M. Tech. in Intelligent Automation and Robotics,

First Year, Second Semester, 2018

ADVANCED DIGITAL SIGNAL PROCESSING

Time: 3 Hours Full Marks: 100

Answer any FIVE questions.

1) a) Derive the Fast Fourier Algorithm using DFT.
   b) Determine the Fourier Transform for the given discrete-time signal:
   i) $x(n) = a^{-n}\, u(-n)$, $|a|>1$
   ii) $x(n) = a^{|n|}$, $|a|<1$
   iii) $x(n) = y(n) - y(n-1)$
   iv) $x(n) = \delta(n-n_0)$ [20]

2) Characterize the following systems as being either linear or nonlinear, either time invariant or time varying, and causal or non-causal:
   (a) $y(n) = (n + b)x(n - 4)$
   (b) $y(n) = x^2(n + 1)$. [20]

3) a)Derive Inverse Fourier Transform using Exponential Fourier Series.
   b) Determine the Inverse DTFT of:
   i) $X(\omega) = 2\cos(2\omega)$, $\omega \in (-\Pi, \Pi)$
   ii) $X(\omega) = 1$, $|\omega| \leq \omega_1$
   $= 0$, $\omega_1 < |\omega| < \Pi$ [20]

4) a) Determine the 8-point DFT of the given data sequence by decimation-in-time FFT:
   $x(n)=\{4,2,6,2,1,2,4,8\}$

b) Determine the Z-Transform and Region of Convergence of the following signals:

i) $x(n) = -a^n\, u(-n-1) - b^n\, u(-n-1)$, b>a

ii) $x(n) = \sin(\omega n)\, u(n)$ [20]

5) a) Derive Inverse Z-Transform.

b) Find the Inverse Z-Transform of

$$X(Z) = \frac{Z}{(Z-2)(Z-4)(Z-6)}$$ [20]

6) a) Derive Discrete Fourier Transform and Inverse Discrete Fourier Transform.

b) Determine the 4-point DFT and IDFT of

$x(n) = 1,\ n \in [0,3]$

$= 0$, otherwise [20]