BEL ECE Q&A SET 6

Q. 1) Simplify the expression $\overline{\overline{AB} + \bar{A} + AB}$

(a) = 1

(b) = 0

(c) = A

(d) = $\bar{A}$

ANS: B

Applying De-Morgan's law in the above expression can be written as:

$$F = \overline{\overline{AB}}.\,\overline{\bar{A}}.\,\overline{AB}$$

F = AB.A.($\bar{A}$ + $\bar{B}$)

F = AB($\bar{A}$ + $\bar{B}$)

F = AB$\bar{A}$ + AB$\bar{B}$

F = 0

Q. 2) Find the average value of the current , $I(t) = 10 + 10\pi \sin 314t$

(a) 200 Amp

(b) 10 Amp

(c) 0 Amp

(d) 30 Amp

ANS: B

The average of the sine wave is 0A.

The RMS value of the sine wave is given by:

$$\text{RMS} = \frac{A}{\sqrt{2}}$$

where, A is the max value of the sine signal

Calculation:

Given, $i = (10 + 10\pi \sin 314t)$ A

$i_{avg} = (DC)_{avg} + (AC)_{avg}$

$i_{avg} = 10 + 0$

$i_{avg} = 10$ A

Q. 3) Maxwell's third equation is derived from _______.

(a) Ampere's circuital law

(b) Gauss's law of electrostatic

(c) Faraday's law of electromagnetic induction

(d) Gauss's law of magnetostatics

ANS: C

Q. 4) The equivalent circuit of a zener diode consists of

(a) A resistance in parallel with DC battery

(b) A capacitance in series with DC battery

(c) A capacitance in series with current source

(d) 'A small dynamic resistance in series with DC battery

ANS: D

Zener diode:

- A Zener diode is a semiconductor device that allows **current to flow either in a forward or reverse direction.**
- Since it is **highly doped,** the depletion layer is very thin and has a high voltage gradient and electric field.

Q. 5) Main advantage of fiber optic cable over co-axial cable is

(a) Easy handling

(b) Less weight

(c) Easy testing

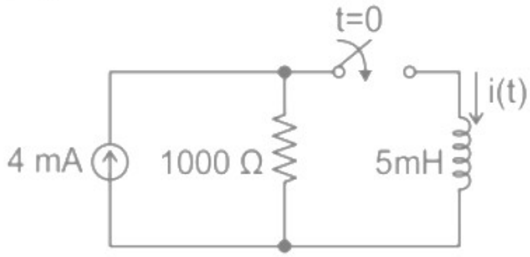
(d) Low loss

ANS: D

The advantages of optical fibers are:

- Optical fibers have greater information-carrying capacity due to large bandwidth
- Optical fibers are free from electromagnetic interference and offer high signal security
- Optical fibers suffer less attenuation than coaxial cable and twisted wire cables.

Q. 6) Find the inductor current after the switch closes in the circuit.



(a) $i\left(t\right)=4\ \left(1+e^{-\frac{t}{5}}\right)$ mA, and t is in μs

(b)
$i\left(t\right)=4\ \left(1+e^{\frac{t}{5}}\right)$mA, and t is in μs

(c) $i\left(t\right)=4\ \left(1-e^{-\frac{t}{5}}\right)$ mA, and t is in μs

(d) $i\left(t\right)=4\ \left(1-e^{\frac{t}{5}}\right)$ mA, and t is in μs

ANS: C

Time constant, $\tau=\frac{5\times10^{-3}}{1000}=5\times10^{-6}\ sec$

At t = 0 or initial condition, the switch is open. So, the inductor circuit is open.

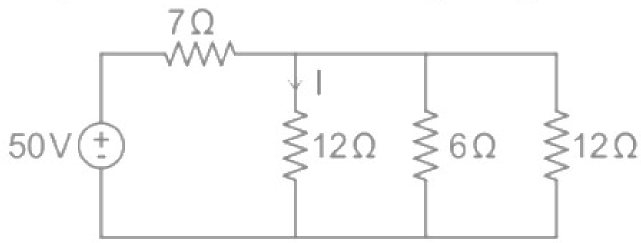
Hence inductor current is zero i.e. i (0) = 0

i(∞) = 4 A

Now the current equation is,

$i\left(t\right)=4\ \left(1-e^{-\frac{t}{5}}\right)\ mA$ and t is in μs

Q. 7) Calculate the current 'I' flowing through 12 Ω resistor in the circuit shown.



(a) 3.25 A

(b) 7.25 A

(c) 1.25 A

(d) 5.55 A

ANS: C

By applying KVL, $\frac{V-50}{7} + \frac{V}{12} + \frac{V}{6} + \frac{V}{12} = 0$

$\therefore$V = 15 V.

The current passes through 12 Ω = $\frac{15}{12} = 1.25\ A$

Q. 8) The phase constant of a good dielectric with ε_r = 1.5 and μ_r = 6 at 200 MHz is:

(a) π rad/s

(b) 4π rad/s

(c) 2π rad/s

(d) 1.5π rad/s

ANS: B

Given:

$\varepsilon_r = 1.5$

$\mu_r = 6$

f = 200 MHz

$$\beta = \omega\sqrt{\mu\epsilon}$$

$$\beta = 2\pi f\sqrt{\mu_r\mu_0\epsilon_r\epsilon_0}$$

$$\because c = \frac{1}{\sqrt{\epsilon_0\ \mu_0}} = 3\times10^8\ m/s$$

On solving we'll get:

$$\beta = 4\pi$$

Q. 9) Hall effect can be used to measure
1. Carrier concentration

2. Type of semiconductor

3. Magnetic field

4. Conductivity

(a) 1 only

(b) 1 and 3 only

(c) 1, 2 and 4 only

(d) All of the above

ANS: C

Q. 10) A good transimpedance amplifier has

(a) low input impedance and high output impedance.

(b) high input impedance and high output impedance.

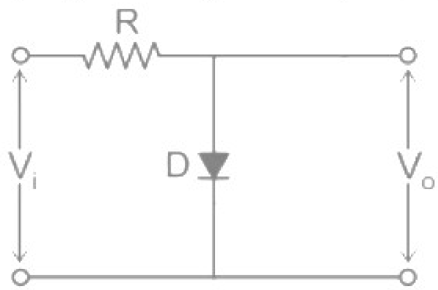
(c) high input impedance and low output impedance.

(d) low input impedance and low output impedance.

ANS: D

Type of Amplifier	R_{in}	R_{out}
Voltage Amplifier	High	Low
Current Amplifier	Low	High
Transconductance	High	High
Transimpedance amplifier	**Low**	**Low**

Q. 11) Following circuit is _______ clipper.



(a) Shunt negative

(b) Series negative

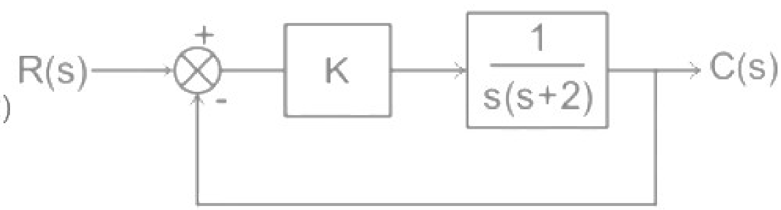
(c) Shunt positive

(d) Series positive

ANS: C

The circuit clips the positive half of the input and the diode is connected in parallel to the load, therefore the circuit is said to be Shunt positive clipper.

Q. 12)



For r(t) = 0.9 t, it is required that the steady state error should be less than 0.05. The value of gain K of proportional controller for the system shown above is _____.

(a) K > 40

(b) K > 36

(c) K < 36

(d) K < 40

ANS: B

From the block diagram,

$$G(s)\,H(s) = \frac{K}{s(s+2)}$$

$$K_v = \underset{s \to 0}{lt}\, s.\frac{K}{s(s+2)}$$

$$= \underset{s \to 0}{lt}\, \frac{K}{(s+2)} = \frac{K}{2}$$

$e_{ss} < 0.05$

$$\Rightarrow \frac{A}{K_v} < 0.05$$

$$\Rightarrow \frac{0.9}{\left(\frac{K}{2}\right)} < 0.05$$

$$\Rightarrow \frac{2(0.9)}{K} < 0.05$$

$$\Rightarrow K > \frac{1.8}{0.05}$$

$\Rightarrow K > 36$

Q. 13) 2's complement of -7 is

(a) 0111

(b) 1000

(c) 1111

(d) 1001

ANS: D

The binary form of 7 ↔ 0111

1's complement of -7 = 1(for sign) (000)(1's complement of 7)

= 1000

2's complement of -7 = 1's complement + 1 = 1000 + 1 = 1001

Q. 14) Given $(125)_R = (203)_5$. The value of radix R will be

(a) 26

(b) 10

(c) 8

(d) 6

ANS: D

$(125)_R = (203)_5$

If the two numbers are equivalent, they will remain equal in other number systems as well.

Converting both the sides to decimal and equating, we get:

$1\times R^2 + 2\times R^1 + 5\times 2^0 = 2\times 5^2 + 0\times 5^1 + 3\times 5^0$

$R^2 + 2R + 5 = 50 + 3$

$R^2 + 2R - 48 = 0$

$R^2 + 8R - 6R - 48 = 0$

$R(R + 8) - 6 (R + 8) = 0$

$(R + 8)(R - 6) = 0$

The valid value of R = 6

Q. 15) The Q-factor of an RLC circuit is 5 at its resonance frequency of 2 kHz. Find the bandwidth of the circuit.

(a) 10 kHz

(b) 400 Hz

(c) 1 kHz

(d) 200 Hz

ANS: B

We know that Quality factor (Q) is the ratio of resonance frequency and bandwidth, i.e.,

$$Q = \frac{f_o}{B.W}$$

$$\Rightarrow B.W = \frac{f_o}{Q}$$

B.W = $\frac{2000}{5}$

= 400 Hz

Q. 16) What is the peak reverse voltage of a diode?

(a) The maximum amount of voltage the diode can withstand in Forward-bias

(b) The maximum amount of voltage the diode can withstand in reverse-bias

(c) The forward voltage drop of a diode

(d) The internal voltage drop of a diode

ANS: B

Q. 17) The break away point in the root loci plot for the loop transfer function $G(S) = \frac{K}{S(S+3)^2}$ is

(a) -2.5

(b) -1.0

(c) -2.0

(d) -0.5

ANS: B

Given loop transfer function is, $G(s) = \frac{K}{s(s+3)^2}$

For breakaway points, $\frac{dK}{ds} = 0$

$\Rightarrow \frac{d}{ds}\left[s(s+3)^2\right] = 0$

$\Rightarrow \frac{d}{ds}\left[s^3 + 6s^2 + 9s\right] = 0$

$\Rightarrow 3s^2 + 12s + 9 = 0$

$\Rightarrow s^2 + 4s + 3 = 0$

$\Rightarrow (s + 3)(s + 1) = 0$

$\Rightarrow s = -3, s = -1$

s = -1 is a valid breakaway point.

Q. 18) A 400 W carrier is amplitude modulated and has side-band power of 50 W. The depth of modulation is

(a) 1

(b) 0.45

(c) 0.50

(d) 0.55

ANS: C

In Amplitude modulated system

Power in side band is given by

$$P_{SB} = P_c \left(\frac{\mu^2}{2}\right)$$

Hence

$$\frac{P_{SB}}{P_c} = \left(\frac{\mu^2}{2}\right)$$

$$\frac{50}{400} = \left(\frac{\mu^2}{2}\right)$$

μ = 0.5

Q. 19) A transmission line of surge impedance 300 Ω is connected to a load of 300 Ω. The reflection coefficient of transmission line at the load end will be

(a) 0

(b) -1

(c) 2

(d) +1

ANS: A

Given that,

Surge impedance of transmission line $Z_C = 300\ \Omega$

Load impedance at the end transmission line $Z_L = 300\ \Omega$

Therefore, reflection coefficient of transmission line at load end is

$$\tau_r = \frac{300-300}{300+300} = 0$$

Q. 20) Find the position constant and steady-state error, respectively, for an open-loop transfer function given by.

$$H(s)G(s) = \frac{(s+3)}{(s+1)(s+2)}$$

(a) 2, 0.8

(b) 11, 9

(c) 1.5, 0.4

(d) 2, 0.5

ANS: C

$$H(s)G(s) = \frac{(s+3)}{(s+1)(s+2)}$$

We have to determine the position error constant (K_P),

K_P = position error constant = $\lim_{s \to 0} G(s)\,H(s)$

$$\lim_{s \to 0} G(s)H(s) = \frac{(s+3)}{(s+1)(s+2)}$$

$$K_P = \frac{3}{2} = 1.5$$

Now the steady-state error would be:

$$Error = \frac{1}{1+K_p}$$

$$Error = \frac{1}{1+1.5} = 0.4$$

Q. 21) Consider the following statement:
Fourier Series of any periodic function x(t) can be obtained if,

1. $\int_{t_1}^{\infty} |x(t)| < \infty$

2. Signal x(t) must have a finite number of maxima and minima in the expansion interval.

3. x(t) can have an infinite number of finite discontinuities in the expansion interval.

4. $x^2(t)$ is absolute summable

Which of the statement is/are false:

(a) 1 and 4

(b) 1 and 2

(c) 3 only

(d) 1 and 3

ANS: C

Q. 22) Kirchhoff's current law is based upon which of the following fact?

(a) Charge accumulation is possible at node.

(b) There is a possibility for a node to store energy.

(c) Charge accumulation may or may not be possible.

(d) There cannot be an accumulation of charge at a node.

ANS: D

Q. 23) In phase modulation, phase deviation is proportional to:

(a) Carrier phase

(b) Message signal

(c) Carrier amplitude

(d) Message signal frequencies

ANS: B

A general expression for a phase-modulated wave is:

$x_{PM}(t) = A\cos[2\pi f_c t + k_p m(t)]$

The instantaneous angle is given as:

$\phi_i(t) = 2\pi f_c t + k_p\, m(t)$

Phase deviation is, therefore:

$$\Delta[\phi_i(t)] = k_p m(t)$$

Conclusion: The phase deviation is proportional to the message signal.

Q. 24) In a bipolar junction transistor, the emitter efficiency is (p-n-p transistor):

(a) $\dfrac{\text{Current of injected carriers at } J_E}{\text{total collector current}}$

(b) $\dfrac{\text{Current of injected carriers at } J_E}{\text{total emitter current}}$

(c) $\dfrac{\text{Current of injected carriers at } J_C}{\text{total collector current}}$

(d) $\dfrac{\text{Current of injected carriers at } J_C}{\text{total emitter current}}$

ANS: B

Q. 25) In an open device, current through it is

(a) zero and voltage is unknown.

(b) known and voltage is zero.

(c) zero and voltage is also zero.

(d) unknown and voltage is also unknown.

ANS: A

Q. 26) A diode for which you can change the reverse bias and thus vary the capacitance is called a -

(a) Switching diode

(b) Varactor diode

(c) Tunnel diode

(d) Zener diode

ANS: B

Varactor diode refers to the variable Capacitor diode, which means the capacitance of the diode varies linearly with the applied voltage when it is **reversed biased.**

Q. 27) A wave is incident from free-space onto a dielectric region of dielectric constant $\varepsilon_r = 4$, The wave impedance in the dielectric is:

(a) 55.5 Ω

(b) 100.5 Ω

(c) 108.6 Ω

(d) 188.5 Ω

ANS: D

The wave impedance is given by the expression:

$$\eta = \eta_o \sqrt{\frac{\mu_r}{\varepsilon_r}}$$

η_o is the intrinsic impedance of free space = 377 Ω

Calculation:

$\varepsilon_r = 4$, $\mu_r = 1$

$$\eta = 377\sqrt{\frac{1}{4}}$$

= 188.5 Ω

Q. 28) An LTI system will be stable, if the impulse response h(t) has the restriction

(a) $\int_{-\infty}^{\infty} |h(\tau)\, d\tau| < \infty$

(b) $\int_{-\infty}^{\infty} h(\tau) \, . \, h(t-\tau)\, d\tau = 0$

(c) y(t) = h(t).x(t)

(d) h(0) = 0

ANS: A

Q. 29) If N is the doping level of substrate and V is the effective voltage across the junction in a MOSFET, then the depletion region width for the junction is given by:

(a) $\sqrt{\frac{2\epsilon_{st}\epsilon_0 V}{qN}}$

(b) $\sqrt{\frac{2\epsilon_{st}\epsilon_0 qv}{N}}$

(c) $\sqrt{\frac{2\epsilon_{st} N}{qV}}$

(d) $\frac{2\epsilon_{st}\epsilon_0 V}{qN}$

ANS: A

The Depletion region width of MOSFET is given by:

$$W = \sqrt{\frac{2\epsilon_{si}\epsilon_0 V}{qN}}$$

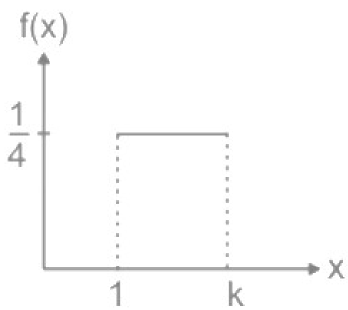
Where v is applied potential

q= electron charge

N =Doping Concentration

ϵ is the permittivity of materials

Q. 30) The continuous random variable X has pdf f(x) as shown below. Find the variance.



(a) $\frac{2}{\sqrt{3}}$

(b) $\frac{4}{3}$

(c) $\frac{16}{9}$

(d) $\frac{5}{3}$

ANS: B

The area under the curve must be 1,

$\Rightarrow \frac{1}{4}(k-1) = 1$

$\Rightarrow$ k = 5

Variance $= \frac{(b-a)^2}{12} = \frac{(5-1)^2}{12} = \frac{16}{12} = \frac{4}{3}$

Q. 31) Which of the following will not be present in the trigonometric Fourier series of an even function of time?

(a) sine term

(b) cosine term

(c) DC term

(d) odd harmonic term

ANS: A

Symmetry	**Condition**	**Fourier series**
Even	f(t) = f(-t)	**The DC and cosine terms can exist**
Odd	f(t) = -f(-t)	Sine terms can exist
Half wave	f(t ± T/2) = -f(t)	Odd harmonics
	f(t ± T/2) = f(t)	Even harmonics

Q. 32) A source produces three symbols A, B and C with probabilities, P(A) = ½, P(B) = ¼ and P(C) = ¼. The source entropy is

(a) ½ bit/symbol

(b) 1 bit/symbol

(c) 1 ¼ bits/symbol

(d) 1 ½ bits/symbol

ANS: D

Given:

P(A) = ½, P(B) = ¼ and P(C) = ¼

The entropy will be:

$$H = \frac{1}{2}\log_2(2) + \frac{1}{4}\log_2 4 + \frac{1}{4}\log_2 4$$

$$H = \frac{1}{2} + \frac{2}{4} + \frac{2}{4}$$

H = 6/4 = 1 ½ bits/symbol

Q. 33) What is the effect of current shunt feedback in an amplifier?

(a) Decrease the input resistance and increase the output resistance

(b) Decrease both the input and output resistances

(c) Increase the input resistance and decrease the output resistance

(d) Increase both input and output resistances

ANS: A

Q. 34) For which of the following calculations can superposition principle be applied?

(a) Voltage and power

(b) Current and power

(c) Voltage, current and power

(d) Voltage and current

ANS: D

Q. 35) Consider a signal $x(t) = 4 \cos(2t/3) + 8 \sin(0.5t) + 7 \sin(t/3 - \pi/6)$ Calculate the fundamental period.

(a) 6π seconds

(b) 2π seconds

(c) 12π seconds

(d) π seconds

ANS: C

Given:

$$x\,(t) = 4\cos\left(\frac{2t}{3}\right) + 8\sin(.5t) + 7\sin\left(\frac{t}{3} - \frac{\pi}{6}\right)$$

$$T_1 = \frac{\frac{2\pi}{2}}{3} = 3\pi$$

$$T_2 = \frac{2\pi}{.5} = 4\pi$$

$$T_3 = \frac{2\pi}{\frac{1}{3}} = 6\pi$$

Time period = L.C.M. (T_1, T_2, T_3)

= L.C.M. (3π, 4π, 6π)

=12π

Q. 36) The characteristic impedance of an 80 cm long lossless transmission line having L = 0.25 μH/m and C = 100 pF/m will be

(a) 25 Ω

(b) 40 Ω

(c) 50 Ω

(d) 80 Ω

ANS: C

$$Z_0 = \sqrt{\frac{L}{C}}$$

Calculation:

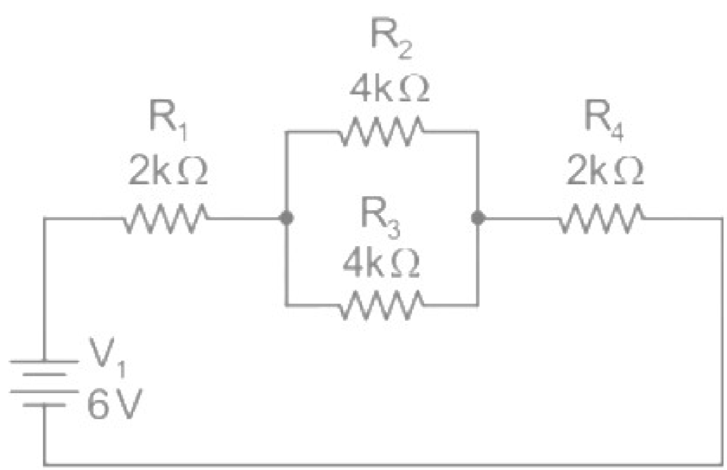
With L = 0.25 μH/m and C = 100 pF/m, we get:

$$Z_0 = \sqrt{\frac{0.25 \times 10^{-6}}{100 \times 10^{-12}}}$$

$$Z_0 = \sqrt{2500}$$

Z_0 = 50 Ω

Q. 37) What is the total current (mA) in the given circuit?



(a) 1 mA

(b) 1.6 mA

(c) 0.75 mA

(d) 0.5 mA

ANS: A

The equivalent resistance of the parallel combination of R_2 and R_3 will be:

$$R_{eq} = \frac{4k \times 4k}{4k+4k} = 2k\Omega$$

The equivalent resistance will be the series combination of 2 kΩ + 2 kΩ + 2 kΩ, i.e.

R'_{eq} = 6 kΩ

The current flowing across the circuit will be:

$$I = \frac{6}{6k} = 1\ mA$$

Q. 38) Which of the following gates is required to build a half adder?

(a) EX-OR gate and OR gate

(b) EX-OR gate and NOR gate

(c) Four NAND gate

(d) EX-OR gate and AND gate

ANS: D

Q. 39) Which one of the following is not a basic MOSFET device type?

(a) Enhancement P-channel MOSFET

(b) Depletion N-channel MOSFET

(c) Narrow P-channel MOSFET

(d) Enhancement N-channel MOSFET

ANS: C

Q. 40) The solution to the ordinary differential equation $\frac{d^2y}{dx^2} + \frac{dy}{dx} - 6y = 0$ is

(a) $y = c_1e^{3x} + c_2e^{-2x}$

(b) $y = c_1e^{3x} + c_2e^{2x}$

(c) $y = c_1e^{-3x} + c_2e^{2x}$

(d) $y = c_1e^{-3x} + c_2e^{-2x}$

ANS: C

The given ordinary differential equation (ODE) is

$$\frac{d^2y}{dx^2} + \frac{dy}{dx} - 6y = 0$$

The given equation can be written as

D = d/dx

$(D^2 + D - 6)\ y = 0$

The auxiliary equation is $D^2 + D - 6 = 0 \Rightarrow (D - 2) \times (D + 3) = 0$

The roots of auxiliary equation are -3 and 2

The complementary function C.F = $c_1e^{-3x} + c_2e^{2x}$

Since the RHS = 0, **there in no particular integral**

The solution is $\mathbf{y = c_1e^{-3x} + c_2e^{2x}}$

Q. 41) The depletion region in a Junction Diode contains

(a) only charge carriers (of minority type and majority type)

(b) no charge at all

(c) vacuum and no atoms at all

(d) only ions, i.e., immobile charges

ANS: D

Q. 42) Which of the following is responsible for thermal runaway in BJT?

(a) Change in β value with temperature

(b) Increase in forward bias current

(c) Increase in junction voltage

(d) Increase in reverse biased minority current.

ANS: D

Q. 43) In a non-inverting OPAMP, if R1 = 20 K ohms and Rf = 200 K ohms, then find the gain of the amplifier.

(a) 11

(b) 10

(c) 1.1

(d) 100

ANS: A

R_1 = 20 kΩ and R_2 = 200 kΩ

The voltage gain

$$A_v = 1 + \frac{R_2}{R_1}$$

$$A_V = 1 + \frac{200}{20}$$

= 11

Q. 44) Figure 1 represents a Y network of three equal resistances of 5 Ω each. The equivalent delta network of figure 2 will comprise of three equal resistances each equal to:

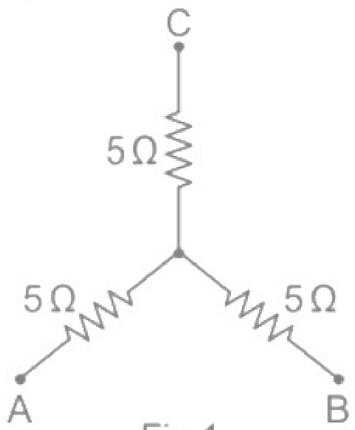


Fig 1

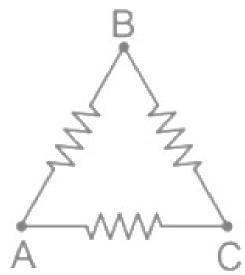


Fig 2

(a) 15 Ω

(b) 2.5 Ω

(c) 5 Ω

(d) 10 Ω

ANS: A

$$R_a = \frac{R_1R_2+R_2R_3+R_3R_1}{R_1}$$

$$R_b = \frac{R_1R_2+R_2R_3+R_3R_1}{R_2}$$

$$R_c = \frac{R_1R_2+R_2R_3+R_3R_1}{R_3}$$

Calculation:

Given $R_1 = 5\ \Omega$, $R_2 = 5\ \Omega$, $R_3 = 5\ \Omega$

$$R_a = \frac{5\times5+5\times5+5\times5}{5}$$

$R_a = 15\ \Omega$

Similarly,

$R_b = 15\ \Omega$

$R_c = 15\ \Omega$

Q. 45) Impedance of an inductor is twice that of a capacitor at a particular frequency f. If they are connected in series, what is the resonant frequency?

(a) $\frac{f}{\sqrt{2}}$

(b) $\sqrt{2}f$

(c) 2f

(d) 4f

ANS: B

When impedance of an inductor is twice that of a capacitor and they are connected in series, their resonant frequency is given by:

$X_L = 2X_C$

$\omega L = \frac{2}{\omega C}$

$\omega^2 = \frac{2}{LC}$

$\omega = \frac{\sqrt{2}}{\sqrt{LC}}$

$2\pi f_{new} = \frac{\sqrt{2}}{\sqrt{LC}}$

$f_{new} = \frac{\sqrt{2}}{2\pi\sqrt{LC}}$

Since, resonant frequency (f) = $\frac{1}{2\pi\sqrt{LC}}$

$\mathbf{f_{new} = \sqrt{2}\, f}$

Q. 46) The main purpose of modulation is to

(a) Combine two waves of different frequencies

(b) Achieve wave shaping of the carrier wave

(c) Transmitting low frequency information over long distance efficiently

(d) Produce side bands

ANS: C

Q. 47) $H(e^{j\omega})$ is the frequency response of a discrete time LTI system and $H_1(e^{j\omega})$ is the frequency response of its inverse function. Then

(a) $H(e^{j\omega})H_1(e^{j\omega}) = 1$

(b) $H(e^{j\omega})H_1(e^{j\omega}) = \delta(\omega)$

(c) $H(e^{j\omega}) * H_1(e^{j\omega}) = 1$

(d) $H(e^{j\omega}) * H_1(e^{j\omega}) = \delta(\omega)$

ANS: A

D.T.F.T

Discrete-time Fourier transform is defined by

$$H\left(e^{j\omega}\right) = \sum_{n=-\infty}^{\infty} h[n]\, e^{-j\omega n}$$

Inverse function of x(n) is defined as:

$h_1(n) = 1/h(n)$

$H_1(e^{j\omega}) = 1/H(e^{j\omega})$

$H(e^{j\omega})\, H_1(e^{j\omega}) = 1$

Q. 48) The bandwidth of a single stage amplifier is _______ that of a multistage amplifier

(a) More than

(b) The same as

(c) Less than

(d) Data insufficient

ANS: A

- The gain of the multistage amplifier increases.
- As the product of gain and bandwidth is constant, **the bandwidth decreases.** Hence the bandwidth of a single-stage amplifier is **more than** that of a multistage amplifier

Q. 49) For satellite communication the standard uplink and downlink frequencies, respectively, in C-band are:

(a) 6 GHz and 4 GHz

(b) 12 GHz and 8 GHz

(c) 4 GHz and 6 GHz

(d) 12 GHz and 9 GHz

ANS: A

Q. 50) Convert hex number to decimal.
$(0101)_{16}$

(a) 572

(b) 527

(c) 257

(d) 253

ANS: C

Given,

Hexadecimal number is $(0101)_{16}$

Expanding according to equation 1,

$(0 \times 16^3) + (1 \times 16^2) + (0 \times 16^1) + (1 \times 16^0)$

$= (0 \times 4096) + (1 \times 256) + (0 \times 16) + (1 \times 1)$

$= (257)_{10}$

So, the decimal equivalent of the given hexadecimal number is $(257)_{10}$

Q. 51) A 120 Ah capacity battery can deliver a current of 8 A for a period of

(a) 20 hrs

(b) 15 hrs

(c) 12 hrs

(d) 8 hrs

ANS: B

Given that,

capacity of battery = 120 AH

current = 8A

Now backup time can be calculated as

Backup time = 120/8

Backup time = 15 hours

A 120 Ah capacity battery can deliver a current of 8A for a period of **15 hours**

Q. 52) A capacitor of capacitance 50 micro farads is charged to a potential difference of 200 Volts. Find out energy stored in the condenser ?

(a) 1 joule

(b) 100 milli joule

(c) 10 milli joule

(d) 100 joule

ANS: A

Given:

C = 50 μF, V = 200V

The energy stored in the capacitor is:

$$U = \frac{1}{2}CV^2$$

$$U = \frac{1}{2}(50 \times 10^{-6}) \times (200)^2$$

U = 1J

Q. 53) The formula for determining resonant frequency (f_r)of series RLC Circuit is

(a) $f_r = \sqrt{LC}$

(b) $f_r = \dfrac{1}{\sqrt{LC}}$

(c) $f_r = 2\pi\sqrt{LC}$

(d) $f_r = \dfrac{1}{2\pi\sqrt{LC}}$

ANS: D

Q. 54) In a certain series resonant circuit V_c = 100 V, V_L = 100 V and V_R = 35 V. The source voltage is

(a) 100 V

(b) 135 V

(c) 65 V

(d) 35 V

ANS: D

Given:

V_C = 100 V, V_L = 100 V and V_R = 35 V

At resonance, the source voltage will be equal to the voltage across the resistor, i.e.

$V_S = V_R$ = 35 V

Q. 55) During forward bias and reverse bias, and ideal diode has ___________ respectively.

(a) zero conductance & zero resistance

(b) zero conductance & infinite resistance

(c) infinite conductance & infinite resistance

(d) infinite conductance & zero resistance

ANS: C

Q. 56) If the carrier modulated by a digital bit stream had one of the possible phases of 0°, 90° 180° and 270° then the modulation is called

(a) BPSK

(b) QPSK

(c) QAM

(d) MSK

ANS: B

Q. 57) Which one of the following is an element which samples the continuous signal into sequence pulses appearing at regular interval of time?

(a) Coupler

(b) Sampler

(c) A/D Converter

(d) D/A Converter

ANS: B

Q. 58) The 8085 Microprocessor has

(a) 8 - bit data bus 16 - bit address bus

(b) 8 - bit data bus 8 - bit address bus

(c) 16 - bit data bus 8 - bit address bus

(d) 16 - bit data bus 16 - bit address bus

ANS: A

Q. 59) In TTL family, the Totem-pole circuit on the output is used to provide ________.

(a) active pull up and active pull down

(b) active pull up

(c) active pull down

(d) inactive output state

ANS: A

Q. 60) The unit impulse response of a system is $h\left(t\right) = e^{-t}$, t ≥ 0. For this system, the steady state value of the output for unit step input is equal to

(a) -1

(b) 0

(c) 1

(d) ∞

ANS: C

Q. 61) Find out the equivalent of $A + A' + B'$.

(a) 1

(b) AB

(c) A

(d) B

ANS: A

$Y = A + A' + B'$

By using Inverse law

$Y = 1 + B'$

$Y = 1$

Q. 62) The values of c for which the function f(x) is a p.d.f. is?

$$f(x) = \begin{cases} \frac{c}{\sqrt{x}}, & 0 < x < 4 \\ 0, & otherwise \end{cases}$$

(a) $\frac{1}{2}$

(b) $\frac{1}{3}$

(c) $\frac{1}{4}$

(d) $\frac{1}{6}$

ANS: C

$$\text{PDF} = \text{f}(\text{x}) = \begin{cases} \frac{c}{\sqrt{x}}, & 0 < x < 4 \\ 0, & otherwise \end{cases}$$

Using Equation (2):

$$\int_0^4 \frac{c}{\sqrt{x}} dx = 1$$

$$[2c\sqrt{x}]_0^4 = 1$$

4c = 1

$$c = \frac{1}{4}$$

Q. 63) The probability of having an electron in the Fermi level for semiconductor is:

(a) 1

(b) infinity

(c) 0.5

(d) Cannot be defined if the temperature is not given

ANS: C

For metal, the probability is 1.
For semiconductors, the probability is 0.5.
For insulators, the probability is 0.

Q. 64) Negative feedback in amplifier:

(a) Increase stability

(b) Increases noise

(c) Increases frequency distortion

(d) Increases gain

ANS: A

The negative feedback in amplifiers causes:

- Reduced the gain and **increases the stability.**
- Increases the bandwidth to maintain constant gain-bandwidth product
- Reduces the distortion and noise in the amplifier
- The signal-to-noise ratio is not affected.

Q. 65) The battery with a 1400 mAh can supply 2.8 Ampere current for:

(a) 60 minutes

(b) 30 minutes

(c) 100 minutes

(d) 50 minutes

ANS: B

The capacity of battery = 1400 mAh

Current delivered = 2.8 A

Duration of time (T) will now be:

$$T = \frac{1400\, mAh}{2.8\ A}$$

$$T = \frac{1400 \times 10^{-3} h}{2.8\ A}$$

T = 0.5 hr = 0.5 × 60 min

T = 30 mins

Q. 66) In an impedance smith chart a clockwise movement along a constant resistance circle gives rise to

(a) a decrease in value of reactance

(b) a increase in value of reactance

(c) No change in value of reactance

(d) No change in value of impedance

ANS: B

Q. 67) The binary equivalent of the octal number 456 is ________.

(a) 100111101

(b) 100101110

(c) 101011110

(d) 101001101

ANS: B

- From the above table, the binary equivalent of 6 is 110.
- The binary equivalent of 5 is 101.
- The binary equivalent of 4 is 100.

Hence, the binary equivalent of the octal number 456 is 100101110

Q. 68) Class C amplifiers are used as

(a) RF amplifiers

(b) AF amplifiers

(c) Small signal amplifiers

(d) IF amplifiers

ANS: A

Power Amplifier	**Conduction Angle**	**Maximum Efficiency**	**Figure of Merit**
Class A	360°	50%	2
Class B	**180°**	**78.5%**	0.4
Class AB	180° - 360°	50 - 78.5%	0.4 - 2
Class C	< 180°	≥ 90°	< 0.25

Q. 69) Power amplifiers generally use transformer coupling because transformer coupling provides

(a) Cooling of the circuit

(b) Distortion less output

(c) Good frequency response

(d) Impedance matching

ANS: D

Advantages of transformer coupling:

- **An excellent impedance matching is provided.**
- The gain achieved is higher.
- There will be no power loss in the collector and base resistors.
- Efficient in operation.

Q. 70) The directivity of an antenna array can be increased by adding more antenna elements, as a larger number of elements:

(a) improves the radiation efficiency

(b) increases the effective area of the antenna

(c) results in a better impedance matching

(d) allows more power to be transmitted by the antenna

ANS: B

Effective Area (A_c):

It describes how has much power the antenna can capture from a given plane wave.

$A_c = \frac{\lambda^2}{4\pi} D$ From the above, it is clear that **if G_d increases then D also increases. This indicates that A_c also increases.**

Q. 71) A proportional plus derivative controller:

1. has high sensitivity.

2. increases the stability of the system.

3. improves steady-state accuracy.

Which of the above statements are correct?

(a) 1, 2, and 3

(b) 1 and 2 only

(c) 1 and 3 only

(d) 2 and 3 only

ANS: B

Q. 72) The result of $h(2t) * \delta(t-t_0)$ (" * " denotes convolution and "δ()" denotes the Dirac delta function) is:

(a) $h(2t - 2t_0)$

(b) $h(2t_0 - 2t)$

(c) $h(-2t - 2t_0)$

(d) $h(2t + 2t_0)$

ANS: A

Given signal is $h(2t)$ and convolution is done with $\delta(t - t_0)$

$$h(2t) * \delta(t - t_0) = h(2(t - t_0))$$

$$h(2t) * \delta(t - t_0) = h(2t - 2t_0)$$

Q. 73) A capacitor carries a charge of 0.1 C at 5.0 V. Its capacitance is

(a) 0.05 F

(b) 0.02 F

(c) 0.5 F

(d) 0.2 F

ANS: B

Given:

$Q = 0.1\ C$, $V = 5.0\ V$

From equation (1);

$$C = \frac{0.1}{5}$$

$C = 0.02\ F$

Q. 74) The 555 timer can be used in which of the following configurations?

(a) astable, monostable and bistable

(b) monostable, toggled

(c) astable, toggled

(d) bistable, tristable

ANS: A

Q. 75) An unit impulse function in continuous form is defined to be

(a) $\delta(t) = t$

(b) $\delta(t) = 1$

(c) $\delta(t) = \begin{cases} \infty, & t = 0 \\ 0, & t \neq 0 \end{cases}$

(d) $\delta(t) = \begin{cases} 0, & t = 0 \\ 1, & t \neq 0 \end{cases}$

ANS: C

Q. 76) Consider the analog signal $x(t) = 3 \cos 100 \pi t$. If the signal is sampled at 200 Hz, the discrete time signal obtained will be

(a) $3 \cos (\pi n/4)$

(b) $3 \cos (\pi n/2)$

(c) $3 \cos (\pi n)$

(d) $3 \cos (\pi n/3)$

ANS: B

For a signal x(t) sampled with a sampling interval T_S, the discrete sequence can be written as:

$$x\,(n) = x(t)|_{t=nT_s}$$

T_S = sampling interval

Analysis:

x(t) = 3 cos 100 πt

f_S = 200 Hz, T_S = 1/200 = 0.005 sec

x(n) = 3 cos 100π(n/200)

x(n) = 3 cos (πn/2)

Q. 77) A capacitor is charged through a resistance R then the time constant of the circuit is

(a) $\frac{R}{C}$

(b) $\frac{1}{RC}$

(c) RC

(d) $\frac{C}{R}$

ANS: C

Q. 78) A uniform plane wave in the free space is normally incident on an infinitely thick dielectric slab (dielectric constant $\epsilon_r = 9$). The magnitude of the reflection coefficient is

(a) 0

(b) 0.3

(c) 0.5

(d) 0.8

ANS: C

The magnitude of the reflection coefficient = |Γ|

$$\Gamma = \frac{\sqrt{\epsilon_{r_1}} - \sqrt{\epsilon_{r2}}}{\sqrt{\epsilon_{r_1}} + \sqrt{\epsilon_{r2}}}$$

Calculation:

$$\Gamma = \frac{1-3}{1+3} = -0.5$$

$$|\,\Gamma| = \ 0.5$$

Q. 79) Built-in potential V_0 of a junction depends on:

(a) Doping densities and Temperature

(b) Only Temperature

(c) Cross sectional area of the junction

(d) Doping densities only

ANS: A

Q. 80) Which of the following is correct for a D-type flip-flop ?

(a) The Q output is either SET or RESET as soon as the D input goes HIGH or LOW

(b) The output complement follows the input when enabled

(c) Only one of the inputs can be HIGH at a time

(d) The output toggles if one of the inputs is held HIGH

ANS: A

Q. 81) For a thermally grown silicon dioxide layer, in a MOSFET, the leakage current between the gate and channel is:

(a) 0

(b) Very small

(c) Large

(d) Very large

ANS: B

Q. 82) The r.m.s. value of an a.c. signal is 10V. It's peak value will be:

(a) 6.37 V

(b) 14.14 V

(c) 141 V

(d) None of these

ANS: B

RMS value of an AC signal (sine wave)

$$V_{rms} = \frac{V_m}{\sqrt{2}}$$

Where,

V_m : Maximum value or Peak value

Calculation:

$V_{rms} = 10$ V

$V_m = 10\sqrt{2}$

$V_m = 14.14$ V

Q. 83) In which combination, Ammeter is connected with circuit:

(a) Series

(b) Sometime series, sometimes parallel

(c) Parallel

(d) None of these

ANS: A

Ammeter:

1. The electrical instrument which is used to measure the electric current in an electric circuit is called an ammeter.

2. An **Ammeter** is connected in the series combination because the **current remains constant in the series combination**.

3. This helps in getting an accurate reading from the instruments

Q. 84) If the minimum range is to be doubled in a radar, the peak power has to be increased by a factor of

(a) 4

(b) 8

(c) 16

(d) 32

ANS: C

We observe that, $R \propto (P_t)^{1/4}$

Now, to double the range R, P_t has to be increased by a factor of 16

Q. 85) The transconductance of a JFET is computed at constant V_{DS} by:

(a) Ratio of change in I_d to change of V_{gs}

(b) Ratio of change in V_{gs} to change of I_d

(c) Product of change in V_{gs} to change of I_d

(d) Ratio of change in V_{ds} to change of I_d

ANS: A

Q. 86) Which register pair of 8085 is used to store the memory address for memory-related instructions?

(a) B, C registers

(b) H, L registers

(c) A, Flag register

(d) D, E registers

ANS: B

Q. 87) Two rectangular waveguides have dimensions of 1 cm × 0.5 cm and 1 cm × 0.25 cm respectively. Their respective cutoff frequencies will be

(a) 15 GHz and 30 GHz

(b) 15 GHz and 15 GHz

(c) 30 GHz and 30 GHz

(d) 30 GHz and 15 GHz

ANS: B

The minimum cutoff frequency in a rectangular waveguide is for TE_{10}

$$i.e.\ f_{c(10)} = \frac{c}{2}\sqrt{\frac{m^2}{a^2}} = \frac{c}{2a}$$

The cut off frequency is given by:

$$f_c = \frac{c}{2a} = \frac{3\times10^8}{2\times1\times10^{-2}} = 15\ GHz$$

It will be the same for both since the cut-off frequency is only dependent on broadside length (a).

Q. 88) What is the maximum frequency of modulating signal in FM system, if it has 8 significant sidebands, and the maximum bandwidth is 32 kHz?

(a) 4 kHz

(b) 8 kHz

(c) 16 kHz

(d) 2 kHz

ANS: D

BW = 32 KHz

Given FM system has 8 sidebands (significant) i.e. 8 sidebands on the positive side of frequency & 8 sidebands on the negative side of the frequency

So, It has sidebands up to order '8'.

According to carson rule:

Significant sideband upto order of $(\beta + 1)$ has B.W

$BW = (\beta + 1)\, 2f_m$

So,

$32 = 8 \times 2\, f_m$

$f_m = 2$ kHz

Q. 89) If X and Y are random variables such that $E[2X + Y] = 0$ and $E[X + 2Y] = 33$, then $E[X] + E[Y] =$ ________.

(a) 9

(b) 6

(c) 13

(d) 11

ANS: D

$E[2X + Y] = 0$

$2E[X] + E[Y] = 0$ ----(1)

$E[X + 2Y] = 33$

$E[X] + 2E[Y] = 33$ ----(2)

Adding (1) and (2)

$3E[X] + 3E[Y] = 33$

$E[X] + E[Y] = 11$

Q. 90) The central tapping of the transformer in centre tapped full wave rectifier is used:

(a) To isolate the load from secondary winding

(b) To step up the voltage of the transformer

(c) To step down the voltage of the transformer

(d) To make both the diodes to conduct during alternate half cycles

ANS: D

Q. 91) A signal of maximum frequency of 10 kHz is sampled at Nyquist rate. The time interval between two successive samples is

(a) 50 μs

(b) 100 μs

(c) 500 μs

(d) 1000 μs

ANS: A

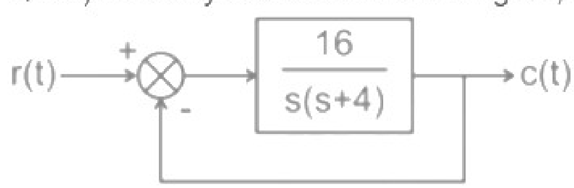
$f_m = 10$ kHz

$f_s = 20$ kHz

$$T_s \leq \frac{1}{2 \times 10}$$

Ts = 50 μs

Q. 92) In the system shown in the figure, r(t) = sin ωt



The steady-state response c(t) will exhibit a resonance peak at a frequency of:

(a) 4 rad/sec

(b) 2√2 rad/sec

(c) 2 rad/sec

(d) √2 rad/sec

ANS: B

The given feedback is a unity feedback system,

$$CLTF = \frac{G(s)}{1+G(s)} = \frac{\frac{16}{s(s+4)}}{1+\frac{16}{s(s+4)}}$$

$$= \frac{16}{s(s+4)+16} = \frac{16}{s^2+4s+16}$$

The characteristic equation is given by;

$s^2 + 4s + 16 = 0$

Comparing this with the standard 2nd order characteristic equation $s^2 + 2\xi\omega_n s + \omega_n^2 = 0$, we see that,

$\omega_n^2 = 16.$

So, $\omega_n = 4$

And, $2\xi\omega_n = 4$

So, $\xi = 0.5 = \frac{1}{2}$

So, the resonant frequency is given by;

$$\omega_r = \omega_n\sqrt{1-2\xi^2}$$

$$\omega_r = 4\sqrt{1-2\left(\frac{1}{2}\right)^2}$$

$$= 4\sqrt{1-\frac{1}{2}} = 2\sqrt{2}\,rad/sec$$

Q. 93) The term heterodyning refers to

(a) Frequency conversion

(b) Frequency mixing

(c) Frequency conversion & mixing

(d) None of the mentioned

ANS: C

Q. 94) For the open loop transfer function $G(s)H(s) = \frac{K}{s(s+4)(s+5)}$. The point of intersection of root locus with imaginary axis is ______.

(a) $\pm j2\sqrt{5}$

(b) $\pm j4\sqrt{5}$

(c) $\pm j\sqrt{5}$

(d) $\pm j3\sqrt{5}$

ANS: A

$$G(s)H(s) = \frac{K}{s(s+4)(s+5)}$$

Characteristic equation, 1 + G(s)H(s) = 0

$$\Rightarrow 1 + \frac{K}{s(s+4)(s+5)} = 0$$

⇒ s(s + 4) (s + 5) + K = 0

⇒ $s^3 + 9s^2 + 20\,s + K = 0$

$$\begin{array}{c|cc} s^3 & 1 & 20 \\ s^2 & 9 & K \\ s^1 & \frac{180-K}{9} & 0 \\ s^0 & K & \end{array}$$

The system to be marginally stable, 180 – K = 0

⇒ K = 180

$9s^2 + K = 0$

⇒ $9s^2 + 180 = 0$

$$\Rightarrow s = \pm j\sqrt{20} = \pm j2\sqrt{5}$$

Q. 95) The special case of a finite-duration sequence is given as

$$x(n) = \left\{2, \underset{\uparrow}{4}, 0, 3\right\}$$

The sequence x(n) into a sum of weighted impulse sequences will be

(a) 2δ(n + 1) + 4δ(n) + 3δ(n – 2)

(b) 2δ(n) + 4δ(n –1) + 3δ(n – 3)

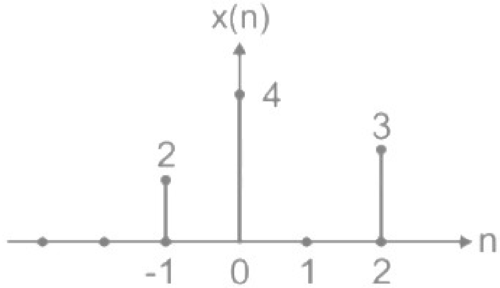
(c) 2δ(n) + 4δ(n –1) + 3δ(n – 2)

(d) 2δ(n + 1) + 4δ(n) + 3δ(n – 1)

ANS: A

$$x(n) = \left\{2, \underset{\uparrow}{4}, 0, 3\right\}$$

The arrow indicates the origin. This can be represented as:



In terms of unit impulse sequences, this can be represented as:

x(n) = 2δ(n + 1) + 4δ(n) + 3δ(n – 2)

Q. 96) ________ is also known as Hertz antenna

(a) Concave plane antenna

(b) Horn antenna

(c) Parabolic reflector antenna

(d) Half-wave dipole antenna

ANS: D

Hertz antenna is a dipole antenna of length equal to half of the wavelength of transmitted EM wave.

$$\therefore l = \frac{\lambda}{2} = \frac{\nu}{2f}$$

Q. 97) Which of the following is the CORRECT representation of transconductance?

(a) $G_M = I/V_i$

(b) $G_M = V/V_i$

(c) $G_M = I/I_i$

(d) $GM = V/I_i$

ANS: A

Q. 98) ________ is usually used in RF power amplifier and in amateur radio.

(a) Primary amplifier

(b) Secondary amplifier

(c) Non-linear amplifier

(d) Linear amplifier

ANS: D

Q. 99) The Fourier transform of a double sided exponential function $e^{-\frac{1}{2}|t|}$ is

(a) $\frac{2}{1\,+\,4\omega^2}$

(b) $\frac{1\,+\,4\omega^2}{4}$

(c) $\frac{1\,+\,4\omega^2}{2}$

(d) $\frac{4}{1\,+\,4\omega^2}$

ANS: D

For the given two-sided exponential:

$$x\left(t\right) = e^{-\frac{1}{2}|t|}$$

$$a = \frac{1}{2}$$

The Fourier transform from equation (1) will be:

$$e^{\frac{-1}{2}|t|} \leftrightarrow \frac{2\times\frac{1}{2}}{\left(\frac{1}{2}\right)^2+\omega^2}$$

$$e^{-\frac{1}{2}|t|} \leftrightarrow \frac{1}{\omega^2+\frac{1}{4}}$$

$$e^{-\frac{1}{2}|t|} \leftrightarrow \frac{4}{1+4\omega^2}$$

Q. 100) TRAP is

(a) Maskable, highest priority and software interrupt

(b) Non-maskable, highest priority and hardware interrupt

(c) Non-maskable, highest priority software interrupt

(d) Maskable, lowest priority and hardware interrupt

ANS: B

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