All Assignments

Use MATLAB wherever possible to work the problem or check your work on a problem. ***Whenever a requested problem asks you to plot or sketch the answer, you must use MATLAB to do your work***.

Treat the homework like a quiz! In other words, don't do the homework with the notes open. Instead, study and learn the material as well as you can, and then try to work the homework problems. If you get stuck, cover up the homework, re-read the notes, and try again.

If you work homework as a group, you **must** identify the group[*].

Assignment-7

- Reading - Lecture Notes
  - Sections #8 & #9
- Homework
  - **7-A)** A refrigeration unit of 50 kg mass operates at 900 rpm. The unit is supported by five equal springs. Specify the values of the springs if 15 percent or less of the unbalance is transmitted to the foundation.

  - **7-B)** An instrument in an aircraft is to be isolated from the engine vibrations ranging from 530 to 1,860 cycles per minute. If the damping is negligible and the instrument is of 3.5 kg mass, specify the springs for the mounting for 90 percent isolation.

  - **7-C)** A 75 kg table for repairing instruments is isolated from the floor by springs with k = 25 kN/m and dampers with c = 0.95 kN-s/m. If the floor vibrates vertically ±3.5 mm at a frequency of 15 Hz, (a) find the amplitude and phase of the motion of the table (relative to the floor motion), and (b) are the dampers advantageous in this application? Support your conclusion with analysis.

  - **7-D)** An electric motor of mass 60 kg is mounted on an isolator block of mass 2050 kg and the resonant frequency of the total assembly is 100 cpm with a damping factor of $\zeta = 0.15$. If there is an unbalance in the motor that results in a harmonic force of $F = 137 \sin 35t$ N, determine the amplitude of vibration of the block and the force transmitted to the floor.

  - **7-E)** A table for sorting seeds requires a reciprocating motion with a stroke of 3.1 mm and a frequency from 12 to 120 Hz. The excitation is provided by an eccentric weight shaker. The total mass of the table and shaker is 65 kg. (a) Propose a scheme for mounting the table. (b) Specify the spring constant and the unbalance of the exciter; such that the resultant stroke is within 1.5% of desired across the frequency range; and no more than 6.0 cm of static spring deflection.

  - **7-F)** A variable-speed counter-rotating eccentric-weight exciter is attached to a machine to determine its natural frequency. With the exciter at 800 rpm, a stroboscope shows that the

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[*] *Remember that failure to provide proper reference/citation is called **plagiarism**.*

eccentric weights of the exciter are at the top the instant the machine is moving upward through its static equilibrium position. The amplitude of the displacement is 14 mm. The mass of the machine is 350 kg and that of the exciter is 9 kg with an unbalance of 0.15 kg-m. Find (a) the natural frequency and the damping factor of the machine and its mounting (without exciter), (b) the amplitude of motion of machine (with exciter) at 1100 rpm, and the angular position of the eccentrics at the instant the structure is moving upward through its equilibrium position.

Solve following problem by both Newton's Method and Lagrange's Method. [Be careful about the kinematics.]

- o **7-G)** Using Newton's Method, and the given set of coordinates, draw the complete two-sided free body diagram, identify any constraint equations, and determine the equations of motion for the adjacent figure in terms of the given coordinate x_2.

- o **7-H)** Using Lagrange's Method, and the given set of coordinates, identify any constraint equations, and determine the equations of motion for the adjacent figure in terms of the given coordinate x_2.