

Name :

Roll No. :

Invigilator's Signature :

CS/M.Tech(EIE)/SEM-2/EIEM-204C/2012

2012

DIGITAL SIGNAL AND IMAGE PROCESSING

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

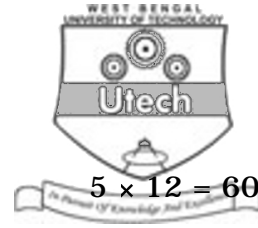
*Candidates are required to give their answers in their own words
as far as practicable.*

GROUP - A

Answer any *five* questions.

$5 \times 2 = 10$

1. a) If $X(n)$ has the Z-transform as $X(Z)$, prove that $x(n-1)$ has the Z-transform of $Z^{-1}X(Z)$.
- b) Prove that $Y(Z) = X(Z)H(Z)$ when
$$y(n) = x(n) * h(n).$$
- c) If $x(n)$ is real and even, then what is the characteristic of its DFT?
- d) For the signal sequence $x(n) = a^n$ for $n \geq 0$ and $x(n) = b^n$ for $n < 0$ [$|a| < |b|$], where is the region of convergence?
- e) If $X(Z) = (Z^2 - 3) / (2Z^2 - 5Z + 1)$, find $x(0)$.
- f) Define a recursive process.

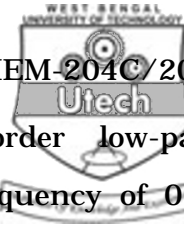


GROUP - B

Answer any *five* questions.

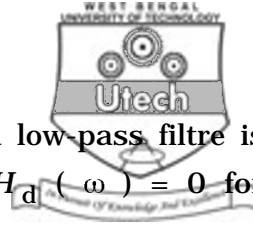
5 × 12 = 60

2. a) A system is defined by the difference equation $y(n) - 2ky(n) + k^2y(n-2) = x(n)$. Determine the range of the parameter k for which system is stable. 4
- b) Determine the transfer function $h(n)$ of the system. 4
- c) Using initial value theorem, find $h(0)$. 2
- d) Draw the region of convergence. 2
3. a) Determine the inverse Z-transform of $H(Z) = (Z + 2) / (2Z^2 - 7Z + 3)$. 6
- b) Realise a system network to implement the function $y(n) - 2y(n-1) + 3y(n-2) = 3x(n) + 2x(n-1) + x(n-2)$ using direct form II. 6
4. a) What is radix-2 FFT algorithm ? What are the decimation in frequency and decimation in time in FFT ? How many complex multiplication and complex addition operations are required for 1024 points radix-2 butterfly structure of FFT ? 2 + 2 + 2
- b) Find $y(n) = x_1(n) * x_2(n)$ by DFT and IDFT method, where $x_1(n) = [1, 2, 2, 1]$ and $x_2(n) = [1, 1, 1, 1]$. 6



5. a) Find the expression for a first order low-pass butterworth filter with 3dB cut-off frequency of 0.2π using bilinear transformation. 6
- b) Realise above filtre with direct form-II. 6
6. What are the applications of morphological operations ? Define morphological dilation and erotion operation in image processing. What are the properties of dialation ? 4 + 4 + 4
7. Define segmentation. Suppose there are two types of regions R_1 and R_2 in a gray level image. Gray level pixels of R_1 follow the Gaussian distribution with mean μ_1 and variance σ and those of R_2 follow mean μ_2 and same variance. If the probabities are P_1 and P_2 for the regions R_1 and R_2 respectively, find the optimum threshold for image segmentation. 2 + 10
8. a) What is image compression ? Briefly mention the types of image compression. 2 + 3
- b) Find out the code words and average code length using Huffman coding scheme for the set of events S_i and probabilities as given below :

Input	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8
Probabilities	0.30	0.20	0.15	0.15	0.10	0.05	0.03	0.02



9. The frequency domain characteristics of a low-pass filter is $H_d(\omega) = e^{-3j\omega}$ for $0 \leq \omega \leq \frac{\pi}{2}$ and $H_d(\omega) = 0$ for $\frac{\pi}{2} < \omega \leq \pi$. Determine the transfer function $h_d(n)$ by frequency sampling method with $N = 7$.

12

