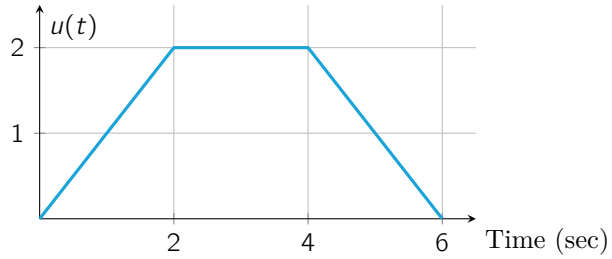
Control Systems : Set 1 : Transfer functions

Prob 1 | Consider a system with transfer function given by

$$G(s) = \frac{\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2}$$

and the signal $u(t)$ shown in the figure below.



a) Write the Laplace transform of the signal $u(t)$.

b) What is the Laplace transform of the output if the signal $u(t)$ is applied to the system $G(s)$?

Prob 2 | Find the Laplace transforms of the following functions

Note that you can use Matlab to compute Laplace transforms and check your work, for example:

```
>> syms t
>> laplace(4*sin(6*t) + cos(2*t+3))

ans =

24/(s^2 + 36) - (2*sin(3) - s*cos(3))/(s^2 + 4)
```

a) $f(t) = 1 + 5t$

b) $f(t) = (t+1)^2$

c) $f(t) = 4\cos 6t$

d) $f(t) = t^2 + e^{-2t}\sin 3t$

Prob 3 | Find the inverse Laplace transforms of the following functions

Note that you can use Matlab to compute inverse Laplace transforms and check your work, for example:

```
>> syms s
>> ilaplace(s/(s^2+3) + 1/s^4)
```

ans =

cos(3^(1/2)*t) + t^3/6

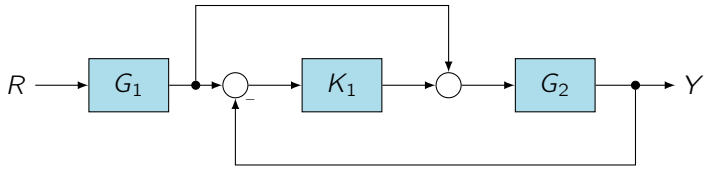
a) $F(s) = \dfrac{1}{s(s+1)}$

b) $F(s) = \dfrac{5}{s(s+1)(s+5)}$

c) $F(s) = \dfrac{3}{s^2+4s+13}$

d) $F(s) = \dfrac{5}{s(s+1)(s+5)(s^2+2s+3)}$

Prob 4 | Compute the transfer function from R to Y for the feedforward block diagram shown below.



Prob 5 | Compute the transfer function from R to Y for the block diagram shown below.