GUJARAT TECHNOLOGICAL UNIVERSITY ME – SEMESTER IV (NEW) – • EXAMINATION – WINTER 2016

Subject Code: 2744101

Date: 26/10/2016

Subject Name: Advanced Topics in Signal and Image Processing Time:02:30 pm to 05:00 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) Compare canonic and non-canonic filter structure. Obtain the Direct Form-I 07 realization for the system described by the following difference equation: y(n) = 0.5y(n-1) = 0.25y(n-2) + y(n) + 0.4y(n-1)

$$y(n) = 0.5y(n-1) - 0.25y(n-2) + x(n) + 0.4x(n-1)$$

(b) Determine and draw the cascade and parallel realization for the system 07 described by the system function:

$$H(z) = \frac{10\left(1 - \frac{1}{2}Z^{-1}\right)\left(1 - \frac{2}{8}Z^{-1}\right)(1 - 2Z^{-1})}{\left(1 - \frac{3}{4}Z^{-1}\right)\left(1 - \frac{1}{8}Z^{-1}\right)(1 - Z^{-1} - \frac{1}{2}Z^{-2})}$$

- **Q.2** (a) Do the following:
 - (1) The length of an FIR Filter is 9. If the filter has a linear phase, prove that the following equation is satisfied: $\sum_{n=0}^{M-1} h(n) \sin(\omega \alpha - \omega n) = 0$
 - (2) A 4th order FIR filter has zeros: $z_1, z_2 = 0.5 e^{\pm j\frac{\pi}{6}}$ and $z_3, z_4 = 2 e^{\pm j\frac{\pi}{3}}$ state whether filter has linear phase property.
 - (b) Design a Low Pass digital filter used in A/D-H(Z)-D/A structure that will have 07 a -3dB cutoff at $30\pi rad/sec$ and attenuation of 50dB at $45\pi rad/sec$. The filter is required to have a linear phase and system has sampling rate of 100samples/sec.(Use hamming window).

OR

(b) Explain : FIR Differentiator in detail with suitable mathematics.
(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) = Ω_c/(S+Ω_c), where Ω_c is

the 3dB bandwidth of analog filter.

- (b) Explain Elliptic Filters in details with suitable mathematical equations. 07 OR
- **Q.3** (a) Determine H(z) using Impulse Invariant method for the following system 07 function:

$$Ha(s) = \frac{1}{(s+0.5)(s^2+0.5s+2)}$$

- (b) Explain the design steps for IIR Filter design using approximation of derivates. 07
- Q.4 (a) Explain: Down-Sampler in detail with suitable equations.
 - (b) Determine :Chain Codes, First Difference and Shape Number for the following 07 shapes: (Use anti clockwise direction and 8-direction chain code)

07

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OR

- Q.4 (a) Explain: Filtering for Multi stage decimator with suitable example.(b) List and Explain desirable properties of descriptors.
- Q.5 (a) Given the confusion matrix for classification of numbers between 0 to 07 9, calculate the precision and recall per category.

			0								
True Tables	Class "0"	34	0	0	0	0	0	38	0	0	28
	Class "1"	0	54	5	1	0	2	0	38	0	0
	Class "2"	0	9	39	13	12	7	0	20	0	0
	Class "3"	0	4	15	32	29	18	0	2	0	0
	Class "4"	1	0	8	30	23	36	0	2	0	0
	Class "5"	0	0	15	28	28	29	0	0	0	0
	Class "6"	37	0	0	0	0	0	33	0	1	29
	Class "7"	0	33	19	1	1	1	0	45	0	0
	Class "8"	0	0	0	0	0	0	0	0	98	2
	Class "9"	32	0	0	0	1	0	37	0	0	30
	Number of times alogaified as										

Matching table for test set

Number of times classified as

- (b) Explain: Minimum Distance Classifier in detail with suitable mathematics. 07OR
- Q.5 (a) For two-class KNN classifier, consider the following training set in 2D feature space. Instances for two classes are shown by square (□) and circle (○). A test instance is shown by a filled triangle (▲).
 - 1. What would be the class assigned to this test instance for k=1, k=3 and k=5.
 - 2. Is there a value of k for which the classifier would always predict the Class shown by square (\Box) ? If yes, specify the value of k. If not, mention the reason.



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

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