GROUP ASSIGNMENTS (CHAPTER 2)

Group (1)

A 10 - pound weight attached to a spring stretches it 2 feet. The weight is attached to a dashpot damping device that offers a resistance numerically equal to $\beta(\beta > 0)$ times the instantaneous velocity. Determine the values of the damping constant β so that the subsequent motion is a) overdamped; b)critically damped; c) underdamped.

Group (2)

A 16 - pound weight stretches a spring 8/3 feet. Initially the weight starts from rest 2 feet below the equilibrium position and the subsequent motion takes place in a medium that offers a damping force numerically equal to ½ the instantaneous velocity. Find the equation of motion if the weight is driven by an external force equal to $f(t) = 10\cos 3t$.

Group (3)

The motion of a mass-spring system with damping governed by:

$$\frac{d^2y}{dt^2} + by' + 16y = 0; \quad y(0) = 1, \quad y'(0) = 0.$$

Find the equation of motion and sketch its graph for *b* = 0, 6, 8 and 10.

Group (4)

Determine the equation of motion for an undamped system at resonance governed by:

$$\frac{d^2y}{dt^2} + y = 5\cos t; \qquad y(0) = 1, \quad y'(0) = 0.$$

Sketch the solution.

Group (5)

The response of an overdamped system to constant force is governed by:

$$\frac{d^2y}{dt^2} + 8\frac{dy}{dt} + 6y = 18; \qquad y(0) = 0, \quad y'(0) = 0.$$

Compute and sketch the displacement *y*(*t*). What is the limiting value of *y*(*t*) at $t \to +\infty$?

Group (6)

An RLC series circuit has a voltage source given by $E(t)$=20 V , a resistor of 100 Ω, an inductor of 4 H and a capacitor of 0.01 F. If the initial current is zero and the initial charge on the capacitor is 4 C, determine the current in the circuit for t>0.

Group (7)

An RLC series circuit has a voltage source given by of $E(t)$=10cos 20t V , a resistor of 120 Ω, an inductor of 4 H and a capacitor of $(2200)^{-1}$ F. Find the steady state current (solution) for this circuit.

Group (8)

An RLC series circuit has a voltage source given by of $E(t)$=30sin 50t V , no resistor, an inductor of 2 H and a capacitor of 0.02 F. What is the current in this circuit for t>0 if at t =0, $I(0)=q(0)=0$?

Group (9)

The equation of motion is given by

$$x'' + \frac{a}{m}x' + \frac{k}{m}x = \frac{F(t)}{m}.$$

A 10 kg mass m is attached to a spring having a spring constant k of 140 Nm^{-1} and with applied external force $F(t) = 5\sin t$. Use the method of undetermined coefficients to find the subsequent motion of the mass $x(t)$, if the force due to resistance a is 90 N.