Faculty of Engineering & Technology

Fourth Semester B.E. (Electrical Engg.) (C.B.S.) Examination

APPLIED MATHEMATICS—IV

Paper—IV

Time—Three Hours] [Maximum Marks—80

INSTRUCTIONS TO CANDIDATES

(1) All questions carry marks as indicated.
(2) Assume suitable data wherever necessary.
(3) Illustrate your answers wherever necessary with the help of neat sketches.
(4) Table for area under standard normal curve is permitted.
(5) Use of non-programmable calculator is permitted.
(6) Solve :
Que. No.–1 **OR** Que. No.–2
Que. No.–3 **OR** Que. No.–4
Que. No.–5 **OR** Que. No.–6
Que. No.–7 **OR** Que. No.–8
Que. No.–9 **OR** Que. No.–10
Que. No.–11 **OR** Que. No.–12

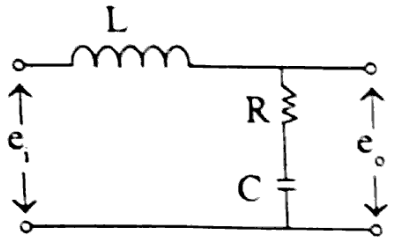
1. (a) Define :

(i) Rise time

(ii) Peak time

(iii) Settling time 6

(b) Obtain the mathematical model and transfer function for the system given below. Also state the order of system.



6

OR

2. (a) Obtain unit step response of unity feedback system whose open loop transfer function is $G(s) = \frac{4}{s(s+5)}$. 6

(b) Define

(i) Step signal

(ii) Ramp signal

(iii) Parabolic signal

and find their Laplace transforms. 6

3. (a) If $Z\{f(n)\} = f(z)$, then prove that

$Z\{n\, f(n)\} = -z\frac{d}{dz}F(z)$ and hence find $Z\{n^2\}$. 6

(b) Show that :

$$\frac{1}{n!} * \frac{1}{n!} = \frac{2^n}{n!},$$

where * is the convolution operation. 6

OR

4. (a) Find $Z^{-1}\left\{\frac{z^2}{(z-a)(z-b)}\right\}$ using residue method. 6

(b) Solve the difference equation :

$$y_{n+2} - 3\,y_{n+1} - 10\,y_n = 0,\ y_0 = 1,\ y_1 = 0.$$ 6

5. (a) Given universal set X = {0, 1, 2, 3, 4, 5}. The membership functions of fuzzy sets A, B and C are

$$\mu_A(x) = \frac{x}{x+2},\ \mu_B(x) = 2^{-x} \text{ and}$$

$$\mu_C(x) = \frac{1}{1+10(x-2)^2}$$

Plot the graphs of μ_A, μ_B and μ_C and check whether

(i) $A \cup (\overline{A} \cap B) = A \cup B$

(ii) $A \cap \overline{A} = \phi$. 6

(b) Define :

(i) Fuzzy set

(ii) α-level set

(iii) Normalized Fuzzy set. 6

OR

6. (a) If $A = \left\{\frac{0.3}{30}, \frac{0.7}{60}, \frac{1}{100}, \frac{0.2}{120}\right\}$ and

$B = \left\{\frac{0.2}{20}, \frac{0.4}{40}, \frac{0.6}{60}, \frac{0.8}{80}\right\}$ are

Fuzzy sets, then find the relation $R = A \times B$. Also find R^2. 6

(b) Define (i) Union, (ii) Intersection of two Fuzzy relations R and S. If R and S are respectively as under, then find (i) $R \cup S$ amd (ii) $R \cap S$

	y_1	y_2	y_3	y_4
x_1	0.4	0.5	0.1	0
x_2	0.8	0.9	1.0	1.0
x_3	0.2	0.1	0.5	0.6

	y_1	y_2	y_3	y_4
x_1	0.5	0.2	0.6	0.8
x_2	0.9	1	0.1	0.1
x_3	0.8	0.9	0.6	0.7

6

7. (a) Define :

(i) Absolute error

(ii) Relative error

(iii) Percentage error.

Find relative maximum error in the function

$u = \frac{5xy^2}{z^3}$ at $x = y = z = 1$ with

$\Delta x = \Delta y = \Delta z = 0.001$. 6

(b) Find the root of the equation $x \log_{10} x = 1.2$, using method of False position. 6

OR

8. (a) Find the root of following equation by using Newton-Raphson method :

$e^x - 4x = 0$. 5

(b) Use Gauss-Seidal method to solve $2x + y - 8z = 15$, $6x - 3y + z = 11$ and $x - 7y + z = 10$. 7

9. (a) Solve $\frac{dy}{dx} = 2y + 3e^x$, $y(0) = 0$ using Taylor's series method to find $y(0.1)$ and $y(0.2)$. 7

(b) Solve : $\frac{d^2y}{dx^2} - xy + 4y = 0$, $y(0) = 3$, $y'(0) = 0$

for $x = 0.2$ by Runge-Kutta method. (Take $h = 0.2$). 7

OR

10. (a) Solve $\frac{dy}{dx} = 2e^x - y$, $y(0) = 2$ to find $y(0.4)$ and $y(0.5)$, given $y(0.1) = 2.01$, $y(0.2) = 2.04$, $y(0.3) = 2.09$ by using Milne's predictor-corrector method. 7

(b) Apply Euler's modified method to solve for y(2), the differential equation :

$\frac{dy}{dx} = 2 + \sqrt{xy}$, given $y = 1$, when $x = 1$. (Take $h = 0.25$). 7

11. (a) Three machines A, B, C produce respectively 60%, 30% and 10% of the total number of items of a factory. The percentage of defective output of these machines are respectively 2%, 3% and 4%. An item is selected at random and is found defective. Find the probability that the item was produced by machine (i) A and (ii) B. 6

(b) Let X be a random variable having density function

$$f(x) = \begin{cases} kx, & 0 \le x \le 2 \\ 0, & \text{otherwise} \end{cases}$$

Find

(i) the constant k

(ii) $P(X > 1)$

(iii) the distribution function f(x). 6

(c) If 3% of the electric bulbs manufactured by company are defective, find the probability that in a sample of 100 bulbs :

(i) exactly 2

(ii) between 1 and 3

(iii) at the most 2 bulbs

will be defective. Use Poisson distribution with $\lambda = np$. 6

OR

12. (a) A random variable X has following probability distribution :

x	0	1	2	3	4	5	6	7	8
f(x)	a	3a	5a	7a	9a	11a	13a	15a	17a

(i) Determine the constant a

(ii) Find $P(x < 3)$ and

(iii) Find the distribution function. 6

(b) Find :

(i) Mean, (ii) Variance and (iii) The moment generating function for the distribution :

$$f(x) = \begin{cases} e^{-x}, & x > 0 \\ 0, & x \leq 0 \end{cases}$$ 7

(c) Find the probability of guessing at least 6 of the 10 answers on a true-false examination. 5