Roll No.: .....

National Institute of Technology, Delhi

Name of the Examination: B.Tech

Branch : ECE **Semester** : 6th

Title of the Course : Digital Signal Processing **Course Code** : EC 355

Time: 3 Hours **Maximum Marks: 50**

Note: All questions are compulsory and carry equal marks.

Q 1 State and explain DIT FFT algorithm for calculating N point DFT [5]

Q 2 The transfer function of discrete time causal system is given by

$$H(z) = \frac{5\left(1-\frac{1}{4}Z^{-1}\right)\left(1-\frac{2}{3}Z^{-1}\right)(1+Z^{-1})}{\left(1-\frac{3}{4}Z^{-1}\right)\left(1-\frac{1}{8}Z^{-1}\right)[1-(\frac{1}{2}+j\frac{1}{2})Z^{-1}][1-(\frac{1}{2}-j\frac{1}{2})Z^{-1}]}$$

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, $X(k) = \{4,0,-4,1\}$. 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

$$H_d(e^{-jw}) = \begin{cases} 1, & \frac{\pi}{4} \le |w| \le \pi \\ 0, & |w| \le \frac{\pi}{4} \end{cases}$$

Using a Hanning window with M=11 and plot the magnitude response. [5]

Q 6. Find IDFT of the sequence X(K)=(1,2,3,4) [5]

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

$$H_a(s) = \frac{1}{(s+0.5)(s^2+0.5s+2)}.$$ [5]

Q 8 Derive the transformation formula for impulse invariant mapping technique. [5]

Q 9 The system transfer function of analog filter is given by

$$H_a(s) = \frac{s+0.1}{(s+0.1)^2+9}$$ [5]

Obtain the transfer function of digital filter using Bilinear Transformation which is resonant at $w_r = \frac{\pi}{4}$.

Q 10. Using linear convolution , find y(n) for the sequence: x(n)=(1,2,-1,2,3,-2,-3,-1,1,1,2,-1) and h(n)=(1,2) using overlap add method. [5]