

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

**Course Code: EE407**

**Course Name: DIGITAL SIGNAL PROCESSING**

Max. Marks: 100

Duration: 3 Hours

**PART A**

*Answer all questions, each carries 5 marks.*

Marks

- |   |  |     |
|---|--|-----|
| 1 | State any five properties of DFT.  | (5) |
| 2 | Explain single stage lattice structure for an FIR filter with neat diagram and equations.                                    | (5) |
| 3 | For the analog transfer function $H(s) = \frac{1}{(s+1)(s+2)}$ , determine H(z) using impulse invariance method for T=1 sec. | (5) |
| 4 | What do you understand by linear phase response? Mention the characteristics of linear phase FIR filter.                     | (5) |
| 5 | What is meant by product quantization error in digital signal processing?  | (5) |
| 6 | Define is zero input limit cycle oscillation with an example.  | (5) |
| 7 | Define the function of (i) Program Counter (ii) Program Address Register (iii) Stack and (iv) Microstack                     | (5) |
| 8 | How the instruction set of TMS 320C24x processor is classified?  | (5) |

**PART B**

*Answer any two full questions, each carries 10 marks.*

- |    |  |      |
|----|--|------|
| 9  | Calculate the 8-point DFT of x[n] using Decimation in Frequency FFT Algorithm. x[n]= {0,1,2,3,4,5,6,7}                                     | (10) |
| 10 | a) Perform the linear convolution of the following sequences using overlap-add method. x(n) = {1, -2, 2, -1, 3, -4, 4, -3} and h(n)={1,-1} | (5)  |
|    | b) Determine the cascade form realization for the transfer function of an FIR digital filter which is given by                             | (5)  |
|    | $H(Z) = \left(1 - \frac{1}{4}Z^{-1} + \frac{3}{8}Z^{-2}\right) \left(1 - \frac{1}{8}Z^{-1} - \frac{1}{2}Z^{-2}\right)$                     |      |
| 11 | Realize using direct 1 form, direct-2 form and cascade form representation of filter given by transfer function                            | (10) |

$$H(z) = \frac{8 - 4z^{-1} + 11z^{-2} - 2z^{-3}}{\left(1 - \frac{1}{4}z^{-1}\right)\left(1 - z^{-1} + \frac{1}{2}z^{-2}\right)}$$

### PART C

*Answer any two full questions, each carries 10 marks.*

- 12 Using Bilinear transformation, design a Butterworth filter which uses a sampling rate of 1 kHz, to satisfy following specifications (10)

$$0.8 \leq |H(e^{j\omega})| \leq 1 \text{ for } 0 \leq |\omega| \leq 0.2\pi$$

$$|H(e^{j\omega})| \leq 0.2 \text{ for } |\omega| \geq 0.6\pi$$

- 13 a) Derive the equation for transformation of H(s) to H(z) using impulse invariance method. Discuss about stability of the system after transformation. (5)
- b) Compare Rectangular and hanning window with the help of required equations. (5)
- 14 Using frequency sampling method, design a band pass filter with following specifications. (10)

Sampling frequency  $f=10$  kHz, Cut-off frequencies  $f_{c1} = 2000$  kHz and  $f_{c2} = 4000$  kHz. Take  $N=7$ .

### PART D

*Answer any two full questions, each carries 10 marks.*

- 15 a) In the given IIR system, the products are rounded to 4 bits including sign bit. (7)

$$H(z) = \frac{1}{(1 - 0.35z^{-1})(1 - 0.62z^{-1})}$$

Find the output round off noise power in direct form realization.

- b) Compare the fixed point and floating point arithmetic. (3)
- 16 a) What are the methods used to prevent overflow in digital filter implementations? (5)
- b) Define any five I/O instructions used in TMS320C24x (5)
- 17 What are the addressing modes in TMS 320C24x processor? Describe with examples. (10)

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**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
SEVENTH SEMESTER B.TECH DEGREE EXAMINATION(S), MAY 2019

**Course Code: EE407**

**Course Name: DIGITAL SIGNAL PROCESSING**

Max. Marks: 100

Duration: 3 Hours

**PART A**

*Answer all questions, each carries 5 marks.*

Marks

- |   |  |     |
|---|--|-----|
| 1 | What is the need of zero padding? Obtain linear convolution of the sequence $x(n)=\{1,2,3\}$ , $h(n)=\{-1,-2\}$ using circular convolution.  | (5) |
| 2 | Realize the system function using minimum number of multipliers<br>$H(z) = (1 + Z^{-1})(1 + \frac{1}{2}Z^{-1} + \frac{1}{2}Z^{-2} + Z^{-3})$ | (5) |
| 3 | For the analog transfer function $H(s) = \frac{10}{(s^2+7s+10)}$ , determine $H(z)$ using impulse invariant method for $T=0.2$ sec           | (5) |
| 4 | Compare Hamming and Barlett windows with required equations.   | (5) |
| 5 | Express the fraction $7/8$ and $-7/8$ in sign magnitude, 1's complement and 2's complement.  | (5) |
| 6 | What is zero input limit cycle oscillation?  | (5) |
| 7 | What are the different buses of TMS 320 C24x processor and their functions?  | (5) |
| 8 | Define any 5 arithmetic and logic instructions in TMS 320 C24x processor.  | (5) |

**PART B**

*Answer any two full questions, each carries 10 marks.*

- |    |   |      |
|----|---|------|
| 9  | Determine the 8-point DFT of the following sequence.<br>$x(n)=\{0.5, 0.5, 0.5, 0.5, 0, 0, 0, 0\}$ . Using radix-2 decimation in time FFT algorithm. | (10) |
| 10 | a) Perform the linear convolution of the following sequence by Overlap save method. $x(n)=\{1,2,3,-1,-2,-3,4,5,6\}$ and $h(n)=\{2,1,-1\}$           | (5)  |
|    | b) Obtain direct form II realization of a system described by,<br>$y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n) + \frac{1}{2}x(n-1)$         | (5)  |
| 11 | Obtain the cascade and parallel realizations for the system function  | (10) |

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

**PART C**

*Answer any two full questions, each carries 10 marks.*

- 12 Design a digital Butterworth filter satisfying the constraints: (10)

$$0.9 \leq |H(e^{jw})| \leq 1 \quad \text{for } 0 \leq w \leq \pi/2$$

$$|H(e^{jw})| \leq 0.2 \quad \text{for } 3\pi/4 \leq w \leq \pi,$$

with T=1 sec using bilinear transformation.

- 13 a) Write down the transfer function H(s) of a 2<sup>nd</sup> order Chebyshev low pass filter (6)  
with 3 dB cut-off frequency of 1 rad/sec. Determine H(z) by using approximation of derivative method with a sampling interval of 1 sec.

- b) Compare IIR and FIR filters. (4)

- 14 Design a high pass filter with a frequency response (10)

$$H(e^{jw}) = 1, \quad \frac{\pi}{6} \leq |w| \leq \pi$$

$$= 0, \quad \text{otherwise}$$

using Hanning window. Take N=7

**PART D**

*Answer any two full questions, each carries 10 marks.*

- 15 a) Draw the product quantization noise model of a second order IIR system. (5)

- b) Two first order filters are connected in cascade whose system functions of the (5)  
individual sections are  $H_1(z) = 1/(1 - 0.5z^{-1})$  and  $H_2(z) = 1/(1 - 0.6z^{-1})$ .

Determine overall output noise power.

- 16 a) Obtain the limit cycle behaviour of the system described by (5)

$$y(n) = Q[ay(n-1)] + x(n), \quad \text{where } y(n) \text{ is the output of the filter and } Q[\cdot] \text{ is the}$$

rounded operation. Assume  $a = \frac{7}{8}$ ,  $x(0) = \frac{3}{4}$  &  $x = 0$ , for  $n > 0$  choose 4 bit

sign magnitude.

- b) What are the functions of TREG and PREG in TMS 320 C24x processor? (5)

- 17 Draw and describe the functional block diagram of TMS 320 C24x processor. (10)

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**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
SEVENTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), DECEMBER 2019

**Course Code: EE407**

**Course Name: DIGITAL SIGNAL PROCESSING**

Max. Marks: 100

Duration: 3 Hours

**PART A**

*Answer all questions, each carries 5 marks.*

Marks

- |   |  |     |
|---|--|-----|
| 1 | The first five points of the 8 point DFT of a real valued sequence are $\{28, -4 + 9.565j, -4 + 4j, -4 + 1.656j, -4\}$ . Determine the remaining three points. | (5) |
| 2 | Explain transposed structure with an example.  | (5) |
| 3 | Describe warping effect with a diagram.  | (5) |
| 4 | What is the principle of designing FIR filter using frequency sampling method.   | (5) |
| 5 | What is meant by rounding? Explain its effect on all types of number representations.  | (5) |
| 6 | Express 0.875 and $-0.875$ in sign-magnitude, two's complement, and one's complement format.   | (5) |
| 7 | With a block diagram, describe Central Arithmetic Logic Unit in TMS 320 C24x in detail.  | (5) |
| 8 | How instruction set is classified in TMS 320 C24x processor?   | (5) |

**PART B**

*Answer any two full questions, each carries 10 marks.*

- |    |   |      |
|----|---|------|
| 9  | Find IDFT of the sequence $X(k) = \{4, 1 - 2.414j, 0, 1 - 0.414j, 0, 1 + 0.414j, 0, 1 + 2.414j\}$ using radix 2 DIF FFT algorithm.                | (10) |
| 10 | a) Consider the sequence $x_1(n) = \{0, 1, 2, 3, 4\}$ , $x_2(n) = \{0, 1, 0, 0, 0\}$ . Determine a sequence $y(n)$ so that $Y(K) = X_1(K) X_2(K)$ | (5)  |
|    | b) Realise the given Transfer function with minimum number of multipliers.  | (5)  |
|    | $H(Z) = 1 + \frac{1}{3}Z^{-1} + \frac{1}{4}Z^{-2} + \frac{1}{4}Z^{-3} + \frac{1}{3}Z^{-4} + Z^{-5}$   |      |
| 11 | Obtain direct form II, cascade form and parallel form realization of the LTI system governed by   | (10) |

$$y(n) = \frac{-3}{8} y(n-1) + \frac{3}{32} y(n-2) + \frac{1}{64} y(n-3) + x(n) + 3x(n-1) + 2x(n-2)$$

**PART C**

*Answer any two full questions, each carries 10 marks.*

- 12 Design a low pass Butterworth digital filter to give attenuation of 3dB or less for frequencies up to 2kHz and attenuation of 20dB or more beyond 4kHz. Use bilinear transformation and obtain H(z) of the desired filter. Given sampling interval T=0.1 millisecond. (10)
- 13 a) Write down the transfer function H(s) of a 3<sup>rd</sup> order Chebyshev low pass filter and cut-off frequency of 1 rad/sec. Determine H(z) by using approximation of derivative method with a sampling interval of 1 sec. (7)
- b) What is the need for windowing technique for FIR filter design? (3)
- 14 Design a bandpass filter to pass the frequency in the range 1-2 rad/samples using Hamming window. Also find frequency response of the filter. Take N=5. (10)

**PART D**

*Answer any two full questions, each carries 10 marks.*

- 15 a) Obtain the limit cycle behaviour of the system described by  $y(n) = Q[ay(n-1)] + x(n)$ , where  $y(n)$  is the output of the filter and  $Q[.]$  is the rounded operation. Assume  $a = -\frac{1}{2}$ ,  $x(0) = 0.875$  &  $x = 0$ , for  $n > 0$  choose 4 bit including sign bit. (6)
- b) Draw the product quantization noise model of IIR system with two first order sections in cascade. (4)
- 16 a) The output of an ADC is applied to a digital filter with system function  $H(z) = \frac{0.5z}{(z-0.5)}$ . Find the output noise power from digital filter when input signal is quantized to have 8 bits. (5)
- b) Define any 5 branching instructions in TMS 320 C24x processor. (5)
- 17 Draw the internal architecture of Central Processing Unit of TMS 320 C24x processor and define each block. (10)

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**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
SEVENTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), MARCH 2020

**Course Code: EE407**

**Course Name: DIGITAL SIGNAL PROCESSING**

Max. Marks: 100

Duration: 3 Hours

**PART A**

*Answer all questions, each carries 5 marks.*

Marks

- |   |   |     |
|---|---|-----|
| 1 | How circular and linear convolutions are performed using DFT?   | (5) |
| 2 | State and explain flow graph reversal theorem   | (5) |
| 3 | What do you mean by frequency warping? An ideal discrete time high pass filter with cut off frequency $\pi/2$ was designed using bilinear transformation with $T=1$ sec. What is the cut off frequency of the continuous time ideal high pass filter? | (5) |
| 4 | What is a linear phase filter? What conditions are to be satisfied by an FIR filter in order to have linear phase?  | (5) |
| 5 | What is the effect of quantization of filter coefficients in digital filters?   | (5) |
| 6 | What do you mean by dead band of a filter? How will you compute the dead band of the system $y(n) = 0.8y(n - 1) + x(n)$ ?   | (5) |
| 7 | What are the elements in the control unit of TMS 320 C24x DSP Processor?  | (5) |
| 8 | Which are the TREG, PREG and Multiply Instructions of TMS 320 C24x DSP Processor?   | (5) |

**PART B**

*Answer any two full questions, each carries 10 marks.*

- |    |   |      |
|----|---|------|
| 9  | Given $x(n) = \{1, 2, 3, 4, 4, 3, 2, 1\}$ , Compute 8-point DFT of $x(n)$ using DIT FFT algorithm   | (10) |
| 10 | a) Find the output $y(n)$ of a filter whose impulse response is $h(n) = \{2, 2\}$ and the input signal to the filter is $x(n) = \{-2, 0, 2, 1, 3, 1, -1, -2\}$ using overlap-save method  | (5)  |
|    | b) Realize the system function $H(z) = 1 + \frac{3}{4}z^{-1} + \frac{17}{8}z^{-2} + \frac{3}{4}z^{-3} + z^{-4}$ using minimum number of multipliers.  | (5)  |
| 11 | Consider the discrete time, linear, causal system described by the difference equation $y(n) - \frac{3}{4}y(n - 1) + \frac{1}{8}y(n - 2) = x(n) + \frac{1}{3}x(n - 1)$ . Obtain the direct form I and Direct form II realizations of the system | (10) |

**PART C**

*Answer any two full questions, each carries 10 marks.*

- 12 Design a digital Butterworth filter using bilinear transformation which satisfies (10)  
the following conditions:

$$0.75 \leq |H(e^{j\omega})| \leq 1, \quad 0 \leq \omega \leq 0.2\pi$$

$$|H(e^{j\omega})| \leq 0.2, \quad 0.5\pi \leq \omega \leq \pi$$

Take sampling time T=1 sec

- 13 a) Can we physically realise an ideal filter? Justify your answer (2)  
b) What is impulse invariant transformation? What are its disadvantages? (3)  
c) Which are the desirable characteristics of windows? (2)  
d) What is Gibb's phenomenon? (3)
- 14 Design an ideal low pass filter, whose desired frequency response given by (10)

$$H_d(e^{j\omega}) = \begin{cases} 1 & \text{for } -\pi/3 \leq \omega \leq \pi/3 \\ 0 & \text{for } \pi/3 \leq |\omega| < \pi \end{cases}$$

Determine the filter coefficients, using Hanning window. Determine the impulse response and H(z). Given N=9.

**PART D**

*Answer any two full questions, each carries 10 marks.*

- 15 a) Draw the quantization noise model of the first order system function (6)  
 $H(z) = \frac{1}{1 - 0.4z^{-1}}$ . Products are rounded to 4 bits including sign bit. Find the  
steady state noise power due to product round off.  
b) Explain signal scaling in digital filters. (4)
- 16 a) What are the possible errors due to truncation, in sign magnitude and two's (5)  
complement representations if the system uses b+1 bits including sign bit for the  
number representation?  
b) Explain the bus structure of TMS 320 C24x DSP Processor (5)
- 17 a) Explain in detail indirect addressing mode of TMS 320 C24x DSP Processor (5)  
with examples  
b) Discuss about any five Accumulator, arithmetic, and logic instructions of TMS (5)  
320 C24x DSP Processor with examples

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**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

Seventh semester B.Tech examinations (S), September 2020

**Course Code: EE407****Course Name: DIGITAL SIGNAL PROCESSING**

Max. Marks: 100

Duration: 3 Hours

**PART A***Answer all questions, each carries 5 marks.*

Marks

- 1 What is the necessity of computing Fast Fourier Transform? Calculate the number of multiplication needed in the calculation of DFT using FFT algorithm with 32 point sequence. (5)
- 2 Check whether the following transfer function is of linear phase. Justify your answer.  $H(z) = \left(\frac{1}{2} + z^{-1} + \frac{1}{2}z^{-2}\right)\left(1 + \frac{1}{3}z^{-1} + z^{-2}\right)$  (5)
- 3 How s-plane is mapped to z-plane using impulse invariant transformation? Comment on the stability of the filter after this transformation. (5)
- 4 What do you mean by Gibbs phenomenon in connection with FIR filter design. How its effect can be reduced? (5)
- 5 Explain product quantization error and obtain the quantization noise model for a second order system. (5)
- 6 What is truncation? What is the error caused due to truncation of a number to b bits? (5)
- 7 What are the memory and I/O spaces used in TMS320C24x processor? (5)
- 8 Explain (i) Interrupt flag register (ii) Microstack (iii) Scaling shifters (5)

**PART B***Answer any two full questions, each carries 10 marks.*

- 9 Given  $x(n) = \{1, 2, 3, 4, 4, 3, 2, 1\}$ , find  $X(K)$  using DIF FFT algorithm. (10)
- 10 a) How will you compute linear convolution using DFTs? (5)
- b) Realize the following system function using minimum number of multipliers: (5)

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

(10)

- 11 Obtain the direct form II and cascade realization of

$$y(n) = x(n) + 2x(n-1) + \frac{1}{2}y(n-1) - \frac{1}{2}y(n-2)$$

**PART C**

*Answer any two full questions, each carries 10 marks.*

- 12 (a) Find the order of an analog Butterworth filter that has a -2dB passband attenuation at a frequency of 20rad/sec and atleast -10dB stopband attenuation at 30rad/sec (5)
- (b) With the help of neat diagrams, explain frequency warping. How it can be eliminated? (5)
- 13 a) For the analog transfer function  $H(s) = \frac{2}{(s+2)(s+3)}$ , determine  $H(z)$  using bilinear transformation method for  $T=1$  sec. (5)
- b) The desired frequency response of a lowpass filter is given below. (5)

$$H_d(\omega) = \begin{cases} e^{-j3\omega} & \text{for } -\frac{\pi}{4} \leq \omega \leq \frac{\pi}{4} \\ 0 & \text{for } \frac{\pi}{4} \leq |\omega| \leq \pi \end{cases}$$

. Obtain the filter coefficients  $h(n)$  by using a rectangular window.

- 14 Using frequency sampling method design an FIR lowpass filter with  $\omega_c = \frac{\pi}{4}$  rad/sec for  $N=15$ . (10)

**PART D**

*Answer any two full questions, each carries 10 marks.*

- 15 Find the effect of coefficient quantization on pole locations of the given IIR system when it is realised in cascade form. Assume a word length of 3 bits excluding sign bit. (10)

$$H(z) = \frac{1}{1 - 0.8z^{-1} + 0.15z^{-2}}$$

- 16 a) Check whether limit cycle exists for the following first order IIR filter with difference equation  $y(n) = x(n) + Q[ay(n-1)]$  if  $a = -\frac{1}{3}$  and the input  $x(n) = 0.875, n = 0$  and  $x(n) = 0, n \neq 0$  and  $y(-1) = 0$ . The data register length is 4 bits including sign bit.  $Q[.]$  represents rounding operation. (5)
- b) How the instruction sets of TMS320C24x processor are classified? (5)
- 17 With a functional block diagram, explain the main architectural features of TMS320C24x processor. (10)

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**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

Seventh Semester B.Tech Degree Examination (Regular and Supplementary), December 2020

**Course Code: EE407****Course Name: DIGITAL SIGNAL PROCESSING**

Max. Marks: 100

Duration: 3 Hours

**PART A***Answer all questions, each carries 5 marks.*

Marks

- 1 State and prove complex conjugate property of Discrete Fourier Transform (DFT). (5)
- 2 Draw the cascade structure of the FIR filter represented by the system function  $H(z) = (1 + 2z^{-1})\left(1 + \frac{1}{2}z^{-1} + z^{-2}\right)$  (5)  
Can you realize this system using minimum number of multipliers?
- 3 Convert the analog filter with system function  $H(s) = \frac{s + 0.1}{(s + 0.1)^2 + 9}$  into a digital filter by means of the impulse invariance method. Sampling time  $T=1\text{sec}$ . (5)
- 4 What is the advantage of windowing technique in FIR filter design? What are the desirable characteristics of a window used to truncate the infinite impulse response? (5)
- 5 What are the common methods of quantization? Explain. (5)
- 6 With suitable example explain floating point number representation (5)
- 7 What are the functions of Auxiliary Register Arithmetic Unit (ARAU) of TMS320C24x DSP Controller? (5)
- 8 With diagram explain the multiplication operation in TMS320C24x DSP Controller. (5)

**PART B***Answer any two full questions, each carries 10 marks.*

- 9 a) Find the 8 point DFT of the sequence  $x(n)=\{5,4,3,2,2,3,4,5\}$  using Decimation in Time FFT algorithm. (10)
- 10 a) Explain circular time shift property of DFT. Let  $x(n)=\{1,2,3,4,5\}$ . The five point DFT of  $x(n)$  is denoted as  $X(k)$ . If  $Y(k) = e^{-\frac{j6k\pi}{5}}X(k)$ , find  $y(n)$ . (5)  
b) With the help of diagram and equations explain the single stage all pole lattice IIR filter structure. (5)
- 11 a) Draw the FIR linear phase realization using minimum number of multipliers of the system function  $H(z) = (1 + \frac{1}{2}z^{-1} + z^{-2})(1 + \frac{1}{4}z^{-1} + z^{-2})$  (4)

- b) Determine and draw the parallel form realization of the IIR filter structure represented by the difference equation  $y(n) = -0.1y(n-1) + 0.72y(n-2) + 0.7x(n) - 0.252x(n-2)$  (6)

**PART C**

*Answer any two full questions, each carries 10 marks.*

- 12 Design a digital Butterworth filter satisfying the constraints (10)
- $$0.707 \leq |H(e^{j\omega})| \leq 1 \quad \text{for } 0 \leq \omega \leq \pi/2$$
- $$|H(e^{j\omega})| \leq 0.2 \quad \text{for } 3\pi/4 \leq \omega \leq \pi$$
- with  $T=1s$  using Bilinear transformation
- 13 a) A digital low pass filter is required to meet the following specifications: Pass band ripple  $\leq 1dB$ , Pass band edge frequency:  $4kHz$ , Stop band attenuation  $\geq 40dB$ , Stop band edge frequency:  $6kHz$  and Sampling frequency:  $24kHz$ . Determine the order of a Chebyshev filter to meet the specifications in the digital implementation using bilinear transformation. (5)
- b) With equations explain how impulse response of an FIR filter is obtained using frequency sampling method. (5)
- 14 a) Design an FIR high pass filter using hanning window with a cut off frequency of  $1.2 \text{ rad/sec}$  and length  $N=7$ . (10)

**PART D**

*Answer any two full questions, each carries 10 marks.*

- 15 a) Consider the cascaded realisation of the following first order sections.  $H_1(z) = \frac{1}{1-0.9z^{-1}}$  (8)
- $$\frac{1}{1-0.9z^{-1}} H_2(z) = \frac{1}{1-0.8z^{-1}}$$
- Obtain the product quantisation model of the system and determine overall output noise power.
- b) Which are the methods used to prevent overflow? (2)
- 16 a) Explain limit cycle oscillations in digital filters. (5)
- b) Explain the IO and Memory instructions in TMS320C24x DSP controller. (5)
- 17 a) Explain the central processing unit of TMS320C24x. (5)
- b) Explain the three basic memory addressing modes used by the TMS320C24x instruction set. (5)

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