M.Sc. 1st Semester Examination 2009

ELECTRONICS

(Mathematical Methods and Numerical Analysis)

PAPER—EL-1101

Full Marks : 50

Time : 2 hours

Answer **Q. No. 1** and any **three** from the rest

The figures in the right-hand margin indicate marks

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

Illustrate the answers wherever necessary

1. Answer *all* questions: 2×5

(*a*) If the exact and approximate value of a measurement are respectively $\frac{1}{3}$ and 0·34 calculate its percentage error.

(*b*) Write the following expression in *C* equivalent form:

(*i*) $y = x^{1/2} + \sqrt{x} + \log_e |a + b|$.

(*ii*) $Z = \sin x^2 + \frac{|a+b|}{3/2}$.

(*c*) Show that Fourier transform of a Gaussian is a Gaussian.

(*d*) Explain the analyticity of a complex function in terms of Cauchy - Riemann equation.

(*e*) Is Laplace transform exists for all function? Explain with example.

2. (*a*) Check whether $f(z) = e^z$ and z^* are analytic functions of z from Cauchy – Riemann condition.

(*b*) Using the residue theorem, evaluate

$$I = \int_0^{2\pi} \frac{d\theta}{5 + 4\cos\theta}.$$ 4 + 6

3. (*a*) State and prove the convolution theorem in Laplace transformations.

(*b*) Apply it to solve $X(t)$ which satisfies the equation

$$X(t) = t^2 + \int_0^t \sin(t-u)\, X(u)\, du.$$

$(2+4)+4$

4. (*a*) Write a short notes on 'for' loop in C language.

(*b*) Write a program in C to evaluate the integral

$$\int_a^b (x^2 + xe^x)\, dx$$

by Trapezoidal rule taking n subintervals.

(*c*) Suppose

$$f(x) = \begin{cases} 2x+5, & 0 \leq x < 1 \\ x^2 - 2x, & 1 \leq x < 2 \end{cases}$$

Write a program segment in C to find the value of $f(x)$ for a given x using only block 'if' statement.

$2\frac{1}{2} + 5 + 2\frac{1}{2}$

5. (*a*) Prove that the reccurrence relation

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

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

(*b*) Write down the Rodrigues formula for $P_n(w)$ related to Legendre Polynomial and find $P_0(w)$, $P_1(w)$, $P_2(w)$.

(*c*) Show that

$$P_l(-w) = (-1)^l P_l(w).$$ 3 + 4 + 3

6. (*a*) Prove Parseval's theorem for the Fourier transform.

(*b*) Develop the second derivative of a function numerically in terms of $F(x_i)$, $F(x_{i-1})$ and $F(x_{i+1})$ with comments.

(*c*) What do you mean by string and pointer in C ? 5 + 3 + 2

[*Internal Assessment* : 10 Marks]