**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI**
**(END SEMESTER EXAMINATION)**

**CLASS: BTECH** **SEMESTER : IV**
**BRANCH: ECE** **SESSION : SP/2023**

**SUBJECT: EC251N SIGNALS AND SYSTEMS**

**TIME: 3 HOURS** **FULL MARKS: 50**

**instructions:**
**1. The question paper contains 5 questions each of 10 marks and total 50 marks.**
**2. Attempt all questions.**
**3. The missing data, if any, may be assumed suitably.**
***4. B*efore attempting the question paper, be sure that you have got the correct question paper.**
**5. Tables/data hand book/graph paper etc. to be supplied to the candidates in the examination hall.**

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| | | | CO | BL |
|---|---|---|---|---|
| Q.1(a) | Define an energy vs power signal. Find the periodicity of the signal $x[n] = cos\frac{\pi}{3}n + sin\frac{\pi}{4}n$ and sketch the signal defined as $x(t) = u(t+1) + 2u(t) - u(t-1) - u(t-2) - u(t-3)$ | [5] | CO1 | BL1 |
| Q.1(b) | Define the linear and time invariance property of a system. Check the causality and stability of the continuous time LTI system having impulse response $h(t) = e^{-2t}$u(t+5) | [5] | CO1 | BL4 |
| Q.2(a) | State the convolution operation. Find the convolution of the two sequences $x_1(n) = \{2,4,6,1,3\}$ and $x_2(n) = \{5,2,1,1,2\}$ | [5] | CO2 | BL3 |
| Q.2(b) | A causal LTI system is described as: $y[n] - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n)$ . Determine the frequency response of the system. | [5] | CO2 | BL5 |
| Q.3(a) | State the Parseval's theorem. Using the convolution theorem, find the inverse Fourier transform x(n) of $X(\omega) = \frac{1}{(1-ae^{-j\omega})^2}$ $\quad |a| < 1$ | [5] | CO3 | BL2 |
| Q.3(b) | Consider a continuous- time LTI system for which the input x(t) and output y(t) are related by $y''(t) + y'(t) - 2y(t) = x(t)$. Determine the impulse response h(t) for (a) system is causal (b) system is stable | [5] | CO3 | BL5 |
| Q.4(a) | Outline the mapping between Laplace transform and Z-transform. Find the inverse z-transform of the signal defined as $X(z) = \frac{z+2}{2z^2-7z+2}$ if the ROCs are: (a)$\|z\| > 3$ (b) $\|z\| < 1/2$ (c) $1/2 < \|z\| < 3$ | [5] | CO4 | BL4 |
| Q.4(b) | Define stability and causality in Z-domain. Evaluate the output y(n) of the LTI system with initial conditions defined as $y[n] - \frac{1}{2}$ y[n-1] = x[n]; $x[n] = (\frac{1}{3})^n, y[-1] = 1$ | [5] | CO4 | BL5 |
| Q.5(a) | Define sampling theorem. Describe the aliasing effect with suitable example. A 1 kHz sinusoidal signal is ideally sampled at 1500 samples/sec and then passed through an ideal low-pass filter with cut-off frequency 800 Hz. Find out the frequency of the output signal. | [5] | CO5 | BL2 |
| Q.5(b) | Represent the sampled signal in spectral domain. Explain the zero order and first order hold reconstruction of sampled signal. | [5] | CO5 | BL5 |

**::::::25/04/2023::::::M**