MANIPAL ACADEMY OF HIGHER EDUCATION
MANIPAL SCHOOL OF INFORMATION SCIENCES

SECOND SEMESTER MASTER OF ENGINEERING – ME (EMBEDDED SYSTEMS)
DEGREE EXAMINATION – August 2022 (Make-up)
SUBJECT: ESD 5001 / ESD 603 – DIGITAL SIGNAL PROCESSING

Time: 10.00 – 13.00 Hrs.   Max. Marks: 100

22 August 2022, Monday

Note: Answer ALL Questions

1. Explain Radix-2 DIF-FFT algorithm with N = 8. Calculate the number of complex multiplication and addition present in the algorithm.   (TLO 2.1 – CO1)   (10 Marks)

2. Show the realization of the following system function using Direct form-I, Direct form-II and Cascade form   (TLO 3.1 – CO2)
   $H(z) = [(z^2 + 0.5z + 1)(z + 0.6)] / [(z^2 + 0.6z + 0.2)(z - 0.8)]$ (10 Marks)

3. Design and realize an ideal linear phase band-pass FIR filter with cutoff frequencies $\pi/6$ and $\pi/3$ radians, using frequency sampling technique. Assume 25 tap coefficients.
                                                                        (TLO 4.1 – CO2)   (10 Marks)

4. It is desired to remove low frequencies of an analog signal with a digital linear phase FIR filter. The 3 dB frequency is 2 KHz, transition width is 500 Hz and the stop band attenuation is 50 dB. Use suitable window function to design and realize the filter to meet the above specification. The filter employs a sampling frequency of 10 KHz.
                                                                        (TLO 4.2 – CO2)   (10 Marks)

5. Design and realize a digital Chebychev filter using Impulse Invariance transformation to meet the following specifications. Use a sampling frequency = 40k rad/sec.
                                                                        (TLO 5.2 – CO2)
   $|H(j\Omega)| \geq -2$ dB $0 \leq \Omega \leq 1k$ rad/sec
   $|H(j\Omega)| \leq -50$ dB $\Omega \geq 10k$ rad/sec.   (20 Marks)

6. What is Multirate Signal Processing? Produce the expressions both in time domain and in frequency domain for the signal, which is down sampled by an Integer factor D.
                                                                        (TLO 6.1 – CO3)   (10 Marks)

7. Design a phase shifter that shifts the phase of the spectrum of a signal by a value less than one unit. Also explain how a phase shift of more than one unit, can be achieved in this design.
                                                                        (TLO 6.2 – CO3)   (10 Marks)

8. Explain analytically, how optimum filter coefficients are obtained on Mean Square Error sense in Wiener Noise Canceller Configuration.   (TLO 7.1 – CO3)   (10 Marks)

9. Explain why a MAC operation is implemented in hardware in PDSPs. Explain how convolution is performed using a single MAC unit. Explain the difference between a MAC instruction and MAC with data shift instruction.   (TLO 8.1 – CO4)   (10 Marks)

****