UNIVERSITY OF RUHUNA

Faculty of Engineering

Mid-Semester 7 Examination in Engineering: June 2015

Module Number: EE7223   **Module Name: Digital Signal Processing**

[Two Hours]

[Answer **all questions**, each question carries **5 marks**]

Q1 a) Prove and explain graphically, the difference between the relations

i) $x[n] \cdot \delta[n-n_0] = x[n]$ and

ii) $x[n] * \delta[n-n_0] = x[n-n_0]$.

Hint: Consider the input sequence $x[n] = \left\{1, 1, \underset{\uparrow}{2}, 1, 1\right\}$.

[2.5 Marks]

b) Explain the discrete-time system $y[n] = \text{sgn}(x[n])$ with regard to the following properties.

i)   Dynamicity   ii)   Time invariance
iii) Linearity   iv)   Causality
v)   Stability

Hint: $\text{sgn}(x[n]) = \begin{cases} 1 & n \geq 0 \\ -1 & n < 0 \end{cases}$

[2.5 Marks]

Q2 Consider the second-order difference equation of a Linear-time Invariant (LTI)

$$y[n] - 3y[n-1] - 4y[n-2] = x[n] + 2x[n-1].$$

a) Determine the general form of the homogeneous solution of the system.

[2.0 Marks]

b) Determine the particular solution $y_p[n]$ of the difference equation when $x[n] = 4^n u[n]$.

[2.0 Marks]

c) Show that

$$y_p[n] = \lim_{n \to \infty} y_{zs}[n]$$

where $y_{zs}[n]$ denotes the zero-state response of the LTI system.

[1.0 Mark]

Q3 Determine the Z-transforms of each of the following discrete-time signals.

a) $x[n] = 3\delta[n] + \delta[n-2] + \delta[n+2]$

[1.5 Marks]

b) $x[n] = \cos[n\omega_0] \cdot u[n]$

[2.0 Marks]

c) $x[n] = \left(\dfrac{1}{2}\right)^n u[n+2] + (3)^n u[n-1]$

[1.5 Marks]

Q4 a) Determine the causal discrete-time input sequence $x[n]$ for which the Z-transform is

$$X(Z) = \frac{2+3Z^{-1}}{\left(1+Z^{-1}\right)\left(1+\frac{1}{4}Z^{-1}-\frac{1}{8}Z^{-2}\right)}$$

using the partial fraction method.

[3.0 Marks]

b) Verify the result obtained in part a) for $0 \le n \le 3$ by determining the power series expansion of $X(Z)$.

[2.0 Marks]

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Mid - Semester 7 Examination in Engineering: June 2015

Module Number: ME 7363   **Module Name: Energy Technology**

[Two Hours]

[Answer **all questions**, each question carries *five* marks]

Q1. **a)** Briefly describe the formation process of Petroleum Oil Deposits.

[2 Marks]

b) Discuss the possible reasons for the recent fossil fuel prices dropping down in the world market.

[1.5 Marks]

c) State two nonconventional fossil fuel sources. Discuss their advantages and disadvantages.

[1.5 Marks]

Q2. **a)** What is called the "Green House Effect" and how does it lead to "Global Warming"?.

[2 Marks]

b) State three Green House Gases (GHGs) emitted to the atmosphere due to the usage of Fossil Fuels and discuss their main human activity sources and Global Warming Potential (GWP).

[3 Marks]

Q3. **a)** With neatly drawn sketches discuss the two main petroleum recovery processes from the earth.

[3 Marks]

b) Explain the process of conversion of solid coal to Synthetic Natural Gas (SNG) by coal gasification

[2 Marks]

Q4. **a)** List out the four (04) biomass technologies available in the world

[2 Marks]

b) What are the methods available for direct combustion of biomass in industry? Briefly explain two of these methods with suitable sketches.

[3 Marks]