Define the following terms:

1. Frequency ratio
2. Resonant frequency
3. Damping effect

1. Frequency ratio: The frequency ratio is an important concept in the analysis of dynamic systems, such as vibrating structures or mechanical systems. When an external force or input is applied to a vibrating system, the frequency ratio determines how the system responds to that input. If the frequency of the input matches the natural frequency of the system, the amplitude of the vibrations will be amplified, a phenomenon known as resonance.

2. Resonant frequency: The resonant frequency is the natural frequency at which a vibrating system vibrates most strongly or with the greatest amplitude. It is determined by the physical characteristics of the system, such as its mass, stiffness, and damping. Resonance can be beneficial or detrimental, depending on the application. For example, musical instruments rely on resonance

to produce sound, while resonance in a building or bridge can lead to structural failure.

3. Damping effect: Damping is the dissipation of energy in a vibrating system, resulting in a decrease in the amplitude of the vibrations over time. This effect is usually caused by internal friction or external forces such as air resistance or friction between the system and its surroundings. Damping can be beneficial in some cases, such as shock absorbers in cars or buildings designed to resist earthquakes. However, excessive damping can reduce the performance of a system or cause it to become unstable. The amount of damping present in a system is often expressed as a damping ratio, which is the ratio of the actual damping to the critical damping.