In Problems 1-2, find the general solution of the equation.

**Problem 1.** \( y'' + 4y = 3\cos(2t) \).

**Problem 2.** \( y'' + 2y' - 8y = t - \cos t + e^{2t} \).

In Problems 3-8, write the general solution of the equation with undetermined coefficients (but do not find the coefficients). Indicate which coefficients are undetermined but fixed (such as \( A, B \)), and which are general constants which are to be determined for the initial value problem \( (C_1, C_2) \). Example:

\[
y'' - y = 2te^t \Rightarrow y = C_1 e^t + C_2 e^{-t} + (At^2 + Bt)e^t.
\]

**Problem 3.** \( y'' - y' - 6y = \cos t + t + e^t \).

**Problem 4.** \( y'' + 4y' + 13y = (t^2 + 2t)e^{-2t} \sin(3t) + (t + 3)e^t \cos(4t) + te^t - t^2 + 3 \).

**Problem 5.** \( y'' - 4y' + 4y = 4(t^2 - 1)e^{2t} + t^3 - 2t + \cos t \).

**Problem 6.** \( y'' - 2y' = t^2 - 4t - (2t^2 - 4t) \sin t \).

**Problem 7.** \( y'' + y = -2t^2 \sin t + (5t^5 - 2t^2) \cos(2t) \).

**Problem 8.** \( y'' + 4y' + 8y = 3e^{-2t} \cos(2t) - (t^3 + 1)e^{-2t} \sin(2t) + t^4 \).

**Problem 9.** For a mechanical system with \( m = 3, \ k = 12 \) and no damping, find \( u(t) \), the phase, the initial phase and the amplitude, for the following initial conditions:

(i) initial position \( u(0) = 1 \) and zero initial speed;
(ii) initial position at the equilibrium and \( u'(0) = 2 \);
(iii) initial position at the equilibrium and zero initial speed;
(iv) \( u(0) = 2 \) and \( u'(0) = -1 \);
(v) \( u(0) = -\sqrt{3} \) and \( u'(0) = 1 \).