**Time: 3 Hrs**                                                            **Total marks: 80**
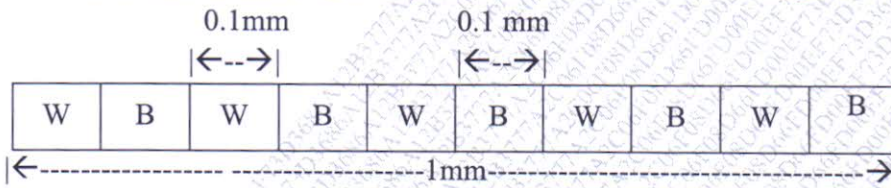
**Instructions**

1.  Q1 is compulsory
2.  Solve **any three** from remaining
3.  Assume suitable data if necessary

Q1 Answer the following

1.  Image resulting from poor illumination could be difficult to segment, State true or false, Justify your answer                                                           4M
2.  For given figure, Improve and reduce the spatial resolution, consider W= White line, B = Black line, Size of each white and black line is 0.1 mm, total length is 1 mm.     4M

<div align="center">

0.1mm             0.1 mm

|←--→|       |←--→|

| W | B | W | B | W | B | W | B | W | B |
|---|---|---|---|---|---|---|---|---|---|

|←------------------ --------------------1mm-----------------------------------→|

</div>

3.  Two images have same histogram which of the following properties must they have in common 1) same total power 2)same entropy 3) same inter pixel covariance function Justify your answer                                                                  4M
4.  Compare 2-D motion and optical flow                                          4M
5.  Draw and explain the model of image degradation/restoration process          4M

Q2

1.  For given image find and equalize histogram                                   8M

<div align="center">

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| 5 | 5 | 6 | 6 |
| 6 | 7 | 6 | 6 |
| 6 | 7 | 2 | 3 |

</div>

2.  Explain 1) Contrast stretching 2) Log Transformation with neat diagrams        6M
3.  Prove Periodicity and symmetry properties of DFT                               6M

Q3

1.  Apply 1) Averaging filter 2) Median filter on following image. Use pixel replication for padding. No marks if procedure not followed                                8M

<div align="center">

| 4  | 8  | 9  |
|----|----|----|
| 12 | 15 | 18 |
| 30 | 32 | 46 |

</div>

2. Explain 1) Sharpening using $2^{nd}$ order derivative 2) Unsharp masking and high boost filtering

      8M

3. Let V = {0,1} . Compute 1) Euclidean distance 2) City block distance 3) Chess board distance between pixels p and q

      4M

| 0 | 1 | 1 | 1 |
|---|---|---|---|
| 1 | 0 | 0 | 1 (q) |
| 1 | 1 | 1 | 1 |
| 1 (p) | 1 | 1 | 1 |

Q4

1. Draw PDF and write equation for following noise models
   a. Gaussian Noise    b. Rayleigh noise    c. Erlang noise

      6M

2. Apply bit plane slicing on following image

| 5 | 7 | 5 |
|---|---|---|
| 4 | 6 | 3 |
| 1 | 3 | 2 |

3. Find the border for image F given below using two different structural elements A and B respectively

      10M

F=

```
0 0 1 1 1 1 0 1 1 1 0
0 1 1 1 1 1 1 1 1 1 0
0 1 1 1 1 1 1 1 1 1 0
1 1 1 1 0 1 1 1 1 1 1
0 1 1 1 1 1 1 1 1 1 1
0 1 1 1 1 1 1 1 1 1 0
0 1 1 1 1 1 1 1 1 1 0
0 0 0 0 0 1 1 1 0 0 0
```

A=

| 0 | 1 | 0 |
|---|---|---|
| 1 | 1 | 1 |
| 0 | 1 | 0 |

B=

| 1 | 1 | 1 |
|---|---|---|
| 1 | 1 | 1 |
| 1 | 1 | 1 |

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Q5
1. Classify video frames? What is GOP?                                              6M
2. Which are the digital quality measures? Explain any 2                            6M
3. Find DCT of given image by finding kernel function                              8M

| 4 | 2 | 2 | 1 |
|---|---|---|---|
| 2 | 5 | 8 | 9 |
| 2 | 4 | 5 | 2 |
| 2 | 3 | 2 | 2 |

Q6
1. Explain motion estimation criterion based on optical flow equation              10M
2. Write Short Notes on **any two**                                                10M
   1. Exhaustive block matching algorithms
   2. Binary Feature Matching
   3. Motion Representation

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

N.B.:    (1) Question no 1 is compulsory
         (2) Solve any three from remaining five
         (3) Assume suitable data if required.
         (4) Figures to the right indicate full marks.
         (5) Draw neat diagrams wherever required.

1    (a)   What is timing advance in GSM?        05
     (b)   Explain Foliage loss in propagation.        05
     (c)   What is cell dragging and dwell time?        05
     (d)   How handoffs are prioritized        05

2.   (a)   If bw=1.25MHz, R=9600 bps and minimum acceptable $E_b/N_0$ is found to be    10
         10 dB determine the maximum no of users that can be supported in a single-
         cell CDMA system using a) omnidirectional base station antennas and no voice
         activity detection and b) 3 sectors at base station and activity detection with
         $\alpha=3/8$ assume the system is interference limited.
     (b)   Draw and explain 3GPP architecture        10

3    (a)   Draw and explain Signaling architecture of GSM.        10

     (b)   What is the concept of software Defined Radio        10

4    (a)   Classify small scale fading based on Multipath Time Delay Spread and    10
         Doppler spread and explain in brief each type.

     (b)   Explain Block Call delayed and Block Call cleared System        10

5    (a)   Draw reference architecture of GPRS and explain role of SGSN and GGSN    10

     (b)   Draw and explain IMT 2000 architecture        10

6.    Write short note on

       a) MIMO technique in LTE

       b) Rake Receiver

       c) Power control in CDMA 2000 and WCDMA

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(3 Hours) [Total Marks: 80]

**N.B.**
    (1) **Question No.1** is compulsory
    (2) **Attempt** any **three** questions from remaining questions.
    (3) **Figures** to right indicate **full** marks

1.   a) Explain the advantages and disadvantages of SONET/SDH     05
     b) Compare Linear and Nonlinear Scattering     05
     c) What is the Numerical Aperture of Fiber? Give its significance     05
     d) What is Optical Circulator? Give its applications.     05

2.   a) Explain in brief intermodal and intramodal dispersion in fiber     10

     b) A 6Km optical link consist of multimode step index fiber with a core refractive   10
       index of 1.5 and relative refractive index difference of 1%. Estimate
       (i) Delay difference between slowest and fastest modes at the fiber output
       (ii) RMS pulse spreading due to intermodal dispersion on the link
       (iii) Maximum bit rate that may be obtained without substantial errors on the link
          assuming only intermodal dispersion
       (iv) Bandwidth Length product corresponding to (iii)

3.   a) What are the different fiber fabrication methods? Explain double crucible method  10
       of fiber fabrication.

     b) What is optical amplifier? Compare different types of optical amplifiers     10

4.   a) Explain in detail working principle of PIN photodetector. Explain its merits
       and demerits     10

     b) What is OTN? Draw and explain its frame structure     10

5.   a) What are the advantages of OTDM? Explain its working principle     10

     b) Discuss the term power penalty with suitable system model     10

6.   Write short notes on any two     20

    a) Passive optical Network
    b) Dispersion compensation
    c) Performance and fault management in optical network
    d) Optical safety

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(3 Hours) Max Marks: 80

1. Question No. 1 is compulsory.
2. Out of remaining questions, attempt any three questions.
3. Assume suitable additional data if required.
4. Figures in brackets on the right hand side indicate full marks.

Q.1
(a) What factors limit transistor use at microwave frequencies? [5]
(b) Explain Doppler shift and its role in CW radar. [5]
(c) Explain the working of Phase shifter. [5]
(d) Explain the principle of working of quarter wave transformer. [5]

Q.2
(a) Explain how avalanche devices operate. Name three devices that use the [10] avalanche mode for their operation.
(b) Design single-stub (short circuit) shunt tuning networks to match a load [10] impedance $Z_L = 60 - j80\ \Omega$, to a 50 $\Omega$ line. Assuming that the load is matched at 2 GHz

Q.3
(a) Explain the working of a negative resistance parametric amplifier. [10]
(b) Explain the concept of velocity modulation. Also explain the working of [10] cylindrical magnetron.

Q.4
(a) Derive equation for phase velocity, cutoff frequency, cutoff wavelength and [10] field equations for rectangular waveguide.
(b) Explain how avalanche devices operate. Name three devices that use the [10] avalanche mode for their operation.

Q.5
(a) Derive the Radar range equation as governed by minimum detectable signal to [10] noise ratio.
(b) Draw the functional block diagram of an MTI Radar system and explain its [10] operation. Define the terms blind speed and MTI improvement factor.

Q.6
(a) Instrument landing system. [5]
(b) Ferrite device Isolator [5]
(c) Hybrid ring [5]
(d) Modes in Gunn diode [5]

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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 labelled diagram whenever necessary.
4) Assume suitable date if necessary.

Q.1 Solve **any four**.
(a) Describe activation function used in RBF neural network and it's properties. (5)
(b) What is λ cut set? Explain with an example. (5)
(c) Draw and explain working of AND and OR function using single neuron. (5)
(d) Prove De Morgan's Theorems for following fuzzy sets. (5)

$$A=\{\frac{0}{0}+\frac{0.5}{20}+\frac{0.65}{40}+\frac{0.85}{60}\}$$
$$B=\{\frac{0}{0}+\frac{0.45}{20}+\frac{0.6}{40}+\frac{0.8}{60}\}$$

(e) With mathematical list four different activation functions used in neurons. (5)

Q.2(a) Explain Error Back Propagation learning algorithm for the training of perceptron network. (10)

(b) Three fuzzy sets are defined as follows: (10)

$$A=\{\frac{0.1}{30}+\frac{0.2}{60}+\frac{0.3}{90}+\frac{0.4}{120}\}$$
$$B=\{\frac{1}{1}+\frac{0.2}{2}+\frac{0.5}{3}+\frac{0.7}{4}\}$$
$$c=\{\frac{0.33}{100}+\frac{0.67}{200}+\frac{0.92}{300}+\frac{0.21}{400}\}$$

Find the following:
(i) R=AXB (ii) S=B X C (iii) T =R o S (by max-min composition)
(iv) T=R o S (by max product composition)

Q.3(a) Explain ADALINE training algorithm with flow chart. (10)
(b) Explain with diagram any four fuzzy membership functions with diagrams and examples. (10)

Q.4(a) Explain in details discrete Hopfield network with training and testing algorithm. (10)
(b) Find the weights required to perform the following classifications using perceptron (10) network. The vectors (1 1 -1 -1); (1 -1 1 -1) are members of one class (target =1). Vectors (-1 -1 -1 1) and (-1 -1 1 1) are not members of the class (target = -1). Assuming learning rate = 1 and initial weights=0. (Max Epochs=2). Assume threshold =0.

Q.5(a) Describe with neat diagram the radial basis function neural network for function approximation. (10)
(b) Explain the application of fuzzy logic in image filtering. (10)

Q.6(a) Design a fuzzy controller for deciding the washing cycle duration. Inputs are washing (10) load and dirt. Justify the design for the washing time duration for high dirt and high load.
(b) Describe the application of neural network for dot matrix character recognition. (10)

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