

Duration: 03 Hours

Marks: 80

- NB:** 1. Question No. 1 is compulsory.
 2. Attempt **any three** questions from remaining **five** questions.
 3. Indicate **question no.** properly.

- Q.1 a) State and explain various dynamic forces encountered by package during distribution **5**
 b) An object is dropped in the vicinity of the earth's surface. Find its position relative to the release point and its velocity after 1 second & 5 seconds. **5**
 c) Explain in brief vibration sensitivity in random vibrations **5**
 d) Prove $\delta t = \frac{dm}{Gm}$ **5**
- Q.2 a) 100 pound product measures 10 in X 10 in X 10 in. and can sustain up to 50 g shock without damage. It is equally sensitive to shock on all six faces. If a maximum drop height of 5 ft is expected in distribution, what is the modulus of elasticity of the required cushion material? Assume that the working length of the cushion material is fifty percent of the cushions total thickness. **10**
 b) A product has a small electrical component which is known to have a natural frequency of 5Hz, when a product is placed in the package a cushion deflects 0.2 inches. The product package system is transported in a truck with 6 Hz vibration frequency and associated max. acceleration of 0.5 g. What will happen to this product in transport **10**
- Q.3 a) A Product – Package system has a small internal component which is known to have a natural frequency of 3 Hz (this may be small circuit board, transistor or similar mechanical/electrical part). When the product is placed in the package a cushion deflects 0.27 inches. This product package system is to be transported in a truck with a 4 Hz vibration frequency and associated maximum acceleration of 0.5 g. What will happen to this product in transport? **10**
 b) Derive the equation for two springs or cushions - i) Acting in Parallel and **10**
 ii) acting in Series
- Q.4 a) A cushion measuring 10 in × 12 in × 3 in has a spring constant of 400 lb/in, if it's top 1 in of the cushion is shaved off. What is the new spring constant? **10**
 b) i) Derive the equation for Impact Velocity (consider initial velocity as zero) **10**
 ii) Derive the equation for natural frequency
- Q.5 a) If a product in a package deflects its cushion a distance of 0.5 inches, what happens if the package-product is transported on a vehicle which has a forcing vibration input of 0.1 g at 4.5 Hz. Find the magnitude of vibration of the item on the spring. Calculate the amplitude of the displacement of the package on its cushion. **10**
 b) If a product deflects its cushion 0.76 in, what is the natural frequency of the product – package system? What is the maximum amplitude and acceleration of the product if the product –package is transported in a vehicle with a forcing vibration of 0.3 g at 4.1 Hz? Is the forced vibration of the product in phase or out of phase with 4.1 Hz forcing vibration? **10**

- Q.6 a) A product weighing 500 Pounds can sustain maximum shock of 5 g's. Assuming the drop height of 24 inches, compute K2 for a linear cushion. Find the Maximum deflection of the spring and compute the duration of the shock pulse(τ) **10**
- b) A product which is damaged at Gm over 40 is cushioned with linear spring which has a working length of 5/8 of total length. Find the dimensions of the box needed to hold the product and the required cushioning if it is equally sensitive to shock in all directions and if the product has dimensions of 11 in X 14 in X 17 in. The maximum drop height expected in distribution is 42 inches. **10**
