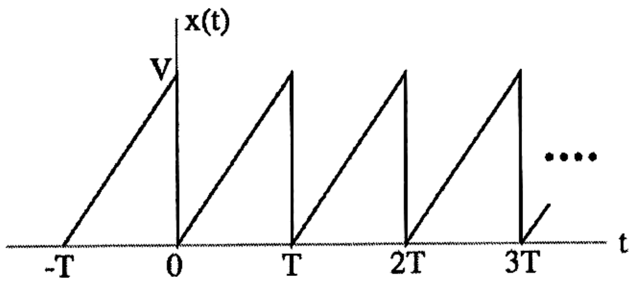
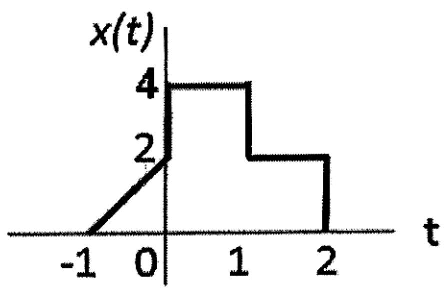
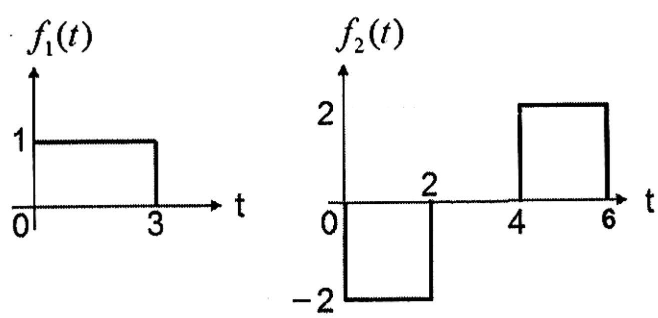
Ref No: Ex/EE/5/T/221/2019

B.E. E (PART TIME) 2ND YEAR 2ND SEMESTER EXAM 2019

SUBJECT: - SIGNALS & SYSTEMS

Time: Three hours | **Full Marks 100 (50 marks for each part)**

Use a separate Answer-Script for each part

No. of Questions	PART-I	Marks
	Answer any 4 questions; 2 marks for well organized answers (12X4+2=50)	
1.	Find Fourier coefficients, Amplitude and Phase Spectra for the following signal *x(t)*. 	12
2. a)	A signal *x(t)* is shown below:  Find the even and odd components of *x(t)*.	8
b)	Prove that any signal can be resolved into even and odd components.	4
3.	Perform graphically the convolution between $f_1(t)$ and $f_2(t)$ as shown in the following figure. 	12

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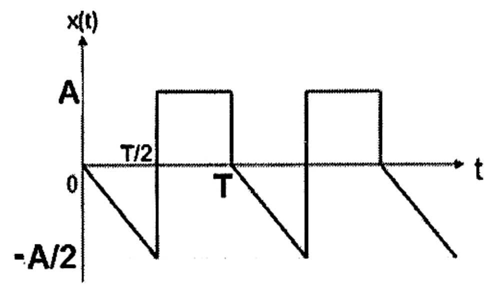
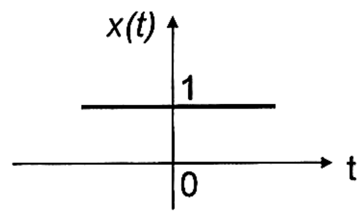
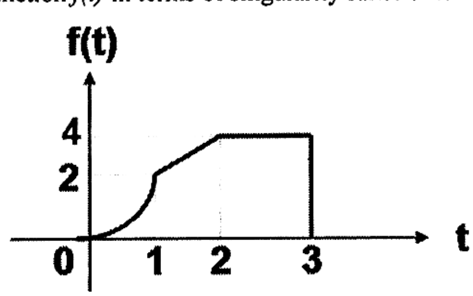
<table>
<tr><td>4.</td><td>Define crest factor of a time domain signal. Find the crest factor of the following signal.



</td><td>12</td></tr>
<tr><td>5. a)</td><td>State Dirichlet Conditions for a signal x(t) to have a Fourier series expansion.</td><td>4</td></tr>
<tr><td>b)</td><td>


Find Fourier Transform of *x(t)*.</td><td>8</td></tr>
<tr><td>6. a)</td><td>Check, whether the signal x(t) is a power signal or an energy signal?
Where, $x(t) = (\alpha^2 + t^4)^{-1/2}$ and α is a positive constant.</td><td>4</td></tr>
<tr><td>b)</td><td>A continuous time signal $x(t) = x_1(t) + x_2(t) + x_3(t)$,
$x_1(t)$, $x_2(t)$ and $x_3(t)$ have time periods of 200 ms, 8s and 500 ms, respectively. Find the time period of x(t).</td><td>4</td></tr>
<tr><td>c)</td><td>Prove that, output of a system is the convolution of input and the impulse response of the system itself.</td><td>4</td></tr>
<tr><td>7. a)</td><td>Express following function *f(t)* in terms of singularity functions:



</td><td>6</td></tr>
<tr><td>b)</td><td>Derive an expression of complex form of Fourier series from trigonometric form of Fourier series.</td><td>6</td></tr>
</table>

Ref. No.: EX/EE/5/T/221/2019

BACHELOR OF ENGINEERING (ELECTRICAL ENGINEERING)

2^{ND} YEAR 2^{ND} SEMESTER EXAMINATION, 2019

Subject: SIGNALS & SYSTEMS **Time: Three Hours** **Full Marks: 100**

Part II (50 marks)

Question 1 is compulsory

Answer ***Any Two*** questions from the rest (2×20)

Question No.			Marks
Q1		Answer ***any Two*** of the following:	
	(a)	Determine if the following system is (i) time-invariant, (ii) linear, (iii) causal, and/or (iv) memoryless. $$\dot{y}(t) + 4ty(t) = 2x(t)$$	5
	(b)	Solve the following differential equation using the Laplace Transform method: $$\dot{y} - 2y = 2x, \text{ with, } x(t) = u(t), y(0) = -1.$$	5
	(c)	Determine whether the system characterized by the differential equation $\ddot{y}(t) + 2\dot{y}(t) + 2y(t) = x(t)$ is stable or not? Assume zero initial conditions.	5
	(d)	Determine the analog diagram to implement the following differential equation $$\dot{x}(t) + 0.1x(t) = 1,\ x(0) = 0.$$	5
Q2	(a)	For a standard 2^{nd} order system find the expressions for the time-response for (i) un-damped, (ii) critically damped conditions. Show the respective pole locations.	4+4
	(b)	Find the transfer function, $Y(s)/X(s)$, for the circuit shown in Figure Q-2(b). Find the values of ξ and ω_n for C_1=C_2=100μF, R_1=R_2=2000Ω.	8+4

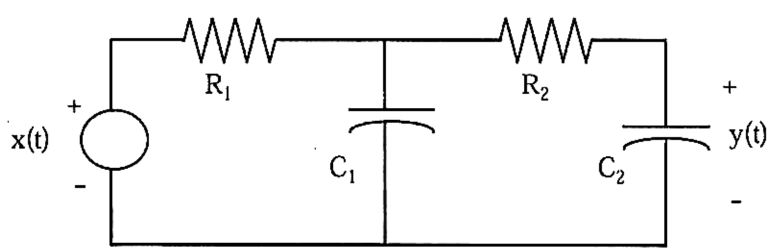


Figure Q-2(b)

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Ref. No.: EX/EE/5/T/221/2019

Q3 (a) (i) Draw analog simulation diagram for the following system, and, (ii) obtain magnitude-scaled analog simulation of the system to utilize the full amplifier range of 0 to 10 volts without any overloading. 4+8

$$\ddot{x} + 2\dot{x} + 25x = 500, \qquad x(0) = 20, \qquad \dot{x}(0) = 0,$$

$$\text{with, } |x|_{max} = 20, \quad |\dot{x}|_{max} = 100.$$

(b) Stating the simplifying assumptions obtain the block diagram representation of an armature controlled d. c. motor driving a load with viscous friction. Derive the corresponding transfer function assuming the angular velocity to be the output. 4+4

Q4 (a) Define state and output equation for an LTI system. Draw the block diagram representation of the state and the output equations. 4+4

(b) For an R-L-C series circuit driven by a constant voltage source obtain the state-space model. Assume the voltage across the capacitor to be the output. Draw the corresponding block diagram indicating the individual state variables. 8+4

Q5 (a) Consider the mechanical system shown in Figure Q-5(a). 6+6

The external force $u(t)$ is the input to the system, and the displacement $y(t)$ of the mass is the output.

The displacement $y(t)$ is measured from the equilibrium position in the absence of the external force.

(i) Obtain transfer function of the system.

(ii) Obtain the analogous electrical network based on *force-voltage* analogy.

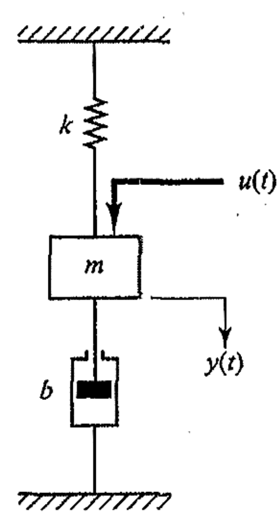

Figure Q-5(a)

(b) Draw asymptotic Bode magnitude plot for the system with a transfer function: 8

$$G(s) = \frac{10(s+2)}{s(s+0.5)}$$