Analog and Digital Signal Processing
Course Code: CSE363
Mid-Term Exam.

BME Program
Level 300
Exam Date: 24-11- 2018
Allowed Time: 1 Hour

Open-Sheet Exam

Answer <u>eight</u> questions only of the following. Full mark is 40.

Part I

Q.1) Find the inverse Laplace transform of X(s) given by

$$X(s) = \frac{2 + 2se^{-2s} + 4e^{-4s}}{s^2 + 4s + 3} \qquad \mathrm{Re}(s) > -1$$ **[5 Marks]**

Q.2) Consider an LTI system described by the differential equation

$$y''(t) + 5y'(t) + 6y(t) = x(t), \quad y(0) = 2, \quad y'(0) = 1 \quad , \quad x(t) = e^{-t}u(t)$$

i. Find the system function.
ii. Find the output of the system, y(t). **[5 Marks]**

Q.3) Find the inverse Z-transform the following function using power series expansion.

$$X(z) = \frac{z}{2z^2 - 3z + 1} \qquad |z| < 1/2$$ **[5 Marks]**

Q.4) Consider a system described by

$$y(n) - 0.5y(n-1) = x(n), \quad y(-1) = 1, \quad , \quad x(n) = (1/3)^n u(n)$$

i. Determine the output of the system.
ii. Express the output *y(n)* as a sum of two components; the zero-state response and the zero-input response. **[5 Marks]**

Q.5) Design a maximally flat analog low-pass filter with the following specifications:
i. A pass-band of (0≤Ω≤20 rad/sec) with no more than 2 dB attenuation.
ii. A stop-band attenuation of greater than 10 dB for Ω≥30 rad/sec. **[5 Marks]**

Part II

Q.6) Determine whether or not each of the following signals is periodic. If a signal is periodic, determine its fundamental period. **[5 Marks]**

i. $x(t) = \cos(\pi/3)t + \sin(\pi/4)t$ ii. $x(n) = \cos(n/4)$

Q.7) Determine whether the following signals are energy, power, or none

i. $x(t) = e^{-at}u(t)$ ii $x(n) = (-0.5)^n u(n)$

Q.8) A system is given by $y(t) = x(t)\cos(\omega_o t)$, Is this system memoryless? causal? linear? time-invariant? BIBO stable? **[5 Marks]**

Q.9) Compute the output *y(t)* for a system with input $x(t) = e^{at}u(-t)$ and impulse response $h(t) = e^{-at}u(t)$ **[5 Marks]**

Q.10) Consider a system given by $y(t) = \int_{-\infty}^{t} e^{-(t-\tau)}x(\tau)d\tau$. Find the impulse response of the system. Show that the function e^{st} is an eigen-function of the system. **[5 Marks]**

My best wishes to all of you! *Assoc. Prof. Hossam El-Din Moustafa*