QP Code:EC2T05-2 **(Pages: 3)**

Reg No : ..... Name : .....

MAR ATHANASIUS COLLEGE OF ENGINEERING, KOTHAMANGALAM

(Govt. Aided Autonomous Institution)

Fourth Semester B.Tech. Degree Examination, May, 2026

Course Code: B24EC2T05

Course Name: SIGNALS AND SYSTEMS

Max. Marks: 100 Duration:3 Hours

PART - A: 30 Marks (10 Qns x 3 Marks)

Answer all questions

1. Define unit step signal and unit impulse signal. Write their mathematical expressions for CT and DT cases.
2. Check whether the given signal is periodic or not. If periodic find the period
   $x(t) = 3sin(200\pi t) + 4cos(100\pi t)$
3. Explain the conditions for existance of Laplace transform.
4. Obtain the relation between Laplace Transform and Fourier Transform
5. Determine the output y(t) using convolution for x(t) = u(t), h(t) = e^{-2t} u(t).
6. Write the relationship between input, output and system function in the frequency domain using the Fourier Transform.
7. State and prove frequency shifing DTFT property.
8. $x(n) = a^n u(n) - b^n u(-n-1)$ Determine the Z-transform and ROC.
9. Express DTFT in terms of Z-transform.
10. The difference equation of a discrete-time LTI system is
    $y[n] = x[n] + 3x[n-1] - 2x[n-2]$. Determine the impulse response h[n].

PART - B: 70 Marks (5 Qns x 14 Marks)

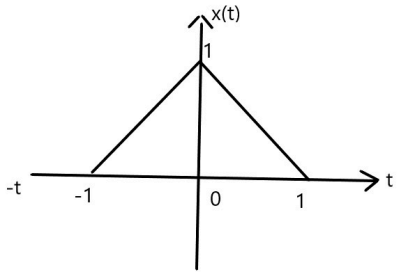
Answer any one full question from each module.

Module 1

11. (a) Check whether the following systems are
    1. Static or dynamic 2. Linear or Non-linear 3. Causal or non-causal 4. Time-invariant or time variant
    $(i)\frac{d^3y(t)}{dt^3} + 2\frac{d^2y(t)}{dt^2} + 4\frac{dy(t)}{dt} = x(t+1)$ (ii) $y(t) = at^2x(t) + btx(t-4)$ (10 Marks)
    (b) State and explain BIBO stability criterion. (4 Marks)

OR

12. (a) Consider the triangular wave form x(t) shown in Fig. Sketch and label carefully each of the following signals



(i) $x(2t+3)$ (ii) $x\left(\frac{t}{2}-3\right)$ (iii)$x\left(\frac{t+3}{2}\right)$ (iv)$x(-2t+3)$ (8 Marks)

(b) Explain time compression and time expansion method of signal with an example (6 Marks)

Module 2

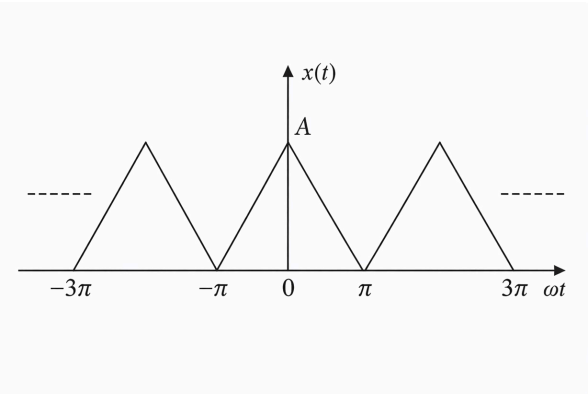
13. (a) State and prove any two properties of CTFT and demonstrate one using a simple signal. (6 Marks)

(b) Find the Fourier transform of the following signals (i) $x(t) = \cos(\omega_0 t)\, u(t)$ (8 Marks)

(ii) $x(t) = e^{-t}\sin(5t)\, u(t)$

OR

14. Find the trigonometric and exponential Fourier series for the given waveform (14 Marks)



Module 3

15. A causal LTI system is described by $\frac{d^2y(t)}{dt^2} + 6\frac{dy(t)}{dt} + 9y(t) = x(t)$; Find the impulse response. Find the response when $x(t) = u(t)$

OR

16. A system is described by the differential equation $\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 4y(t) = x(t)$; Determine the response of the system to an input $x(t) = e^{-2t}u(t)$; applied at t = 0. The initial conditions are:
$y(0^-) = -2, \quad \frac{dy(0)}{dt} = -1$

Module 4

17. A signal x(t) = 2 cos(400πt) + 6 cos(640πt) is ideally sampled at f_s=500 Hz. If the sampled signal is passed through an ideal low pass filter with a cutoff frequency of 400 Hz, what frequency components will appear in the output? Sketch the output spectrum. Also find the output signal.

OR

18. Determine the Fourier series coefficients of the signal x(n) and plot its magnitude and phase spectrum.

$x(n) = 1 + \sin\left(\frac{2\pi}{N}n\right) + 3\cos\left(\frac{2\pi}{N}n\right) + \cos\left(\frac{4\pi}{N}n + \frac{\pi}{2}\right)$

Module 5

19. Solve the following difference equation using unilateral Z-transform.

$y(n) - \frac{5}{6}y(n-1) + \frac{1}{6}y(n-2) = x(n)$ for $n \geq 0$

with initial conditions y(−1) = 3, y(−2) = −2

and input $x(n) = \left(\frac{1}{4}\right)^n u(n)$

OR

20. Determine the impulse response and step response of the causal system given below and discuss on stability:

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

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