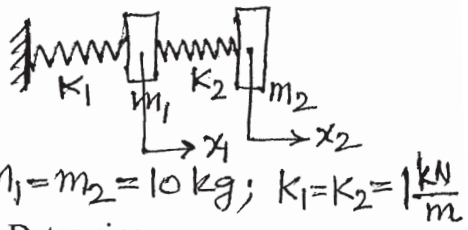
MAJOR TEST 2nd SEM.06-07: MEL 746 DESIGN FOR NOISE, VIB. & HARSHNESS

Attempt all questions MM: 100

Time: 2 Hrs.

Q1. Consider the system in Figure.



$m_1 = m_2 = 10\ kg$; $K_1 = K_2 = 1 \frac{kN}{m}$

(a). Set up the equation for free vibration of the system.

(b). Solve the system equations for natural frequencies and mode shapes.

©. Show that mode shapes are (i) mass- matrix (ii) stiffness matrix, orthogonal.

(d). At t=0, mass 2 is given an initial deflection of 1 cm. Determine the system response as a function of time, using the method of modal analysis.

(5+5+5+10)

Q2. (a) A redesign produces small changes ΔM and ΔK in mass [M] and stiffness [K] matrices of a system respectively, resulting in a slight change $\Delta\lambda_i$ (where $\lambda_i = \omega_i^2$; ω_i being the i^{th} mode natural frequency) in eigenvalue. Using Rayleigh quotient and neglecting terms of higher order, set up an expression for $\Delta\lambda_i$ in terms of λ_i, ΔM, ΔK, [M] and $\{\varphi_i\}$(eigenvector in i^{th} mode).

(b) Consider the system of Fig. 1. Using the expression derived in part (a) above, determine change in both eigenvalues of the system, if both the masses are increased by 10% and both the stiffnesses are reduced by 5%. (10+10)

Q3. A Helmholtz resonator in the form of a sphere has a radius of 0.1 m.

(a) What diameter hole should be drilled in the sphere if it has to resonate in air at a frequency of 300 Hz?

(b) If the pressure amplitude of the incident acoustic wave is 50 μbar at 300 Hz, what will be the amplitude of internal pressure in resonator? (5+5)

Q4. Consider a reverberation chamber of size 3 m * 3m * 3m, made of concrete walls with an absorptivity of 0.025. Determine,

(a) the reverberation time of the chamber.

(b) The steady state sound pressure level produced inside the room due to a sound source of 10 μwatt output at a frequency of 1 kHz.

(c) absorption coefficient of an acoustic panel of size 1m*1m, if its introduction in the chamber decreases the reverberation time by 15 %.

(d) drop in the value of steady state sound pressure level, in part ©.

(e) energy density in part (b) (i) inside the room (ii) close to the walls.

(f) In part (b), time taken to attain 90% of the steady state pressure level (in dB).

(5*6=30)

Q5. Write short notes on

(a) Interior noise control in automotive systems.

(b) Sources of noise in railway systems.

(c) Issues in aircraft noise control (7+7+6)

Q6. (a) Explain the underlying principle of measurement of sound intensity.

(b) Explain the construction of a typical sound intensity probe.

© Explain with at least one example when you would prefer sound intensity measurement over a sound pressure level measurement

(5+5+5)