M.Sc. 1st Semester Examination, 2023

ELECTRONICS

PAPER — ELC-101(U1&U2)

Full Marks : 50

Time : 2 hours

The figures in the right hand margin indicate marks

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

PAPER — ELC-101 U1

(*Mathematical Methods*)

GROUP — A

Answer any **two** questions : 2×2

1. State the convolution theorem in Laplace transforms.   2

2. What is inner product in vector space ?   2

3. Define unitary matrix with an example.   1 + 1

4. Does Laplace transform exist for all functions ? Explain with example.   2

GROUP – B

Answer any **two** questions :   4 × 2

5. Show that $u = x^3 - 3y^2x$ is harmonic and find its conjugate function.   2 + 2

6. State and explain Parseval's relation for Fourier transforms. Discuss its implications for signal processing and analysis.   2 + 2

7. Form a set of three orthonormal vectors by the Gram-Schmidt process using the input vectors in the order given below :   4

$$C_1 = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}, C_2 = \begin{pmatrix} 1 \\ 1 \\ 2 \end{pmatrix}, C_3 = \begin{pmatrix} 1 \\ 0 \\ 2 \end{pmatrix}$$

8. Find Fourier sine transform of   4

$$f(x) = \frac{e^{-ax}}{x}; \ a > 0.$$

GROUP – C

Answer any **one** question : 8×1

9. (*i*) State Cauchy's integral theorem and apply Cauchy-Riemann condition to prove it.

  (*ii*) Expand $\frac{1}{1-Z}$ in Taylor's series about $Z_0 = i.$ $(2 + 4) + 2$

10. (*i*) If $F(t) = t^a$ and $G(t) = t^b$, $a > -1$, $b > -1$, show that the convolution $F*G$ is given

by $F * G = t^{a=b=1} \int_0^1 y^a (1-y)^b \, dy.$

  (*ii*) Using partial fraction expansions, show that

$$L^{-1}\left\{\frac{s}{(s+a)(s+b)}\right\} = \frac{ae^{-at} - be^{-bt}}{a-b}; a \neq b$$

4 + 4

[Internal Assessment — 5 Marks]

PAPER — ELC-101 U2

(*Computational Techniques*)

GROUP — A

Answer any **two** questions :   2 × 2

1. What do you mean by symmetric round-off? 2

2. What are the limitations of the Newton-Raphson method ?   2

3. Find the truncation error in the result of the following function for $x = \frac{1}{3}$ when first three terms are used :   2

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \frac{x^5}{5!} + \frac{x^6}{6!}$$ 2

4. Define and explain the concept of a pivot element in the context of Gauss elimination.

GROUP – B

Answer any **two** questions : 4×2

5. If $u = \frac{3xy^2}{z^3}$ and errors in x, y, z are 0.001, compute the relative maximum error in u when $x = y = z = 1$.   4

6. Derive the iterative formula for Regula-Falsi method to find a root of an equation $f(x) = 0$.   4

7. Establish Newton's forward interpolation formula.   4

8. Describe bisection method to solve the equation $f(x) = 0$, when a root lies between a and b.   4

(Turn Over)

GROUP – C

Answer any **one** question : 8×1

9. Compute $y(0.3)$ from the equation

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

   taking $h = 0.1$, by 4th order Runge-Kutta
   method, correct to five decimal places.   8

10. Evaluate approximately by trapezoidal rule,

    the integral $\int_0^1 (4x - 3x^2)dx$, by taking $n = 10$.

    Also compute the exact integral and find the
    absolute error and the relative error.

                                             $4 + 2 + 1 + 1$

   [Internal Assessment – 5 Marks]

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