

Cankaya University , Electronic and Communication Engineering Department

ECE 310 Digital Signal Processing, Completion Exam Questions

- 1)  $\frac{d^2y(t)}{dt^2} + 2\frac{dy(t)}{dt} - 3y(t) = \frac{d^2x(t)}{dt^2} + 2x(t)$  **(20pts)**
- For the above differential equation, find the transfer function  $H(s)$ , and determine whether the system is stable or not.
  - Transfer the above equation to its digital equivalent form, i.e., transfer to a difference equation, and find the transfer function  $H(z)$  of the difference equation. Use forward difference method, and take sampling period  $T_s = 1$ .
- 2)  $x[n] = [1 \ -1 \ -2 \ -1]$   $y[n] = [1 \ -1 \ 1]$  Find 5-point circular convolution of  $x[n]$  and  $y[n]$ . (15pts)
- 3) A low-pass analog filter specifications are given as **(30pts)**
- $$w_p = 1000\text{rad/sec} \quad w_s = 8000\text{rad/sec} \quad R_p = 10\text{dB} \quad R_s = 40\text{dB}$$
- Design the above filter using Butterworth low-pass filter transfer function.
  - Construct the circuit diagram of your designed filter using its transfer function.
- 4) A low-pass digital filter specifications are given as **(35pts)**
- $$w_p = 0.1\pi \text{ rad/sec} \quad w_s = 0.7\pi \text{ rad/sec} \quad R_p = 10\text{dB} \quad R_s = 40\text{dB}$$
- Find the transfer function  $H(z)$  of the digital filter with the above given specifications. Take sampling period  $T_s = 1$ .
  - Using  $H(z)$  write a difference equation involving filter input and output.
  - Using the difference equation you found write a matlab pseudo code that takes input signal  $x[n]$  and outputs the filtered signal  $y[n]$ .