Pro-One

GATE

Graduate Aptitude Test in Engineering

Electronics and Communication Engineering

Sample Booklet

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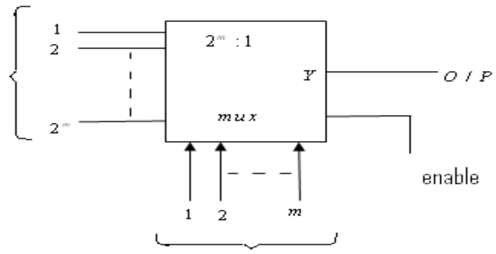
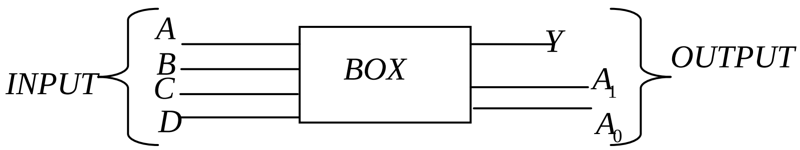
DIGITAL CIRCUITS

- **MULTIPLEXER→** multiplexer take 2^m inputs, 'm' select lines and having one output transparency of inputs to the output depend on select line.



1. **Consider we have four p line i/p and one o/p line as below**



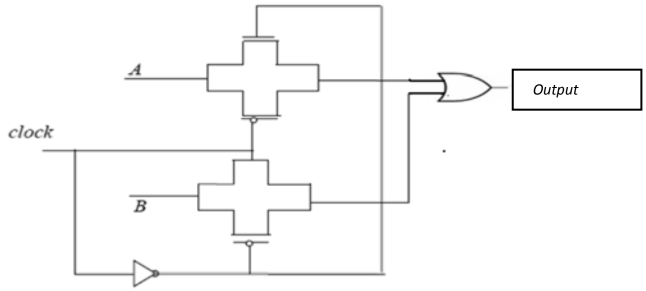
If we want to select i\p depends on address line generated by control unit, which element is best suited for box?

a. Decoder b. Demux c. ALU d. MUX

Answer: (d)

Solution: if one have multiple i/p M and have o/p '1' with select lines x then, MUX is useful element and it hold following relation 2^x=N

2. **Consider a circuit shown below.**



Where A, B=input, and O/P is taken at the output of OR gate present at the right most Part which logic block it represent?

a. Demux b. MUX c. multiplexer d. encoder

Answer: b

Solution:

Circuit shown in above problem have i\p A and B, it produce o\p depend upon clock logic level, thus clock act as select line. Hence final equivalent block will be as above.

ELECTROMAGNITICS

Antenna:

If the physical dimensions of current carrying element are comparable to the wavelength then it acts as a radiator (antenna).
In fact current carrying conductors radiate energy at all frequencies, but the radiation will be significant only when above condition is satisfied.

For example transmission line in Fig-2 has more radiation then that in fig1.

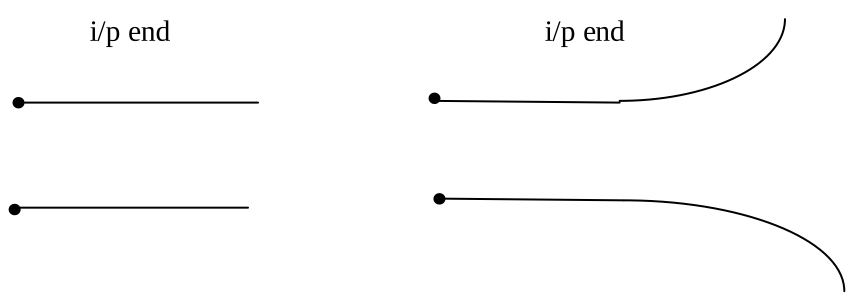


fig1 fig2

While in fig1, the amount of propagation is more than the amount of radiation when compared with fig2.

Antenna gain:

Any point in space can be represented using a 3 dimensional co-ordinate system such as, Cartesian (with x-axis, y-axis and z-axis) or Spherical or Cylindrical co-ordinate systems. Each of these are orthogonal systems.

QUESTIONS

1.The length of a half wave dipole antenna to be used to receive a 10Mhz radio signal=____________

a.15m b.30m c.300m d.3km

Answer: (a)

Solution:

$$f=\frac{c}{\lambda}\Rightarrow\lambda=\frac{3\times10^{8}}{10^{7}}=30m \quad \textbf{Length of half wave dipole antenna} =\frac{\lambda}{2}=15m$$

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2. A short vertical grounded antenna is designed to radiate at

1 MHz will have a radiation resistance of _______ Ω, if the effective

Length of the antenna is $\frac{30}{\pi}m$

(a) 1.6 (b) 3.2 (c) 15.8 (d) none

Answer :(a)

Solution:

$$\text{Radiation resistance} = \frac{160\pi^2 l_e^2}{\lambda^2}\Omega=\frac{160\pi^2\left(\frac{30}{\pi}\right)^2}{300\times300}\Omega=1.6\Omega$$

SIGNALS AND SYSTEMS

A signal by definition anything that conveys some information.

Periodic signal:

A signal f(t) is said to be periodic with period(a non zero real number) if

F(t+T)=f(t) and T is the minimum

1. **Period of the function** $\sin\left(\frac{\pi}{26}(t-1950)\right)$ **is ____ in seconds**

(a) 26 (b) 1950 (c) $\frac{\pi}{13}$ (d) 52

Answer: (d)

Solution:

$$\sin\left(\frac{\pi}{26}(t-1950)\right)=\sin\left(\frac{2\pi t}{52}-\frac{\pi(1950)}{26}\right)$$

Comparing with $\sin(\frac{2\pi t}{T}+\phi) = 52\sec$

Convolution in time domain:

If f(t) $\overset{L}{\leftrightarrow}$ F(s), g(t) $\overset{L}{\leftrightarrow}$ G(s),then

$$L\{f(t)*g(t)\}=F(s)G(s)$$

Where f(t)*g(t) is the convolution of f(t) and g(t)= $\int_0^t f(v)g(t-v)dv$

Example:

1. **To find inverse Laplace transform of** $\frac{1}{s(s+1)}$ **using convolution theorem**

Sol: $L^{-1}\left[\frac{1}{s(s+1)}\right]=L^{-1}\left[\frac{1}{s}-\frac{1}{(s+1)}\right]$

Let F(s)=1/s $\Rightarrow$ f(t)=u(t)

$$G(s)=\frac{1}{s(s+1)}\Rightarrow g(t)=e^{-t}u(t)$$

Where u(t) is unit step function, $u(t)=\begin{cases}1, t\geq 0\\ 0, t<0\end{cases}$

2. $\delta(-t+1) * \delta(t-8)$ =

(a) δ (9) (b) δ (t-9) (c) δ (2t-9) (d) δ (t+9)

Answer: (d)

3. **Odd part of the function α(t) = δ(t) + u(t) is**

(a) $\frac{u(t)-u(-t)}{2}$ (b) $\delta(t)+u(t)$ (c) 0 (d) $\frac{\delta(t)}{2}+\frac{u(t)}{2}+\frac{\delta(-t)}{2}+\frac{u(-t)}{2}$

Answer :(a)

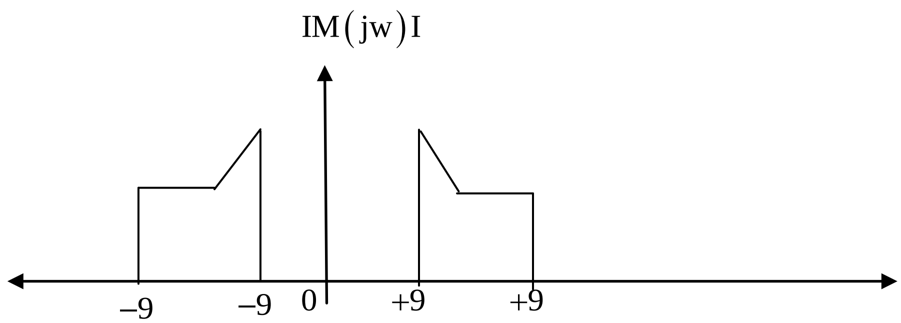
Solution:

Odd part of a signal α(t) is given by $\frac{\alpha(t)-\alpha(-t)}{2}$

Further $\delta(t) = \delta(-t)$ [Impulse function is an even function]

<u>Sampling theorem:</u>

1. **The spectral range of a signal m(t) extend from 9khz to 9.9khz as shown in fig.**



The minimum sampling frequency needed for recovery of the signal =

(a) 19.8khz (b) 1.8khz (c) 18khz (d) 18.9khz

Answer:(c)

Solution:

For band pass kind of signals min. samples frequency =fmin = 2(Fmin-Fmin)

If at least one of fmax or fmin

Here fmax=9.9khz, Fmin=9khz

Fsmin=1.8khz is called because fmin/fmax=5=an integer

Note: Please see next question also. For band pass signals sampling frequency formula is not always same as that for low pass signals for which fmin=0hz

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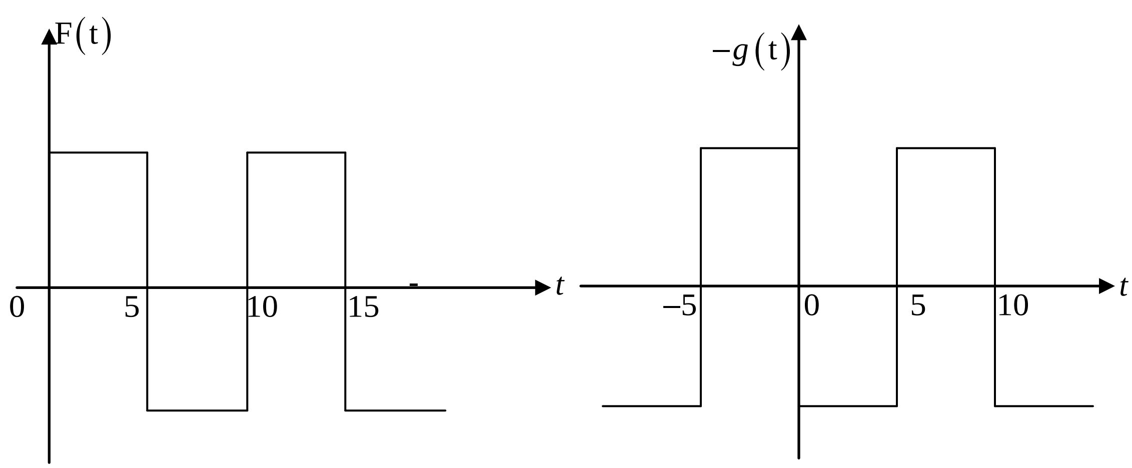
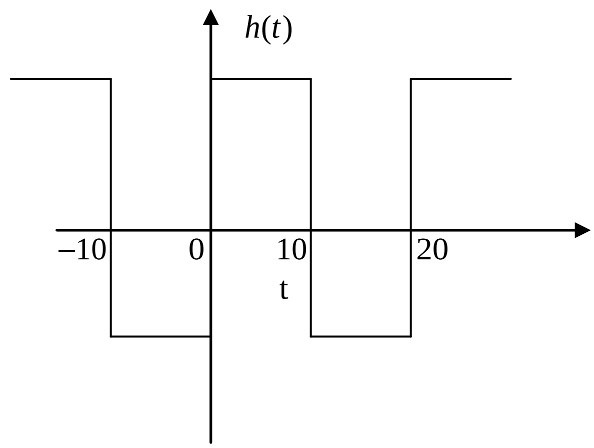
2: Two signals f(t) g(t) are h(t) are as shown in fig. which signal needs higher sampling frequency if the samples?





(a) f(t) and h(t) (b) g(t) and h(t) (c) f(t) and g(t) (d) h(t)

Answer: (c)

Solution:

F(t)and g(t) have same time period and its is half of that of h(t). so frequency content of f(t) and g(t) will be higher than that of h(t).

3: If message signals having highest frequency component of 9khz needs to be processed and be transmitted as pulse coded modulated then the bit rate will be___ if PCM is supposed to have 128 levels and if the original signal has to be reconstructed in the receiver with minimum distortion.

(a) 7 Bits (b) 8 Bits (c) 6 Bits (d)5 Bits

Answer: (a)

Solution:

Highest frequency component in the modulating message signal=9khz=fmax

$\Rightarrow$ Minimum sampling frequency=18KHZ(=2Fmax)

i.e, 18000 sample/second

128 levels=> 7bits($\therefore 2^7 = 128$)