Roll No.: .....

National Institute of Technology, Delhi

Name of the Examination: B.Tech

Branch	: ECE	Semester	: 5th
Title of the Course	: Digital Signal Processing	Course Code	: EC 355

Time: 3 Hours | Maximum Marks: 50

Note:

- All parts of a single question must be answered together and in the same sequence as given in question paper. ELSE QUESTION SHALL NOT BE EVALUATED.
- Section A carry only one (01) question of 10 parts of 01 mark each and all parts are compulsory. Section B contains five (05) questions of 5 marks each and any four (04) are to be attempted. Section C contains three (03) questions of ten (10) marks each and any two (02) are to be attempted.

Section A (All parts are compulsory)

Q 1. (a) How a stable analog filter can be converted into a stable digital filter. [1]
(b) Explain Gibb's phenomenon. [1]
(c) Write the general expression for IIR filter. [1]
(d) Write the basic operations required to implement the specified equation of a system. [1]
(e) How many complex multiplications and additions are required to perform each FFT algorithm? [1]
(f) What is the fourier transform of rectangular window of length M-1? [1]
(g) If X(k) is the N-point DFT of a sequence x(n), then what is the DFT of x*(n)? [1]
(h) If ROC of X(z) is $r1 < |z| < r2$, then what is the ROC of $X(a^{-1}z)$? [1]
(i) Obtain the fourier transform of the signal: $\frac{1}{2}\left[\delta(t+1)+\delta\left(t+\frac{1}{2}\right)+\delta\left(t-\frac{1}{2}\right)+\delta(t-1)\right]$. [1]
(j) What are $\delta[2n]$ and $\delta[3t]$? [1]

Section B (Attempt any four)

Q 2 The transfer function of discrete time causal system is given by $H(z)=\frac{1-z^{-1}}{1-0.2z^{-1}-0.15z^{-2}}$.
Draw cascade and parallel realization. [5]

Q 3. A system has an impulse response, $h(n)=(0.5)^n u(n)+n(0.2)^n u(n)$.
Determine parallel realization of the system. [5]

Q 4. DFT of a sequence $x(n)$ is given by, $X(k)=\{6,0,-2,0\}$. Determine:
(i) Sequence $x(n)$.
(ii) Plot $x_1(n)$ if $X_1(k)=X(k)e^{-j2\pi k/2}$. [5]

Q 5. Design a filter with

$$H_d(e^{-jw})=\begin{cases} e^{-j3w}, & -\frac{\pi}{4}\le w\le\frac{\pi}{4} \\ 0, & \frac{\pi}{4}\le w\le\pi \end{cases}$$

Using a Hamming window with M=7. [5]

Q 6. Compare all the types of windows defining their functions and frequency domain characteristics. [5]

Section C (Attempt any two)

Q 7 (a) Determine H(z) using impulse invariance method for the following system function

$$H_a(s) = \frac{1}{(s+0.5)(s^2+0.5s+2)}.$$ [7]

(b) Discuss the stability of impulse invariant mapping technique. [3]

Q 8 (a) The system transfer function of analog filter is given by

$$H_a(s) = \frac{s+0.1}{(s+0.1)^2+16}$$ [7]

Obtain the transfer function of digital filter using Bilinear Transformation which is resonant at $w_r = \frac{\pi}{2}$.

(b) Derive the transformation formula for the bilinear transformation. [3]

Q 9. Let x(n) be a finite duration sequence of length 8 such that $x(n) = \{-1,0,2,0,-4,0,2,0\}$. [10]

(a) Find X(k) using DIT FFT flow graph.

(b) Using the result in (a), find DFT of the sequence $x_1(n) = \{-1,2,-4,+2\}$. Justify your answer.

(c) Using the result in (b), find DFT of the sequence $x_2(n) = \{-4,+2,-1,+2\}$. Justify your answer.