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M.Tech. (EE) (2018 Batch) (Sem.–2)

# ADVANCED DIGITAL SIGNAL PROCESSING

Subject Code : MTEE-203B-18

M.Code : 76103

Time : 3 Hrs. Max. Marks : 60

**INSTRUCTIONS TO CANDIDATES :**
1. Attempt any FIVE questions out of EIGHT questions.
2. Each question carries TWELVE marks.

1. Determine the correct classification of the system with proper justification

   a) $y(n) = 2x(n) + 3$ in terms of linear or nonlinear,

   b) $y(n) = x(n+1) + \dfrac{x(n)}{x(n-1)}$ in terms of causal or not causal,

   c) $y(n) = 3nx(n)$ in terms of time variant or time invariant,

   d) $h(n) = 4^n u(-n)$ in terms of stable or not stable.

2. State the property of differentiation in Z-domain. Also find Z-transform of the sequence $x(n) = (n+0.5)\left(\frac{1}{3}\right)^n u(n)$.

3. Input $x(n) = \{1, 2, 3, 1\}$ and Impulse response $h(n) = \{1, 1, 1\}$ of a LTI system. Determine the response of the system by calculating linear convolution using circular convolution.

4. Design a discrete time Butterworth filter for the following specifications using an impulse invariant method

   $0.8 \le |H(e^{j\omega})| \le 1$ for $0 \le \omega \le 0.2\pi$

   $|H(e^{j\omega})| \le 0.2$ for $0.6\pi \le \omega \le \pi$. The sampling frequency is 1Hz.

5. Design a low pass FIR filter with a cutoff frequency of 0.25 kHz and a sampling frequency of 1 kHz using Hanning window. Assume a filter length N = 11. Find its windowed causal impulse response sequence and transfer function H(z) of the causal filter.

6. What are overflow oscillations and zero input limit cycle oscillations in IIR filters? Explain each using a suitable example.

7. Describe all poles and all zeros model. Also provide the estimation of power spectrum of stationary random signals.

8. Write short notes on :

   a) Optimum signal estimation

   b) Mean square error estimation.



**NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.**