

1128

M. E. (Electronics and Communication Engineering)
First Semester
ECE-1101/6101: Advanced Digital Signal Processing

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt five questions in all, including Question No. 1 which is compulsory and selecting two questions from each Section.

x-x-x

- 1 (a) What is bit reversal? (1)
- 1 (b) State the advantages of FFT over DFTs. (1)
- (c) State various applications of DSP. (1)
- (d) State the properties of FIR filter. (1)
- (e) Why are FIR filters widely used for adaptive filters? (1)
- (f) What is meant by up-sampling and down-sampling? (1)
- 1 (g) What is meant by fixed point arithmetic? Give example (1)
- (h) Give disadvantages of TMS320c6X series DSP processor. (1)
- (i) Give computation complexity of Blackman-Turkey method of power spectrum estimation. (1)
- 1 (j) Which method of power spectrum estimation is known as MEM. (1)

SECTION A

- 2 (a) Compute and sketch eight point DFT and DCT sequences of the sequence $x(n) = \{1,3,4,2\}$ and state Parseval's theorem of DFT. (5)
- 2 (b) Compute 16-point DFT of the sequence $x(n) = \cos(n\pi/2); n = 0,1,2, \dots, 15$ using radix-2 decimation in time algorithm. (5)
- 3 (a) How will you design linear phase FIR filters by using frequency sampling method? Explain in detail. (5)
- 3 (b) Derive the relationship of the mapping from s-plane to z-plane for the IIR filter by Design by the bilinear transformation and also prove that bilinear transformation maps the point $s = 0$ into the point $z = 1$. (5)
- 4 (a) Determine the expression of output for the case of sampling rate conversion by a rational factor I/D. (3)
- 4 (b) Obtain the block diagram of poly-phase filter structure for $M = 4$ to the efficient implementation of sampling rate conversion. (4)
- 4 (c) Draw the block diagram of a sub-band speech coder and synthesis of sub-band-encoded signals for the application of multi-rate digital signal processing. (3)

SECTION B

- 5 (a) An ARMA process has an autocorrelation $\{\gamma_{xx}(m)\}$ whose Z-transform is given by
$$\frac{9(z-1/3)(z-3)}{(z-1/2)(z-2)}$$
 - (i) Determine the filter $H(z)$ for generating $x(n)$ from a white noise input sequence. Is $H(z)$ unique explain. (6)
 - (ii) Determine a stable whitening filter for the sequence $\{x(n)\}$. (4)form $S(t) = \text{Re}[S_l(t, \tau)e^{j2\pi f_c t}]$. Where $S_l(t, \tau) = \sum_n I_n g(t - nT - \tau)$ and $\{I_n\}$ is a sequence of complex valued data.

- 6 (a) Discuss briefly about the following applications of an adaptive filter. (5)
 (i) System modeling.
 (ii) Adaptive noise cancelling system.
- 6 (b) Briefly describe architecture and addressing modes of TMS320c6X series of DSP processor. (5)
- 7 (a) Compare Bartlett, Welch and Blackman-Turkey methods of power spectrum estimation. (5)
- 7 (b) Determine the mean and autocorrelation of the sequence $x(n)$, which is the output of a ARMA (1, 1) process described by the difference equation (5)

$$x(n) = \frac{1}{2}x(n-1) + w(n) - w(n-1)$$

where $w(n)$ is a white noise process with variance σ_w^2 .

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