[Time:3 Hrs] **[Marks:80]**

Please check whether you have got the right question paper.

N.B:
1. **Question No.1 is compulsory**
2. **Solve any three question from the remaining five**
3. **Figures to the right indicate full marks**
4. **Assume suitable data if necessary and mention the same in answer sheet**

Q.1 Attempt **any 4** question 20

a. Derive the continuity equation. What is use of this equation in electromagnetics

b. Describe corner reflector antenna. Give a typical application scenario for this antenna

c. Compare near field and far field radiation of antenna

d. Calculate directivity and gain of a given linear broadside uniform array of 5 isotropic elements with a separation of quarter wavelength between the elements.

e. Describe duct propagation.

Q.2 a. Write Maxwell's equation in point form and integral form. Give the word statement for each equation. 10

b. Derive the Helmholtz wave equation for free space in terms of electric and magnetic fields 10

Q.3 a. Derive the expression for vector magnteic potential in terms of current density 10

b. Derive the expression of total field for n isotropic point sources of equal amplitude and spacing 10

Q.4 a. Describe the construction and radiation pattern of Log Periodic antenna. Whys is it called Log periodic? 10

b. Discuss feeding techniques for rectangular and circularpatch antenna. 10

Q.5 a.With neat sketch explain Horn antenna, also describe how radiation pattern can be modified using physical dimensions of the same antenna. 10

b. Discuss radiation pattern of resonant dipole for following lengths

i) Half wavelength ($\lambda/2$)

ii)Full wavelength (λ)

iii) 1.5 wavelength(1.5λ)

iv) 3 wavelengths (3λ)

Q.6 Short note on:**(Attempt any two)** 20

a. Infinitesimal dipole

b. Application of Gauss law for surface charge

c. FRIIS transmission equation.

d. Array synthesis using Binomial array

Duration: 3hrs **[Max Marks: 80]**

N.B. : (1) Question No 1 is Compulsory.
(2) Attempt any three questions out of the remaining five.
(3) All questions carry equal marks.
(4) Assume suitable data, if required, and state it clearly.

1 Attempt **any FOUR.** **[20]**

a Perform bit-plane slicing on the following image.

$$I = \begin{bmatrix} 12 & 14 & 9 \\ 7 & 11 & 10 \\ 5 & 6 & 8 \end{bmatrix}$$

Reconstruct the image after discarding the LSB plane.

b State the basic steps in frequency domain filtering.

c Define morphological erosion and dilation of a binary image.

d State the principle of basic global thresholding.

e Compute the co-occurrence matrix $C_{1,0}$ of the following image. (One pixel to the right)

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

2 **a** Explain the working of the following sharpening spatial domain filters. **[10]**

- The Laplacian
- Unsharp masking
- High boost filtering

b Perform Histogram Equalization for the following image. Show the original and equalized histogram. **[10]**

Intensity	0	1	2	3	4	5	6	7
No. of pixels	70	100	40	60	10	70	10	40

3 **a** Write an expression for a two-dimensional DCT. Form a 4x4 DCT matrix and compute the DCT of the following sub-image. **[10]**

$$I = \begin{bmatrix} 1 & 2 & 2 & 1 \\ 2 & 1 & 2 & 1 \\ 1 & 2 & 2 & 1 \\ 2 & 1 & 2 & 1 \end{bmatrix}$$

b Compare Ideal, Butterworth and Gaussian Low Pass Filtering in frequency domain. **[10]**

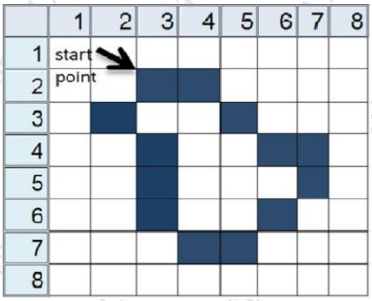
4 **a** Perform segmentation using split-and-merge technique on the following image. Show the quad-tree representation. **[10]**

6	5	6	6	7	7	6	6
6	7	6	7	5	5	4	7
6	6	4	4	3	2	5	6
5	4	5	4	2	3	4	6
0	3	2	3	3	2	4	7
0	0	0	0	2	2	5	6
1	1	0	1	0	3	4	4
1	0	1	0	2	3	5	4

b Explain morphological region filling. **[10]**

5 **a** Explain the working of Canny edge detector. **[10]**

b Find the chain code and shape number of the following shape. **[10]**



6 **a** Illustrate K-means algorithm for classification of data with a suitable example. **[10]**

b Explain the Support Vector Machine classifier for binary classification. **[10]**

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(3 Hours) **Total Marks: 80**

N.B. : (1) Questions No.**1** is **compulsory**.
(2) Solve any **three** questions out of **remaining**
(3) Draw neat labeled diagram whenever necessary
(4) Assume suitable data if necessary

Q1. **Answer any 4 questions:**

a. Brief with suitable diagram the feature map extraction process of convolutional neural network for image recognition. 5

b. Prove De-Morgan's theorem If X and Y are two fuzzy sets with membership functions: μ_x ={0.3,0.7,0.2, 0.4 } μ_y= {0.1,0.4,0.8,0.3}. 5

c. Discuss competitive learning with a flow chart. 5

d. Brief about supervised and unsupervised learning? Give their examples 5

e. Explain cross validation error based stopping criteria used in neural network training. 5

Q2.a. What are activation functions in neural networks? What are their properties? Draw any four activation functions with their mathematical equations. 10

b. Explain the working of K-Means clustering algorithm with flowchart. 10

Q3.a. Explain with a flow chart the error backpropagation learning algorithm. 10

b. Explain a Mamdani fuzzy controller for deciding the wash time in a washing machine. Consider inputs as washing load and dirt. Use any suitable membership functions with three descriptors for input and output. 10

Q4.a. What is De-fuzzification? Discuss any two methods of De-fuzzification. 10

b. Implement AND function using perceptron network. Consider bipolar inputs and targets, initial bias and weights as 0 and the learning rate as 1. 10

Q5.a. With a flow chart explain the gradient descent algorithm. 10

b. Define the terms support vectors and hyperplane with reference to a support vector machine. How do support vector machines differ from conventional classifiers? What are the advantages and limitations of SVMs? 10

Q.6.a. What is the difference between machine learning and deep learning? Draw and explain the architecture of Convolution Neural Network. Discuss its applications. 10

b. Construct a discrete Hopfield network to store the patterns S1 = [1 -1 1 -1] and S2 = [-1 1 -1 1]. If the received pattern is [1 1 -1 1], identify the correct pattern. 10

(3 Hours) **[Total Marks: 80]**

N.B.: (1) Question No. 1 is **compulsory**.

(2) Solve any **three** questions from the remaining **five**

(3) **Figures** to the **right** indicate **full** marks

(4) Assume suitable data if necessary and mention the same in answer sheet.

Q.1	a)	Differentiate between Microprocessor & Microcontroller.	**[5]**
	b)	Compare AJMP, SJMP and LJMP instruction of 8051.	**[5]**
	c)	Write short notes on CPSR of ARM7.	**[5]**
	d)	Develop an assembly language program using ARM instruction set to calculate $3x^2 + 5y^2$. Assume x=8 and y=5.	**[5]**
Q.2	a)	Explain 8051 timer using TMOD and block diagram.	**[10]**
	b)	Write a program for 8051 to copy a block of data 10 bytes long from RAM locations starting at 35H to RAM locations starting at 60H.	**[10]**
Q.3	a)	Explain Interrupt structure of 8051.	**[10]**
	b)	Suppose common cathode 7-segment display is interfaced with 8051. Develop Assembly language program for 8051 to display 0 to 9 decimal numbers on 7-segment display with some delay between two numbers.	**[10]**
Q.4	a)	Explain Serial Communication in 8051.	**[10]**
	b)	Draw and explain the data flow model of ARM7.	**[10]**
Q.5	a)	Draw and explain the register organization of ARM7.	**[10]**
	b)	Explain ARM addressing modes of ARM7 Processor with example in each.	**[10]**
Q.6	a)	Develop an ARM assembly language program to read two 32 numbers bit numbers stored consecutively starting at 0x40000000. Add, subtract and multiply the two numbers and store result in next consecutive memory location starting 0x40000008.	**[10]**
	b)	ARM based system is working on 15MHz, P-clk frequency. An LED is interface with Port-0 pin 16. Develop embedded C program to blink this LED using hardware timer.	**[10]**

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