

## Problem 24

A spring-mass system with a hardening spring (Problem 32 of Section 3.7) is acted on by a periodic external force. In the absence of damping, suppose that the displacement of the mass satisfies the initial value problem

$$u'' + u + \frac{1}{5}u^3 = \cos \omega t, \quad u(0) = 0, \quad u'(0) = 0.$$

- (a) Let  $\omega = 1$  and plot a computer-generated solution of the given problem. Does the system exhibit a beat?
- (b) Plot the solution for several values of  $\omega$  between  $1/2$  and  $2$ . Describe how the solution changes as  $\omega$  increases.