Sardar Patel Institute of Technology

Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058,
(Autonomous College Affiliated to University of Mumbai)

End Semester Examination-May 2022

Max. Marks: 60
Class: TY B.Tech
Course Code: IT303
Name of the Course: Foundation of Signal Processing

Duration: 2hrs 15mins
Semester: VI
Branch: Computer/IT

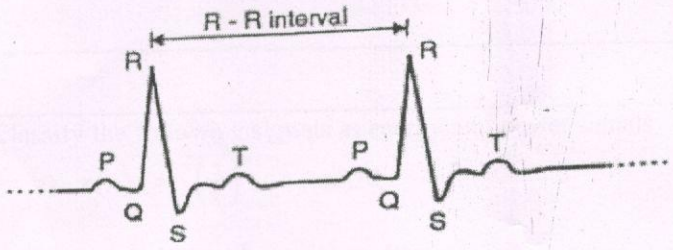
Instruction:

(1) All questions are compulsory
(2) Draw neat diagrams
(3) Assume suitable data if necessary
(4) Use of Scientific Calculator is permitted

Q. No.		Marks	CO
Q. 1 (a)	Classify the following signals as energy and power signals a) $x(n) = \left(\frac{1}{2}\right)^n \quad n \geq 0$ $= (2)^n \quad n < 0$ b) $x(n) = A\cos(b\,n + \phi)$ Where b is the last digit of your UCID Number. for example: if your UCID is 2020201063, then take **b = 3**, If the last digit is zero then **b = 8**	04	CO1
Q. 1 (b)	A causal FIR system has three cascaded blocks, first two of them have individual impulse responses $h_1(n) = 2\,\delta(n-2) + 2\,\delta(n-1) + \delta(n)$ $h_2(n) = u(n) - u(n-2)$ Find the impulse response of the third block $h_3(n)$, if an overall impulse response is $h(n) = \{2, 5, 6, 3, 2, 2\}$	04	CO1
Q. 1 (c)	State Sampling Theorem. For an analog signal, $x(t) = 3\cos(50\pi t) + 10\sin(300\pi t) - \cos(100\pi t)$ Calculate Nyquist Rate **(OR)** What is aliasing observed in the sampling process? How can this be avoided? A continuous time signal $x(t) = \cos(20\pi t)$ is sampled with the sampling frequency (F_s) = 40Hz. Find the corresponding discrete time signal	04	CO1

Q. 2 (a)	An analog signal $x(t) = \sin(480 \pi t) + 3 \sin(720 \pi t)$, band-limited to 500 Hz is sampled with a sampling frequency of 1000 Hz. Compute 4 point DFT of the first four samples of x[n].	04	CO2
Q. 2 (b)	Given $x[n] = 2\delta[n] + 3\delta[n-1] + 4\delta[n-2] + 5\delta[n-3]$. Plot Magnitude Spectrum.	04	CO2
Q. 2 (c)	The first five points of the eight point DFT of a real valued sequence are X[k] = { 2.25, 4.12 – j 5.30, 16.4, 0.25+ j 0.18, 12 }. Determine the remaining three points. State the DFT property used. **(OR)** Let x[n] be a 4 point sequence with X[k] = {1, 2, 3, 4}. Find the DFT of the following sequences using X[k] and not otherwise. (1) x[n-1] (2) x[n+1]	04	CO2
Q. 3 (a)	Assume that a complex multiplication takes 1 microsecond and that the amount of time to compute a DFT is determined by the amount of time to perform all the multiplications. 1. How much time does it take to compute 256 point DFT directly ? 2. How much time is required if FFT is used to compute a 256 point FFT ?	06	CO2
Q. 3 (b)	Calculate 4-point fast circular convolution of the following discrete time signals $x(n) = u(n) - u(n-4)$ $h(n) = 2\delta(n) + \delta(n-2) - 3\delta(n-3)$	06	CO2
Q. 4 (a)	An n^{th} order filter whose impulse response is given as $h(n) = u(n) - u(n-3)$. An EMG discrete time signal $x(n)$ is passed through $x(n) = \{1, 2, 3, 4, 5, 6, 7, 8\}$ Perform Linear Filtering for the same to obtain output y(n) **if your last UCID Number is odd, use Overlap Discard Method** **else if your last UCID Number is even, use Overlap Add Method**	06	CO3
Q. 4 (b)	Obtain 4-point fast correlation for a X-filter fed through an DT input $x(n) = \sin\left(\frac{2n\pi}{N}\right)u(n)$ having impulse response formulated as $h(n) = \cos\left(\frac{2n\pi}{N}\right)u(n)$	06	CO3

#2

Q. 5 (a)	Specify the design considerations to develop a Real Time System using DSP Hardware? (OR) State the need of a DSP Processor. Draw a Block diagram of any DSP processor and explain the features of the DSP Processor.	06	CO4
Q. 5 (b)	ECG Monitoring on unborn baby is required to be done. Description of Problem: Electrical activity of the heart is called an ElectroCardioGram (ECG). Fetal ECG represents electrical activity of the baby's heart. It is similar to the adult ECG waveform. ECG contains five peaks namely PQRST. This waveform is shown in Figure below  The shape of QRS complex waveform changes from patient to patient Instantaneous heart rate is obtained by multiplying the time interval between R-to-R (in miliseconds) by 60,000. (1) To Capture ECG Signal and measure instantaneous Heart Rate, develop a system based on sensors & DSP Processor. Draw block diagram of the DSP system. Justify the need of each component of system. (2) State Algorithms/Flowchart to address the problem.	06	CO4

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