

1st Semester Examination
ELECTRONICS (Honours)
Paper - C 2-T

(Mathematics Foundation for Electorincs)

Full Marks : 40

Time : 2 Hours

*The figures in the margin indicate full marks.
Candidates are required to give their answers
in their own words as far as practicable.
Illustrate the answers wherever necessary.*

1. Answer any five questions : 2×5=10
- (i) Define contour integral of the function $f(z)$. 2
- (ii) Show that $|\cos \theta + i \sin \theta| = 1$ 2
- (iii) Is Laplace transform exists for all functions?
Explain with example. 2

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(iv) Show that the function $v(x, y) = 3x^2y - y^3$ satisfies Laplace's equation. 2

(v) Obtain the solution of the differential equation

$$\frac{dN}{dt} = -\lambda N \text{ with the boundary condition}$$

$N = n_0$, at $t = 0$. Assume λ to be a constant.

2

(vi) If A and B are two matrices, show that

$$(A+B)(A-B) = A^2 - B^2, \text{ if and only if } A \text{ and}$$

B commute.

2

(vii) Prove that the matrix $A = \begin{bmatrix} 0 & -i \\ i & 0 \end{bmatrix}$ is a

Hermitian matrix.

2

(viii) Given $Z = (1+i)(2-3i)$. Put z in the standard form, $(x+iy)$.

2

2. Answer any *four* questions :

4×5

(i) A matrix is given by

$$A = \begin{bmatrix} 2+3i & 1-i & 5i & -3 \\ 1+i & 6-i & 1+3i & -1-2i \\ 5-6i & 3 & 0 & -4 \end{bmatrix}$$

Obtain the complex conjugate and transpose of the matrix A. (2^{1/2}+2^{1/2})

(ii) Solve the equation

$$\frac{d^2 y}{dx^2} + 9y = 2 \sin 3x$$

Subject to the initial condition $y = 1, y' = 0$ at $x = 0$. 5

(iii) Find the Laplace transform of $\frac{\cos at - \cos bt}{t}$ 5

(iv) Find the inverse transform of

$$\frac{5s + 3}{(s - 1)(s^2 + 2s + 5)}$$
 5

(v) Using the residue theorem, evaluate 5

$$I = \int_0^{2\pi} \frac{d\theta}{5 + 4 \cos \theta}$$

(vi) In an electrical circuit with e.m.f. $E(t)$, resistance R and inductance L , the current i builds up at the rate given by

[Turn Over]

$$L \frac{di}{dt} + Ri = E(t)$$

If the switch is connected at $t = 0$ and disconnected at $t = a$, find the current i at any instant. 5

3. Answer any *one* question : 1×10

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

(b) Evaluate $\oint_c \frac{\sin^2 z - z^2}{(z-a)^3} dz$, where the

contour encircles the point $z = a$. 2+4+4

(ii) Find the power series solution of the following differential equation : 10

$$\frac{d^2 y}{dt^2} + w^2 y = 0$$

where w is a constant.
