

## MATH 2132 Problem Workshop 7

1. Solve the following differential equations/initial value problems/boundary value problems, using Laplace Transforms.

(a)  $y'' + 3y' + 7y = 3 \sin 2t$ ,  $y(0) = 1$ ,  $y'(0) = 2$ .

(b)  $y'' + 4y' + 4y = te^{-2t}$ ,  $y(0) = -1$ ,  $y'(0) = 0$ .

(c)  $y'' + 20y = t^2 - e^{-t}$ ,  $y(0) = 0$ ,  $y'(0) = 2$ .

(d)  $y'' - 2y' + y = \cos 2t$ ,  $y(0) = 1$ ,  $y(\pi) = 1$ .

(e)  $y'' + 2y' + 7y = e^t \sin t$ .

2. A 200 gram mass is at rest on the end of a spring with constant 10 Newtons per metre. At  $t = 0$ , a force  $f(t) = 4 \sin 10t$  begins to act on the mass. Find the displacement of the mass as a function of time.
3. A 100 gram mass is suspended from a spring with constant 25 Newtons per metre. At  $t = 0$ , the mass is lifted 10 centimetres above its rest position and given velocity 2 metres per second downward. During its subsequent motion, damping equal to the velocity also acts on the mass. In addition after 4 seconds, a constant force of 50 Newtons acts vertically upwards on the mass. Find the displacement of the mass as a function of time.
4. Do the previous example except change the force to an instantaneous impulse force.