

**AUSTRALIAN NATIONAL UNIVERSITY**  
**Department of Engineering**

ENGN6612/4612 Digital Signal Processing and Control  
Problem Set #2  $z$ -Transform

**Q1**

Using the definition of the  $z$ -transform, find the  $z$ -transform of the following discrete-time functions:

- (a)  $\delta[n]$
- (b)  $\delta[n - k]$
- (c)  $u[n]$
- (d)  $c^n u[n]$  where  $c$  is a complex constant
- (e)  $\sin[\omega n]u[n]$
- (f)  $\cos[\omega n]u[n]$
- (g)  $r^n \sin[\omega n]u[n]$
- (h)  $r^n \cos[\omega n]u[n]$  (challenge problem)

**Q2**

Find the  $z$ -transform of the following discrete-time functions:

- (a)  $x[n] = 7 \left(\frac{1}{3}\right)^n u[n] - 6 \left(\frac{1}{2}\right)^n u[n]$
- (b)  $x[n] = \left(\frac{1}{4}\right)^n u[n] + 2 \left(\frac{1}{3}\right)^n u[n]$
- (c)  $x[n] = \left\{ \frac{5}{12} + \frac{1}{3}(-2)^n - \frac{3}{4}(-3)^n \right\} u[n]$  (challenge problem)