B TECH`
(SEM III) THEORY EXAMINATION 2019-20
BASIC SYSTEM ANALYSIS

Time: 3 Hours **Total Marks: 100**

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. **Attempt all questions in brief.** **2 x10 = 20**
   a. Check the system for periodicity $x(t) = e^{j(\pi t - 3)}$
   b. What is the difference between power and energy signal?
   c. Explain time scaling and time reversal properties of continuous time Fourier series.
   d. Find the inverse Fourier transform of $\delta(\omega)$.
   e. Explain the concept of poles and zeros in Laplace transform.
   f. Find the Laplace transform of $x(t) = e^{-at}$
   g. Explain the term state variable and state vector.
   h. What are the benefits of state space analysis?
   i. Explain time shifting property of Z transform.
   j. Determine the unilateral Z transform of $x(n) = a^n n(n+1)$

SECTION B

2. **Attempt any three of the following:** **10 x 3 = 30**
   a. For the given mechanical system draw the f-V and F.I. analogous circuit.

   b. Find the trigonometrically Fourier series for the waveform shown and also sketch line spectrum.

   c. Explain initial value and final value theorem and find the initial and final value of following Laplace transform
      (i) $(3s+5)/s(s^2 + 6s+2)$ (ii) $1/(s^2+9)$
   d. What is the significance of state transition matrix? Explain its properties in detail.
   e. Explain z transform and its properties in detail.

SECTION C

3. **Attempt any two part of the following:** **5 x 2 = 10**
   (a) Explain force current and force voltage analogy of a mechanical and electrical system.
   (b) Determine response of first order system with unit step and unit ramp input.
   (c) Check if the following signal is periodic. If periodic, determine the fundamental period and frequency.
      $x(t) = 7 \sin(3\pi t - \pi/2) - 2\cos(2\pi t + \pi/3) - 8 \cos(7\pi t - \pi/4)$

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4.   **Attempt any two part of the following:**   **5 x 2 = 10**
   (a)   Explain half wave and quarter wave symmetry in Fourier series.
   (b)   Explain convolution and multiplication property of Fourier transform.
   (c)   Find the frequency response $H(\omega)$ and impulse response $h(t)$ of the LTI system.
           $d^2y(t)/dt^2 + 4dy(t)/dt+3y(t) = dx(t)/dt+2x(t)$

5.   **Attempt any two part of the following:**   **5 x 2 = 10**
   (a)   Determine inverse Laplace transform of the function
           $s^2/(s-1)(s-0.5)^2$
   (b)   Consider the R-L circuit with $R = 4\Omega$ and $L= 1H$ excited by a 48V d.c. source as
           shown in figure. Assume the initial current through the inductor is 3A. Using the
           Laplace transform determine the current $i(t)$: $t>=0$. Also draw the s-domain
           representation of the circuit.
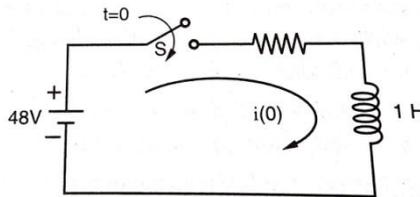
   (c)   Find the Laplace transform of
           $1/ (s^2+9s+20)$ For the signal $y(t) = t^2x(t)$

6.   **Attempt any two part of the following:**   **5 x 2 = 10**
   (a)   Find the transfer function for the system which is represented in state space
           representation as follows:
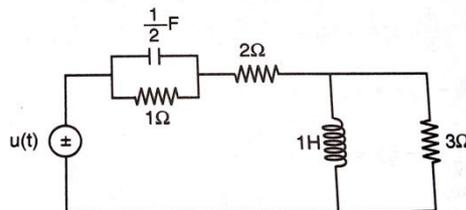
   (b)   Find the state equation for the system shown in figure.

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} -2 & 1 & 0 \\ 0 & -3 & 1 \\ -3 & -4 & -5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$$

$$y = \begin{bmatrix} 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}.$$

   (c)   Draw and explain state models for linear time invariant systems.

7.   **Attempt any two part of the following:**   **5 x 2 = 10**
   (a)   Evaluate the inverse z transform of $X(z) = 1/(1-2z^{-1})$, $|z|>2$ using the contour
           integration method.
   (b)   Determine the z- transform of the following signal
           $g_1(n) = a^n \cos(\omega_o n) u(n)$
   (c)   Find $x(\omega)$ if $X(z)$ is given by
           $$\frac{z+1}{3(z-1)(z+0.9)}$$