

AUSTRALIAN NATIONAL UNIVERSITY
Department of Engineering

ENGN6612/4612 Digital Signal Processing and Control
Problem Set #5 Discrete Time Fourier Transform (DTFT)

Q1

Find $X(e^{j\omega})$ and sketch $|X(e^{j\omega})|$ and $\angle X(e^{j\omega})$ when $x[n]$ is given by the following:

- (a) $a^n u[n]$, $a = -0.6$
- (b) $\delta[n-3]$ (challenge problem)

Q2

Consider a discrete time filter described by the following difference equations:

- (a) $y[n] = \frac{1}{2}(x[n] + x[n-1])$ (This is called a two-point moving-average filter)
- (b) $y[n] = x[n] + 0.6y[n-1]$
- (c) $y[n] = \frac{1}{3}(x[n+1] + x[n] + x[n-1])$ (challenge problem).

For each filter:-

- Find the transfer function $H(z)$.
- Find whether the filter is FIR or IIR.
- Determine the frequency response $H(e^{j\omega})$.
- Determine and roughly sketch magnitude of the frequency response of the filter for $-\pi \leq \omega \leq \pi$.