MADE EASY PUBLICATIONS

POSTAL BOOK PACKAGE 2024

CONTENTS

ELECTRONICS ENGINEERING

Objective Practice Sets

Signals and Systems

1 CHAPTER Basics of Signals and Systems

MCQ and NAT Questions

Q.1 If a function $f(t)\,u(t)$ is shifted to right side by t_0, then the function can be expressed as
(a) $f(t-t_0)\,u(t)$
(b) $f(t)\,u(t-t_0)$
(c) $f(t-t_0)\,u(t-t_0)$
(d) $f(t+t_0)\,u(t+t_0)$

Q.2 An impulse function consists, of
(a) entire frequency range with same relative phase
(b) infinite bandwidth with linear phase variations
(c) pure d.c.
(d) large d.c. along with weak harmonics.

Q.3 If $a(n)$ is the response of a linear, time-invariant, discrete-time system to a unit step input, then the response of the same system to a unit impulse input is
(a) $\frac{d}{dn}[a(n)]$
(b) $na(n)$
(c) $a(n)-a(n-1)$
(d) $a(n+1)-2a(n)+a(n-1)$

Q.4 The unit impulse response of a linear time invariant system is the unit step function $u(t)$. For $t > 0$, the response of the system to an excitation $e^{-at}u(t)$, $a > 0$ will be
(a) ae^{-at} (b) $(1/a)(1-e^{-at})$
(c) $a(1-e^{-at})$ (d) $1-e^{-at}$

Q.5 The unit step response of a system is given by $(1-e^{-at})\,u(t)$, the impulse response is given by
(a) $e^{\alpha t}u(t)$ (b) $e^{-\alpha t}u(t)$
(c) $\frac{1}{\alpha}e^{-\alpha t}u(t)$ (d) $\alpha e^{-\alpha t}u(t)$

Q.6 A function $f(t)$ is an even function, if for all values of t
(a) $f(t) = f(-t)$ (b) $f(t) = -f(-t)$
(c) $f(t) = f(t+T/2)$ (d) $f(t) = -f(t+T/2)$
(T is the time-period of the function)

Q.7 The function $\delta(2n)$ is equal to
(a) $\delta(n)$ (b) $\frac{1}{2}\delta(n)$
(c) $2\delta(n)$ (d) $2\delta\left(\frac{n}{2}\right)$

Q.8 If $x_1(t) = 2\sin\pi t + \cos 4\pi t$ and $x_2(t) = \sin 5\pi t + 3\sin 13\pi t$, then
(a) $x_1(t)$ and $x_2(t)$ both are periodic.
(b) $x_1(t)$ and $x_2(t)$ both are not periodic.
(c) $x_1(t)$ is periodic, but $x_2(t)$ is not periodic.
(d) $x_1(t)$ is not periodic, but $x_2(t)$ is periodic.

Q.9 Energy signals are the signals with
(a) $0 < E < \infty$, $P = 0$ (b) $0 < E < \infty$, $P = \infty$
(c) $0 < P < \infty$, $E = \infty$ (d) $0 < P < \infty$, $E = 0$

Q.10 Power signals are the signals with
(a) $0 < E < \infty$, $P = 0$
(b) $0 < E < \infty$, $P = \infty$
(c) $0 < P < \infty$, $E = \infty$
(d) $0 < P < \infty$, $E = 0$

Q.11 A signum function is
(a) zero for t greater than zero
(b) zero of t less than zero
(c) unity for t less than zero
(d) $2\,u(t)-1$

Q.12 The average value of the waveform $x(t) = 4\cos 4t - 5\sin 5t$ is
(a) 0 (b) $-\left(\frac{2}{\pi}\right)$
(c) $\frac{2}{\pi}$ (d) $\frac{20}{\pi}$

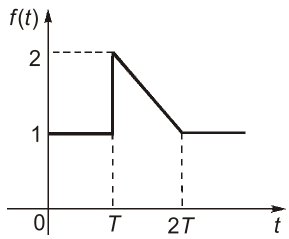
Q.13 If two signals are given as,

$$x_1(t) = e^{jt} \text{ and } x_2(t) = e^{t(j+1)}$$

Then which one of the following statements is correct?
(a) Both $x_1(t)$ and $x_2(t)$ are periodic
(b) Only $x_1(t)$ is periodic
(c) Only $x_2(t)$ is periodic
(d) Neither $x_1(t)$ nor $x_2(t)$ is periodic

Q.14 If a continuous time signal $x(t)$ can take on any value in the continuous interval $(-\infty, \infty)$, it is called
(a) Deterministic signal (b) Random signal
(c) Analog signal (d) Digital signal

Q.15 The function $f(t)$ shown in the figure can be represented as



(a) $u(t)+u(t-T)-\frac{(t-T)}{T}u(t-T)+\frac{(t-2T)}{T}u(t-2T)$

(b) $u(t)-u(t-T)+\frac{(t-T)}{T}u(t-T)-\frac{(t-2T)}{T}u(t-2T)$

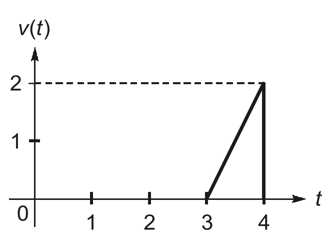
(c) $u(t)-u(t-T)-\frac{(t-T)}{T}u(t-T)-\frac{2(t-2T)}{T}u(t-2T)$

(d) $u(t)+u(t-T)+\frac{(t-T)}{T}u(t-T)-\frac{2(t-2T)}{T}u(t-2T)$

Q.16 Which of the following statements is/are true?
1. If $x(t)$ is a continuous time periodic signal with period T, then $y(t) = x(2t)$ will also be periodic with period $2T$.
2. Sum of two continuous time periodic signals may or may not be periodic.
3. Sum of two discrete time periodic signals may or may not be periodic.

(a) 2 and 3 only (b) 1 and 3 only
(c) 1 and 2 only (d) 2 only

Q.17 In the graph shown below, which one of the following express $v(t)$?



(a) $(2t + 6)[u(t-3) + 2u(t-4)]$
(b) $(-2t-6)[u(t-3) + u(t-4)]$
(c) $(-2t+6)[u(t-3) + u(t-4)]$
(d) $(2t-6)[u(t-3) - u(t-4)]$

Q.18 Match **List-I** with **List-II** and select the correct answer using the code given below the Lists:

List-I	List-II
A. Even signal	1. $x(n) = \left(\frac{1}{4}\right)^n u(n)$
B. Causal signal	2. $x(-n) = x(n)$
C. Periodic signal	3. $x(t) = u(t)$
D. Energy signal	4. $x(n) = x(n+N)$

Codes:

	A	B	C	D
(a)	2	3	4	1
(b)	1	3	4	2
(c)	2	4	3	1
(d)	1	4	3	2

Q.19 Which one of the following relation is not correct?
(a) $f(t)\delta(t) = f(0)\delta(t)$

(b) $\int_{-\infty}^{\infty} f(t)\delta(t-\tau)dt = f(\tau)$

(c) $f(t) * \delta(t-\tau) = f(t-\tau)$

(d) $\int_{-\infty}^{\infty} \delta(at)dt = 1$

Q.20 Which of the following signals are periodic?
1. $\cos\left(\frac{\pi}{3}n\right) + \sin\left(\frac{\pi}{3}n\right)$
2. $\cos\left(\frac{1}{2}n\right) + \cos\left(\frac{1}{3}n\right)$
3. Even $\{\cos(4\pi t)u(t)\}$
4. Even $\{\sin(4\pi t)u(t)\}$

(a) 1 and 4 only (b) 1, 2 and 3 only
(c) 1 and 3 only (d) 1, 3 and 4 only

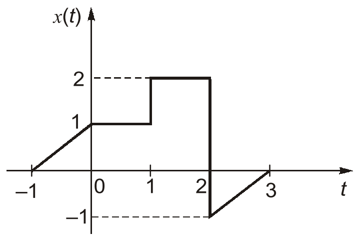
Q.21 The power in the signal

$$s(t) = 8\cos\left(20\pi t - \frac{\pi}{2}\right) + 4\sin(15\pi t) \text{ is}$$

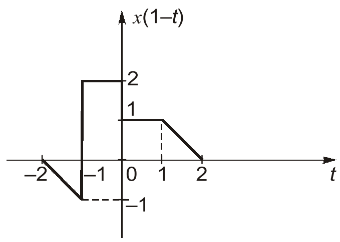
(a) 40 (b) 41
(c) 42 (d) 82

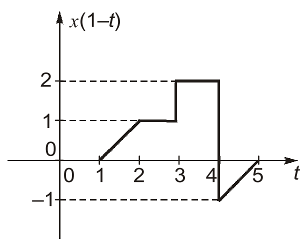
Q.22 **Statement (I):** The total energy of an energy signal falls between the limits 0 and ∞.
Statement (II): The average power of an energy signal is zero.
(a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I)
(b) Both Statement (I) and Statement (II) are individually true but Statement (II) is **NOT** the correct explanation of Statement (I)
(c) Statement (I) is true but Statement (II) is false
(d) Statement (I) is false but Statement (II) is true

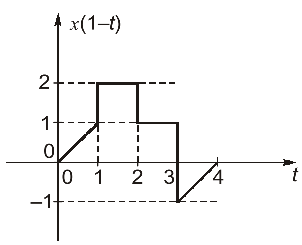
Q.23 If a plot of a signal $x(t)$ is as shown in the Figure.

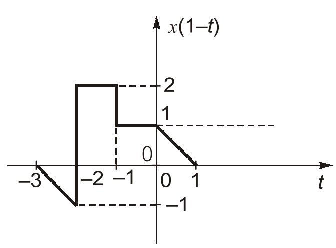


Then the plot of the signal $x(1-t)$ will be:

(a)


(b)


(c)


(d)


Q.24 The signal $x(t) = A\cos(\omega_0 t + \phi)$ is
(a) an energy signal
(b) a power signal
(c) an energy as well as a power signal
(d) neither an energy nor a power signal

Q.25 Double integration of a unit step function would lead to
(a) an impulse (b) a parabola
(c) a ramp (d) a doublet

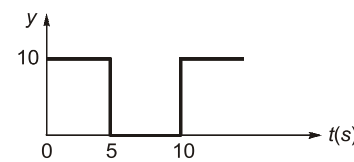
Q.26 If $\int_{-\infty}^{\infty} e^{3\left(\frac{t}{2}-1\right)}.\sin\frac{\pi t}{8\beta}.\delta(2-t) = \frac{-1}{\sqrt{2}}$.

Then the maximum value of β is

(a) -1 (b) $\frac{1}{5}$
(c) $\frac{1}{13}$ (d) $\frac{1}{21}$

Q.27 For a periodic waveform to be halfwave symmetric, it must be represented by a function satisfying
(a) $f(t) = f(t + T/2)$ (b) $f(t) = -f(t + T/2)$
(c) $f(t) = f-(-t)$ (d) $f(t) = f(-t)$

Q.28 In the given figure, the effective value of the waveform is



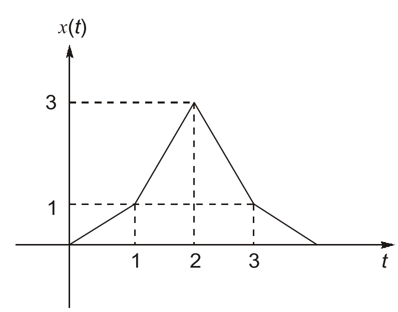
(a) 5.0 (b) 2.5
(c) $\sqrt{2.5}$ (d) $\sqrt{50}$

Q.29 Consider the sequence

$$x[n] = [-4 - j5 \quad \underset{\uparrow}{1 + j2} \quad 4]$$

The conjugate anti-symmetric part of the sequence is
(a) $[-4 - j2.5 \quad j2 \quad 4 - j2.5]$
(b) $[-j2.5 \quad 1 \quad j2.5]$
(c) $[-j5 \quad j2 \quad 0]$
(d) $[-4 \quad 1 \quad 4]$

Q.30 If $y(t) = \int_{-\infty}^{\infty} x(t).\delta'(t-2.5)dt$. Then value of $y(t)$ is



(a) 2 (b) –2
(c) –3 (d) dependent on 't'

Q.31 $x[n]$ is defined as

$$x[n] = \begin{cases} 0 & \text{for } n < -2 \text{ and } n > 4 \\ 1, & \text{otherwise} \end{cases}$$

Determine the value of n for which $x[-n-2]$ is guaranteed to be zero.
(a) $n < 1$ and $n > 7$ (b) $n < -4$ and $n > 2$
(c) $n < -6$ and $n > 0$ (d) $n < -2$ and $n > 4$

Multiple Select Questions (MSQs)

Q.41 For which of the following function(s) the time scaling operation will effect its original nature of the function:

(a) $\delta(t)$
(b) $u(t)$
(c) $r(t)$
(d) A rectangular pulse within finite duration.

Q.42 A discrete system with input $x[n]$ and output $y[n]$ are related by

$$y[n] = \sum_{n=-\infty}^{\infty} x[n]e^{-j\omega n}$$

The system is

(a) unstable (b) stable
(c) time variant (d) time invariant

Q.43 Consider a continuous time signal

$x(t) = 2\cos\left(\frac{\pi t}{4}\right) * \delta\left(\frac{t}{2}-1\right)$. Then for which value of 't', signal $x(t)$ is zero.

(a) $t = 0$ (b) $t = 2$
(c) $t = 1$ (d) $t = 4$

Q.44 Consider a discrete-time periodic signal $x[n] = \begin{cases} 1, & 0 \le n \le 7 \\ 0, & 8 \le n \le 9 \end{cases}$ with period of $N = 10$. A function $y[n]$ is defined as $y[n] = \xi[n] - \xi[n-1]$, then the correct options regarding $y[n]$ are

(a) period $N = 10$
(b) period $N = 8$
(c) $y[n] = \{1,0,0,0,0,0,0,0,-1,0\}$ for one time period
(d) $y[n] = \{1,0,0,0,0,0,-1,0\}$ for one time period

■■■■

Answers Basics of Signals and Systems

1. (c)	2. (a)	3. (c)	4. (b)	5. (d)	6. (a)	7. (a)
8. (a)	9. (a)	10. (c)	11. (d)	12. (a)	13. (b)	14. (c)
15. (a)	16. (d)	17. (d)	18. (a)	19. (d)	20. (c)	21. (a)
22. (b)	23. (a)	24. (b)	25. (b)	26. (b)	27. (b)	28. (d)
29. (a)	30. (a)	31. (c)	32. (a)	33. (–2)	34. (8)	35. (4)
36. (2)	37. (4)	38. (24)	39. (0)	40. (0.232)	41. (a, c, d)	42. (b, c)
43. (a, d)	44. (a, c)					

Explanations Basics of Signals and Systems

1. (c)

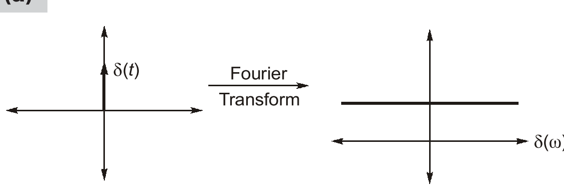
Since $f(t)u(t) = f(t)$ for $t > 0$ also we know $u(t-t_0) = 1$, for $t > t_0$

Here in right side shifting that means $t_0 > 0$

$\therefore$ by property on shifting right side,

$$f(t)\,u(t) = \xrightarrow[\text{shifting RHS by } t_0]{\text{on}} f(t-t_0)\,u(t-t_0)$$

2. (a)



3. (c)

For discrete time system,

$$d(n) = u(n) - u(n-1)$$

For continuous time system,

$$\delta(t) = \frac{d}{dt}u(t)$$

4. (b)

Since, for unit impulse, response is unit step i.e. transfer function is integrator.

$$\therefore \quad y(t) = \int_{-\infty}^{t} e^{-at}\,u(t)\,dt\,;\; u(t) = \begin{cases} 1, & t > 0 \\ 0, & \text{elseswhere} \end{cases}$$

$$= \int_0^t e^{-at}\,dt = \frac{1}{a}(1-e^{-at})$$

5. (d)

$$\delta(t) = \frac{d}{dt}u(t)$$

$$\text{Impulse response} = \frac{d}{dt}((1-e^{-\alpha t})u(t))$$

$$= \frac{d}{dt}(u(t) - u(t)e^{-\alpha t})$$

$$= \delta(t) - \delta(t)e^{-\alpha t} + \alpha e^{-\alpha t}u(t)$$

$\because$ $f(t)\,\delta(t) = f(0)\,\delta(t)$

$\therefore$ Impulse response $= \alpha e^{-\alpha t}u(t)$

6. (a)

For even function, $f(t) = f(-t)$

For odd function, $f(t) = -f(-t)$

7. (a)

Properties :

For continuous system

$$\delta(at) = \frac{1}{|a|}\delta(t)$$

For discrete system

$$\delta[an] = \delta[n]$$

8. (a)

$$x_1(t) = 2\sin\pi t + \cos 4\pi t$$

$$\therefore \quad \omega_1 = \frac{\pi}{1}$$

$$\omega_2 = \frac{4\pi}{1}$$

$$\omega_0 = \text{HCF}(\omega_1, \omega_2)$$

$$= \text{HCF}\left(\frac{\pi}{1}, \frac{4\pi}{1}\right) = \pi$$

$$\therefore \quad T = \frac{2\pi}{\omega_0} = \frac{2\pi}{\pi} = 2$$

$$x_2(t) = \sin 5\pi t + 3\sin 13\pi t$$

$$\omega_1 = \frac{5\pi}{1}; \quad \omega_2 = \frac{13\pi}{1}$$

$$\omega_0 = \text{HFC}\,(5\pi, 13\pi)$$

$$\omega_0 = \pi$$

$$\therefore \quad T = \frac{2\pi}{\omega_0} = \frac{2\pi}{\pi} = 2$$

$\therefore$ Both are periodic.

9. (a)

Energy signal: $E \neq \infty$, $P = 0$,

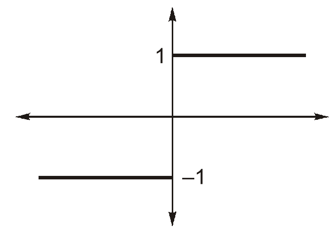
where E is energy and P is average power.

10. (c)

Power signal : $E = \infty$, $P \neq \infty$

11. (d)

Signum function is



$$2u(t) - 1 = \begin{cases} 1, & t > 0 \\ -1, & t < 0 \end{cases}$$

$$u(t) = 1, \quad t > 0$$
$$= 0, \quad \text{elsewhere}$$

12. (a)

The collective signal is periodic with period

$$= \text{LCM}\left(\frac{\pi}{2}, \frac{2\pi}{5}\right) = 2\pi\,.$$

Average value of a sinusoidal signal = 0.

$$V_{\text{avg.}} = \frac{1}{T}\int_0^T (v_1(t) + v_2(t))\,dt$$

$$= \frac{1}{T}\int_0^T (v_1(t)\,dt + \frac{1}{T}\int_0^T v_2(t)\,dt$$

$$= V_{\text{avg}_1} + V_{\text{avg}_2} = 0$$

13. (b)

Only complex exponential are periodic.

$$x_2(t) = e^{t(j+1)} = e^{jt}\,e^{t}$$

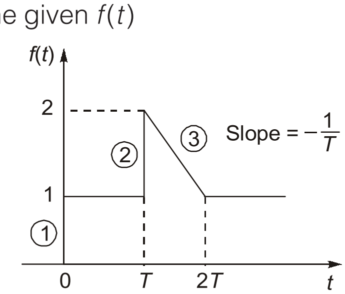
(because of this term x_2(t) is non-periodic)

14. (c)

If a continuous time signal can take on any value in the continuous interval $(-\infty, \infty)$ then this signal is known as analog signal.

15. (a)

For the given $f(t)$



Step (1) = $u(t)$ = $u(t)$ both steps are of unity magnitude

Step (2) = $u(t-T)$ = $u(t-T)$

Hence ramp (3) = $\frac{-1}{T}\{r(t-T)-r(t-2T)\}$

$$= \frac{-1}{T}\{(t-T)u(t-T)-(t-2T)u(t-2T)\}$$

Since, $r(t) = tu(t)$

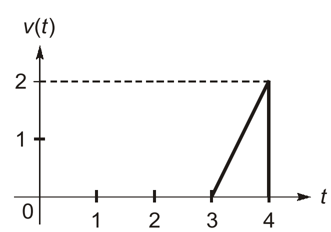
Hence,

$$f(t) = u(t)+u(t-T)-\frac{(t-T)}{T}u(t-T)+\frac{(t-2T)}{T}u(t-2T)$$

16. (d)

- If $x(t)$ is periodic with time period T, then $y(t) = x(2t)$ will be periodic with time period $T/2$.
- Sum of two discrete time periodic signals is always periodic.

17. (d)



v(t) consist 1 Ramp and 1 negative step,

Hence Ramp (1) having slope = 2

So Ramp (1) = $2\{r(t-3)-r(t-4)\}$

step (2) = $-2u(t-4)$

So, $v(t) = 2r(t-3) - 2r(t-4) - 2u(t-4)$

$= 2(t-3)\,u(t-3) - 2(t-4)u(t-4) - 2u(t-4)$

$= 2(t-3)\,u(t-3) - 2(t-3)u(t-4)$

$= (2t-6)\,\{u(t-3) - u(t-4)\}$

18. (a)

- Even signal $x(n) = x(-n)$
- Causal system is one in which output at any time depends only on present and/or past values of input.
- Periodic signal is one which satisfies $x(n) = x(n+N)$;
  $N \rightarrow$ Fundamental period.
- Energy signal is absolutely summable i.e. $x(n)$

$$= \left|\left(\frac{1}{4}\right)^n u(n)\right| < \infty$$

19. (d)

$$\int_{-\infty}^{\infty} \delta(at)\,dt = \frac{1}{a}$$

Since, $\delta(at) = \frac{1}{|a|}\delta(t)$

20. (c)

1. $\cos\left(\frac{\pi}{3}n\right)+\sin\left(\frac{\pi}{3}n\right) \Rightarrow$ periodic

   Period = $\frac{2\pi\times 3}{\pi} = 6$

2. $\cos\left(\frac{1}{2}n\right)+\cos\left(\frac{1}{3}n\right) \Rightarrow$ non-periodic

3. Even $\{\cos(4\pi t)u(t)\}$

   $= \frac{\cos(4\pi t)\,u(t)+\cos(-4\pi t)u(-t)}{2}$

   $= \frac{\cos 4\pi t}{2} \Rightarrow$ Periodic

4. Even $\{\sin(4\pi t)u(t)\}$

   $= \frac{\sin(4\pi t)u(t)+\sin(-4\pi t)u(-t)}{2} \Rightarrow$ non-periodic

21. (a)

Given: $s(t) = 8\cos\left(20\pi t-\frac{\pi}{2}\right)+4\sin(15\pi t)$

$s(t) = 8\sin 20\pi t + 4\sin 15\pi t$

When both the sinusoidal signal having different frequency. Then overall power (P) = $P_1 + P_2$

$$P = \frac{8^2}{2}+\frac{4^2}{2} = 40$$

22. (b)

Energy of any signal is given by

$$E = \int_{-\infty}^{\infty}\left|x^2(t)\right|dt$$

and power of a signal is given by

$$P = \lim_{T\to\infty}\int_{-T/2}^{T/2}\frac{1}{T}\left|x^2(t)\,dt\right|$$

For energy signal, Energy is finite

$$\therefore \quad P = \lim_{T\to\infty}\frac{E}{T}$$

$$P = \frac{E}{\infty} = 0$$

$\rightarrow$ All the finite duration and bounded signals are energy signals.

Hence statements (I) and (II) are correct but statement (II) is not correct explanation of statement (I).

23. (a)

For given question $x(t)$ is defined for $-1 < t < 3$

Left shifted of $x(t)$ by 1: $-2 < t + 1 < 2$

Time reversal, $-2 < -t + 1 < 2$

So range of $x(1-t)$ will be -2 to 2 by checking options.

24. (b)

$$x(t) = A\cos(\omega_0 t + q)$$

this is periodic signal and according to definition, all periodic signals are power signal.

Here, $$\text{Power} = \left(\frac{A}{\sqrt{2}}\right)^2 = \frac{A^2}{2}$$

25. (b)

$$\int_t u(\tau)d\tau = r(t) \quad \text{Ramp}$$

$$\int_t r(\tau)\,d\tau = p(t) \quad \text{Parabola}$$

26. (b)

$$\delta(2-t) = \delta(t-2)$$

$$f(t) = e^{3\left(\frac{2}{2}-1\right)}.\sin\frac{\pi(2)}{8\beta}$$

$$= e^{3(1-1)}\sin\frac{\pi}{4\beta} = \frac{-1}{\sqrt{2}}$$

$$\sin\frac{\pi}{4\beta} = \frac{-1}{\sqrt{2}}$$

$$\beta = \frac{1}{5}, \frac{1}{13} \quad \text{and } \beta = -1$$

$$\beta_{max} = \frac{1}{5}$$

27. (b)

For half wave symmetry

$$f(t) = -f\left(t+\frac{T}{2}\right) = -f\left(t-\frac{T}{2}\right)$$

28. (d)

Effective value = rms value

$$\text{Here} = \sqrt{\frac{1}{10}\int_0^5 (10)^2\,dt} = \sqrt{50}$$

29. (a)

Given, $$x[n] = [-4 \;\; -5j \;\; \underset{\uparrow}{1+2j} \;\; 4]$$

$$x^*[n] = [-4+5j \;\; \underset{\uparrow}{1-2j} \;\; 4]$$

$$x^*[-n] = [4 \;\; 1-2j \;\; -4+5j]$$

Now, $$x_{oc} = \frac{x(n) - x^*(-n)}{2}$$

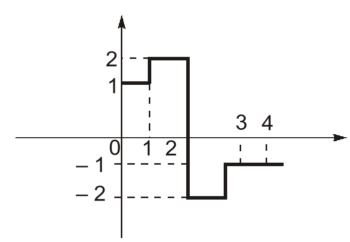
$$x_{oc} = \left[\frac{-4-5j-4}{2}\;\frac{(1+2j)-(1-2j)}{2},\;\frac{4-(-4+5j)}{2}\right]$$

$$x_{oc} = [-4-2.5j \;\; \underset{\uparrow}{2j} \;\; 4-2.5j]$$

30. (a)

$$y(t) = \int_{-\infty}^{\infty} x(t).\delta'(t-2.5)dt$$

$$= -\left.\frac{dx(t)}{dt}\right|_{t=2.5}$$



$$y(t) = -(-2) = 2$$

31. (c)