Ref No: Ex/EE/5/T/221/2017

BACHELOR OF ELECTRICAL ENGINEERING (EVENING) 2ND YEAR EXAMINATION, 2017

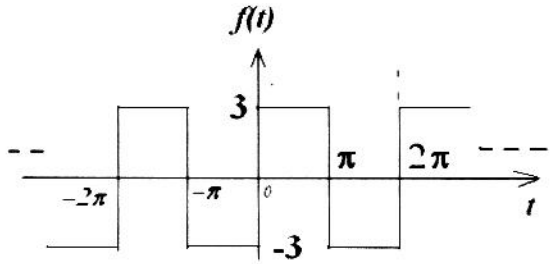
(2nd Semester)

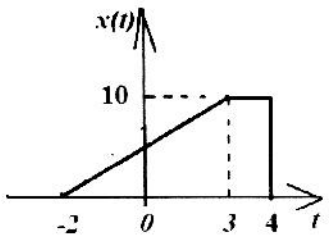
SIGNALS AND SYSTEMS

Full Marks 100

Time: Three hours **(50 marks for each part)**

Use a separate Answer-Script for each part

No. of Questions	PART I	Marks
	Answer any THREE questions **Two marks reserved for neatness**	
1 . (a)	**Explain how the expression for the exponential Fourier series for periodic signals is obtained from the expression for the trigonometric Fourier series. From a knowledge of the mathematical expression for the periodic signal , how would you obtain the complex Fourier coefficients ?**	**7**
(b)	**For the periodic signal *f(t)* shown in Fig. [A], obtain its complex Fourier coefficients, and sketch its amplitude and phase spectra up to the 5th harmonic.**  **Fig. [A]**	**9**
2.	**Define odd functions and even functions.** **Explain how a signal *f(t)* can be decomposed into odd and even components.** **Decompose the signal *x(t)* shown in Fig. [B] into odd and even components.** **Express the signal *x(t)* shown in Fig. [B] in terms of singularity functions. Also sketch the derivative of *x(t)*.**	**2+3 +5+6**

No. of Questions	PART I	Marks
	 Fig. [B]	
3. (a)	**Introduce the concept of "Total Energy" and "Average Power" of signals.**	4+3 +4
	Define power signals and energy signals.	
	Determine whether the following are power or energy signals or neither of them. (i) $x(t) = 2r(t) - 2r(t-4) - 8u(t-4)$ (ii) $g(t) = e^{-5t}u(t)$	
(b)	**Determine the expressions for the amplitude and the phase spectrum functions of the signal** $y(t) = e^{-5\|t\|}$	5
4.(a)	**Define convolution of two signals.**	2+8
	Sketch the following signals. Convolve them graphically, and sketch the result of the convolution. $x(t) = 3u(t-5) - 3u(t-6)$ $g(t) = 2u(t) - 2u(t-3)$	
(b)	**Define a unit impulse function and state its properties.**	6

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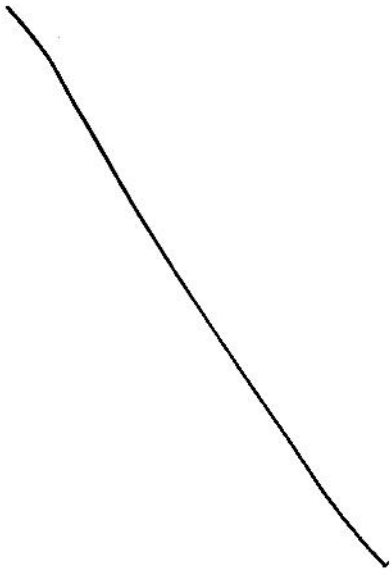
No. of Questions	PART I	Marks
5.	**Write short notes on any two of the following.** **(a) 'Duty cycle' and 'Crest Factor' of periodic trains of rectangular pulses.** **(b) Ramp and parabola signals.** **(c) Parseval's formula and energy spectral density.** **(d) Fourier transforms and spectra of unit dc, signum function and unit step.**	**8+8**



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B. ELECTRICAL ENGG. (EVENING) 2ND YEAR 2ND SEMESTER EXAMINATION, 2017

SIGNALS AND SYSTEMS

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

Use a separate answer script for each part

PART-II

Answer *any* ***three*** questions.

Two marks reserved for neatness.

1. (a) Define each of the following types of systems with suitable example - linear, causal, time invariant, stable.
(b) State and explain the properties of LTI system.
(c) Check for linearity and time invariance of the following systems,
i) $y(t) = t\,x^3(t)$
ii) $y[n] = \frac{1}{3}x[n] + x[n+1]$

(4 X 2) + 2 + (2 X 3)

2. (a) Deduce the transfer function of an armature controlled D.C. motor.
(b) Find out the Electrical analogous circuits (force-voltage & force-current analogy) for the Mechanical system given below.

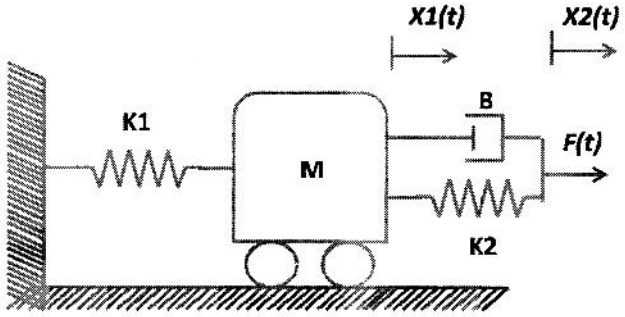

Fig.1

8 + 8

3. (a) Derive the expression of "Rise time" and "Peak time" for a 2nd order underdamped system excited by unit step input.
(b) A system is described by the equation,

$$\frac{d^2y}{dt^2} + 5\frac{dy}{dt} + 16y = 24x$$

Determine the rise time, peak time and maximum overshoot of the response for unit step input.

8 + 8

4. (a) Find the closed loop transfer function of the system shown in fig. 2 using block diagram reduction technique.

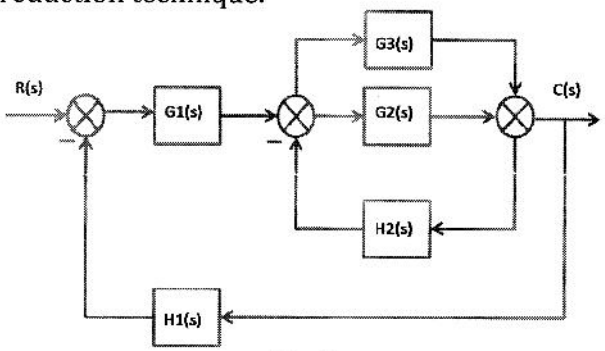

Fig. 2

(b) Design an analog computer that simulates the following system,

$$\frac{d^2y(t)}{dt^2} + 8\frac{dy(t)}{dt} + 25\,y(t) = 500 \;;\quad y(0) = 40 \;,\; \dot{y}(0) = 150$$

$$|y(t)|_{max} = 50, \quad |\dot{y}(t)|_{max} = 250$$

The input voltage is given as 10v.

6 + 10

5. (a) Obtain the state model of the system described below in phase variable form.

$$\dddot{y} + 2\ddot{y} + 3\dot{y} + 11y = \dot{u} + 3u$$

(c) Derive the expression for transfer function in terms of the state model of a system. Verify this expression for the system mentioned above.

10 + 6