*Name* : .....

*Roll No.* : .....

*Invigilator's Signature* : .....

**CS/M.Tech(ECE)/SEM-1/MCE-103/2012-13**

**2012**

# ADVANCED DIGITAL SIGNAL PROCESSING

*Time Allotted* : 3 Hours *Full Marks* : 70

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words as far as practicable.*

## GROUP – A
## ( Objective Type Questions )

1. Answer any *ten* of the following : 10 × 1 = 10

i) What is linear time invariant system ?

ii) Write short notes on system and signals.

iii) Distinguish between a causal and non-causal system.

iv) Define even and odd signals.

v) State sampling theorem.

vi) Distinguish between deterministic and random signals.

vii) Define DFT and IDFT.

viii) Find the values of $W_N^k$ , when $N = 8$, for $k = 2, 3$.

ix) Compare DIT radix-2 FFT and DIF radix-2 FFT.

x) Differentiate IIR filters and FIR filters.

xi) Write the characteristics features of Hanning window.

xii) Define pre-warping effect. Why is it employed ?

## GROUP – B
## ( Short Answer Type Questions )

Answer any *three* of the following. $3 \times 5 = 15$

2. Explain the concept of energy and power signals. Also checck whether the following signals are energy or power signals.

$x(n) = [1/3]^n u(n)$, (*b*) $x(n) = \sin[1/4]^n$

3. Determine the *z*-transform of $x[n] = -(0.5)\, u[-n-1]$ and the region of convergence.

4. State and prove shifting property of DFT.

5. Describe bilinear transformation mapping for designing IIR filter.

6. Write the expression for Kaiser window function. Write the characteristics features of rectangular window.

**GROUP – C**
**( Long Answer Type Questions )**
Answer any *three* of the following. 3 × 15 = 45

7. a) Check the following system for linearity, time invariance, causulity and stability. 8

i) $y(n) = e^{x(n)}$

ii) $y(n) = x(-n + 2)$.

b) Find the $z$-transform of $x_1(n) = \{ 3, 5, 7 \}$ and $x_2(n) = \{ 3, 0.5.0.7 \}$. What is the relation between $X_1(z)$ and $X_2(z)$? 7

8. a) Compute 4-point DFT of a causal three sample sequence is given by,

$x(n) = 1/3,\ 0 \le n \le 2$

$= 0,$ else 10

b) State and prove shifting property, of DFT. 5

9. a) Determine the inverse of $z$-transform of causal

$$X(z) = \frac{4 - 8z^{-1} + 6z^{-2}}{(1 - 2z^{-1})^2 (1 - z^{-1})}.$$

Using partial fraction expansion.

b) State and prove that the product of the two sequences $x_1(n)$ and $x_2(n)$ is equivalent to the convolution of their respective $z$-transforms. i.e. $X_1(z) * X_2(z)$.

10. a) Apply impluse invariant transformation to $H(s) = 2 / (s + 1)(s + 2)$ with $T$ = 1sec and find $H(z)$. 10

b) Describe bilinear transformation mapping for designing IIR filter. 5

11. Write short notes on any *three* of the following : 3 × 5

a) Kalman Filter

b) Power Spectrum analysis using DFT

c) Wavelet Transform

d) DFT

e) FFT.