B.E. Fourth Semester (Electrical Engineering (Electronics & Power)) (C.B.S.)

# Applied Mathematics - IV

## Paper - I

P. Pages : 3 **KNT/KW/16/7278**

Time : Three Hours Max. Marks : 80

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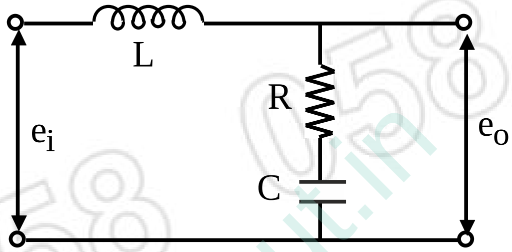
Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Assume suitable data whenever necessary.
9. Use of non programmable calculator is permitted.

**1.** a) Obtain the mathematical model and transfer function for the system given below. Also state the order of the system. **6**




b) Define : **6**

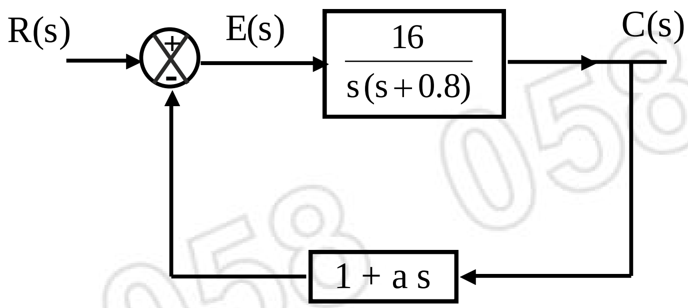
i) Step signal

ii) Ramp signal and

iii) Parabolic signal and find their Laplace transform.

**OR**

**2.** a) For the following system, find the value of 'a' such that the damping ratio is 0.5. Determine rise time, peak time and settling time in unit step response. **6**




b) Discuss unit ramp response of first order system whose transfer function is $G(s)=\frac{1}{Ts+1}$. Also show that its steady state error is equal to T. **6**

**3.** a) If $Z\{f(n)\}=F(z)$, then prove that $f_\infty = \lim_{n\to\infty} f(n) = \lim_{z\to 1}(z-1)F(z)$. **6**

b) Show that $\frac{1}{n!} * \frac{1}{n!} = \frac{2^n}{n!}$, where $*$ is the convolution operation. **6**

**OR**

**4.** a) Using Residue method, find $Z^{-1}\left\{\frac{z^4}{(z-a)^4}\right\}$ **6**

b) Solve the difference equation $y_{n+2} - 2\cos\alpha\, y_{n+1} + y_n = 0,\ y_0 = 1,\ y_1 = \cos\alpha$ by using Z-transform. **6**

**5.** a) Define : **6**

i) Fuzzy set, ii) $\alpha$-level set and iii) Normalized fuzzy set.

b) 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**

**OR**

**6.** a) If R and S are fuzzy relations given by **6**

$$R = \begin{array}{c} \\ x_1 \\ x_2 \\ x_3 \end{array}\!\!\begin{array}{c} \begin{array}{cc} y_1 & y_2 \end{array} \\ \begin{bmatrix} 0.5 & 0.1 \\ 0.2 & 0.9 \\ 0.8 & 0.6 \end{bmatrix} \end{array} \text{ and } S = \begin{array}{c} \\ x_1 \\ x_2 \\ x_3 \end{array}\!\!\begin{array}{c} \begin{array}{cc} y_1 & y_2 \end{array} \\ \begin{bmatrix} 0.6 & 0.5 \\ 0.4 & 0.8 \\ 0.7 & 0.9 \end{bmatrix} \end{array},$$

Find $R \cup S$ and $R \cap S$.

b) For the fuzzy sets A and B define $A - B$ and $A \oplus B$. **6**

If $A = \frac{0.2}{x_1} + \frac{0.5}{x_2} + \frac{0.6}{x_3}$ and $B = \frac{0.1}{x_1} + \frac{0.4}{x_2} + \frac{0.5}{x_3}$,

then find $A - B$ and $A \oplus B$.

**7.** a) Find by Newton - Raphson method the real root of the equation $3x - \cos x - 1 = 0$. **5**

b) Solve the following system using Gauss-Seidal method: **7**

$6x + 15y + 2z = 72,\ 27x + 6y - z = 85,\ x + y + 54z = 110$.

**OR**

**8.** a) Using Regula-falsi method find the real root (correct up to 3rd decimal place) of the equation $x e^x - \cos x = 0$. **6**

b) Apply Crout's method to solve the system of equations : **6**

$x + y + z = 1,\ 3x + y - 3z = 5,\ x - 2y - 5z = 10$.

**9.** a) Using modified Euler's method, solve the equation : **7**

$\frac{dy}{dx} = x + |\sqrt{y}|,\ y(0) = 1$ for the range $0 \le x \le 0.6$ with h = 0.2.

b) Solve by Runge-Kutta method. **7**

$\frac{dy}{dx} = yz + x, \ \frac{dz}{dx} = xz + y$ for x = 0.2, given y(0) = 1, z(0) = -1 and h = 0.2.

**OR**

**10.** a) Find the series solution of the D.E. using Taylor's series method : **7**

$\frac{dy}{dx} = \frac{1}{2}(y^2 + xy^2), \ y(0) = 1$

And hence find y(0.1) correct up to $3^{rd}$ decimal place.

b) Solve $\frac{dy}{dx} = 2e^x - y, \ y(0) = 2, \ y(0.1) = 2.010, \ y(0.2) = 2.040, y(0.3) = 2.090$ to find y(0.4) by Milne's predictor corrector method. **7**

**11.** a) An insurance company insured 2000 scooter drivers, 4000 car drivers and 6000 truck drivers. The respective probabilities of an accident are 0.01, 0.03 and 0.15. One of the ensured persons meets an accident. What is the probability that he is a scooter driver ? **6**

b) Let X be the random variable giving the number of heads in three tosses of a fair coin. Find **6**
i) the probability function,
ii) the distribution function
Also draw their graphs.

c) A random variable X has the density function given by **6**

$$f(x) = \begin{cases} 2e^{-2x} & , \ x \geq 0 \\ 0 & , \ x < 0 \end{cases}$$

Find
i) E(X) ii) Var (X) and
iii) moment generating function.

**OR**

**12.** a) A random variable X has density function $f(x) = \begin{cases} kx^2 & , \ 1 \leq x \leq 2 \\ kx & , \ 2 < x < 3 \\ 0 & , \ \text{otherwise} \end{cases}$ **6**

Find the constant k and the distribution function.

b) Find moment generating function and first four moments about the origin for the random variable X given by $X = \begin{cases} 1/2 & , \ \text{prob.} 1/2 \\ -1/2 & , \ \text{prob.} 1/2 \end{cases}$ **6**

c) If 3% of the electric bulbs manufactured by a company are defective, find the probability that in a sample of 100 bulbs - **6**
i) at least 2 bulbs
ii) at the most 2 bulbs
iii) between 1 and 3 will be defective.

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