

2025

**ELECTRONICS — HONOURS**

**Paper : DSCC-4**

**(Mathematical Foundation, Numerical Analysis and Scilab)**

**Full Marks : 75**

*The figures in the margin indicate full marks.*

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

Answer **question no. 1** in **Group - I** and **any three** questions from **Group - II**  
and **any four** questions from **Group - III**.

**Group - I**

1. Answer **any ten** questions :

2×10

- (a) State Gauss divergence theorem.
- (b) What do you mean by surface integral of a vector function?
- (c) Mention the important properties of eigenvalues.
- (d) What is pivoting in Gauss Elimination?
- (e) Mention the difference between ordinary differential equation and partial differential equation.
- (f) Define homogenous differential equation. How it can be solved using variables separable method?
- (g) Determine the integrating factor of the given equation  $x^2 \frac{dy}{dx} + y = 1$ .
- (h) Mention the steps to solve an exact differential equation.
- (i) Mention the difference between Bisection method and Newton-Raphson method.
- (j) State Newton's forward and backward interpolation formula.
- (k) What do you mean by SciNotes in Scilab?
- (l) How row and column of a matrix can be deleted in Scilab?

**Group - II**

2. What is meant by curl of a vector? Prove that  $\text{curl } \phi = 0$ .

2+3

3. Show that the following differential equation is exact and find its solution :

$$2xydx + x^2dy = 0$$

2+3

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4. Name a few numerical methods to solve an ordinary differential equation. Write the forward and backward difference formulas for numerical differentiation. 2+3

5. Find the particular solution for the second order homogeneous differential equation :

$$y'' + 4y' + 4y = 0, \text{ where } y(0) = 1 \text{ and } y'(0) = 1.$$

Write down Bessel's differential equation. 3+2

6. Explain the mathematical built in function of finding the square root and exponential of a number in Scilab. Give examples. 3+2

### Group - III

7. (a) Determine the characteristics equation and hence find the eigenvalues of the matrix  $A$ .

$$A = \begin{bmatrix} 3 & -1 \\ 2 & 0 \end{bmatrix}$$

- (b) Find the eigenvectors corresponding to the eigenvalues obtained in part (a). 5+5

8. (a) Obtain the general solution of the following separable differential equation :

$$x^2 dy = -(x^2 - 1)y^3 dx$$

- (b) Obtain the general solution of the following exact differential equation :

$$(2xy - 3x^2)dx + (x^2 - 2y)dy = 0$$

- (c) Obtain the integrating factor and solve the differential equation:

$$x^2 dy/dx + 3xy = x^3$$

3+3+4

9. Define round off error and truncation error. What is meant by absolute and relative errors? The height of a building is measured to be 8 meters while its true height 8.2 meters. What are the absolute and relative errors in measurements? What is meant by error propagation? 2+2+1+1+2+2

10. (a) Define gradient of a scalar point function.

- (b) Find the gradient of the scalar function,  $\phi = x^2y + yz^3$ .

- (c) Verify that the vector field,  $\vec{F} = (x^2 - yz)\hat{i} + (y^2 - xz)\hat{j} + (z^2 - xy)\hat{k}$  is irrotational. 2+3+5

11. What is interpolation? How is it different from curve-fitting? Write down Lagrange's interpolation polynomial of 2nd degree. Use it to interpolate the value of  $f(x)$  at  $x = 2.5$  from the given values of  $x$  and  $f(x)$  tabulated below : 1+1+3+5

$x$	1.0	4.0	6.0
$f(x)$	-0.2	2.0	10.0

12. (a) Write a Scilab program to solve an algebraic non-linear equation using bisection method.

- (b) Mention the difference between for-end and while-end loops in Scilab. Give examples. 4+(2+2)+(1+1)