6 mark.

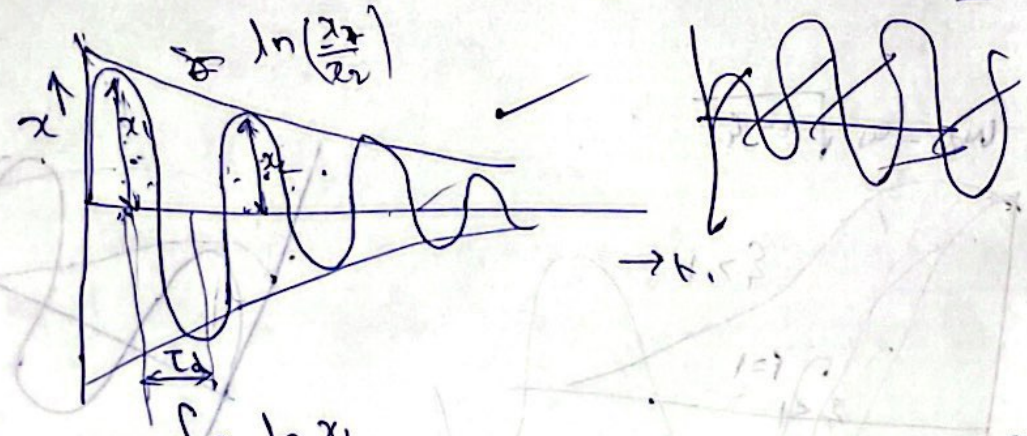
LOGARITHMIC DECREMENT:-

The amount of damping present in a system can be measured by the rate of decay of oscillation. The larger the damping, the greater will be the rate of decay.

The ratio of two successive oscillations is constant in an underdamped system. Natural logarithm of this ratio is called logarithmic decrement.

The general equation for a damped vibration.

$$x = A e^{-\xi \omega_n t} \sin\left[\left(\sqrt{1-\xi^2}\right)\omega_n t_1 + \phi\right]$$



$$\delta = \ln \frac{x_1}{x_2}$$

$$= \ln \frac{e^{-\xi\omega_n t}\left[\sin\left(\left(\sqrt{1-\xi^2}\right)\omega_n t_1 + \phi\right)\right]}{e^{-\xi\omega_n(t_1+\tau_d)}\left[\sin\left(\sqrt{1-\xi^2}\right)\omega_n(t+\tau_d)+\phi\right]}$$

$$\sin\left(\left(\sqrt{1-\xi^2}\right)\omega_n t_1 + \phi\right) = \sin\left[\sqrt{1-\xi^2}\,\omega_n(t_1+\tau_d)+\phi\right]$$

$$\delta = \ln \frac{e^{-\xi\omega_n t_1}}{e^{-\xi\omega_n(t_1+\tau_d)}}$$

$$= \ln e^{\xi\omega_n\tau_d}$$

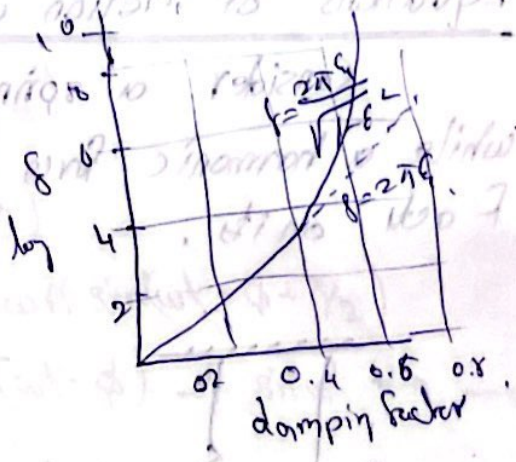
$$\delta = \xi\omega_n\tau_d$$

$$\tau_d = \frac{2\pi}{\omega_n \sqrt{1-\xi^2}}$$

$$\delta = \frac{2\pi\xi}{\sqrt{1-\xi^2}}$$

$$\sqrt{1-\xi^2} \simeq 1$$

$$\boxed{\delta = 2\pi\xi}$$



Forced Vibration :- (2 marks)

Vibration which occurs under the influence of external force, is called forced vibration. The external force keeps the system vibrating. This force is called external excitation. The excitation may be periodic, impulsive or random in nature.

- periodic force may be harmonic and non-harmonic
- Vibrations because of impulsive forces are called transient.
- Earthquake is because of random forces.

Sources of Excitation:

The external excitation to a system can be easily detected. This excitation is in the form of motion and is produced by one dynamic system to another. Both such systems are connected together rigidly and form one dynamic system having several degrees of freedom.

Another excitation is internal and occurs due to unbalance in the system.

a) Thermal effects
b) Resonance
c) Bent shaft
d) Bearing defects.
e) magnetic effects
f) mass of rotating parts not distributed uniformly.