CO2	CLO 8	AME524.08
15	random vibration	If the excitation is random, the resulting vibration is called random vibration	Understand	CO2	CLO 8	AME524.08
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	CO3	CLO 9	AME524.09
2	Damping	The mechanism by which the vibrational energy is gradually converted into heat or sound is known as damping.	Remember	CO3	CLO 9	AME524.09
3	Viscous damping	In viscous damping, the damping force is proportionalto the velocity of the vibrating body.	Remember	CO3	CLO 9	AME524.09
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	CO3	CLO 10	AME524.10
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	CO3	CLO 10	AME524.10
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	CO3	CLO 10	AME524.10
7	Harmonic motion	The simplest type of periodic motion is harmonic motion.	Remember	CO3	CLO 10	AME524.10
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 themean position, is known as simple harmonic motion.	Remember	CO3	CLO 10	AME524.10

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9	Torsional vibration	If a rigid body oscillates about a specific reference axis, the resulting motion is calledtorsional vibration.	Remember	CO3	CLO 11	AME524.11
10	Orthogonality	As the number of degrees of freedom increases, the solution of the characteristicequation becomes more complex. The mode shapes exhibit a property known asorthogonality.	Remember	CO3	CLO 11	AME524.11
11	Proportional damping.	The solution of forced-vibration problemsassociated with viscously damped systems can also be found conveniently by usinga conceptcalled proportional damping.	Remember	CO3	CLO 11	AME524.11
12	lumped-parameter or lumped-mass or discrete-mass systems	The lumped masses are assumedto be connected by massless elastic and damping members. Linear (or angular) coordinates are used to describe the motion of the lumped masses (or rigid bodies). Such models are called lumped-parameter or lumped-mass or discrete-mass systems	Remember	CO3	CLO 12	AME524.12
13	Finite element method	Method of approximating a continuous system as a multidegree-offreedomsystem 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	CO3	CLO 12	AME524.12
14	Influence coefficients	The equations of motion of a multidegree-of-freedom system can also be written in terms ofinfluence coefficients, which are extensively used in structural engineering. Basically, one setof influence coefficients can be associated with each of the matrices involved in the equations of motion.	Remember	CO3	CLO 12	AME524.12
15	Flexibility influence coefficients	The influence coefficients corresponding to the inverse stiffness matrix are called the flexibility influence coefficients.	Remember	CO3	CLO 12	AME524.12
UNIT - IV						
1	Condition monitoring	Condition monitoring (or, colloquially, CM) is the process of monitoring a parameter of condition in machinery (vibration, temperature etc.), in order to identify a significant change	Remember	CO4	CLO 13	AME524.13

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		which is indicative of a developing fault				
2	Rotating equipment	Rotating equipment is an industry umbrella term that includes gearboxes, reciprocating and centrifugal machinery.	Remember	CO4	CLO 13	AME524.13
3	Criticality Index	The Criticality Index is often used to determine the degree on condition monitoring on a given machine taking into account the machines purpose.	Remember	CO4	CLO 13	AME524.13
4	What technique will be used by most vibration analysis instruments?	Fast Fourier Transform	Remember	CO4	CLO 13	AME524.13
5	Chip Detectors	Filters and magnetic plugs are designed to retain chips and other debris in circulating lubricant systems and these are analysed for quantity, type, shape, size, and so on. Alternatively, suspended particles can be detected in flow past a window.	Remember	CO4	CLO 13	AME524.13
6	Ferrography.	This represents the microscopic investigation and analysis of debris retained magnetically (hence the name) but which can contain non-magnetic particles caught up with the magnetic ones.	Remember	CO4	CLO 13	AME524.13
7	Root cause analysis(RCA)	root cause analysis (RCA) is a method of problem solving used for identifying the root causes of faults or problems.	Remember	CO4	CLO 13	AME524.13
8	Applications of RCA	Manufacturing and industrial process control, IT and Telecommunications, Health and Safety.	Remember	CO4	CLO 13	AME524.13
9	How do you analyze a trend analysis?	Trend analysis is the process of comparing business data over time to identify any consistent results or trends. You can then develop a strategy to respond to thesetrends in line with your business goals	Remember	CO4	CLO 13	AME524.13
10	What is frequency domain analysis?	In electronics, control systems engineering, and statistics, the frequency domainrefers to the analysis of mathematical functions or signals with respect to frequency, rather than time. The inverse Fourier transform converts the frequency-do main function back to the time function.	Remember	CO4	CLO 13	AME524.13
11	What is vibration analysis?	Vibration Analysis refers to the process of measuring the vibration levels and frequencies of industrial machinery,	Remember	CO4	CLO 13	AME524.13

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		and using that information to determine the "health" of the machine, and its components. ... This vibration can be measured, using a device called an accelerometer.				
12	Why frequency domain analysis is important?	Frequency domain analysis is mostly used to signals or functions that are periodic over time. This does not mean that frequency domain analysis cannot be used in signals that are not periodic. The most important concept in the frequency domain analysis is the transformation.	Remember	CO4	CLO 13	AME524.13
13	What are frequency components?	A given function or signal can be converted between the time and frequencydomains with a pair of mathematical operators called a transform. An example is the Fourier transform, which converts the time function into a sum of sine waves of different frequencies, each of which represents a frequency component.	Remember	CO4	CLO 13	AME524.13
14	Why do we use Fourier transform? What is it used for?	Almost every imaginable signal can be broken down into a combination of simple waves This break down, and how much of each wave is needed, is the Fourier Transform. Fourier transforms (FT) take a signal and express it in terms of the frequencies of the waves that make up that signal.	Remember	CO4	CLO 13	AME524.13
15	What is time domain analysis?	Time domain is the analysis of mathematical functions, physical signals or timeseries of economic or environmental data, with respect to time. In the time domain, the signal or function's value is known for all real numbers, for the case of continuous time, or at various separate instants in the case of discrete time.	Remember	CO4	CLO 13	AME524.13
UNIT - V						
1	Nodes	The points at which w_n=0for all times are called nodes.	Remember	CO5	CLO 13	AME524.13
2	Euler-Bernoulli or thin beam theory	From the elementary theory of bending of beams.	Remember	CO5	CLO 13	AME524.13
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	Remember	CO5	CLO 13	AME524.13

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		Timoshenko beam theory.				
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	CO5	CLO 13	AME524.13
5	Rayleigh-Ritz method	Based on Rayleigh s quotient, for finding the approximate fundamental frequencies of continuous systems is outlined. The extension of the method, known as the Rayleigh-Ritz method.	Remember	CO5	CLO 13	AME524.13
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.	Understand	CO5	CLO 19	AME524.19
7	System of infinite degrees of freedom	A continuous system is also called a system of infinite degrees of freedom.	Remember	CO5	CLO 14	AME524.14
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	CO5	CLO 14	AME524.14
9	Frequency or characteristic equation	Equation $\sin\frac{\omega l}{c} = 0$ is called the frequency or characteristic equation.	Remember	CO5	CLO 14	AME524.14
10	Eigen values	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 eigen values (or natural frequencies or characteristic values) of the problem.	Remember	CO5	CLO 15	AME524.15
11	Fundamental mode	The mode corresponding to n = 1 is called the fundamental mode.	Remember	CO5	CLO 15	AME524.15
12	Fundamental frequency.	The mode corresponding to n = 1 is called the fundamental mode, and ω_1 is called the fundamental frequency.	Remember	CO5	CLO 16	AME524.16
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	CO5	CLO 17	AME524.17
14	Torsional stiffness	Where G is the shear modulus and GJ(x) is the torsional stiffness.	Remember	CO5	CLO 17	AME524.17
15	Dunkerley's method.	Dunkerley's method is used in mechanical engineering to determine the critical speed of a shaft-rotor system.	Remember	CO5	CLO 17	AME524.17

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