B. Tech.
(SEM. III) (ODD SEM.) THEORY
EXAMINATION, 2014-15
BASIC SYSTEM ANALYSIS

Time : 3 Hours] [Total Marks : 100

Note : Attempt all questions.

1. Answer any TWO parts: 10x2=20
   (a) Determine whether the system \( y(t) = 10x(t) + 5 \) is
       (i) Static or dynamic
       (ii) Linear or non-linear
       (iii) Causal or non-causal
       (iv) Stable or unstable.
   (b) Synthesize the waveform as shown in Fig. 1 in term of basic signals.

![Diagram of waveform with points A, B, C, D, and labels 0, 1, 2, 3, and 2, 1 along the axes.](image-url)
(c) Draw the equivalent mechanical system of the given system. Hence write the set of equilibrium for it and obtain electrical analogous circuits using,
(i) F-V Analogy and (ii) F-I Analogy

![Diagram of mechanical system](image)

Fig. 2

2. Answer any TWO parts: 10x2=20

(a) List the properties to be satisfied by a periodic function for which Fourier series exists. Discuss the procedure for evaluating coefficient of a trigonometric Fourier series.

(b) Using waveform symmetries obtain trigonometric Fourier series for the following sawtooth waveform.

![Sawtooth waveform](image)

Fig. 3

(c) Use duality to evaluate the inverse Fourier transform of the step function in frequency, \( F'(j \omega) = u(\omega) \)
3. Answer any TWO parts: 10x2=20
(a) Find the Laplace transformation of voltage waveform shown in fig. 4

Fig. 4

(b) Find the inverse Laplace Transformation of following

(i) \[ \frac{3s}{(s^2 + 1)(s^2 + 4)} \]
(ii) \[ \frac{s^2}{(s^2 + 1)^2} \]

(c) Consider the circuit shown in figure 3, where the switch S is switched on at \( t=0 \). Obtain the expression for the current. Also find the current through the capacitor at \( t=0^+ \). Assume the capacitor to be discharged initially.

4. Answer any TWO parts: 10x2=20
(a) Define and explain the following terms,
(i) State variables (ii) State vector
(iii) State trajectory (iv) State
(v) State Space.
(b) System matrix of a system is given by

\[
A = \begin{bmatrix}
1 & -5 \\
2 & 2 \\
1 & 7 \\
2 & 5
\end{bmatrix}
\]

Find the state transition matrix \( \Phi(t) \) of the system,

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(c) obtain the state variable representation of the systems described by the following differential equations

\[(i) \quad y + 4y + 5y + 2y = u\]

\[(ii) \quad \frac{d^3 x}{dt^3} + 3 \frac{d^2 x}{dt^2} + 4 \frac{dx}{dt} + 4x = u_1(t) + 3u_2(t) + 4u_3(t)\]

and the outputs,

\[y_1 = 4 \frac{dx}{dt} + 3u_1\]

\[y_2 = \frac{d^2 x}{dt^2} + 4u_2 + u_3\]

5. Answer any TWO parts: 10×2=20

(a) Solve the following difference equation by means of the z-transform: \(f(k+2) - f(k) = 0; f(0) = 1, f(1) = 1\)

(b) Determine the discrete time signal for which the z-transform of a function \(f(t)\) is given by:

\[f(z) = \log(1 + az^{-1}); |z| > |a|\]

(c) find the inverse z-transform of

\[f(z) = \frac{36z^2 - 10z}{12z^2 - 7z + 1}; ROC: \frac{1}{4} < |z| < \frac{1}{3}\]