M.E. IT (ICE) 2nd Semester Examination, 2012
Sub: Digital Voice and Picture Processing (ICE-1001)
Answer any FIVE questions. The questions are of equal value.

Full Marks: 70 Time- 3 hours

1. What are the critical differences in functionality of waveform approximating coders and parametric coders? Highlight the main objectives of linear prediction vocoders along with its main weakness. Briefly explain the role of different factors in designing speech coding algorithm.
In standard telephony, the voice is filtered to 4000 Hertz (4 kHz) and then sampled at 8000 samples per second. Each sample is then quantized to one of 256 possible levels, represented by 8 bits. Determine the total number of bits required to transmit the signal. Also find out theoretical minimum transmission bandwidth required to transmit above PCM signal.

3+ 3 + 4 + 4 = 14

2. a) What are the critical differences between forward and backward adaptive quantizer?
b) With a block diagram, explain what is meant by vector quantization. Write down the two necessary conditions for optimality in codebook design.
c) How can you realize a speech production system using filter bank in digital domain? Hence develop solution to LPC analysis based on covariance method.

3 +(2+2) +(3 + 4)=14

3. a) Highlight the relative merits and demerits of full search and binary search codebook. Draw the block-diagram of a two-stage cascaded vector quantization and show that both the computation and storage requirements reduce with an increase in the number of stages.
b) Write down the different steps for K-means algorithm in codebook design and also comment on the solutions thus obtained.
c) Mention the role of variance of the input speech signal on vector quantization and show mathematically that how shape vectors minimizes the distortion in codebook design.

(3+ 4) + 3 + 4 = 14

4. a) What is speech intelligibility? Derive the mathematical expression that determines the number of bits needed in the quantizer for certain signal to quantization noise ratio (SNR) and in estimating the performance of a uniform quantizer for a given bit rate.
b) Highlight the critical differences in one-shot optimization and iterative sequential approach to overcome the delay problem in mean square error solution

while designing pitch prediction filter. Derive the expression of pitch prediction gain for one-shot method and write down the expression of pitch filter for three-tap.

(2+4) + (3 + 5) = 14

5. What are the principal ways to estimate degradation function for use in image restoration? What are the major problems associated with inverse filtering for still picture restoration and explain how the problems can be tackled using Wiener filtering? Now, mention the additional difficulty in Wiener filleting and explain how does constrained least square filtering solve it?

(2+2+3+2+5)

6. a) Given a low contrast digital picture, develop mathematical form of a transformation function which when applied on the picture yields high contrast one.

b) Briefly explain, highlighting the relative contribution of illumination and reflectance components, digital still picture enhancement using homomorphic filtering.

C) Write down the transfer function of an ideal notch reject filter and hence design an optimum notch filtering for periodic noise reduction in digital picture.

3+5+(2+4)

7. Why do we do image compression? What are the various forms of redundancy present in a picture signal? –briefly explain them. How does transform coding help in image compression over spatial domain approach? Why is DCT preferred to DFT for block transform coding? Briefly describe the algorithm for JPEG compression of an 8-bit/pixel grayscale picture.

(2+3+2+3+4)