Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

V SEMESTER B.TECH. (MECHATRONICS ENGINEERING)

SUBJECT: DIGITAL SIGNAL PROCESSING [MTE 3105]

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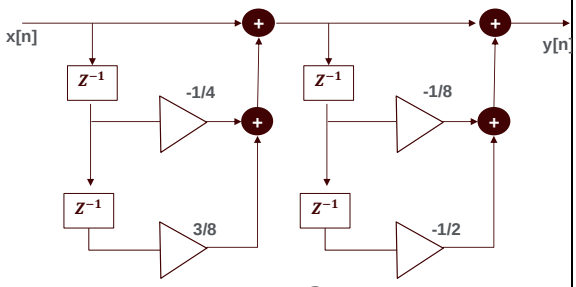
Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Data not provided may be suitably assumed

1A.	Calculate the order of a Low Pass IIR filter with 3 dB frequency = 1000π and stopband frequency = 2000π. User requirement for attenuation in stopband is ≥ 40 dB. Further, discuss the reason, why do we over satisfy the stop band frequency, and not pass band frequency.	**(4)**	CO3
1B.	Determine the value of α for the following situation: Signal $x_1[n]$ and $x_2[n]$ has same energy. Suppose $x_1[n] = \alpha\ 0.5^n\ u[n]$ where α is a real positive number. Assume $x_2[n] = \begin{cases}\sqrt{1.5}\,; n = 0,1; \\ 0\ ; 0therwise\end{cases}$	**(3)**	CO1
1C.	Compute the 4- point DFT of the sequence $x(n) = \{1,2,3,0\}$ using DIF-FFT algorithm.	**(3)**	CO2
2A	Classify the following signals as periodic or aperiodic. If periodic, find its periodicity. (i) $x(t) = 2\cos(5t + 1) - \sin(4t)$ (ii) $x[n] = 3\cos(4\,\pi\, n) + 2\sin(\pi\, n)$	**(4)**	CO1
2B	Compute the system function $H(z) = \frac{Y(z)}{X(z)}$ for a causal LTI system, which is described by the difference equation $y[n] = y[n-1] + y[n-2] + x[n-1]$, and plot pole zero location on z plane.	**(2)**	CO2
2C	Determine the $h[n]$ from the given z-transform $H(z) = \frac{1+2z^{-1}-5z^{-2}+6z^{-3}}{1-3z^{-1}+2z^{-2}}$, ROC: $\lvert z\rvert > 2$.	**(4)**	CO2
3A	Explain the following terms of digital signal processor: (i) Parallel logic unit (PLU), and (ii) Auxiliary register arithmetic unit (ARAU).	**(3)**	CO4

3B	State and justify the type of FIR (finite impulse response) filter shown in the **Fig. 3B**.  Fig**: 3B**	**(3)**	CO3
3C	Calculate the region of convergence of the z-transform of the sequence: $\left(\frac{5}{6}\right)^n u[n] - \left(\frac{6}{5}\right)^n u[-n-1]$.	**(4)**	CO2
4A	Design a FIR low pass filter using Hanning window with 11 coefficients for the following specifications: Passband edge frequency =0.25 kHz and Sampling frequency = 1 kHz.	**(8)**	CO3
4B	Compare the fixed-point and 32-bit floating point digital signal processor in terms of (i) accuracy, and (ii) cost vs ease of use.	**(2)**	CO4
5A	Design a high pass digital IIR filter using Butterworth approximation and bilinear transformation to meet the following specifications: Stopband ripple$\leq 15\ dB$, Passband edge =150 Hz, Passband attenuation $> 1\ dB$, Stopband edge =100 Hz, and sampling frequency = 1 KHz	**(7)**	CO3
5B	Develop a Direct form-I realization of the following difference equation: $y(n) = 2x(n) + 8x(n-1) + 5x(n-2) + 7x(n-3) - 3y(n-1) - 4y(n-2) - 2y(n-3)$	**(3)**	CO3