ROLL NO. _____

**Code: AE77/AC77 Subject: DIGITAL SIGNAL PROCESSING**

# AMIETE – ET/CS (NEW SCHEME)

**Time: 3 Hours** **JUNE 2012** **Max. Marks: 100**

***PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.***

**NOTE: There are 9 Questions in all.**

- **Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **The answer sheet for the Q.1 will be collected by the invigilator after 45 minutes of the commencement of the examination.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

---

**Q.1 Choose the correct or the best alternative in the following:** **(2×10)**

a. In the Fourier transform of a real signal, the magnitude function is

**(A)** symmetric **(B)** anti-symmetric
**(C)** recursive **(D)** scaling

b. The estimate of power density spectrum is known as

**(A)** Auto correlation **(B)** Randomo graph
**(C)** spectrogram **(D)** periodogram

c. In radix 2-FFT algorithm, the value of N is

**(A)** 2 m **(B)** $2^m$
**(C)** $(2)^{1/m}$ **(D)** 2/ m

d. In sampling of x (w), the value of sample at w = 0 is same as value of sample at w equal to

**(A)** π /2 **(B)** 2π
**(C)** π **(D)** 2π /3

e. An analog signal has the spectrum shown in Fig.1. The minimum sampling rate in kHz needed to completely represent this signal is

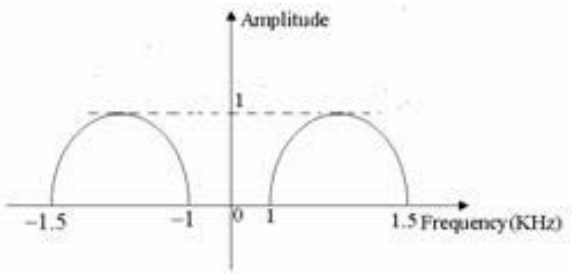


**Fig. 1**

**(A)** 3 **(B)** 2
**(C)** 1 **(D)** 0.5

f. The number of computations required in DIT is _____ as that of DIF.

**(A)** different **(B)** additional data is required
**(C)** same **(D)** double

g. The ideal filter is always

**(A)** causal **(B)** non-causal
**(C)** inverse **(D)** transpose

h. In Kaiser Window, the peak side-lobe is _____ but the width of main-lobe is _____, respectively.

**(A)** variable, variable **(B)** fixed, variable
**(C)** fixed, fixed **(D)** variable, fixed

i. The two types of error produced by A/D conversion are

**(A)** quantization and rounding **(B)** rounding, saturation
**(C)** quantization, saturation **(D)** rounding, adaptive

j. The DFT of finite length sequence $x(n) = \delta(n)$ is

**(A)** 0 **(B)** 1
**(C)** $z^{-1}$ **(D)** $W_N$

---

**Answer any FIVE Questions out of EIGHT Questions.**
**Each question carries 16 marks.**

---

**Q.2** a. Explain the reconstruction of a band-limited signal from its samples. **(8)**

b. The continuous-time signal $x_c(t) = \cos(4000\pi t)$ is sampled with a sampling period of T to obtain a discrete time signal $x(n) = \cos(\pi n/3)$
(i) Determine a choice of T consistent with this information.
(ii) Is the choice for T in part (i) unique? If, not specify another choice of T consistent with information given. **(8)**

**Q.3** a. Discuss the phase distortion and group delay with respect to LTI system's response. **(8)**

b. Consider a causal system whose input and output satisfy the difference equation

$y(n)–a\ y(n–1) = x(n)$ .
(i) Find H(z) , ROC and condition(s) for stability.
(ii) Plot detailed pole-zero diagram.
(iii) Find impulse response.
(iv) Given system is IIR or FIR. State the reason. **(8)**

**Q.4** a. Consider a LTI system with system function
$Z(s) = (1+2z^{-1} + z^{-2}) / (1 – 0.75\ z^{-1}+ 0.125\ z^{-2})$ . Obtain the cascade structure. Comments on the result obtained. **(8)**

b. With the help of signal flow graph, discuss the structure of Linear-Phase FIR system. **(8)**

**Q.5** a. Discuss the utility of the Parks –McClellan algorithm. **(6)**

b. Design a Butterworth low-pass filter using Impulse Invariance concept for the following specifications:
$0.9 \leq |H(e^{jw})| \leq 1, \quad 0 \leq |w| \leq 0.2\pi$
$|H(e^{jw})| \leq 0.18, \quad 0.3\pi \leq |w| \leq \pi.$
Assume $T_d = 1$. Also, assume additional data if required. **(10)**

**Q.6** a. State and prove the following properties of DFT.
(i) Linearity (ii) Duality
(iii) Symmetry (iv) circular shift of a sequence. **(8)**

b. For a delayed impulse sequence $x_1(n) = \delta(n-1)$ and $x_2(n) = \{\underline{5},4,3,2,1,0\}$ is given. Obtain circular convolution using
(i) Graphical Method and
(ii) Using DFT and IDFT method. **(8)**

**Q.7** a. Explain Goertzel Algorithm and its application. **(8)**

b. Develop Decimation in Time algorithm for N=4 and draw signal flow graph. **(8)**

**Q.8** a. Explain properties of periodogram. **(8)**

b. Write short note on Block convolution using the time dependent Fourier transform. **(8)**

**Q.9** a. Using Hilbert Transform, find relationship between magnitude and phase. **(8)**

b. For a real, causal sequence x(n) for which the real part of the DTFT, is $X_R(e^{jw}) = (1-\alpha\cos w) / (1-2\alpha\cos w+\alpha^2)$ with $|\alpha| < 1$. Determine the original sequence x(n), $X(e^{jw})$ and X(z). **(8)**