Total No. of Questions : 8]

SEAT No. : ____

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[5870] - 1065

T.E. (Electronics & Telecommunication Engineering)

DIGITAL SIGNAL PROCESSING (Elective - I)

(2019 Pattern) (Semester - I) (304185)

Time : 2½ Hours] ***[Max. Marks : 70***

Instructions to the candidates :

1) ***Neat diagrams must be drawn wherever necessary.***
2) ***Figures to the right indicate full marks.***
3) ***Use of logarithmic tables slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.***
4) ***Assume suitable data, if necessary.***

Q1) a) Compute DFT of $x[n] = \{1,2,0,1\}$ using direct computation method and matrix method. **[8]**

b) Compute FFT of $x[n] = \{1,1,0,0\}$ using decimation in time (DIT) FFT algorithm and decimation in frequency (DIF) FFT algorithm. **[10]**

OR

Q2) a) Compute circular convolution of $x_1[n] = \{1,2,3,4\}$ and $x_2[n] = \{1,2,3\}$ using graphical method and matrix method. **[8]**

b) Derive decimation in time FFT algorithm for 8 point DFT and explain how butterfly structure is used in FFT. **[10]**

Q3) a) Design analog Butterworth filter to have magnitude of 0.9 at 100 Hz and magnitude of 0.2 at 300 Hz. **[8]**

b) Write transfer function of second order analog Butterworth low pass filter with cutoff frequency 0.8 rad/sec and convert it into digital Butterworth filter using bilinear transformation method with sampling period of 0.1 second. **[5]**

c) Realize the following IIR filter using direct form I and direct form II

$$H(z) = \frac{1+2z^{-1}+3z^{-2}}{1+4z^{-1}+5z^{-2}+7z^{-3}}$$ **[5]**

P.T.O.

OR

Q4) a) Design digital Butterworth filter to meet the following specifications using bilinear transformations with sampling period of 0.5 seconds. **[14]**

$$0.8 \le \left|H(e^{jw})\right| \le 1 \quad , \quad 0 \le w \le 0.3\pi$$

$$\left|H(e^{jw})\right| \le 0.1 \quad , \quad w \ge 0.7\pi$$

b) Realize the following IIR filter using cascade realization **[4]**

$$H(z) = \frac{1+3z^{-1}+2z^{-2}}{1+1.2z^{-1}+0.32z^{-2}}$$

Q5) a) Design FIR filter with order 10 to meet the following specifications using Hamming window. **[9]**

$$\left|H(e^{jw})\right| = 1 \quad , \quad |w| \le 0.5\pi$$

$$\left|H(e^{jw})\right| = 0 \quad , \quad |w| > 0.5\pi$$

b) Design FIR filter to meet following specifications using Hamming window. **[8]**

$$Hd(e^{jw}) = e^{-3jw} \quad , \quad |w| \ge 0.4\pi$$

$$Hd(e^{jw}) = 0 \quad , \quad |w| < 0.4\pi$$

OR

Q6) a) Design FIR filter to meet following specifications using Blackmann window. **[9]**

$$Hd(e^{jw}) = e^{-4jw} \quad , \quad 0.2\pi \le |w| \le 0.5\pi$$

$$= 0 \quad , \quad \text{otherwise}$$

b) Design FIR filter to meet following specifications using rectangular window. **[8]**

$$Hd(e^{jw}) = e^{-5jw} \quad , 0 \le |w| \le 0.3\pi \quad , 0.5\pi \le |w| \le \pi$$

$$= 0 \quad , \quad \text{otherwise}$$

Q7) a) Draw the diagram of human speech production system and explain the role of vocal cords, velum and vocal tract. **[8]**

b) What is artifact ? What are different artifacts in ECG? State their reasons and suggest methods to supress these artifacts. **[9]**

OR

Q8) a) Draw the diagram of standard ECG signal and explain different waves and segments in ECG signal with reference to heart activity. **[8]**

b) Explain ZCR and autocorrelation methods for pitch detection of speech signal. **[9]**

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