

(3 Hours)

(Total Marks : 80)

Note the following instructions.

1. **Question No.1 is compulsory.**
2. Attempt **any three** questions from remaining **five** questions.
3. **Figures** to the **right** indicate **full marks**.

1. Answer **any four** questions :

- (a) Explain speech recognition system with a block diagram [5]
- (b) Using vowel triangle, how do we categorize different vowels [5]
- (c) Explain the human speech production system with the help of a schematic representation of its physiological mechanism. [5]
- (d) Explain pitch period estimation using parallel processing approach [5]
- (e) What is pre-emphasis and how can it help in speech analysis [5]

2. (a) Explain the two interpretations of STFT. Give expressions for each case. Also derive the Sampling rate of STFT [10]

(b) Draw and explain a general discrete time model of speech production system. [10]

3. (a) Derive the overall transfer function (frequency response of uniform tube in terms of volume velocities at glottis and lips) for a uniform lossless tube model of the vocal tract [10]

(b) With the help of block diagram, explain the working of clipping auto correlator. What are the advantages of using three level clipper? [10]

4. (a) Explain in detail the procedure for computation of pitch and formants based on cepstral analysis of speech. [10]

(b) Explain template matching approach using Dynamic time warping technique (DTW) [10]

5. (a) With related equations explain the terms Short time energy, short time magnitude and short time zero crossing rate. How do you distinguish voiced and unvoiced segments based on these parameters? [10]

(b) Explain in detail RELP with a block diagram [10]

6. Write short note on **(any two)** : [20]

- (a) Mel frequency cepstral coefficients (MFCC)
- (b) Code excited LP (CELP) based vocoders
- (c) Speech recognition systems