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Total number of printed pages – 6

B. Tech
CPEC 5402

Seventh Semester Examination – 2007

DIGITAL IMAGE AND SPEECH PROCESSING

Full Marks – 70

Time – 3 Hours

Answer Question No. 1 which is compulsory
and any **five** from the rest.

The figures in the right-hand margin
indicate marks.

1. Answer the following questions : 2×10
- (i) What do you mean by vocabulary size in the context of speech processing ?
 - (ii) What are the applications of LPC analysis ?

P.T.O.

- (iii) What is a spectrogram ?
- (iv) What are wide and narrow band spectrums ?
- (v) State the reasons why a degraded image cannot be restored correctly.
- (vi) What kind of compression would be suitable for medical diagnostic ?
- (vii) What are 4-connectivity and 8-connectivity ?
- (viii) Describe the human speech production process for a vowel sound.
- (ix) What are the measures of the speech quality of a coder ?
- (x) What is the effect of the μ -law quantization ?
2. (i) What are the benefits of using four ink colors (cyan, magenta, yellow and black) in standard printing ? 2.5

- (ii) Describe operations on images which lighten a dark image. 2.5
- (iii) Describe operations to remove salt and pepper noise from an image. 2.5
- (iv) How will you locate 45° edges in an image ? 2.5
3. In image compression, following mechanisms are used to compress pixel data :
- (i) mapping the pixel values to some other set of values
- (ii) quantizing those values
- (iii) symbol encoding the resulting values
- Explain each mechanism. Describe how it helps in compressing images ? Also describe how it affects the visual quality of the decompressed image when compared with original image ? What are the different quality measures of compression ? 10

4. Develop a method to inspect shape of washers (Fig.-1) accurately. You are given a binary image of the washer as input. If the size does not meet predefined standard it will be rejected otherwise accepted. 10



(Fig. - 1)

5. Given the sequence $x = (1, -1, 1, -1)$ 10
- Guess the coefficients of an LPC of order 2 with a prediction error as small as possible.
 - Calculate the prediction error.
 - Give the name of an efficient method to invert matrices that can be used for the calculation of the LPC coefficients.
 - What are the mathematical assumptions on the structure of the matrix?

6. Following is the transfer function for the vocal tract :

$$H(z) = \frac{1}{-\frac{1}{2}z^{-2} + 1 - \frac{2}{3}z^{-1}} \quad 10$$

- What are the Poles?
 - Give the corresponding general linear constant coefficient difference equation.
 - How do the poles relate to the characteristics of the speech generated by the vocal tract?
7. Given a Hidden Markov Model with $N=10$ different states and an observation sequence of length $T=100$. Assume a fully connected HMM (including backwards connection). Give the approximate number of multiplications needed when (a) using Viterbi, (b) calculating all possible sequences. 10

8. Write short notes on the following : 10

- (i) Mel filter bank
- (ii) Levinson-Durbin recursion algorithm
- (iii) STFT
- (iv) Hue, Saturation and Intensity.

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