M.Sc. 1st Semester Examination, 2024

ELECTRONICS

PAPER – ELC-101(U1 & U2)

Full Marks : 50

Time : 2 hours

Answer **all** questions

The figures in the right hand margin indicate marks

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

UNIT – I

(*Mathematical Methods*)

GROUP – A

Answer any **two** questions : 2 × 2

1. What do you mean by dimensionality and span of a vector space ? 1 + 1

2. Write down the Persaval's identities for Fourier Transform.

3. What do you mean by an analytic function ?

4. Define Hermitian and unitary matrices. 1 + 1

GROUP – B

Answer any **two** questions : 4 × 2

5. In polar coordinates, show that the Cauchy-Riemann conditions become

$$\frac{du}{dr} = \frac{1}{r}\frac{du}{d\theta} \quad \text{and} \quad \frac{1}{r}\frac{du}{\partial\theta} = -\frac{du}{dr}.$$

6. Prove the recurrence relation :

$$2J_n'(x) = J_{n-1}(x) - J_{n+1}(x)$$

where $J_n(x)$ is Bessel function of order n.

7. State and prove Liouville's theorem. 1 + 3

8. Starting from

$$I = < f - \sum_i a_i \phi_i \mid f - \sum_j a_j \phi_j > \geq 0$$

derive Bessel's inequality $< f \mid f > \geq \sum_n |a_n|^2$

GROUP – C

Answer any **one** question : 8×1

9. (*i*) State and prove the convolution theorem in Laplace Transform.

(*ii*) Show that the Laplace Transform of an integral is $(2 + 3) + 3$

$$L\left[\int_0^t F(t)dt = \right] \frac{f(s)}{s}$$

10. (*i*) Derive Cauchy's Integral formula.

(*ii*) Evaluate using Cauchy's Integral formula :

$$\int_C \frac{e^{2z}}{(z-1)(z-2)}\,dz,$$

where C is the circle and $|z| = 3$. 5 + 3

[Internal Assessment – 5 Marks]

UNIT – II

(*Computational Techniques*)

GROUP – A

Answer any **two** questions : 2×2

11. What do you mean by transaction error ?

12. What do you mean by interpolation and extrapolation ? 1 + 1

13. What do you mean by a spline function ?

14. Mention the drawback of Bisection method to find the root a nonlinear equation.

GROUP – B

Answer any **two** questions : 4×2

15. Write down the geometrical interpretation of the trapezoidal rule for numerical integration.

16. Use the Regula-Falsi method to solve

$$x^3 - 2x^2 + 10x - 20 = 0$$

17. Write a short note on floating point representation.

18. Compute the value of $\int_0^1 \frac{dx}{1+x^2}$ using trapezoidal rule with h = 0.125.

GROUP – C

Answer any **one** question : 8×1

19. (*i*) Use Lagrange's interpolation formula to find the value of y for $x = 10$ using the table given below : 4

x	5	6	9	11
y	12	13	14	16

(*ii*) Describe Newton Raphson method to find a root of a nonlinear equation. 4

10. (*i*) Solve the following system of equations by Gauss-Jordan method : 4

$$x + y + z = 9$$
$$2x - 3y + 4z = 13$$
$$3x + 4y + 5z = 40$$

(*ii*) Compute $y(0.2)$ from the equation

$$\frac{dy}{dx} = x - y,\ y(0) = 1,$$

taking $h = 0.1$ by 4th order Runge-Kutta method, correct to four decimal places. 4

[Internal Assessment — 5 Marks]