(viii) The unit step response of the system $G(s) = \frac{10}{0.5s+1}$ reaches 98% of its final value after
(a) 10 sec (b) 2 sec (c) 0.5 sec (d) 5 sec.

(ix) For a single input, 4 state and two output system, the dimension of C matrix is
(a) 4 × 4 (b) 2 × 4 (c) 4 × 2 (d) 4 × 1.

(x) The frequency response of a second order system does not exhibit resonance if damping ratio is
(a) 1 (b) 0.707
(c) less than 0.707 (d) less than 1.

Group – B

2. (a) Find the even and odd component of the signal shown in Fig.1

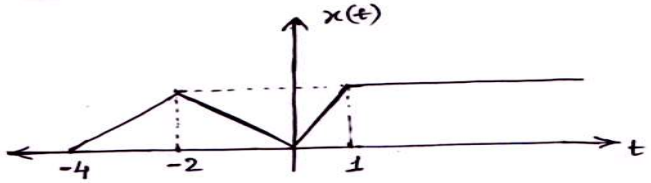


Fig.1

(b) Express the signal shown in Fig.2 in terms of singularity functions.

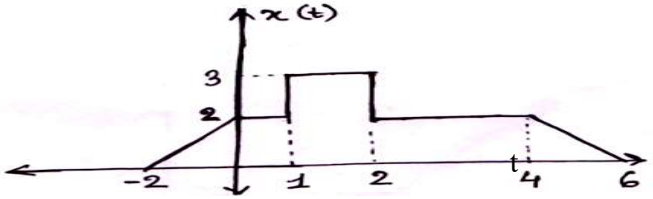
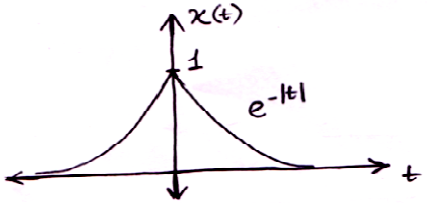
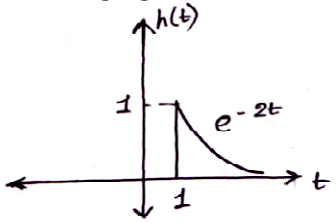


Fig.2

(c) Find the graphical convolution of the following signals.





5 + 2 + 5 = 12

(b) Find the state variable model of the system whose transfer fu is given by

$$G(s) = \frac{s^2+5s+6}{s^5+2s^4+6s^3+8s^2+9s+1}$$

6 + (

9. The state variable model of a system is given by,

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}0\\ 1\end{bmatrix}u \quad \text{and} \quad y = [1 \quad 0]\begin{bmatrix}x_1\\ x_2\end{bmatrix}$$

Find
(i) Transfer function of the system.
(ii) State transition matrix
(iii) Zero input response if $x_1(0) = 1$ and $x_2(0) = 1$
(iv) The state response due to unit impulse input.
(v) The time response y(t).

(3 + 3 + 2 + 3 + 1

B.TECH/EE/5TH SEM/ELEC 3103/2016

SIGNALS & SYSTEMS
(ELEC 3103)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) Unit step signal is a/an
(a) energy signal
(b) power signal
(c) neither power nor energy signal
(d) both energy and power signal.

(ii) Impulse signal is
(a) an even signal (b) an odd signal
(c) a random signal (d) none of the above.

(iii) If a signal f(t) has energy E, the energy of the signal f(2t) is equal to
(a) E (b) E/2 (c) 2E (d) 4E.

(iv) Convolution of two unit step function is
(a) step signal (b) ramp signal
(c) parabolic signal (d) impulse signal.

(v) If a periodic signal has an even symmetry, the Fourier series contains
(a) only sine terms (b) only cosine terms
(c) constant and cosine terms (d) both sine and cosine terms.

(vi) Fourier transform of a gate signal is
(a) sine wave (b) sine function
(c) unit step signal (d) none of these.

(vii) In force-voltage analogy, mass is analogous to
(a) resistance (b) inductance
(c) capacitance (d) conductance.

3. (a) Find the trigonometric Fourier series for the signal f(t) shown in fig. 3.

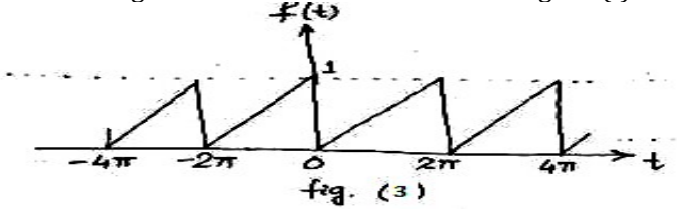


fig. (3)

(b) Find the Fourier Transform of the following (Fig.4) signal x(t) and also sketch its amplitude and phase spectrum.

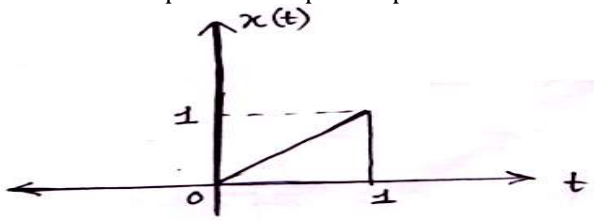


Fig.4

6 + 6 = 12

Group – C

4. (a) State sampling theorem.

(b) Discuss aliasing phenomenon with an example.

(c) Find the Z-transform and ROC of the following signals.
(i) $x(n) = [3(3)^n - 4(2)^n]u(n)$
(ii) $g(n) = [\cos w_0 n]u(n)$

2 + 2 + 8 = 12

5. (a) Find the inverse z-transform by partial fraction method of the following functions.

(i) $X(z) = \frac{\frac{1}{4}z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{4}z^{-1}\right)}$, ROC $|z| > \frac{1}{2}$

(ii) $X(z) = \frac{z^2+z}{(z-1)(z-3)}$, ROC $|z| > 3$

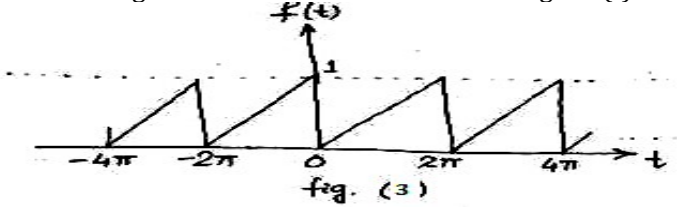
(b) Find the impulse response of the system whose input(x(n)) and output(y(n)) relationship is given by the difference equation

$$y(n) - 4y(n-1) + 3y(n-2) = x(n) + 2x(n-1)$$

(4 + 4) + 4 = 12

B.TECH/EE/5TH SEM/ELEC 3103/2016

3. (a) Find the trigonometric Fourier series for the signal f(t) shown in



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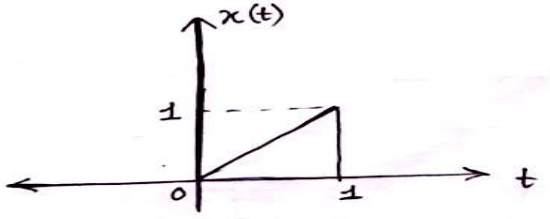

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$$y(n) - 4y(n-1) + 3y(n-2) = x(n) + 2x(n-1)$$

(4 + 4) +

Group – D

6. (a) Find $\frac{V_o(s)}{V_i(s)}$ for the system shown in fig. 5.

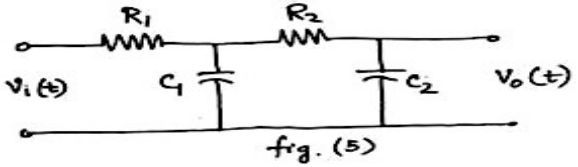

fig. (5)

(b) With the help of neat diagram, explain the step response of a 2nd order underdamped system. Indicate time domain indices in the sketch.

(c) The transient response of a 2nd order underdamped system due to step input is found to have a peak overshoot of 15% at 1.2 sec. Determine i) natural frequency ii) damping factor iii) resonant peak and iv)resonance frequency of the system.

5+ 3 + (1 + 1 + 1 + 1) = 12

7. (a) Obtain the force equilibrium equation for the mechanical system shown in Fig.6. Also draw the force-current analogues circuit.

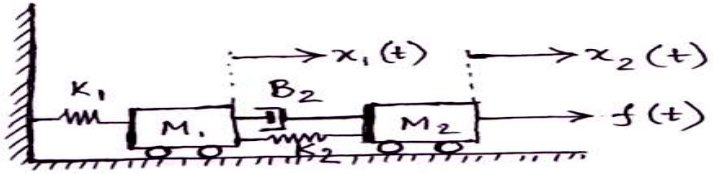

Fig.6

(b) Develop the mathematical model of an armature controlled D.C servo motor to control angular position.

(4 + 3) + 5 = 12

Group – E

8. (a) Construct the state variable model of the system shown in Fig.7. Choose i_1, i_2 and v_3 as state variables; e_1, e_2 as input and v_1, v_2 and v_3 as output.

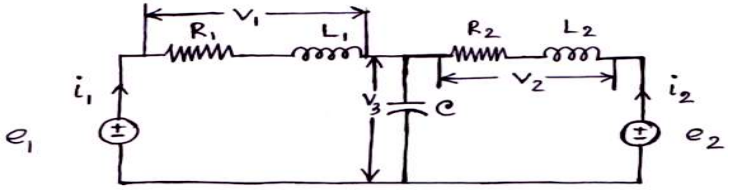

Fig.7

B.TECH/EE/5TH SEM/ELEC 3103/2016

Group – D

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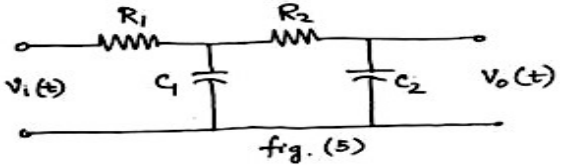

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(b) With the help of neat diagram, explain the step response of order underdamped system. Indicate time domain indices sketch.

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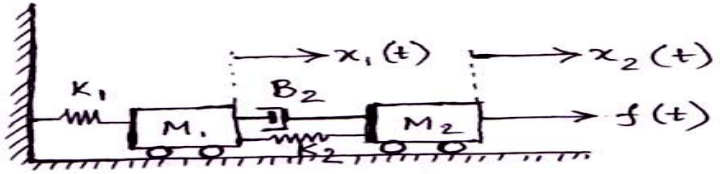

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(4 + 3) + 5

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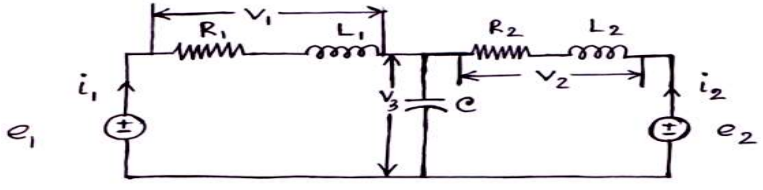

Fig.7