Bengal Engineering and Science University
M.E. 1st. Sem. E&T.C. Final Examination 2012-November
Subject: Digital Signal Processing and its Application (ETC-940)

Answer any 5, taking at least 2 from each group

Time 3 hours **Full Marks: 70**

GROUP A

1. a) Explain the algorithm of sign-magnitude multiplication and 2's-compliment multiplication, which are used in digital signal processing, with necessary circuit diagram.
   b) Write notes on: Short term spectrum analysis. (14)

2. a) Draw the schematic diagram of the human speech production mechanism and explain its operation in brief.
   b) Draw and explain the digital model of speech production system.
   c) Compare human and digital model of speech production system. (14)

3. a) State the basic elements of digital image processing system and describe the operation of each element in brief.
   b) Show that the Fourier transform of the autocorrelation function of f(x) is the power spectrum $|F(u)|^2$. (14)

4. a) What do you mean by non linearity ?
   b) Two nonlinear stages are cascaded. If the input / output characteristic of each stage is approximated by a third order polynomial , determine the P_{1bB} of the cascade in terms of the P_{1dB} of each stage.
   c) Explain the differences between cross modulation and intermodulation. (14)

GROUP B

5. (a) Derive the relationship between Continuous Fourier Transform and Discrete Time Fourier Transform. Illustrate with diagram the effect in frequency domain of sampling rate reduction by an integer factor. (14)
   (b)State and prove the condition for stability of Linear time-invariant system
   (c) What are the properties of Region of Convergence for Z-transform

6. Determine the inverse Z-transform for the following

(a)

$$X(z) = \frac{3z^{-3}}{\left(1 - \frac{1}{4}z^{-1}\right)^2}, \qquad x[n] \text{ left sided}$$

(b)

$$X(z) = \frac{1}{\left(1 + \frac{1}{2}z^{-1}\right)^2 (1 - 2z^{-1})(1 - 3z^{-1})}, \qquad \text{stable sequence}$$

(c)

$$X(z) = \frac{z^7 - 2}{1 - z^{-7}}, \qquad |z| > 1$$

(14)

7. Consider a causal linear time invariant system whose system function is

$$H(z) = \frac{1 - \frac{1}{5}z^{-1}}{\left(1 - \frac{1}{2}z^{-1} + \frac{1}{3}z^{-2}\right)\left(1 + \frac{1}{4}z^{-1}\right)}$$

Draw the signal flow graphs for implementations of the system in each of the following forms:

(i) **Direct form I**
(ii) **Direct form II**
(iii) **Cascade form using first- and second-order direct form II sections**
(iv) **Parallel form using first- and second-order direct form II sections**

(14)

8. Write notes on

(a) Digital IIR filter design using impulse invariance
(b) The JPEG Standard (14)