Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER IV (NEW) – • EXAMINATION – SUMMER 2016

Subject Code: 2744101 Date:04/05/2016

Subject Name: Advanced Topics in Signal and Image Processing

Time:10:30 am to 01:00 pm Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Obtain the Direct Form I and II realizations for a third-order IIR Transfer function which is expressed as below: **07**

$$H(z) = \frac{0.28\,Z^2 + 0.319Z + 0.04}{0.5Z^3 + 0.3Z^2 + 0.17Z - 0.2}$$

(b) Explain: Poly-phase Realization of FIR Filters. **07**
Draw the Poly-phase realization of the system transfer function,
$H(z) = 1 - 4Z^{-1} - 3Z^{-2} + 6Z^{-3} - 9Z^{-4} + 5Z^{-5} + 7Z^{-6}$

Q.2 **(a)** Do the following: **07**

(1) Prove that filter with the following response has linear phase response: $h(n) = \{2,1,1,2\}$

(2) An FIR filter (M=11) is characterized by the following transfer function, $H(z) = \sum_{n=0}^{M-1} h(n)z^{-n}$. Determine the magnitude response and also prove that the phase and group delay are constant.

(b) Design a Low Pass FIR filter using frequency sampling technique having cutoff frequency of $\frac{\pi}{2} rad/sample$. The filter have linear phase 4 and length 17. The Desired filter response is $H_d(w) = \begin{cases} e^{-jw\left(\frac{M-1}{2}\right)}, & for\ |w| \le w_c \\ 0, & elsewhere \end{cases}$. **07**

OR

(b) Compare the followings: **07**

(1) Window design method and Frequency sampling method.

(2) Impulse Invariant and Bilinear Transformation method.

Q.3 **(a)** Design a single pole low pass digital filter with 3dB bandwidth of 0.2π by use of bilinear transformation applied to analog filter, $H_a(s) = \frac{\Omega_c}{S+\Omega_c}$, where Ω_c is the 3dB bandwidth of analog filter. **07**

(b) Explain Elliptic Filters in details with suitable mathematical equations. **07**

OR

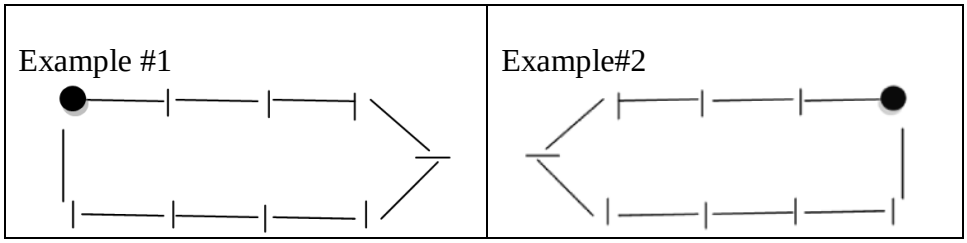
Q.3 **(a)** Determine *H(z)* using Impulse Invariant method at *5Hz*. Sampling frequency from $H_a(s)$ as given below: **07**

$$Ha(s) = \frac{2}{(s+1)(s+2)}$$

(b) Explain Butterworth filter approximation method in detail with suitable mathematical equations. **07**

Q.4 **(a)** Explain: Up-Sampler in detail with suitable equations. **07**

(b) Determine :Chain Codes, First Difference and Shape Number for the following shapes: (Use anti clockwise direction) **07**



OR

Q.4 **(a)** Explain: Filtering for Fractional sampling rate converter. **07**

(b) Explain: Fourier Descriptor in Detail with suitable mathematics. **07**

Q.5 **(a)** An image retrieval system produced the following 10 ranked results for a search operation against a database of 500 images, of which 5 are relevant to query: **07**

Rank	Result
1	R
2	R
3	N
4	R
5	N
6	N
7	N
8	R
9	N
10	R

Where R means *relevant* and N means *not relevant*. Compute Precision and Recall for each point. Also plot the ROC .

(b) Explain: Nearest Neighbor Classifier in detail with suitable mathematics. **07**

OR

Q.5 **(a)** Explain Medial Axis Transform Algorithm and produce the output of the MAT algorithm on the given image. **07**

1	1	1	1	1	1
1	1	1	1	1	1
1	1	1	1	1	1
1	1	1	1	1	1
1	1	1	1	1	1

(b) Explain: Bayesian Classifier in detail with suitable mathematics. **07**

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