ESE - 2016

E&T PAPER - 2 (OBJECTIVE)

QUESTIONS WITH DETAILED SOLUTIONS

SET - B

NAME OF THE SUBJECT	NO. OF QUESTIONS	NAME OF THE SUBJECT	NO. OF QUESTIONS
ANALOG ELECTRONIC CIRCUITS	22	MICROWAVE ENGINEERING	11
DIGITAL ELECTRONIC CIRCUITS	27	MICROPROCESSORS	02
CONTROL SYSTEMS	29	COMPUTER ENGINEERING	11
COMMUNICATION SYSTEMS	18		

ALL QUERIES RELATED TO ESE - 2016 KEY ARE TO BE SENT TO THE FOLLOWING EMAIL ADDRESS

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01. The closed-loop transfer function of a certain control system is given by $\dfrac{C}{R}(s) = \dfrac{100}{s^2 + 10s + 100}$. Then the settling time for a 2% tolerance band is given by

(a) 0.8 s   (b) 1.2 s

(c) 1.5 s   (d) 2.1 s

01. Ans: (a)

Sol: $\dfrac{C}{R}(s) = \dfrac{100}{s^2 + 10s + 100}$

Then settling time for 2% tolerance.

The location of poles $\dfrac{C(s)}{R(s)}$

$\tau = 1/5$

$t_s = 4\tau = 4/5 = 0.8$

02. The unit step input response of a certain control system is given by

$c(t) = 1 + 0.2\, e^{-60t} - 1.2\, e^{-10t}$. The undamped natural frequency ω_n and damping ratio δ are, respectively

(a) 24.5 and 1.27   (b) 33.5 and 1.27

(c) 24.5 and 1.43   (d) 33.5 and 1.43

02. Ans: (c)

Sol: The step response

$c(t) = 1 + 0.2e^{-60t} - 1.2e^{-10t}$ then ω_n and δ are.

$c(t) = 1 + 0.2e^{-60t} - 1.2e^{-10t}$

Impulse response

$h(t) = \dfrac{d}{dt} c(t)$

$\dfrac{dc(t)}{dt} = 0 + (0.2)(-60)e^{-60t} - 1.2(-10)e^{-10t}$

$h(t) = -12e^{-60} + 12e^{-10t}$

Then transfer function

$= 12\left[\dfrac{1}{s+10} - \dfrac{1}{s+60} \right]$

$= 12\left[\dfrac{50}{s^2 + 70s + 600} \right]$

$= \dfrac{600}{s^2 + 70s + 600}$

$\therefore \omega_n^2 = 600$

$\omega_n = 24.49$ rad/sec

$2\xi\omega_n = 70$

$\xi = \dfrac{70}{2(24.49)} = 1.428$

03. In Force-Voltage Analogy

(a) Force is analogous to current

(b) Mass is analogous to capacitance

(c) Velocity is analogous to current

(d) Displacement is analogous to magnetic flux linkage

03. **Ans: (c)**

Sol: In force - voltage analogy Velocity analogous to current

04. For a unity feedback control system having an open-loop transfer function $G(s) = \dfrac{25}{s(s+6)}$, what is the time t_p at which the peak of the step input response occurs?

(a) 0.52 s　　　　　(b) 2.75 s

(c) 0.79s　　　　　(d) 1.57 s

04. **Ans: (c)**

Sol: $G(s)\,H(s) = \dfrac{25}{s(s+6)}$

$C.E = 1+GH = s^2+6s+25 = 0$

$\omega_n = 5 \quad \xi = 0.6 \quad \omega_d = 4$

$t_p = \dfrac{\pi}{\omega_d} = 0.79\text{sec}$

05. The transfer function $G(s) = \dfrac{10(s-1)}{(s+10)}$ represents

(a) Unstable system

(b) Minimum phase system

(c) Non-minimum phase system

(d) PID controller system

05. **Ans: (c)**

Sol: $G(s) = \dfrac{10(s-1)}{(s+10)}$

Represents
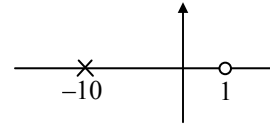
Single right side zero means non-minimum phase

06. What is the maximum input frequency limit of a 3-bit Ripple counter configured around flip-flops, with inherent propagation delay time t_{pd} = 50 ns?

(a) 6670 MHz　　　　(b) 667 MHz

(c) 66.7 MHz　　　　(d) 6.67 MHz

06. **Ans: (d)**

Sol: $f_{clk} = \dfrac{1}{N.t_{pd}} = \dfrac{1}{3\times50\times10^{-9}} = \dfrac{10^9}{150} = 6.67\,\text{MHz}$

07. The characteristic equation of a certain feedback control system is given by $s^4 + 4s^3 + 13s^2 + 36s + k = 0$. The range of values of k for which the feedback system is stable, is given by

(a) $0 < k < 4$

(b) $4 < k < 36$

(c) $0 < k < 36$

(d) $13 < k < 36$

07. Ans: (c)

Sol: $s^4 + 4s^3 + 13s^2 + 36s + k = 0$

Then the system is stable for

$$
\begin{array}{c|ccc}
s^4 & 1 & 13 & k \\
s^3 & 4 & 36 & 0 \\
s^2 & 4 & k & 0 \\
s^1 & \frac{(36-k)}{4} & 0 & 0 \\
s^0 & k & 0 & 0
\end{array}
$$

$36 > k$

$K > 0$

$0 < k < 36$

08. The closed-loop transfer function of a unity feedback control system is,

$$\frac{C(s)}{R(s)} = \frac{\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2}.$$

The velocity error constant of the system is

(a) $\dfrac{\omega_n}{2\zeta}$

(b) $\dfrac{\omega_n}{\zeta}$

(c) $\dfrac{2\omega_n}{\zeta}$

(d) $\dfrac{3\omega_n}{2\zeta}$

08. Ans: (a)

Sol: $\dfrac{C(s)}{R(s)} = \dfrac{\omega_n^2}{s^2 + 2\xi\omega_n s + \omega_n^2}$

The velocity error constant

$$G(s) = \frac{\omega_n^2}{s(s + 2\xi\omega_n)}$$

$$k_v = \underset{s \to 0}{Lt}\ SG(s)$$

$$\Rightarrow \underset{s \to 0}{Lt}\ \frac{\omega_n^2}{(s + 2\xi\omega_n)} = \frac{\omega_n^2}{2\xi\omega_n}$$

$$k_v = \frac{\omega_n}{2\xi}$$

09. The system described by the following state equations

$$\dot{X} = \begin{bmatrix} 0 & 1 \\ 2 & -3 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u, \quad Y = [1, 1]X \text{ is}$$

1. Completely controllable

2. Completely observable

Which of the above statements is/are correct?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

09. Ans: (c)

Sol: $\dot{x} = \begin{bmatrix} 0 & 1 \\ 2 & -3 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} U$

$Y = \begin{bmatrix} 1, & 1 \end{bmatrix} x$

$Q_c = \begin{bmatrix} B & AB \end{bmatrix}$

$AB = \begin{bmatrix} 0 & 1 \\ 2 & -2 \end{bmatrix}\begin{bmatrix} 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 1 \\ -3 \end{bmatrix}$

$Q_c = \begin{bmatrix} 0 & 1 \\ 1 & -3 \end{bmatrix}$

Det $|Q_c| = -1 \neq 0$

$\therefore$ Controllable

$$CA = \begin{bmatrix} 1 & 1 \end{bmatrix} \begin{bmatrix} 0 & +1 \\ 2 & 3 \end{bmatrix}$$

$$= \begin{bmatrix} 2 & -2 \end{bmatrix}$$

$$Q_0 = \begin{bmatrix} 1 & 1 \\ 2 & -2 \end{bmatrix}$$

$\det|Q_0| = -2 - 2 = -4 \neq 0$
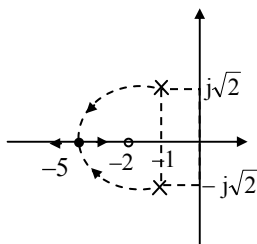
$\therefore$ Observable

10. Consider the system with $G(s) = \dfrac{K(s+2)}{s^2 + 2s + 3}$

and H(s) = 1. The breakaway point(s) of the root loci is/are at

(a) –0.265 only

(b) –3.735 only

(c) –3.735 and –0.265

(d) There is no breakaway point

10. Ans: (d)

Sol: $G(s) = \dfrac{k(s+2)}{s^2 + 2s + 3}$

The Break away point of the system is

$$\dfrac{k(s+2)}{s^2 + 2s + 3} = 1$$

$S = -2, -1 \pm j\sqrt{2}$

$$k = \dfrac{-(s^2 + 2s + 3)}{s+2}$$

$$\dfrac{dk}{ds} = \dfrac{-\left[(s+2)(2s+2) - (s^2 + 2s + 3)\right]}{(s+2)^2} = 0$$

$$\dfrac{dk}{ds} = \dfrac{-\left[2s^2 + 2s + 4s + 4 - s^2 - 2s - 3\right]}{(s+2)^2}$$

$$k^1 = \dfrac{-\left[s^2 + 4s + 1\right]}{(s+2)^2} = 0$$

Break points

$s^2 + 4s + 1 = 0$

$s = -0.26$

$s = -3.73$

$s = -0.26$ is not on root locus therefore it is not valid

$s = -3.73$ is break in point where the Root locus branches are coming from complex plane to real axis.

There fore there are no break away points in the system.

11. How would a binary number 0010 be represented by a 4-bit binary word, if the range of voltage is 0 to 10 V?

(a) 0.666 V (b) 1.333 V

(c) 0.333 V (d) 2.000 V

11. Ans: (b)

Sol: Range of voltage is 0 to 10 V

$\Rightarrow$ Full scale voltage = 10 V

Binary number	Voltage
$(0000)_2 = (0)_{10}$	0V
$(1111)_2 = (15)_{10}$	10V
$(0010)_2 = (2)_{10}$	?

Voltage for binary number $(0010)_2 = \dfrac{10}{15} \times 2$

$$= 1.333V$$

12. For a unity feedback system with open-loop transfer function $\dfrac{25}{s(s+6)}$, the resonant peak output M_m and the corresponding resonant frequency ω_m, are respectively

(a) 2.6 and 2.67 r/s

(b) 1.04 and 2.67 r/s

(c) 2.6 and 4.8 r/s

(d) 1.04 and 4.8 r/s

12. Ans: (b)

Sol: $G(s) = \dfrac{25}{s(s+6)}$

$\dfrac{C(s)}{R(s)} = \dfrac{25}{s^2 + 6s + 25}$

$\omega_n = 5$

$2\xi\omega_n = 6$

$\xi = \dfrac{6}{10} = 0.6$

$M_m = \dfrac{1}{2\xi\sqrt{1-\xi^2}}$

$= \dfrac{1}{2(0.6)\sqrt{1-0.6^2}}$

$= \dfrac{1}{2(0.6)\sqrt{0.64}} = 1.04$

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

$= 5\sqrt{1-2(0.6)^2} = 2.645$ rad/sec

13. The transfer function of a control system is said to be 'All Pass System', if it has

(a) Unit magnitude at all frequencies with anti-symmetric pole-zero pattern

(b) Unit magnitude at all frequencies with symmetric pole-zero pattern

(c) magnitude varying with frequency and with anti-symmetric pole-zero pattern

(d) Unit magnitude at some frequencies with symmetric pole-zero pattern

13. Ans: (a)

Sol:
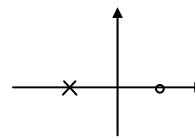
Pole zero pattern is anti-symmetric about imaginary axis.

14. Consider the following:

1. Bode plot

2. Nyquist plot

3. Nichols chart

Which of the above frequency response plots are commonly employed in the analysis of control systems?

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

(c) 2 and 3 only   (d) 1, 2 and 3

14.   **Ans: (d)**

15. An A-to-D converter in which one sub-circuit is a D-to-A converter is

(a) Parallel A/D converter

(b) Dual slope A/D converter

(c) Successive approximation A/D converter

(d) Extended parallel type A/D converter

15.   **Ans: (c)**

16. Consider the transfer function:

$$G(s) = \frac{5(s^2 + 10s + 100)}{s^2(s^2 + 15s + 1)}$$

The corner frequencies in Bode's plot for this transfer function are as

(a) 10 r/s and 10 r/s

(b) 100 r/s and 10 r/s

(c) 10 r/s and 1 r/s

(d) 100 r/s and 1 r/s

16. Ans: (c)

Sol: $G(s) = \dfrac{5(s^2 + 10s + 100)}{s^2(s^2 + 15s + 1)}$

The corner frequencies of Bode plot

ω_n = 10, 1

10rad/sec , 1rad/sec

17. Consider the transfer function (0.1 + 0.01s) for a PD controller. What is the frequency at which the magnitude is 20 dB (by using asymptotic Bode's plot) ?

(a) 2000 r/s   (b) 1000 r/s

(c) 200 r/s   (d) 100 r/s

17. Ans: (b)

Sol: G(s) = (0.1+0.01s)

The frequency at which the magnitude is 20dB

G(s) = 0.1 [1+0.1s]

Asymptotic magnitude

$M_{asy} = 20\log[0.1] + 20\log[0.1\omega]$

= 20

20 log[0.1ω]= 40

0.1ω= 10^2

ω = 1000 rad/sec

18. The main objectives of drawing the root-locus plot are

1. To obtain a clear picture of the open-loop poles and zeros of the system

2. To obtain a clear picture of the transient response of the system for varying gain, K

3. To find the range of K to make the system stable

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

18. Ans: (d)

Sol: Root locus main objectives

1. To obtain a clear picture of the open-Loop poles and zeros of the system.

→The open-loop poles zeros location is known with simple s-plane. The Root locus will give clear picture of closed loop-poles movement.

2. To obtain clear picture of transient response of the system with gain k.

3. To find the range of k to make the system stable.

19. A unity feedback system has open-lop poles at s = –2 ± j2, s = –1 and s = 0 and a zero at s = –3.

What are the angles made by the root-loci asymptotes with the real axis?

(a) 60° , 180° and $–60^o$

(b) 30° , 90° and 60°

(c) 60° , 120° and $–30^o$

(d) 30° , 60° and 180°

19. **Ans: (a)**

Sol: s = –2 ±j2

s= – 1

s = 0

are poles of the system

s = –3 is zero of the system.

The asymptotes are

p =4 →number of poles

z = 1 → number of zeros

p–z = 3

∴ Asymptotes are =± 60°, ± 180°, ± 300°

20. The open-loop transfer function of a unity feedback system is $G(s) = \dfrac{K}{s(s+5)}$. The gain K that results in a phase margin of 45° is

(a) 35 (b) 30

(c) 25 (d) 20

20. **Ans: (a)**

Sol: $G(s) = \dfrac{k}{s(s+5)}$

The k value such that phase margin is = 45°

Phase margin ϕ_{pm}

$\phi_{pm} = 180° + \phi_{sys}(\omega_{gc}) = 45°$

$\phi_{pm}(\omega_{gc}) = -135°$

$\phi_{sys}(\omega) = -90° - \tan^{-1}\left[\dfrac{\omega}{5}\right]$

$\phi_{sys}(\omega_{gc}) = -90° - \tan^{-1}\left[\dfrac{\omega_{gc}}{5}\right]$

$-90° - \tan^{-1}\left[\dfrac{\omega_{gc}}{5}\right] = -135°$

$\omega_{gc} = 5$

Magnitude

$M = \dfrac{k}{\omega\sqrt{\omega^2 + 25}}$

$M(\omega_{gc}) = \dfrac{k}{\omega_{gc}\sqrt{\omega_{gc}^2 + 25}} = 1$

$k = 5\sqrt{25 + 25} = 35.35$

21. From the Nichols chart, one can determine the following quantities pertaining to a closed-loop system:

(a) Magnitude, bandwidth and phase

(b) Bandwidth and phase only

(c) Magnitude and phase only

(d) Bandwidth only

21. **Ans: (a)**

Sol: Nichols chart is used for magnitude, phase and BW

22. In position control systems, the Tacho-generator feedback is used to

(a) Increase the effective damping in the system

(b) Decrease the effective damping in the system

(c) Decrease the Steady state error

(d) Increase the steady state error

22. Ans: (a)

Sol: Tacho-generator feed back is example for D controller. Derivative controller reduces ripples in the response

i.e., maximum peak over shoot reduces.

$\xi \uparrow$

∴ effective damping increases

23. Consider the following statements:

1. The pin diode consists of two narrow, but highly doped, semiconductor regions separated by a thicker, lightly doped material called the intrinsic region.

2. Silicon is used most often for its power-handling capability and because it provides a highly resistive intrinsic region.

3. The pin diode acts as an ordinary diode at frequencies above 100 MHz.

Which of the above statements are correct?

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

(c) 2 and 3 only   (d) 1, 2 and 3

23. Ans: (a)

Sol: The pin diode acts as an ordinary diode at frequencies up to about 100MHz, but above this frequency the operational characteristics changes and begin acting as a variable resistance.

24. Consider the following statements:

1. Additional cavities serve to velocity-modulate the electron beam and produce an increase in the energy available at the output.

2. The addition of intermediate cavities between the input and output cavities of the basic klystron greatly improves the amplification, power output, and efficiency of the klystron.

Which of the above statements is/are correct?

(a) 1 only   (b) 2 only

(c) Both 1 and 2   (d) neither 1 nor 2

24. Ans: (c)

Sol: 1. Additional cavities serve to velocity-modulate the electron beam and produces an increase in the energy available at the output

2. The addition of intermediate cavities between the input and output cavities of the basic klystron greatly improves the amplification, power output and efficiency of the klystron.

25. In a waveguide with perfectly conducting flat wall, the angle of reflection is equal to the angle of
   (a) Diffraction   (b) Incidence
   (c) Refraction   (d) Penetration

25. Ans: (b)

Sol: The angle of reflection is equal to the angle of incidence

26. In microwave system, waveguides have the advantages of
   (a) High power-handling capability and low loss
   (b) Thin dielectric substrate
   (c) Low power-handling and adequate stability
   (d) Positive phase shift

26. Ans: (a)

Sol: High power handling capability and low loss.

27. A straight dipole radiator fed in the centre will produce maximum radiation at

    1. The plane parallel to its axis

    2. The plane normal to its axis

    3. Extreme ends

    Which of the above statements is/are correct?

    (a) 1 only   (b) 2 only

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

27. Ans: (b)

Sol: The plane normal to its axis

28. In communication systems, modulation is the process of

    (a) Improving frequency stability of transmitter

    (b) Combining signal and radio frequency waves

    (c) Generating constant frequency radio waves

    (d) Reducing distortion in RF waves

28. Ans: (b)

29. Which one of the following statements is correct?

    (a) Sampling and quantization operate in amplitude domain?

    (b) Sampling and quantization operate in time domain.

    (c) Sampling operates in time domain and quantization operates in amplitude domain.

    (d) Sampling operates in amplitude domain and quantization operates in time domain.

29. Ans: (c)

Sol: Sampling is a process which discretizing the signal in time domain.

Quantization is a process which discretizing the signal in amplitude domain.

30. What is the voltage attenuation provided by a 25 cm length of waveguide having a = 1 cm and b = 0.5 cm in which a 1 GHz signal is propagated in the dominant mode?

    (a) 721 dB   (b) 681 dB

    (c) 521 dB   (d) 481 dB

30. Ans: (b)

Sol: Attenuation $(\alpha) = 54.5 \dfrac{\ell}{\lambda_C}$ dB

$\ell = 25$ cm $= 25 \times 10^{-2}$m

$\lambda_C = 2a = 2$cm $= 2 \times 10^{-2}$m

$\alpha = 54.5 \left(\dfrac{25}{2} \right)$dB

$\alpha = 681.25$ dB

31. When a plane wave travelling in free-space is incident normally on a medium having $\varepsilon_r = 9.0$ and $\mu_r = 1.0$, the fraction of power transmitted into the medium is

(a) $\dfrac{4}{3}$ 　　　　　(b) $\dfrac{3}{4}$

(c) $\dfrac{1}{2}$ 　　　　　(d) $\dfrac{1}{3}$

31. Ans: (b)

Sol: $\Gamma = \dfrac{\eta_2 - \eta_1}{\eta_2 + \eta_1} = \dfrac{\sqrt{\varepsilon_1} - \sqrt{\varepsilon_2}}{\sqrt{\varepsilon_1} + \sqrt{\varepsilon_2}}$

$\Gamma = \dfrac{1-3}{1+3} = \dfrac{-1}{2}$

Fraction of transmitted power $= (1 - |\Gamma|^2)$

$= \dfrac{3}{4}$

32. A microwave antenna with the absorbing cross-section area (A) and the power flux density (S) in the incident wave is employed as an absorber. The absorbed power (P) of the antenna is

(a) $\dfrac{A}{S}$ 　　　　　(b) $\dfrac{S}{A}$

(c) SA 　　　　　(d) $\dfrac{S+1}{A-1}$

32. Ans: (c)

Sol: P = (S) (A)

33. LASER beam of light essentially finds its application in transmission of a signal in the optical fiber communication systems due to

(a) Incredible speed of signal communication

(b) low loss transmission of the signal

(c) Inexpensive installation cost

(d) Bulk availability of LASER sources

33. Ans: (a)

34. The controller which is highly sensitive to noise is

(a) PI

(b) PD

(c) Both PI and PD

(d) Neither PI nor PD

34. **Ans: (b)**

Sol: PD controller is very sensitive to noise

35. The 2's complement representation of −17 is

(a) 100001 　　　　　(b) 101111

(c) 110011 　　　　　(d) 101110

35. Ans: (b)

Sol: +17 = 010001

−17 = 2's comp of (+17)

= 2's comp of (010001)

= 101111

36. The subtraction of two hexadecimal numbers $84_{16} - 2A_{16}$ results in

(a) $2B_{16}$ (b) $3A_{16}$

(c) $4B_{16}$ (d) $5A_{16}$

36. **Ans: (d)**

Sol: $84_{16} - 2A_{16} = 5A_{16}$

37. The Vestigial Side Band (VSB) modulation is preferred in TV systems because

1. It reduces the bandwidth requirement to half

2. It avoids phase distortion at low frequencies

Which of the above statements is/are correct?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

37. **Ans: (b)**

Sol: Bandwidth is decreases by 2/3 in VSB, but bandwidth is decreases by 1/2 in SSB. So option 1 is wrong. And in VSB it is a condition that it should avoids phase distortion at low frequencies.

38. If, A = 60 and B = 3, then using C-programming A >> B results in

(a) 11100000

(b) 00000111

(c) 00111111

(d) 01111000

38. **Ans: (b)**

Sol: Bit Pattern of the data can be shifted by specified number of Positions to right

When Data is Shifted Right, leading bits are filled with zero. Right shift Operator is Binary Operator [Bi – two]

$A = 60 \Rightarrow 00111100$

$B = 3$(right shift by '3')

$\therefore 00000111$

39. What is the base of the numbers for the following operation to be correct?

$$\frac{(54)_b}{(4)_b} = (13)_b$$

(a) 2 (b) 4

(c) 8 (d) 16

39. **Ans: (c)**

Sol: $\dfrac{54_b}{4_b} = 13_b$

$$\frac{(5b+4)_{10}}{4_{10}} = (b+3)_{10}$$

$$5b + 4 = 4b + 12$$

$$\therefore b = 8$$

40. It is awkward to employ signed-magnitude system in computer arithmetic, because

1. Sign and magnitude have to be handled separately

2. It has two representations for '0'

Which of the above statements is/are correct?

(a) 1 only   (b) 2 only

(c) Both 1 and 2   (d) Neither 1 nor 2

40.   Ans: (b)

Sol: It is awkward to employ signed-magnitude system in computer arithmetic, because it has two representations for '0'

41. A single-stage amplifier has a voltage gain of 100. The load connected to the collector is 500Ω and its input impedance is 1 kΩ. Two such stages are connected in cascade through an R-C coupling. The overall gain is

(a) 10000   (b) 6666·66

(c) 5000   (d) 1666·66

41.   Ans: (b)
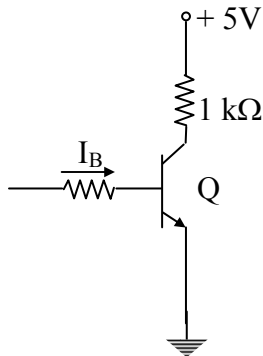
Sol:
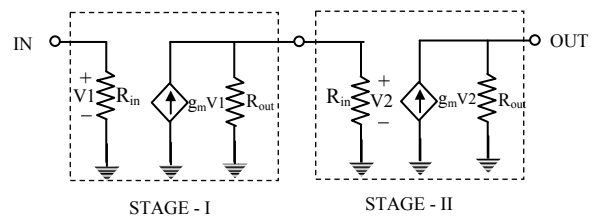
$R_{IN} = 1k\Omega$, $R_{OUT} = 500\Omega$

$g_m R_{OUT} = 100 (\text{Given})$

$$g_m = \frac{100}{500} = 0.2s$$

Over all gain $= g_m(R_{OUT} \| R_{IN}).g_m(R_{OUT})$

$$= 0.2 \times \frac{1 \times 0.5}{1.5} \times 0.2 \times 500$$

$$= 6666.66$$

42. Assuming $V_{CE(Sat)} = 0.3V$ for a Silicon transistor at ambient temperature of 25°c and $h_{FE} = 50$, the minimum base current I_B required to drive the transistor into saturation for the circuit shown is
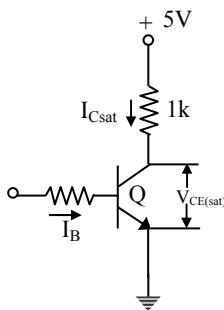

(a) 64 μA   (b) 78 μA

(c) 94 μA   (d) 140 μA

42. **Ans: (c)**

Sol: Step:(1)

KVL for output section of the circuit

$$I_{c_{sat}} = \frac{5V - V_{CE_{sat}}}{1k} = \frac{5V - 0.3V}{1k} = 4.7mA$$

Step: (2)

Minimum Base current required to drive the BJT into saturation, I_{Bmin}

$$I_{Bmin} = \frac{I_{C_{sat}}}{\beta} = \frac{I_{C_{sat}}}{h_{FE}} = \frac{4.7mA}{50} = 94\mu A$$

43. Which of the following regions of operation are mainly responsible for heating of the transistor under switching operation?

1. Saturation region

2. Cut-off region

3. Transition from saturation to cut-off

4. Transition from cut-off to saturation

Select the correct answer using the codes given below

(a) 1, 2, and 4 only

(b) 1, 3, and 4 only

(c) 2 and 3 only

(d) 1 and 3 only

43. **Ans: (b)**

Sol: The heating of a transistor under switching operation occurs during

→ Transition from saturation to cut-off

→ Transition from cut-off to saturation

→ Saturation region

44. In a sinusoidal oscillator, sustained oscillations will be produced only if the loop gain (at the oscillation frequency) is

(a) Less than unity but not zero

(b) zero

(c) Unity

(d) Greater than unity

44. Ans: (c)

Sol: The condition for sustained oscillation in a sinusoidal oscillator at a particular frequency is

$A_v\beta$ = Loop gain = 1 (Bark hausen criteria)

45. The Class-B push-pull amplifier is an efficient two-transistor circuit, in which the two transistors operate in the following way:

(a) Both transistors operate in the active region throughout the negative ac cycle

(b) Both transistors operate in the active region for more than half-cycle but less than a whole cycle

(c) One transistor conducts during the positive half-cycle and the other during the negative half-cycle

(d) Full supply voltage appears across each of the transistors

45. Ans: (c)

Sol: In a class-B push-pull amplifier, the conduction angle of each transistor is 180° (i.e.) Each transistor is biased to conduct for ONE-HALF CYCLE OF INPUT SIGNAL only. In other words,

$\rightarrow$ During +Ve half cycle of input signal, One transistor (Let Q_1) is pulled into ON state and the other transistor (Let Q_2) is pushed into OFF state.

$\rightarrow$ During −Ve half-cycle of input, Q_2 is pulled into ON state and Q_1 is pushed into OFF state.

46. Consider the following statements regarding Wien Bridge oscillator:

1. It has a larger bandwidth than the phase shift oscillator.

2. It has a smaller bandwidth than the phase shift oscillator.

3. It has 2 capacitors while the phase shift oscillator has 3 capacitors.

4. It has 3 capacitors while the phase shift oscillator has 2 capacitors.

Which of the above statements are correct?

(a) 1 and 3 only   (b) 2 and 4 only

(c) 1 and 4 only   (d) 2 and 3 only

46.   Ans: (a)

Sol: RC Phase shift Oscillator

→ Suitable for oscillations in Audio frequency (AF) range, preferably upto 1 kHz.

→ Three identical RC sections are to be used in the phase shift network to construct a practical RC Phase shift oscillator.

Wien Bridge Oscillator

→ Suitable for Oscillations in AF range up to 100kHz.

→ Two RC sections (One series RC & one parallel RC) are used in the feedback network

47.   For normal operation of a transistor

(a) Forward bias the emitter diode and reverse bias the collector diode

(b) Forward bias the emitter diode as well as the collector diode

(c) Reverse bias the emitter diode as well as the collector diode

(d) Reverse bias the emitter diode and forward bias the collector diode

47.   Ans: (a)

Sol: Normal operation of a transistor is ACTIVE REGION of operation

Emitter Diode / Emitter Junction, J_E	Collector Diode / Collector Junction	Region of operation
R. B	R.B	Cut-off Region
F.B	F.B	Saturation Region
F.B	R.B	Normal Active Region
R.B	F.B	Inverse (or) Reverse Active Region

48.   Consider the following statements regarding linear power supply:

1. It requires low frequency transformer.

2. It requires high frequency transformer.

3. The transistor works in active region.

Which of the above statements is/are correct?

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

(c) 1 and 3 only   (d) 3 only

48.   Ans: (c)

Sol: The Requirements of Linear Power supply:

1. As the input signal or line voltage frequency is very low, to handle this, a low frequency transformer is required.

2. As the transistor is a control element in linear voltage regulator, it must be operated in active region, so that the load current (or Emitter current) is controlled as per the requirements

49. The capacitance of a full wave rectifier, with 60 Hz input signal, peak output voltage $V_p = 10V$, load resistance R = 10 kΩ and input ripple voltage $V_r = 0.2V$, is

   (a) 22·7 μF   (b) 33·3 μF

   (c) 41·7 μF   (d) 83·4 μF

49. Ans: (c)

Sol: The general formula for ripple voltage V_{ripple} in FWR with capacitor filter is

$$V_{ripple} = \frac{V_P}{2fCR_L}$$

$$C = \frac{V_P}{2fR_L V_{ripple}}$$

$$= \frac{10V}{2 \times 60Hz \times 10 \times 10^3 \times 0.2V}$$

$$= 41.66 \mu F$$

50. A full wave rectifier connected to the output terminals of the mains transformer produces an RMS voltage of 18 V across the secondary. The no-load voltage across the secondary of the transformer is

   (a) 1·62V   (b) 16·2V

   (c) 61·2V   (d) 6.12V

50. Ans: (b)

Sol: Note: The question should have been "The no-load DC voltage across the output of the rectifier is"

Full wave rectifier

Step(1): $V_{rms} = 18V = \dfrac{V_m}{\sqrt{2}}$

$V_m = \sqrt{2} \times 18V = 25.4558V$

Step (2):

No-load voltage $V_{DC} = \dfrac{2V_m}{\pi}$

$$= \frac{2 \times 25.4558V}{\pi} = 16.2139V$$

51. An op-Amp can be connected to provide

   1. Voltage controlled current source

   2. Current controlled voltage source

   3. Current controlled current source

   Which of the above statements are correct?

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

   (c) 2 and 3 only   (d) 1, 2 and 3

51. Ans: (d)

Sol: An Op-amp can be connected to provide

   1. Voltage controlled voltage source (VCVS), whose output voltage 'V_0' is controlled by the input voltage 'V_i'

   2. Current controlled current source (CCCS), whose output current 'I_0' is controlled by the input current 'I_i'

   3. Voltage controlled current source (VCCS), whose output current 'I_0' is controlled by the input voltage 'V_i'.

   4. Current controlled voltage source (CCVS), whose output voltage 'V_0' is controlled by the input current 'I_i'.

52. In an Op-Amp, if the feedback voltage is reduced by connecting a voltage divider at the output, which of the following will happen?

    1. Input impedance increases

    2. Output impedance reduces

    3. Overall gain increases

    Which of the above statements is/are correct?
    (a) 1only   (b) 2 only
    (c) 3 only   (d) 1, 2 and 3

52. Ans: (c)

Sol: If Feedback factor (β) is reduced

$$A_{CL} = \frac{A}{1+A\beta} \rightarrow \text{Increases}$$

$$R_{IN_{CL}} = R_{IN}(1+A\beta) \rightarrow \text{Decreases}$$

$$R_{OUT_{CL}} = \frac{R_{OUT}}{1+A\beta} \rightarrow \text{Increases}$$

53. The transient response rise time (unity gain) of an Op-Amp is 0.05 μs. The small signal bandwidth is
    (a) 7 kHz   (b) 20 kHz
    (c) 7 MHz   (d) 20 MHz

53. Ans: (c)

Sol: Rise time of an op-Amp, $t_r = 0.05\mu\text{sec}$

Small-signal band width can be related to t_r using the relation

$$t_r = \frac{0.35}{BW}$$

$$BW = \frac{0.35}{t_r} = \frac{0.35}{0.05 \times 10^{-6}} = 7\text{MHz}$$

54. A negative feedback of $\beta = 2.5 \times 10^{-3}$ is applied to an amplifier of open-loop gain 1000. What is the change in overall gain of the feedback amplifier, if the gain of the internal amplifier is reduced by 20%?
    (a) 295·7   (b) 286·7
    (c) 275·7   (d) 266·7

54. Ans: (d)

Sol: A = 1000, $\beta = 2.5 \times 10^{-3} = 0.0025$

Step: (1)

$$A_f = \frac{A}{1+A\beta} = \frac{1000}{1+1000 \times 0.0025}$$

$$= 285.714$$

Step: (2)

Gain of internal amplifier is reduced by 20% $\Rightarrow$ 20% of 1000 = 200

i.e., $A_{New} = 1000 - 200 = 800$

$$A_{f_{New}} = \frac{800}{1+800 \times 0.0025} = \frac{800}{1+2}$$

$$= 266.667$$

55. If the quality factor of a single-stage single-tuned amplifier is doubled, the bandwidth will
    (a) Remain the same
    (b) Become half
    (c) Become double
    (d) Become four times

55.   Ans: (b)

Sol: Quality factor $Q\uparrow = \dfrac{f_0}{BW\downarrow}$

If Q is doubled $\Rightarrow$ Bandwidth will become half

56.   Consider the following statements related to oscillator circuits:

1. The tank circuit of a Hartley oscillator is make up of a tapped capacitor and a common inductor.

2. The tank circuit of a Colpitts oscillator is made up of a tapped capacitor and a common oscillator.

3. The Wien Bridge oscillator is essentially a two-stage amplifier with an RC bridge in the first stage, and, the second stage serving as an inverter.

4. Crystal oscillators are fixed frequency oscillators with a high Q-factor.

Which of the above statements are correct?

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

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

56.   Ans: (b)

Sol: Hartely Oscillator used as a tapped inductor

57.   The most commonly used transistor configuration for use as a switching devices is

(a) Common-base configuration

(b) Common-collector configuration

(c) Collector-emitter shorted configuration

(d) Common-emitter configuration

57.   Ans: (d)

Sol: CB configuration

1. Current amplifier

2. Used as current Buffer

3. Current controlled current source

CC configuration

1. Voltage amplifier

2. Used as voltage Buffer

3. Voltage controlled voltage source

CE configuration

General purpose configuration used in

1. Amplifier circuits

2. Switching circuits.

58.   The value of h_{FE} (the hybrid parameters) of a Common-Emitter (CE) connection of a Bipolar Junction Transistor (BJT) is given as 250. What is the value of α_{dc} (ratio of collector current to emitter current), for this BJT?

(a) 0·436   (b) 0·656

(c) 0·874   (d) 0·996

58.   Ans: (d)

Sol: The current amplification factor of a BJT in CE configuration

$$\beta = h_{FE} = \frac{I_C}{I_B} = 250$$

$$\alpha_{DC} = \frac{I_C}{I_E} = \frac{\beta}{1+\beta} = \frac{250}{251} = 0.996$$

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PAPER PATTERN

S.No.	Section	Subjects	No of Q's	Total marks
1.	Section - 1	Engineering - 1	50	100
2.	Section - 2	Engineering - 2	50	100
3.	Section - 3	General Ability	20	40

PAPER STRUCTURE

1.	Total marks	240
2.	Total Number Questions	120
3.	Time Allowed	3 Hours = 180 Minutes
4.	Medium of Examination	English
5.	Negative Marketing	Yes (25%)
6.	Type of Questions	Objective type

SYLLABUS

SECTION - 1 : Materials and Components, Physical Electronics, Electron Devices and ICs, Network theory, Electromagnetic Theory, Electronic Measurements and Instrumentation, Power Electronics

SECTION - 2 : Analog Electronic Circuits, Digital Electronic Circuits, Control Systems, Communication systems, Microwave Engineering, Computer Engineering, Microprocessors

SECTION - 3 : General ability test (General Knowledge, Current Affairs, General English)

(based on the previous exam papers)

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59. For realizing a binary half-subtractor having two inputs A and B, the correct set of logical expressions for the outputs D (A minus B) and X(borrow) are
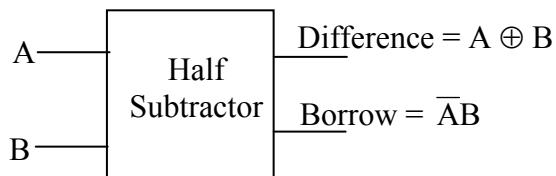
1. The difference output $D = \overline{A}B + A\overline{B}$

2. The borrow output $B = A\overline{B}$

Which of the above statements is/are correct?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

59. Ans: (a)

Sol:

A —— [Half Subtractor] —— Difference = A ⊕ B
B —— Borrow = $\overline{A}B$

60. The simplified form of the Boolean expression AB + A(B + C) + B(B + C) is given by

(a) AB + AC   (b) B + AC

(c) BC + AC   (d) AB + C

60. Ans: (b)

Sol: $F = AB + AB + AC + B + BC$

$= B (A + A + 1 + C) + AC$

$= B + AC$

61. Consider the following statements:

Pointers in C-programming are useful to

1. Handle the data tables efficiently

2. Reduce the length of a program

3. Reduce the complexity of a program

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1, 2 and 3

(c) 2 and 3 only

(d) 1 and 3 only

61. Ans: (b)

Sol: Suppose if there is no pointer concept and if you pass an array from the calling function then we have to declare another array of same size in the called function, it leads memory wastage and redundant copy of data. If you have pointer concept it pass only base address of array instated of complete. So, we can reduce space complexity in the called function.

62. Data transfer between the main memory and the CPU register takes place through two registers, namely,

(a) General purpose register and MDR

(b) Accumulator and Program counter

(c) MAR and MDR

(d) MAR and Accumulator

62. Ans: (c)

Sol:

MAR $\rightarrow$ Memory Address Register

The MAR holds the address of the location to be accessed.

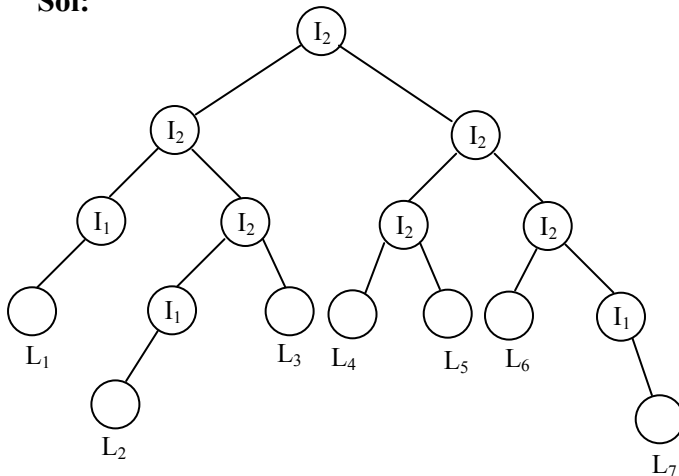**MDR** $\rightarrow$ Memory Data Register

The MDR contains the data to be written into or read out of the addressed location.

63. In a binary tree, the number of internal nodes of degree 1 is 3, and the number of internal nodes of degree 2 is 6. The number of leaf nodes in the binary tree is

(a) 7   (b) 8   (c) 9   (d) 10

63.   Ans: (a)

Sol:

$I_1 = 3,$ $I_2 = 6,$ E = 15

node = 16

number of edges = (2) × 16 + (1) × 3

$\qquad\qquad\qquad = 15$

nodes = 15 + 1 = 16

The number of leaf nodes s = 16 − (6+3)

$\qquad\qquad\qquad = 7$

64. Consider the following:

1. Operation code
2. Source operand reference
3. Result operand reference
4. Next instruction reference

Which of the above are typical elements of machine instructions ?

(a) 1, 2 and 3 only

(b) 1, 2 and 4 only

(c) 3 and 4 only

(d) 1, 2, 3 and 4

64.   Ans: (a)

Sol: Typical elements of machine instructions are

1. Operation code (Op-code)
2. Source operand reference
3. Result operand reference

65. Which addressing mode helps to access table data in memory efficiently?

(a) Indirect mode

(b) Immediate mode

(c) Auto-increment or Auto-decrement mode

(d) Index mode

65.   Ans: (d)

Sol: Index addressing mode helps to access table data in memory efficiently

66. Converting an analog signal to digital signal is done by Sampling and
    (a) Companding   (b) Mixing
    (c) Quantizing   (d) Pre-emphasis

66. Ans: (c)

67. A computer employs RAM chips of 256 bytes and ROM chips of 1024 bytes. If the computer system needs 1 kB of RAM and 1 kB of ROM, then how many address lines are required to access the memory?
    (a) 10   (b) 11   (c) 12   (d) 13

67. Ans: (b)

Sol: Size of ROM = 1 kB, Size of RAM = 1 kB

∴ Total memory size needed = 2 kB $= 2^{11} \times 8$

No. of address lines needed = 11

68. A computer system has a cache with access time 10 ns, a hit ratio of 80% and average memory access time is 20 ns. Then what is the access time for physical memory?
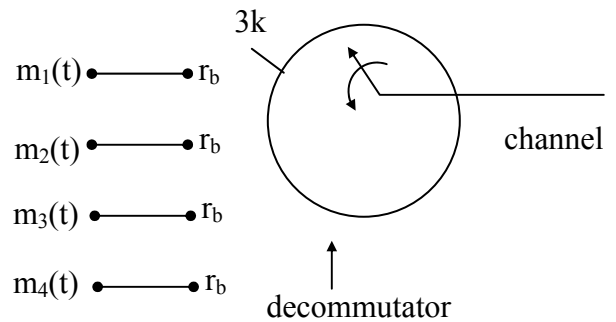   (a) 50 ns   (b) 40 ns
    (c) 30 ns   (d) 20 ns

68. Ans: (a)

Sol: $T_{avg} = (H \times C) + (1-H) \times (M + C)$

20 ns $= (0.8 \times 10$ ns$) + 0.2 \times (M + 10$ ns$)$

$(0.2) \times (M + 10$ ns$) = 12$

0.2 M = 10 ns

∴ M = 50 ns

69. In synchronous TDM, there are four inputs and data rate of each input connection is 3 kbps. If 1 bit at a time is multiplexed, what is the duration of each frame ?
    (a) 0·02 ms   (b) 0·03 ms
    (c) 0·033 ms   (d) 0·22 ms

69. Ans: (c)

Sol: Synchronous TDM,

No. of Inputs = N = 4

Data rate of each input connection = 3 kbps

$= n\, f_s$

Date rate of TDM system (in the channel)

$= N.n\, f_s$

$= 4 \times 3k$

$r_b = 12$ kbps

Each bit duration $= T_b = \dfrac{1}{r_b} = \dfrac{1}{12k}$ sec

"1 bit at a time is multiplexed".

Collection of each sample from all signals constitutes a frame.

Since 1 bit at a time is multiplexing one frame contains 4 bits.

(∵ Input signals are 4)

∴ Frame duration = 4 bits duration

$$= 4 \, T_b$$

$$= 4 \times \frac{1}{12k} = 0.33 \, m\sec$$

70. Consider the following statements comparing static RAM with dynamic RAM:

1. In static RAM typical cell requires more number of transistors than the dynamic RAM.

2. Power consumption per bit of static RAM is less than that of dynamic RAM.

3. Dynamic RAM is less expensive than the static RAM.

Which of the above statements are correct?

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1 and 3 only

70. **Ans: (d)**

Sol:

- In static RAM typical cell requires more number of transistors than the dynamic RAM.

- Dynamic RAM is less expensive than the static RAM.

71. An addressing mode in which the location of the data is contained within the mnemonic, is known as

(a) Immediate addressing mode

(b) Implied addressing mode

(c) Register addressing mode

(d) Direct addressing mode

71. **Ans: (d)**

Sol: An addressing mode in which the location of the data is contained within the mnemonic, is known as "Direct addressing mode".

72. A processor has 32-bit architecture. Each instruction is 1 word long (32 bits). It has 64 registers. It supports 50 instructions, which have 2 register operands + 1 immediate operand. Assuming that the immediate operand is an unsigned integer, what is its maximum value?

(a) 16383   (b) 32767

(c) 65536   (d) 1024

72. **Ans: (a)**

Sol:

←	32 bit	→	
Opcode	Rs	Rd	Operand
$\log_2 50$	$\log_2 64$	$\log_2 64$	
6	6	6	14
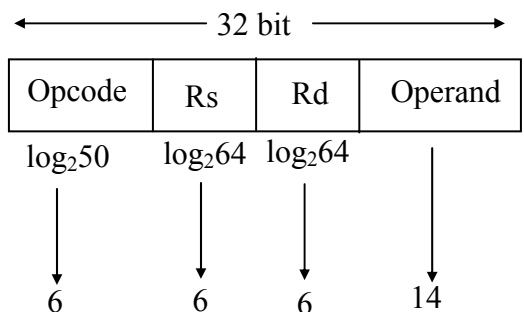
With 14 bit, the Highest unsigned integer is

$$2^{14} - 1 = 16383$$

73. Microwave resonators are used in

    1. Microwave oscillators

    2. Microwave narrow band amplifiers

    3. Microwave frequency meters

    Which of the above are correct ?

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

    (c) 2 and 3 only   (d) 1, 2 and 3

73. Ans: (d)

Sol: Microwave resonators are used in

    1. Microwave oscillators

    2. Microwave amplifier

    3. Microwave wave meters

74. The serial connection of interrupt lines for establishing hardware priority is known as

    (a) Daisy Chaining Priority

    (b) Parallel Priority

    (c) Polling

    (d) Serial-line Priority

74. Ans: (a)

Sol: The serial connection of interrupt lines for establishing hardware priority is known as "Daisy Chaining Priority".

Directions: Each of the next six (6) items consist of two statements, one labeled as the 'Statement (I)' and the other as 'Statement (II)'. Examine these two statements carefully and select the answer to these items using the codes given below:

Codes:

(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 and 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

75. **Statement (I):** PAM can be demodulated using a suitable integrator.

Statement (II): A suitable integrator practically acts as can an envelop detector.

75. **Ans: (a)**

76. **Statement (I):** The direction flag D in 8086 selects increment or decrement mode for DI and/or SI registers.

Statement (II): If D = 0, the register are automatically decremented.

76. **Ans: (c)**

77. **Statement (I):** An antenna of length $\dfrac{\lambda}{2}$ will have radiation patterns of two lobes.

Statement (II): An antenna of length $\dfrac{3\lambda}{2}$ will have radiation pattern of two lobes and two minor lobes.

77. **Ans: (c)**

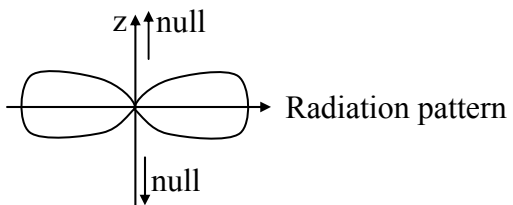**Sol:** $\cos\theta_{null} = \pm 1 \pm \dfrac{n\lambda}{H}$

(1) $\ell = \dfrac{\lambda}{2} \Rightarrow H = \dfrac{\lambda}{4}$

$\cos\theta_{null} = \pm 1 \pm 4n$

For n = 0

$\cos\theta_{null} = \pm 1$

$\theta_{null} = 0, \pi$

(2) $\ell = \dfrac{3\lambda}{2} \Rightarrow H = \dfrac{3\lambda}{4}$

$$\text{Cos } \theta_{null} = \pm 1 \pm \frac{4n}{3}$$

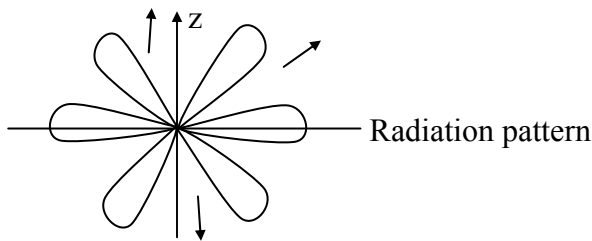For n = 0

$$\cos \theta_{null} = \pm 1$$

$$\theta_{null} = 0, \pi$$

For n = 1

$$\cos \theta_{null} = \pm 1 \pm \frac{4}{3}$$

$$= -1 \pm \frac{4}{3}$$

$$\cos \theta_{null} = \frac{1}{3}, -\frac{1}{3}$$

$$\theta_{null} = 70.5, 109.4$$

Radiation pattern

78. Statement (I): The complex conjugate poles and zeros of the open-loop transfer function have no effect on the root-loci on the real axis.

Statement (II): Angle contribution of such a pair of conjugate poles or zeros is 2π radians on the real axis

78. Ans: (a)

79. Statement (I): A basic memory unit of a flip-flop is a bistable multivibrator.

Statement (II): A flip-flop has two stable states. It remains in one state until it is directed by an input signal to switch over.

79. Ans: (a)

80. Statement (I): Multimode fibers are now used for long distance communication.

Statement (II): Multimode fibers have larger core-radius than single-mode fibers.

80. Ans: (d)

81. Product of Max terms representation for the Boolean function $F = \overline{B}D + \overline{A}D + BD$ is

(a) $\Pi M(1,3,5,7)$ (b) $\Pi M(0,2,4,6)$

(c) $\Pi M(0,1,2,3)$ (d) $\Pi M(4,5,6,7)$

81. Ans: (b)

Sol:

$$F(A,B,D) = \overline{B}D + \overline{A}D + BD$$

$$= \overline{B}D(A + \overline{A}) + \overline{A}D(B + \overline{B}) + BD(A + \overline{A})$$

$$= A\overline{B}D + \overline{A}\,\overline{B}D + \overline{A}BD + \overline{A}\,\overline{B}D$$
$$+ ABD + \overline{A}BD$$

$$= m_5 + m_1 + m_3 + m_1 + m_7 + m_5 + m_7$$

$$= \Sigma m(1, 3, 5, 7)$$

$$F = \prod M (0,2,4,6)$$

82. Simplified form of the Boolean expression

    $Y = \overline{(A.B + \overline{C})(\overline{A} + B + C)}$ is

    (a) $\overline{A}\,\overline{C} + A\overline{C} + \overline{B}\,\overline{C} + \overline{B}\,C$

    (b) $(\overline{A} + \overline{B} + \overline{C})(A + B + C)$

    (c) $(\overline{A} + \overline{B})(A + \overline{C})$

    (d) A(B+C)

82. Ans: (b)

Sol: $Y = \overline{(AB + \overline{C})(\overline{A} + B + C)}$

$= \overline{(AB + \overline{C})(\overline{A.\overline{B}} + C)}$

$= \overline{ABC + \overline{A}\,\overline{B}\,\overline{C}} = \overline{ABC}.\overline{\overline{A}.\overline{B}.\overline{C}}$

$= (\overline{A} + \overline{B} + \overline{C})(A + B + C)$

83. What is the maximum frequency for a sine wave output voltage of 10V peak with an Op-Amp whose slew rate is 1V/μs ?

    (a) 15.92 kHz   (b) 19.73 kHz

    (c) 23.54 kHz   (d) 27.36 kHZ

83. Ans: (a)

Sol: Slew rate of op-Amp = 1V/μsec

$= 1 \times 10^6$ V/sec & $V_m = 10V$

We have slew rate = $2\pi V_m$

The maximum frequency upto which the op-Amp can provide undistorted output ,

$f_{max} = \dfrac{\text{slew rate}}{2\pi V_m} = \dfrac{1 \times 10^6}{2\pi \times 10V}$

$= 15.9235 kHz$

84. Which one of the following statements is correct?

    (a) TTL logic cannot be used un digital circuits

    (b) Digital circuits are linear circuits

    (c) AND gate is a logic circuit whose output is equal to its highest input.

    (d) In a four-input AND circuits, all inputs must be high for the output to be high.

84. Ans: (d)

85. The Slew rate is the rate of change of output voltage of an operational amplifier when a particular input is applied. What is that input?
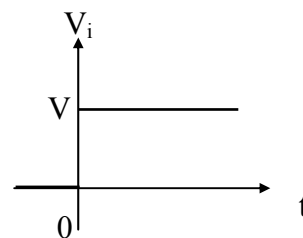
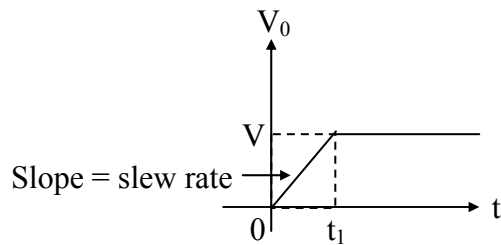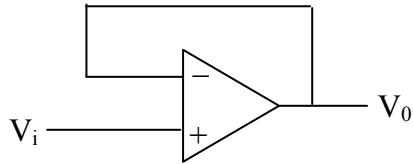   (a) Sine wave input   (b) Ramp input

    (c) Pulse input   (d) Step input

85. Ans: (d)

Sol: Slew rate is defined as the maximum rate of change in the output voltage of an op-Amp caused by step input voltage

Slew rate $= \left[\dfrac{dV_0}{dt}\right]_{max}$ --------(1)

Slope = slew rate

86. Except at high frequencies of switching, nearly all the power dissipated in the switch mode operation of a BJT occurs, when the transistor is in the

   (a) Active region

   (b) Blocking state

   (c) Hard saturation region

   (d) Soft saturation region

86. Ans: (d)

Sol: Switches are designed to operate in either cut-off or hard-saturation. No power dissipation in cut-off.

87. Consider the following statements with respect to combinational circuit:

   1. The output at any time depends only on the present combination of inputs.

   2. It does not employ storage elements

3. It performs an operation that can be specified logically by a set of Boolean functions.

Which of the above statements are correct?

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

   (c) 2 and 3 only   (d) 1, 2 and 3

87. Ans: (d)

88. Consider the following statements:

A multiplexer

   1. selects one of the several inputs and transmit it to a single output.

   2. routes the data from a single input to one of many outputs.

   3. converts parallel data into serial data

   4. is a combinational circuit

Which of the above statements are correct ?

   (a) 1 and 3 only   (b) 2 and 4 only

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

88. Ans: (c)

89. What are the two types of basic adder circuits?

   (a) Half adder and full adder

   (b) Half adder and parallel adder

   (c) Asynchronous adder and synchronous adder

   (d) One's complement adder and two's complement adder

89. Ans: (a)

90. Consider the following statements:

    1. An 8-input MUX can be used to implement any 4 variable functions.

    2. A 3-line to 8-line DEMUX can be used to implement any 4 variable functions.

    3. A 64-input MUX can be built using nine 8-input MUXs.

    4. A 6-line to 64-line DEMUX can be built using nine 3-line to 8-line DEMUXs.

    Which of the above statements are correct?

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

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

90. Ans: (c)

91. For an n-bit binary adder, what is the number of gates through which a carry has to propagate input to output?

    (a) n   (b) 2n

    (c) n^2 (d) n+1

91. Ans: (b)

92. The main disadvantage of DTL logic circuits is

    (a) Medium speed

    (b) Very large power supply voltage

    (c) High cost

    (d) Very large gate propagation delay.

92. Ans: (d)

93. Which one of the following statements best describes the operation of a negative-edge-triggered D flip-flop?

    (a) The logic level at the D input is transferred to Q on NGT of CLK

    (b) The Q output is always identical to the CLK input if the D input is high

    (c) The Q output is always identical to the D input when CLK = PGT

    (d) The Q output is always identical to the D input .

93. Ans: (a)

94. A 3-bit ripple counter is constructed using three T flip-flops to do the binary counting. The three flip-flops have T-inputs fixed at

    (a) 0, 0 and 1   (b) 1, 0 and 1

    (c) 0, 1 and 1   (d) 1, 1 and 1

94. Ans: (d)

Sol: In ripple counter, all T-FFs are operated in Toggle mode. Thus T = 1

95. What is the function $Y = A + \overline{B}C$ in Product-of Sums (POS) form?

    (a) $M_6 \, M_5 \, M_4 \, M_3$

    (b) $M_3 \, M_2 \, M_1 \, M_0$

    (c) $M_0 \, M_2 \, M_3$

    (d) $M_4 \, M_3 \, M_2 \, M_1$

95. Ans: (c)

Sol: $Y = A + \overline{B}C$

$= A(B + \overline{B})(C + \overline{C}) + \overline{B}C(A + \overline{A})$

$= ABC + AB\overline{C} + A\overline{B}C + A\overline{B}\,\overline{C}$
$+ \overline{A}\,\overline{B}C + A\overline{B}C$

$Y = \Sigma m\,(1, 4, 5, 6, 7)$

$= \prod M\,(0, 2, 3)$

96. The initial content of a four-bit shift register is 1000. What is the register content after it is shifted four times to the right, with the serial input being 111100?

(a) 1111   (b) 1100

(c) 1000   (d) 0011

96. Ans: (a)

Sol:

Clk	Serial I/p	Q_3	Q_2	Q_1	Q_0
0	-	1	0	0	0
1	1	1	1	0	0
2	1	1	1	1	0
3	1	1	1	1	1
4	1	1	1	1	1
	0				
	0				

97. When a large number of analog signals is to be converted to digital form, an analog multiplexer is used. The A-to-D converter most suitable in this case will be

(a) Forward counter type

(b) Up-down counter type

(c) Successive approximation type

(d) Dual slope type

97. Ans: (c)

98. For Emitter-coupled logic (ECL), the switching speed is very high because

(a) Negative logic is used

(b) The transistors are not saturated when they are conducting

(c) Multi-emitter transistors are used

(d) Of low fan-out

98. Ans: (b)

99. A flip-flop is a

(a) Combinational logic circuit and edge sensitive

(b) Sequential logic circuit and edge sensitive

(c) Combinational logic circuit and level sensitive

(d) Sequential logic circuit and level sensitive

99. Ans: (b)

100. The transfer function $\dfrac{1}{2s+1}$ will have

   (a) dc gain 1 and high frequency gain 1

   (b) dc gain 0 and high frequency gain ∞

   (c) dc gain 1 and high frequency gain 0

   (d) dc gain 0 and high frequency gain 1

100. Ans: (c)

Sol: $G(s) = \dfrac{1}{2s+1}$

$M = \dfrac{1}{\sqrt{(2\omega)^2 + 1}}$

$\omega = 0 \quad M = 1$

$\omega = \infty \quad M = 0$

101. Consider the following statements :

   The Gain margin and phase margin of an unstable system may respectively be

   1. Positive, negative

   2. Negative , positive

   3. Negative , negative

   Which of the statements is/are correct ?

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

   (c) 2 and 3 only   (d) 1,2 and 3

101. Ans: (a)

Sol: Gain margin and phase margin for unstable system

$GM_{dB} = -ve$ dB

$PM(degrees) = -ve$

102. A phase lead compensator has its transfer function, $G_c(s) = \dfrac{1+0.5s}{1+0.05s}$. The maximum phase lead and the corresponding frequency, respectively are nearly

   (a) $\sin^{-1}(0.9)$ and 6r/s

   (b) $\sin^{-1}(0.82)$ and 4 r/s

   (c) $\sin^{-1}(0.9)$ and 4 r/s

   (d) $\sin^{-1}(0.82)$ and 6 r/s

102. Ans: (d)

Sol: $G(s) = \dfrac{1+0.5S}{1+0.05S}$

$\dfrac{1+\tau s}{1+\alpha\tau s} = \dfrac{1+0.5s}{1+0.05s}$

$\tau = 0.5$

$\alpha\tau = 0.05$

$\alpha = 0.1$

$\omega_m = \dfrac{1}{\tau\sqrt{\alpha}} = \dfrac{1}{0.5\sqrt{0.1}} = 6.3\,\text{rad}/s$

$\phi_m = \sin^{-1}\left[\dfrac{1-\alpha}{1+\alpha}\right] = \sin^{-1}[0.82]$

103. Consider the following statements:

   1. Lead compensation decreases the bandwidth of the system.

   2. Lag compensation increases the bandwidth of the system

   Which of the above statement is/are correct ?

(a) 1 only   (b)2 only

(c) Both 1 and 2   (d) Neither 1 nor 2

103. Ans: (d)

Sol: Lead compensator, Bandwidth increases

Lag compensator , Bandwidth decreases

104. A proportional controller with transfer function, K_P is used with a first-order system having its transfer function as $G(s) = \dfrac{K}{(1+s\tau)}$, in unity feedback structure.

For step inputs, an increase in K_P will

(a) Increase the time constant and decrease the steady state error

(b) Decrease the time constant and decrease the steady state error

(c) Decrease the time constant and increase the steady state error

(d) Increase the time constant and increase the steady state error

104. Ans: (b)

Sol:
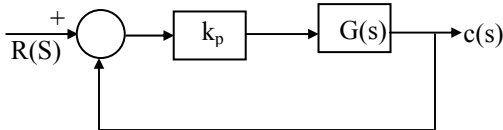
$$OLTF = \dfrac{k_p k}{(1+s\tau)}$$

$$\tau_{OLTF} = \tau$$
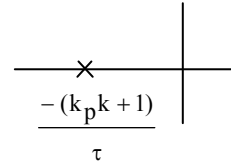
$$k_p = \underset{s\to 0}{Lt}\, OLTF = k_p k$$

$$e_{ss} = \dfrac{1}{1+k_p k}$$

$$k_p \uparrow e_{ss} \downarrow$$

$$CLTF = \dfrac{k_p k}{s\tau +1+ k_p k}$$

$$\tau_{CLTF} = \dfrac{\tau}{1+k_p k}$$

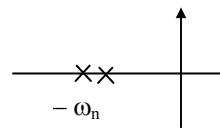$$K_p \uparrow = \tau_{CLTF} \downarrow$$

105. For a second-order differential equation, if the damping ratio ξ is unity, then

(a) Then poles are imaginary and complex conjugate

(b) The poles are in the right half of s-plane

(c) The poles are equal, negative and real

(d) Both the poles are unequal, negative and real

105. Ans: (c)

Sol: $\xi = 1$, $\dfrac{C}{R} = \dfrac{\omega_n^2}{s^2 + 2\xi\omega_n s + \omega_n^2}$

The poles are equal, real and –Ve

106. Consider the following statements associated with micro strip patch antenna:

1. The micro strip patch behaves more like a leaky cavity rather than like a radiator and this is not a highly efficient antenna..

2. They can be adapted for radiation of circularly polarized waves.

Which of the above statement is/true correct ?

(a) 1 only   (b) 2 only

(c) Both 1 and 2   (d) Neither 1 nor 2

106. Ans: (c)

Sol: 1. Microstrip patch antenna behaves like a leaky cavity rather than like a radiator and this is not a highly efficient antenna

2. They can be adapted for radiation of circularly polarized waves.

107. A carrier waveform $10 \cos\omega_c t$ and modulating signal $3 \cos \omega_m t$ have $f_c = 100\text{kHz}$ and $f_m = 4\text{kHz}$. Given that sensitivity of FM is 4 kHz/V and FM spectra beyond J_6 is negligible, what are the channel bandwidth requirements for AM and FM, respectively?

(a) 12 kHz and 48 kHz

(b) 8kHz and 48 kHz

(c) 12 kHz and 254 kHz

(d) 8 kHz and 24 kHz

107. Ans: (b)

Sol: AM Bandwidth $= 2f_m = 2 \times 4\text{k} = 8$ kHz
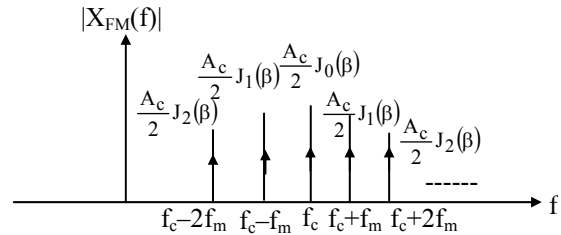
(Positive FM spectrum)

Spectrum beyond J_6 is negligible, so that highest frequency $f_c + 6f_m$ and lowest frequency $f_c - 6f_m$.

So that

FM bandwidth = (highest frequency) − (lowest frequency)

$$= (f_c + 6f_m) - (f_c - 6f_m)$$
$$= 12 \, f_m$$
$$= 12 \times 4 = 48 \text{ kHz}$$

108. When the modulating frequency is doubled, the modulation index is halved, and the modulating voltage remains constant. The modulation system is

1. Amplitude modulation

2. Phase modulation

3. Frequency modulation

Select the correct answer from the codes given below:

(a) 1 only   (b) 2 only

(c) 3 only   (d) 1,2 and 3

108. Ans: (c)

Sol: modulation index of AM

$\mu = k_a A_m$ which is independent of frequency

FM $\beta_f = \dfrac{k_f A_m}{f_m}$ f_m doubled, β_f is half

PM $\beta_p = k_p A_m$, independent of frequency

109. What is the modulation index of an FM signal having a carrier swing of 100kHz and modulating frequency of 8kHz?

    (a) 4.75   (b) 5.50

    (c) 6.25   (d) 7.50

109. Ans: (c)

Sol: $\beta_f = \dfrac{\Delta f}{f_m}$

Carrier swing $2\Delta f = 100$ kHz $\Rightarrow \Delta f = 50$ kHz

    $f_m = 8$ kHz

    $\beta_f = \dfrac{50k}{8k} = 6.25$

110. In a pulse code modulated system, the number of bits is increased from 7 to 8 bits. The improvement in signal to quantization noise ratio will be

    (a) 2dB   (b) 4dB   (c) 6dB   (d) 8dB

110. Ans: (c)

Sol: In a pulse code modulation

    $(SNR)_{dB} = 6n + \alpha$

    Where 'n' is no of bits, α is a constant.

    The improvement

    $(SNR)_{dB} = (SNR)_2 - (SNR)_1$

    $= [6(8) + \alpha] - [6(7) + \alpha] = 6$ dB

111. In the process of modulation

    (a) Some characteristics of a high frequency sine wave varied in accordance with the instantaneous value of a low frequency signal

    (b) Parameters of carrier wave are held constant

    (c) For proper and efficient radiation, the receiving antennas should have heights comparable to half-wavelength of the signal received

    (d) The signal is converted first within the range of 10 Hz to 20Hz

111. Ans: (a)

112. If the sampling is carried out at a rate higher than twice the highest frequency of the original signal (f_{max}), then it is possible to receive the original signal from the sampled signal by passing it through

    (a) A high-pass filter with the cut-off frequency equal to f_{max}

    (b) A low-pass filter with the cut-off frequency equal to f_{max}

    (c) A high-pass filter with the cut-off frequency greater than f_{max}

    (d) A low-pass filter with the cut-off frequency greater than f_{max}

112. Ans: (d)

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- 2011: 25
- 2012: 26
- 2013: 42
- 2014: 121/589
- 2015: 140/434

Year of Exam

113. The open-loop transfer function of a unity feedback system is $G(s) = \dfrac{10(1+0.2s)}{(1+0.5s)}$. The phase shift at $\omega = 0$ and $\omega = \infty$, will be respectively

(a) -90° and 180° (b) 0° and 180°

(c) -90° and 90° (d) 0° and 0°

113. Ans: (d)

Sol: $G(s) = \dfrac{10(1+0.2s)}{(1+0.5s)}$

The phase shift at $\omega = 0$ and $\omega = \infty$

$\phi_{sys}(\omega) = -\operatorname{Tan}^{-1}[0.5\omega] + \operatorname{Tan}^{-1}[0.2\omega]$

$\omega = 0 \quad \phi = 0$

$\omega = \infty \quad \phi = 0$

114. The conversion time for a 10-bit successive approximation A/D converter , for a clock frequency of 1MHz is

(a) 1μs   (b) 5μs   (c) 10μs   (d) 15μs

114. Ans: (c)

Sol: For Successive approximation type ADC,

Conversion Time = N.T

$= 10\,(1\mu \sec)\ [\because f = 1\text{MHz}]$

$= 10\ \mu \sec$

115. The minimum bandwidth of the link needed for a guard band of 10 kHz frequency to prevent interference between six channels, each with 100kHz frequency, is

(a) 425kHz   (b) 575 kHz

(c) 650 kHz   (d) 725 kHz

115. Ans: (c)

Sol: $(B_T)_{min} = \displaystyle\sum_{i=1}^{N} B_i + (N-1)B_g$

Where B_i is the ith signal bandwidth.

B_g is the guard band bandwidth

$= (6 \times 100) + (6-1) \times 10$

$= 650$ kHz

116. The different access methods which permit many satellite users to operate in parallel through a single transponder   without interfering with each other are

1. Frequency Division   Multiple Access (FDMA)

2. Time   Division   Multiple   Access (TDMA)

3. Code Division Multiple Access (CDMA)

Which of the above are correct ?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1,2 and 3

116. Ans: (b)

Sol: TDMA access cannot permit many satellite users to operate in parallel why because every user can transmit data only some fixed time slot.

117. In an optical fibre, the pulse dispersion effect is minimized by

1. Using a high frequency light source

2. Using plastic cladding

3. Minimizing the core diameter

Which of the above statement is/are correct ?

(a) 1 only

(b) 2 only

(c) 3 only

(d) 1,2 and 3

117. Ans: (c)

118. Consider the following statements :

As compared to short-circuited stubs, open circuited stubs are not preferred because the latter

1. Are of different characteristics impedance

2. Have a tendency to radiate

Which of the above statements is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

118. Ans: (b)

119. Consider the following statements for multiple access system in a satellite earth station :

1. Access to same repeater sub-systems and same RF channel is possible

2. Frequency division multiple access is used.

3. Several carries are not amplified by same TWT.

Which of the above statements are correct ?

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

(c) 1 and 2 only   (d) 1, 2 and 3

119. Ans: (c)

Sol: Major advantage of TWT is wide bandwidth, operating frequency range from 300 MHz – 50 GHz

120. The Bode plot of the open-loop transfer function of a system is described as follows:

- Slope – 40dB/decade $\omega < 0.1$ rad/s

- Slope – 20dB/decade $0.1 < \omega < 10$ rad/s

- Slope   0 $\omega > 10$ rad/s

The system described will have

(a) 1 pole and 1 zeros

(b) 2 poles and 2 zeros

(c) 2 pole and 1 zero

(d) 1 pole and 1 zeros

120. **Ans: (b)**

Sol: Slope –40°dB/dec ω < 0.1rad/sec

slope –20dB/dec   0.1 < ω <10

Slope   0 ω > 10

2 poles at origin

At ω = 0.1 slope change

– 40 to – 20

$\therefore$ single zero.

At ω = 10 slope change

–20 to 0

$\therefore$ single zero

Total 2 poles = zeros

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