Duration: 3 Hours Marks: 80

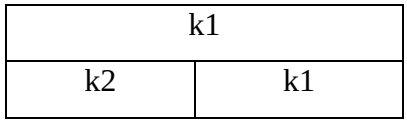
N.B: i. Question No. 1 is compulsory. Attempt any 3 from remaining questions.
ii. Assume suitable data if necessary.
iii. Figures to the right indicates marks.

1. a) Derive equation of motion for non-damped forced vibrations. **5**
   b) Derive expression of natural frequency for a spring mass system. **5**
   c) Explain four situations under which package, gets damaged during distribution. **5**
   d)) For a package of mass 'm' dropped from height 'h' evaluate its impact velocity and time for impact. **5**

2. a) Derive equation of magnification factor in terms of forced and natural frequency. **10**
   b) Derive solution $x=A\sin[\omega t]$ from equation of motion for free vibrations. **10**

3. a) Write a note on PSD profile. **10**
   b) Explain in brief the Mechanical Shock Theory. **10**

4. a) Write a note on overdamped, underdamped and undamped vibrations. **5**
   b) Derive equivalent spring constant for following cushion arrangement. **5**

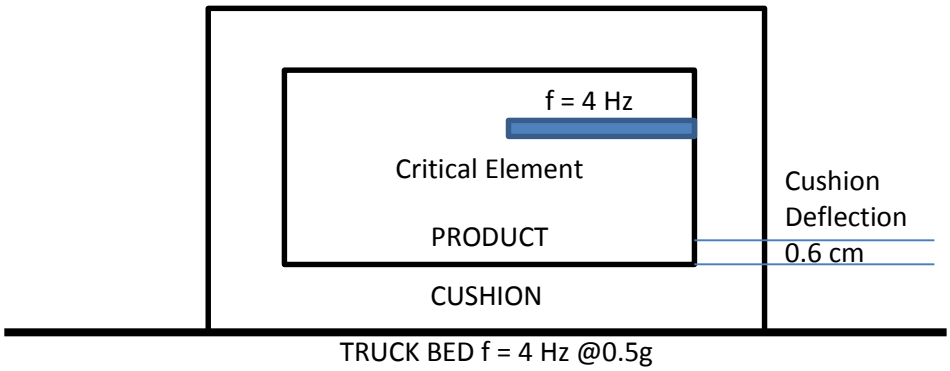


   c) Explain in brief about Damage Boundary Curve. **10**

5. a) Write a brief note on transmissibility curves. **10**
   b) Evaluate maximum displacement, velocity and acceleration for a product cushion system represented by $x = 5\sin(2t)$. **5**
   c) Write a brief note on acceleration due to gravity, g value and its effect on packages. **5**

6. a) A 100 lb. product measures 8in. x 8in. x 8in. and can sustain a shock upto 50g without damage. It is equally sensitivity to shock on all six faces. If a maximum drop height of 6ft. is expected in distribution, evaluate modulus of elasticity of the cushion material assuming working length of 50% of total cushion thickness. Also evaluate the inner container dimension, Gm, τ and δst. **10**

b) An electronic product is packaged as shown. It has critical component which can get damaged due to truck vibrations. Analyze the effect of truck vibrations on product and the critical element. Comment whether the critical element will get damaged. **10**



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