EC-Objective-Paper-II (Set-D)

1. In a geostationary satellite communication system, a message signal is transmitted from an earth station via an uplink to a satellite, amplified in a transponder on board the satellite and then transmitted via a downlink to another earth station. The most popular frequency band for satellite communication is

(A) 16 MHz for the uplink and 14 MHz for the downlink

(B) 4 GHz for the uplink and 6 GHz for the downlink

(C) 6 GHz for the uplink and 4 GHz for the downlink

(D) 10 GHz for the downlink and 8 GHz for the uplink

Key: (C)

Exp: C-band: U/L-6 GHz, D/L-4 GHz and Ku band: U/L-14 GHz, D/L-12 GHz

2. As per WARC-1979 allocation, commercial communication satellites use bandwidth of

(A) 4 MHz (B) 40 MHz (C) 200 MHz (D) 500 MHz

Key: (D)

Exp: For region 2, the 500 MHz band (12.2-12.7 GHz) was divided by WARC 85 into 32 channels each 24 MHz wide, also resulting in overlap that will have to be avoided by reversing direction.

3. Range resolution in RADAR is determined by

(A) The radiated power (B) The bandwidth of transmitted pulse

(C) The antenna size (D) The centre frequency of RADAR

Key: (B)

Exp: The theoretical range resolution cell of a radar system can be calculated from the equation: $S_r \geq \frac{C_0 . \tau}{2}$

4. In satellite communication, Faraday rotation is caused by

(A) Plasma frequency

(B) Earth's magnetic field

(C) Non-Gaussian nature of uplink noise when received in the downlink channel

(D) Ionospheric reflections that occur multiple times

Key: (B)

Exp: Polarization rotation refers to a rotation of the polarization sense of a radio wave, caused by the interaction of a radio wave with electrons in the ionosphere, in the presence of the earth's magnetic field. This condition, referred tas the Faraday Effect, can seriously affect VHF space communication systems that use linear polarization.

5. What will be the total modulation index if a wave is amplitude modulated by three sine waves with modulation indices of 25%, 50% and 75%?

(A) $M_t = 1.5$ (B) $M_t = 0.93$ (C) $M_t = 1.22$ (D) $M_t = 1$

Key: (B)

Exp: $\mu_t = \sqrt{\mu_1^2 + \mu_2^2 + \mu_3^2}$

$= \sqrt{(0.25)^2 + (0.5)^2 + (0.75)^2} = 0.93$

6. Boosting of higher frequency at the transmitter is done by using

(A) De-emphasis (B) AGC circuit

(C) Pre-emphasis (D) Armstrong method

Key: (C)

Exp: Pre-emphasis is a strong high frequency boost before the transmitter.

7. The power contained in single sideband in amplitude modulation is

(A) $\frac{m^2P_c}{2}$ (B) $2m^2P_c$ (C) $\frac{m^2P_c}{4}$ (D) $4m^2P_c$

Key: (C)

Exp: We know that $P_T = P_C\left[1+\frac{m^2}{2}\right]$

$$= \underbrace{P_C}_{\substack{\text{carrier}\\ \text{power}}} + \underbrace{\frac{P_Cm^2}{4} + \frac{P_Cm^2}{4}}_{\text{side band powers}}$$

8. TWT characterized by

(A) Low noise figure, narrow bandwidth and average gain

(B) Gain exceeding 40 dB, wide bandwidth and low noise figure

(C) More noise and wide bandwidth

(D) More noise, narrow bandwidth and high gain

Key: (B)

Exp: Advantages of TWT:

1. Bandwidth is large
2. High reliability
3. High gain
4. Constant performance in space
5. Higher duty cycle.

9. In Gunn diodes, electrons are transferred from

(A) High to low mobility energy bands

(B) Low to high mobility energy bands

(C) Valley to domain formation

(D) Domain to valley formation

Key: (A)

Exp: Greater than about an electric field of 3.2 kV/cm, the electrons in N type GaAs move from a high-mobility, low-energy valley to another valley where the mobility is lower. Consequently, the net electron velocity is lower.

10. Polarization is characteristic of EM wave that gives the direction of

(A) Electrical component of a wave with respect to ground

(B) Magnetic component of EM wave with respect to ground

(C) Both electrical and magnetic components with respect to ground

(D) None of the above

Key: (A)

11. A rectangular waveguide has the dimensions of $5.1\,\text{cm} \times 2.4\,\text{cm}$. For the dominant mode TE_{10} the cut-off frequency is

(A) 2.94 GHz (B) 5.88 GHz (C) 6.25 GHz (D) 68.99 GHz

Key: (A)

Exp: $f_c = \dfrac{c}{2a} \quad ; \quad (a > b)$

$= \dfrac{3 \times 10^{10}}{2 \times 5.1}$

$= 2.94\,\text{GHz}$

12. The semiconductor random access memory of a computer has 65,536 words, each of 8-bits. It can perform two basic operations Read and Write. How many bits are there in the Address Register of this memory?

(A) 8 (B) 12 (C) 16 (D) 24

Key: (C)

13. $S = \begin{bmatrix} 0 & 0 & S_{13} & S_{14} \\ 0 & 0 & S_{23} & S_{24} \\ S_{31} & S_{32} & 0 & 0 \\ S_{41} & S_{42} & 0 & 0 \end{bmatrix}$ is the scattering matrix of

(A) Magic Tee (B) Circulator

(C) Hybrid ring (D) Three port network

Key: (A)

14. Phase velocity v_p and group velocity v_g in a waveguide are related to the velocity of light c as

(A) $v_p v_g = c^2$ (B) $v_p + v_g = c$

(C) $\dfrac{v_p}{v_g} = \text{Constant}$ (D) $v_p + v_g = \text{Constant}$

Key: (A)

15. Which one of the following is not a mode of operation of a Gunn diode?

(A) LSA oscillation mode (B) Stable amplification mode

(C) Bias circuit oscillation mode (D) Non-linear mode

Key: (D)

Exp: Modes of gunn diode

1. Gunn Oscillation Mode
2. Stable Amplification Mode
3. LSA Oscillation Mode
4. Bias-circuit

16. The only modes in micro strip lines are
   (A) TE modes
   (B) TM modes
   (C) TE and TEM modes
   (D) Quasi-transverse electric and magnetic modes

Key: (D)

Exp: Microstrip line:
The line will not support a true TEM wave; at non-zero frequencies, both the E and H fields will have longitudinal components (a hybrid mode). The longitudinal components are small however, and so the dominant mode is referred to as quasi-TEM.

17. If the receiving antenna is polarized at 90^o with respect to transmitting antenna, it will receive
   (A) No signal (B) Minimum signal (C) Maximum signal (D) Same signal

Key: (A)

18. Which of the following methods provides largest bandwidth?
   (A) Proximity coupling (B) Aperture coupling
   (C) Coaxial probe feed (D) Microstrip line feed

Key: (B)

Exp: 1. An aperture-coupled design is proposed for microstrip slot antenna to improve its radiation pattern as well as bandwidth. It is based on coupling of an aperture between the patch antenna and Micro strip slot line.
2. Coaxial probe feed Provide a narrow bandwidth.

19. Which of the following antennas gives circular polarization?
   1. Yagi-Uda
   2. Parabolic
   3. Helical
   4. Dipole
   (A) 1, 2, 3 and 4 (B) 1, 2 and 3 only
   (C) 3 only (D) 4 only

Key: (C)

Exp: Among given antennas, helical antenna only provides circular polarization.

20. If the diameter of a $\frac{\lambda}{2}$ dipole antenna is increased from $\frac{\lambda}{100}$ to $\frac{\lambda}{50}$, then its
   (A) Bandwidth increases (B) Bandwidth decreases
   (C) Gain increases (D) Gain decreases

Key: (C)

21. Which one of the following statements is correct?
   (A) Phase margin is always positive for stable feedback system.
   (B) Phase margin is always negative for stable feedback system.
   (C) Phase margin can be negative or positive for stable feedback system.
   (D) None of the above.

Key: (A)

Exp: Stability of a system is obtained from phase margin sign which has to be compulsorily positive for a system to be stable, where as gain margin can be positive , or negative for a stable system.

22. A Tachometer has a sensitivity of 5 V/1000 rpm. The Gain constant of the Tachometer is

(A) 0.48 V/rad/sec (B) 0.048 V/rad/sec

(C) 4.8 V/rad/sec (D) 48 V/rad/sec

Key: (B)

Exp: Gain constant of tachometer $= \dfrac{\text{Voltage (in Volt)}}{\text{Shaft speed (in rad/sec)}}$

$$= \frac{5}{1000\text{ r.p.m}}$$

$$= \frac{5}{1000\left(\frac{2\pi}{60}\right)\text{rad/sec}}$$

$$= 0.048\text{ rad/sec}$$

23. For a 3^{rd} order system given below, what is the phase crossover frequency?

$$G(s)H(s) = \frac{K}{s^3 + 6s^2 + 11s + 6}$$

(A) $\sqrt{6}$ (B) $\sqrt{11}$ (C) $\pm\sqrt{11}$ (D) $\pm\sqrt{6}$

Key: (B)

Exp: $G(s)H(s) = \dfrac{K}{s^3 + 6s^2 + 11s + 6}$

$$G(\omega)H(\omega) = \frac{L}{-6\omega^2 + 6 + i\left(11\omega - \omega^3\right)}$$

Phase crossover frequency is obtained by equating $\underline{|G(\omega)H(\omega)} = -180^o$

$$-180^o = -\tan^{-1}\left[\frac{11\omega - \omega^3}{6 - 6\omega^2}\right]$$

$$\frac{11\omega - \omega^3}{6 - 6\omega^2} = 0$$

$$11\omega - \omega^3 = 0$$

$$\omega = \pm\sqrt{11}$$

But frequency can't be negative so $\omega = \sqrt{11}$

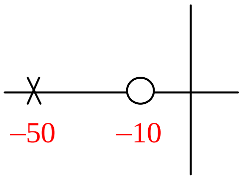
24. Two compensators have transfer functions $G_1(s) = \dfrac{5(s+10)}{(s+50)}$ and $G_2(s) = \dfrac{(s+50)}{5(s+10)}$ respectively.

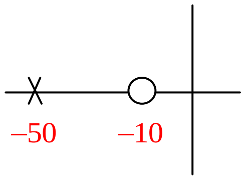
(A) Both are lag (B) Both are lead

(C) G_1 is lead and G_2 is lag (D) G_1 is lag and G_2 is lead

Key: (C)

Exp: $G_1(s)=\dfrac{5(s+10)}{s+50}$ $\qquad$ $G_2(s)=\dfrac{s+50}{5(s+10)}$





Zero near to origin
So it represents lead

Pole near to origin
So it represents lag

25. A proportional plus derivative controller
    1. Has high sensitivity.
    2. Increases the stability of the system.
    3. Improves the 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

Key: (B)

26. In industrial control system, which one of the following methods is most commonly used in designing a system for meeting performance specifications?

    (A) The transfer function is first determined and then either a lead compensation or lag compensation is implemented
    (B) The transfer function is first determined and PID controllers are implemented by mathematically determining PID constants
    (C) PID controllers are implemented without the knowledge of the system parameters using Ziegler-Nichols method
    (D) PID controllers are implemented using Ziegler-Nichols method after determining the system transfer function.

Key: (C)

Exp: In Ziegler Nicholas method by giving a step input first we obtain the response from response curve by taking some parameter k_p, k_j, k_d values one obtained. So here we need the output response curve we don't need any information about system parameter.

27. Which one of the following is the transfer function of the PI-controller?

    (A) $G(s)=\dfrac{(k_1s+k_2)}{k_3}$ (B) $G(s)=\dfrac{(k_1s+k_2s+k_3)}{k_4s}$

    (C) $G(s)=\dfrac{(k_1s+k_2)}{k_3s}$ (D) $G(s)=\dfrac{k_1s}{k_2s}$

Key: (C)

Exp: For a PI controller,

$$G(s)=K_p+\frac{K_I}{s}=\frac{sK_p}{s}=\frac{sK_p+K_I}{s}$$ { It is matching with (C) }

28. One of the main functions of the RF amplifiers in a super-heterodyne receiver is to
(A) Provide improved tracking
(B) Permit better adjacent channel rejection
(C) Increase the tuning range of the receiver
(D) Improve the rejection of the image frequency

Key: (D)

Exp: Main functions of RF amplifier
(1) Amplification of the received radio signal to provide better sensitivity and improved signal to noise ratio.
(2) Rejection of the unwanted signals.
(3) Rejection of the image signal.
Image rejection ratio can be improved by RF amplifier and pre-selector.

29. An FM signal has a carrier swing of 100 kHz when modulating signal has a frequency of 8 kHz. The modulation index is
(A) 12.5 (B) 7.5 (C) 6.25 (D) 15

Key: (C)

Exp: $2\Delta f = 100\text{KHz}$

$\Delta f = 50\text{KHz}$

$$\beta = \frac{\Delta f}{f_m} = \frac{50}{8} = 12.5$$

30. In a digital communication system employing Frequency Shift Keying (FSK), the 0 and 1 bit are represented by sine waves of 10 kHz and 25 kHz respectively. These waveforms will be orthogonal for a bit interval of
(A) $250\,\mu\text{sec}$ (B) $200\,\mu\text{sec}$
(C) $50\mu\text{sec}$ (D) $45\mu\text{sec}$

Key: (B)

Exp: $$f_2 - f_1 = \frac{n}{T_b} \Rightarrow T_b = \frac{n}{f_2 - f_1}$$

Choose n as a integer

$T_b = 200\mu\text{sec}\ (\text{for } n = 3)$

31. If a 400-watt carrier is amplitude modulated to a depth of 75 percent, what is the total power in the modulated wave?
(A) 517.5 W (B) 463.3 W (C) 448.5 W (D) 512.5 W

Key: (D)

Exp: $$P_t = P_c\left[1 + \frac{m^2}{2}\right]$$

Given $P_c = 400,\ m = 75\%$

$$P_t = 400\left[1 + \frac{(0.75)^2}{2}\right]$$

$= 512.5$ Watts

32. The signal $m(t) = \sin c\left(2\times10^{4}t\right)$ is frequency modulated with $K = 10^{3}\ \text{Hz}/\text{V}$. What is the maximum instantaneous frequency of the modulated signal when carrier frequency is 1 MHz?

(A) 0.999 MHz (B) 0.998 MHz (C) 1.002 MHz (D) 1.001 MHz

Key: (D)

Exp: $f_{i(max)} = f_c + k.A_m$

Given $k = 10^3$, $A_m = 1$, $f_c = 1\,\text{MHz}$

$f_{i(max)} = 1\text{M} + 10^3 = 1.001\,\text{MHz}$

33. Amplitude modulation is used for broadcasting because

(A) It is more noise immune than other modulation systems

(B) Compared with other systems it requires less transmitting power

(C) Its use avoids receiver complexity

(D) No other modulation system can provide the necessary BW for high fidelity

Key: (C)

34. In flat-top sampling a hold circuit is sometimes required. This hold circuit can be designed as a sampler followed by

(A) A shunt capacitor

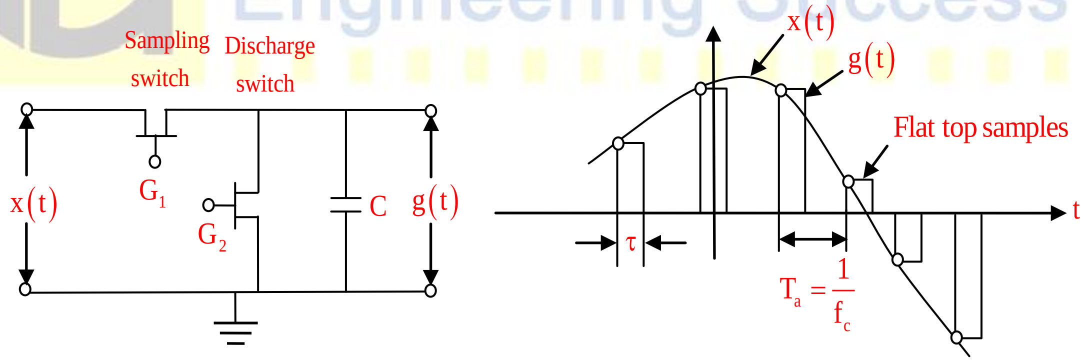
(B) An envelope detector

(C) Parallel RC circuit

(D) A series resistance along with parallel RC circuit in shunt

Key: (A)

Exp:



35. As compared to A-law compander, the $\mu -$law compander produces

(A) More companding at low amplitudes

(B) More companding at high amplitudes

(C) Less companding for low amplitudes

(D) Less companding for high amplitudes

Key: (A)

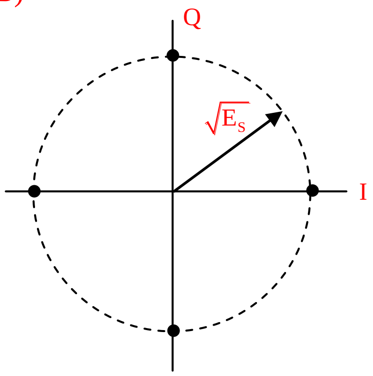
36. A carrier is modulated by a digital bit stream having one of the possible phases of 0^o, 90^o, 180^o and 270^o. Then the modulation is termed as

(A) BPSK (B) QPSK

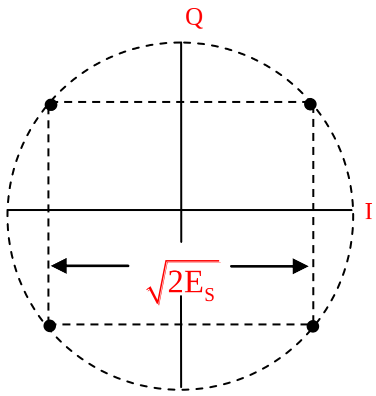
(C) QAM (D) MSK

Key: (B)

Exp:



(a)



(b)

Fig(a): QPSK constellation where the carrier phases are 0, $\pi/2$, π, $3\pi/2$.

Fig(b): QPSK constellation where the carrier phases are $\pi/4$, $3\pi/4$, $5\pi/4$, $7\pi/4$.

37. Consider the following:
1. Pulse-position modulation.
2. Pulse-code modulation.
3. Pulse-width modulation

Which of the above communications are not digital?

(A) 1 and 2 only (B) 2 and 3 only (C) 1 and 3 only (D) 1, 2 and 3

Key: (C)

Exp: PCM (pulse code modulation) is a digital communication technique

38. In a superheterodyne receiver, if the intermediate frequency is 450 kHz and the signal frequency is 1000 kHz, then the local oscillator frequency and image frequency respectively are

(A) 1450 kHz and 100 kHz (B) 550 kHz and 1900 kHz

(C) 1450 kHz and 1900 kHz (D) 550 kHz and 1450 kHz

Key: (C)

Exp: $f_l - f_s = 450\text{ kHz}$ $\quad (f_l \text{ must be greater than } f_s)$

$$f_l = f_s + 450k = 1000k + 450k$$

$$\text{Local} - \text{oscillator frequency}: f_l = 1450\text{ kHz}$$

$$f_{si} = f_s + 2IF = 1000k + 2 \times 450k$$

$$f_{si} = 1900\text{ kHz}$$

39. The cladding which surrounds the fibre core

(A) Is used to protect the fibre

(B) Is used to reduce optical interference

(C) Helps to guide the light in the core

(D) Ensure that refractive index remains unaltered

Key: (C)

Exp: Cladding is one or more layers of materials of lower refractive index, in intimate contact with a core material of higher refractive index. The cladding causes light to be confined to the core of the fiber by total internal reflection at the boundary between the two.

40. In microwave relay communication, the repeater is usually an amplifier for the amplification of

(A) Carrier signal (B) Baseband signal
(C) Amplitude modulated IF signal (D) Frequency modulated IF signal

Key: (B)

Exp: In telecommunication, the term repeater has the following standardized meanings:

1. An analog device that amplifies an input signal regardless of its nature (analog or digital).
2. A digital device that amplifies, reshapes, retimes, or performs a combination of any of these functions on a digital input signal for retransmission. A repeated that includes the retiming function is also known as a regenerator.

41. The efficiency of an antenna having a resistance of $30\,\Omega$ and radiation resistance of $60\,\Omega$ is

(A) 33.3% (B) 50% (C) 66.6 % (D) 75%

Key: (C)

Exp: $\eta\% = \dfrac{R_{rad}}{R_l + R_{rad}}$

Given $R_{red} = 60,\ R_l = 30\Omega\,(\text{loss} - \text{Resistance})$

$\eta\% = \dfrac{60}{90}\times 100 = \dfrac{2}{3}\times 100 = 66.6\%.$

42. An antenna behaves as a Resonant Circuit if

(A) Its length is integral multiple of $\dfrac{n\lambda}{2}$

(B) Its height is integral multiple of $\dfrac{n\lambda}{2}$

(C) Its length is even multiple of $\dfrac{n\lambda}{2}$

(D) Its length is odd multiple of $\dfrac{n\lambda}{2}$

Key: (A)

Exp: At frequencies near $\beta l = n\pi$ (an integrated number of half wave length), the shorted line behaves like a series resonant circuit.

These properties are utilized in the design of band pass and band stop filters at microwave frequencies.

43. Magic Tee is called as

(A) E-H plane Tee (B) Hybrid Tee
(C) Mixer circuit (D) All of the above

Key: (D)

Exp: E-H plane (hybrid or magic tee): This is a combination of E-plane tee and H-plane tee.

Applications of the magic tee

1. Measurement of impedance
2. Antenna duplexer
3. Magic tee as a mixer

44. A transmission line has characteristic impedance of 500Ω. It has been terminated in a $200\,\Omega$ load. If the load is dissipating a continuous power of 100 W, its reflection coefficient is

(A) $\frac{6}{7}$ (B) $\frac{4}{7}$ (C) $\frac{3}{7}$ (D) $\frac{2}{7}$

Key: (C)

Exp: $\Gamma = \frac{z_l - z_0}{z_l + z_0} = \frac{200-500}{700} = \frac{-3}{7}$

$|\Gamma| = \frac{3}{7}$

45. Detection of microwave is carried out by employing

(A) Vacuum tube diode (B) Semiconductor diode
(C) Schottky Barrier diode (D) Field-Effect Transistor

Key: (C)

Exp: The diodes that can be used for detection of microwaves are specially designed i.e.
1) Point contact diode
2) Schottky barrier diode

46. The frequency range of very high frequency (VHF) is

(A) 300 MHz-3000 MHz (B) 30 MHz- 300 MHz
(C) 3 MHz-30 MHz (D) 30 THz- 3000 Hz

Key: (B)

Exp:

HF	High Frequency (Short Wave)	3-30 MHz	100-10 m
VHF	Very High Frequency	30-300 MHz	10-1 m
UHF	Ultra High Frequency	300-3000 MHz	100-10 m

47. On a microstrip line the wavelength measured is 12 mm for a 10 GHz signal. The dielectric constant of the equivalent homogeneous line is

(A) 3.5 (B) 6.25 (C) 5.5 (D) 7.0

Key: (B)

Exp: $\lambda = \frac{c}{\sqrt{\varepsilon_r}\,f}$

$$\sqrt{\varepsilon_r} = \frac{3\times10^8}{12\times10\times10^9\times10^{-2}} = \frac{1}{4} = 0.25 \Rightarrow \varepsilon_r = 6.25$$

48. Microwave link repeaters are typically 50 km apart in TV transmission, because

(A) of atmospheric attenuation
(B) of output power tube limitation
(C) Microwave transmission is through surface wave which attenuates faster
(D) of Earth's curvature

Key: (D)

Exp: Microwave link repeaters are typically 50 km apart because of earth's curvature.

49. The ratio $\frac{\sigma}{\omega\varepsilon}$ is called

1. Intrinsic ratio
2. Loss tangent
3. Conduction ratio
4. Dissipation factor

Which of the above statements is/are correct?

(A) 1 only (B) 2 only (C) 2 and 4 (D) 2 and 3

Key: (C)

Exp: loss tangent / dissipation factor = $\tan\delta = \frac{\sigma}{\omega\varepsilon}$

50. Baretters and Bolometers are used for measurement of

(A) VSWR
(B) Transmission losses
(C) Microwave power
(D) None of the above

Key: (C)

Exp: Microwave power measurements:

→Bolometer: It is a power sensor whose resistance change with changed temperature as it absorbs the microwave power.

→Calorimeter: It is convenient device setup for measuring the high power at microwave

→Baretters

51. The discone antenna is

(A) A useful direction finding antenna
(B) Used as a radar receiving antenna
(C) Circularly polarized like other circular antennas
(D) Useful as VHF receiving antenna

Key: (D)

Exp:
1. A discone is a wide-band antenna because it is a constant angle antenna. The SWR on the coaxial cable connected to the discone antenna can remain below 1.5 for a frequency variation of 7:1.
2. A discone is an omni-directional antenna but has low gain. It is used mostly as a VHF and UHF receiving and transmitting antenna at airports, where communication has to be made with an aircraft from any direction.

52. A satellite link uses different frequencies for receiving and transmitting in order to

(A) Avoid interference from terrestrial microwave link
(B) Minimize free space losses
(C) Maximize antenna gain
(D) Avoid interference between its powerful transmitted signal and weak incoming signal

Key: (D)

Exp: Such high frequency signals are especially susceptible to attenuation in the atmosphere. Therefore, in case of satellite communication two different frequencies are used as carrier frequencies to avoid interference between incoming and outgoing signals.

53. The number of one's present in the binary representation of $15\times256+5\times16+3$ are

(A) 8 (B) 9 (C) 10 (D) 11

Key: (A)

Exp: Let $Y=15\times256+5\times16+3$

$$Y=15\times16^2+5\times16^1+3\times16^o$$

$$Y=(16-1)16^2+5\times16^1+3\times16^o$$

$$Y=(1053)_H-(100)_H=(F53)_H$$

$$Y=(111101010011)_2$$

There are eight ones in 'Y'.

54. The creation of file variable will automatically create a special variable associated with it, called as

(A) Buffer variable (B) Text variable
(C) Allocated variable (D) Floating variable

Key: (A)

55. Wrapping of data functions together in a class is known as

(A) Overloading (B) Data Abstraction
(C) Polymorphism (D) Encapsulation

Key: (D)

56. Given $(135)_{\text{base x}}+(144)_{\text{base x}}=(323)_{\text{base x}}$. What is the value of base x?

(A) 5 (B) 3 (C) 12 (D) 6

Key: (D)

Exp: $(135)_x+(144)_x=(323)_x$

$$1\times x^2+3\times x^1+5\times x^o+1\times x^2+4\times x^1+4\times x^o=3\times x^2+2\times x'+3\times x^o$$

$$2x^2+7x+9=3x^2+2x+3$$

$$x^2-5x-6=0\Rightarrow x^2-6x+x-6=0$$

$$\Rightarrow x(x-6)+1(x-6)=0\Rightarrow(x+1)(x-6)=0$$

$$\Rightarrow x=-1,6$$

$$\Rightarrow x\neq-1 \text{ So, } x=6$$

57. Expression C = i++ causes

(A) Value of i to be assigned to C, and then i to be incremented by 1
(B) i to be incremented by 1, and then value of i to be assigned to C
(C) Value of i to be assigned to C
(D) i to be incremented by 1

Key: (A)

58. The addressing mode that permits relocation, without any change whatsoever in the code, is

(A) Indirect addressing (B) Base register addressing
(C) Indexed addressing (D) PC relative addressing

Key: (B)

59. Which of the following algorithm design techniques is used in the quick sort algorithm?

(A) Dynamic programming (B) Backtracking

(C) Divide and conquer (D) Greedy method

Key: (C)

60. An algorithm is made up of 2 modulates M_1 and M_2. If order of M_1 is f(n) and that of M_2 is g(n), then the order of the algorithm is

(A) $f(n)\times g(n)$ (B) $f(n)+g(n)$ (C) $\min(f(n),g(n))$ (D) $\max(f(n),g(n))$

Key: (D)

61. The current gain of a bipolar transistor drops at high frequency because of

(A) Transistor capacitances

(B) High current effects in the base

(C) Parasitic inductive elements

(D) The early effect

Key: (A)

62. The maximum depletion layer width in Silicon

(A) 0.143 μm (B) 0.857 μm (C) 1 μm (D) 1.143 μm

Key: (D)

63. A bipolar transistor is operating in the active region with a collector current of 1 mA. The β of the transistor is 100 and the thermal voltage (V_T) is 25 mV. The transconductance (g_m) and the input resistance (r_π) of the transistor in the common emitter configuration are, respectively

(A) 25 mA/V and 15.625 kΩ (B) 40 mA/V and 4.0 kΩ

(C) 25 mA/V and 2.5 kΩ (D) 40 mA/V and 2.5 kΩ

Key: (D)

Exp: Given $I_C = 1\text{mA},\ V_T = 25\text{ mV},\ \beta = 100$

$$g_m = \frac{I_C}{V_T} = 40\text{ mA/V}$$

$$r_\pi = \beta\, r_e = \frac{\beta}{g_m} = \frac{100}{g_m} = \frac{100}{40\text{m}} = 2.5\text{ k}\Omega.$$

64. For a transformer, the load connected to the secondary has an impedance of $8\,\Omega$. Its reflected impedance on primary is observed to be $648\,\Omega$. The turns ratio of this transformer is

(A) 6 :1 (B) 10 : 1 (C) 9 : 1 (D) 8 : 1

Key: (C)

Exp: $$\frac{Z_1}{Z_L} = \left(\frac{N_1}{N_2}\right)^2 \Rightarrow \frac{648}{8} = \left(\frac{N_1}{N_2}\right)^2$$

$$\Rightarrow \frac{N_1}{N_2} = \sqrt{81} = \frac{9}{1} = 9:1.$$

65. An amplifier with mid band gain $|A| = 500$ has negative feed back $|b| = \frac{1}{100}$. If upper cut-off without feedback were at 60 kHz, then with feedback it would become

(A) 10 kHz (B) 360 kHz (C) 12 kHz (D) 300 kHz

Key: (B)

Exp: $f_{H(f)} = f_H(1 + A\beta)$

$$= 60k\left(1 + \frac{500}{100}\right) = 360\text{ kHz}$$

66. A tuned amplifier has a maximum output at 4 MHz with a quality factor 50. The bandwidth and half power frequencies are respectively

(A) 80 kHz and 4.04 MHz; 3.96 MHz

(B) 80 kHz and 4.08 MHz; 3.92 MHz

(C) 40 kHz and 4.04 MHz; 3.96 MHz

(D) 40 kHz and 4.08 MHz; 3.92 MHz

Key: (A)

Exp: $B.W = \frac{f_0}{Q}$ $(\text{Here } f_0 = 4\text{ MHz})$

$$= \frac{4 \times 10^6}{50} = 80\text{ kHz}$$

Verfiy from Option(A)

$f_1 = 4.04\text{ MHz},\ f_2 = 3.96\text{ MHz}$

which satisfy B.W 80kHz

67. A power amplifier with a gain of $100\angle 0°$ has an output of 12 V at 1.5 kHz along with a second harmonic content of 25 percent. A negative feedback is to be provided to reduce the harmonic content of the output to 2.5 percent. What should be the gain of the feedback path and the level of signal input to the overall system, respectively?

(A) 0.9 and 0.12 V (B) 0.9 and 12 V (C) 0.09 and 1.2 V (D) 9 and 0.12 V

Key: (C)

Exp: $D_{2f} = \frac{D_2}{1 + A\beta} \Rightarrow 1 + A\beta = \frac{25}{2.5} = 10$

$\Rightarrow A\beta = 9$

$\Rightarrow \beta = \frac{9}{100}$ $\left[A_f = \frac{A}{1+\beta} = 10\right]$

$\frac{\text{Output}}{\text{Input}} = 10 \text{ which is } (A_f)$

Input voltage $= 1.2\text{ V}$

68. The right side of a state equation represents

(A) Next state of flip-flop

(B) Present state of flip-flop

(C) Present state condition that makes the next state equal to 1

(D) None of the above

Key: (C)

Exp: left side of the state equation represents the next state

Right side of the state equation is a Boolean function that specify Present state condition that makes the next state equal to 1

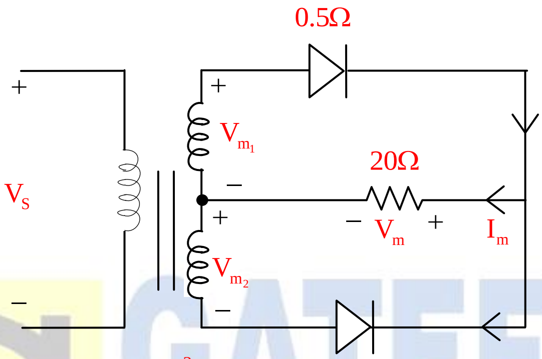
69. A full wave rectifier with a centre-tapped transformer supplies dc current of 100 mA to a load resistance of $20\,\Omega$. The secondary resistance of transformer is $1\,\Omega$. Each diode has a forward resistance of $0.5\,\Omega$. What are rms values of signal voltage across each half of the secondary as well as dc power supplied to the load?

(A) 2.39 V and 0.2 Watt (B) 23.9 V and 2 Watts

(C) 0.239 V and 20 Watts (D) 2.39 V and 2 Watts

Key: (A)

Exp: Consider 1Ω resistor across the secondary winding also



$$V_{dc} = I_{dc}.R_L = 100\times10^{-3}\times200=2V$$

$$V_{dc} = \frac{2V_m}{\pi} \Rightarrow V_m = \pi$$

$$V_{m_1} = \left[\pi + (1.5)\times I_m\right]$$

$$I_{dc} = \frac{2I_m}{\pi} \Rightarrow I_m = \frac{100\times10^{-3}\times\pi}{2} = 0.157$$

$$V_{m_1} = \pi + 0.2355 = 3.3770$$

$$V_{rms} = \frac{V_{m_1}}{V_2} = \frac{3.37}{\sqrt{2}} = 2.388\text{ Volt}$$

$$\text{Power supplied across the load is} = I_{dc}^2 \times R_L = 0.2\,W$$

70. An Op-Amp has the following open loop parameters $Z_{in} = 300\text{ k}\Omega$, $Z_{out} = 100\ \Omega$, A=50,000. The low frequency system input and output impedances, when closed loop gain is set to 100, are

(A) 0.6Ω and 50 kΩ (B) 150 MΩ and 0.2Ω

(C) Same as in open loop (D) None of the above

Key: (B)

Exp: $Z_{in(f)} = Z_i(1+A\beta)$

$$1+A\beta = \frac{50000}{100} = 500 \quad \left(\because A_f = \frac{A}{1+A\beta}\right)$$

$$Z_{in(f)} = 300k\times500 = 150\text{ M}\Omega$$

$$Z_{of} = \frac{Z_o}{1+A\beta} = \frac{100}{500} = 0.2\Omega$$

71. The differential gain of op-amp is 4000 and value of CMRR is 150. Its output voltage, when the two input voltages are 200 μ V and 160 μ V respectively, will be

(A) 16 V (B) 164.8 mV (C) 64 mV (D) 76 mV

Key: (B)

Exp: $V_O = A_d V_d + A_C V_C$

$V_d = V_1 - V_2 = 80\mu v$

$$V_C = \frac{V_1 + V_2}{2} = 18.0\,\mu V$$

$A_d = 4000$

$$A_C = \frac{A_d}{CMRR} = \frac{4000}{150} = 26.66\text{ V}$$

$V_O = 160m + 4.8m = 164.8\text{ mV}$

72. An amplifier using an op-amp with a slew rate SR =1 V/μ sec has a gain of 40 dB. If this amplifier has to faithfully amplify sinusoidal signals from 10 to 20 kHz, without introducing any slew-rate induced distortion, then the input signal level must not exceed

(A) 795 mV (B) 395 mV (C) 79.5 mV (D) 39.5 mV

Key: (C)

Exp: Slow rate = Gain$\times 2\pi\, f_{max}\, V_m$ (without distortion we get)

$$V_m = \frac{1V}{1\mu \times 100 \times 2\pi \times 20k} = 79.5\text{ mV}$$

73. Which oscillator is characterized by a split capacitor in its tank circuit?

(A) RC phase shift oscillator (B) Colpitt's oscillator

(C) Wien bridge oscillator (D) None of the above

Key: (B)

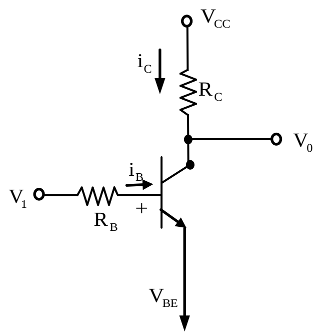
74. A 1 μ s pulse can be converted into a 1 ms pulse by using

(A) A Monostable multivibrator (B) An astable multivibrator

(C) A bistable multivibrator (D) A J-K flip-flop

Key: (A)

75. The transistor switch as shown in figure has $\beta = 120$, $V_{CE(sat)} = 0.2\,V$, $R_C = 1.2\,k\Omega$ and $V_{CC} = 5V$. The output voltage when transistor switch is closed and the minimum base current needed to close the switch are, respectively



(A) 0.2 V and 3.33 μ A

(B) 2 V and 3.33 μ A

(C) 0.2 V and 33.3 μ A

(D) 2 V and 33.3 μ A

Key: (C)

Exp: Switch is closed at output means, transistor in saturation

$$\text{Condition (1)}: I_{B(\min)} \geq \frac{I_C}{\beta}$$

$$\text{Condition }(2): V_O = V_{CE}(\text{sat}) = 0.2\text{V}$$

$$I_{B(\min)} \geq \frac{(5-0.2)}{1.2\text{k} \times 120}$$

$$I_{B(\min)} = 33.3\mu\text{A}$$

76. A plant is controlled by a proportion controller. If a time delay element introduced in the loop, its

(A) Phase margin remains the same (B) Phase margin increases

(C) Phase margin decreases (D) Gain margin increases

Key: (C)

Exp: Let the transfer function of the plant be

$$G(s) = \frac{K}{(s+a)}$$

When we introduce a delay now it becomes

$$G(s) = \frac{Ke^{-\tau_d s}}{(s+a)}$$

From the polar plot of $G_1(s)$ and $G_2(s)$ it can be shown that stability of $G_2(s)$ is less than $G_1(s)$ and hence phase margin decrease.

77. When damping ratio is equal to zero, the damping frequency of a system is

(A) Equal to natural frequency (B) Zero

(C) More than natural frequency (D) Less than natural frequency

Key: (A)

Exp: $\omega_d = \omega_n \sqrt{1-\varepsilon^2}$

When $\varepsilon = 0 \Rightarrow \omega_d = \omega_n$

78. The circuit shown in figure is

(A) OR gate (B) NOR gate

(C) NAND gate (D) AND gate

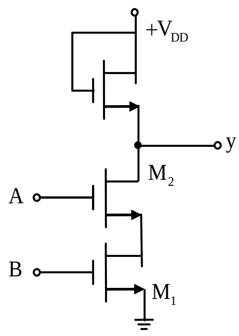
Key: (C)

Exp:

$$\text{NMOS in series} = \text{Complement of }(\text{Product of inputs})$$

$$= \overline{A.B}$$

It means it is the implementation of NAND-gate



79. A binary-to-BCD encoder has four inputs D_0, C_0, B_0 and A_0 and five outputs D, C, B, A and VALID. The outputs D, C, B and A give the proper BCD value of the input and the VALID output is 1 if the input combination is a valid decimal code. If the input combination is an invalid decimal code, the VALID output becomes 0 and all the D, C, B and A outputs show 0 values. If only NOT gates and 2-input OR and AND gates are available, the minimum number of gates required to implement the above circuit is

(A) 10 (B) 9 (C) 8 (D) 7

Key: (C)

Exp: According to the statement given, there are four inputs ($D_0\ C_0\ B_0\ A_0$) and five outputs ($D\ C\ B\ A$ valid). Considering the logic to be implemented the truth table is given below.

D_0	C_0	B_0	A_0	D	C	B	A	Valid
0	0	0	0	0	0	0	0	1
0	0	0	1	0	0	0	1	1
0	0	1	0	0	0	1	0	1
0	0	1	1	0	0	1	1	1
0	1	0	0	0	1	0	1	1
0	1	0	1	0	1	0	1	1
0	1	1	0	0	1	1	0	1
0	1	1	1	0	1	1	1	1
1	0	0	0	1	0	0	0	1
1	0	0	1	1	0	0	1	1
1	0	1	0	0	0	0	0	0
1	0	1	1	0	0	0	0	0
1	1	0	0	0	0	0	0	0
1	1	0	1	0	0	0	0	0
1	1	1	0	0	0	0	0	0
1	1	1	1	0	0	0	0	0

From the truth table,

$$\text{Valid output} = \bar{D}_0 + \bar{C}_0\bar{B}_0$$
$$= \bar{D}_0 + \left(\overline{B_0 + C_0}\right)$$

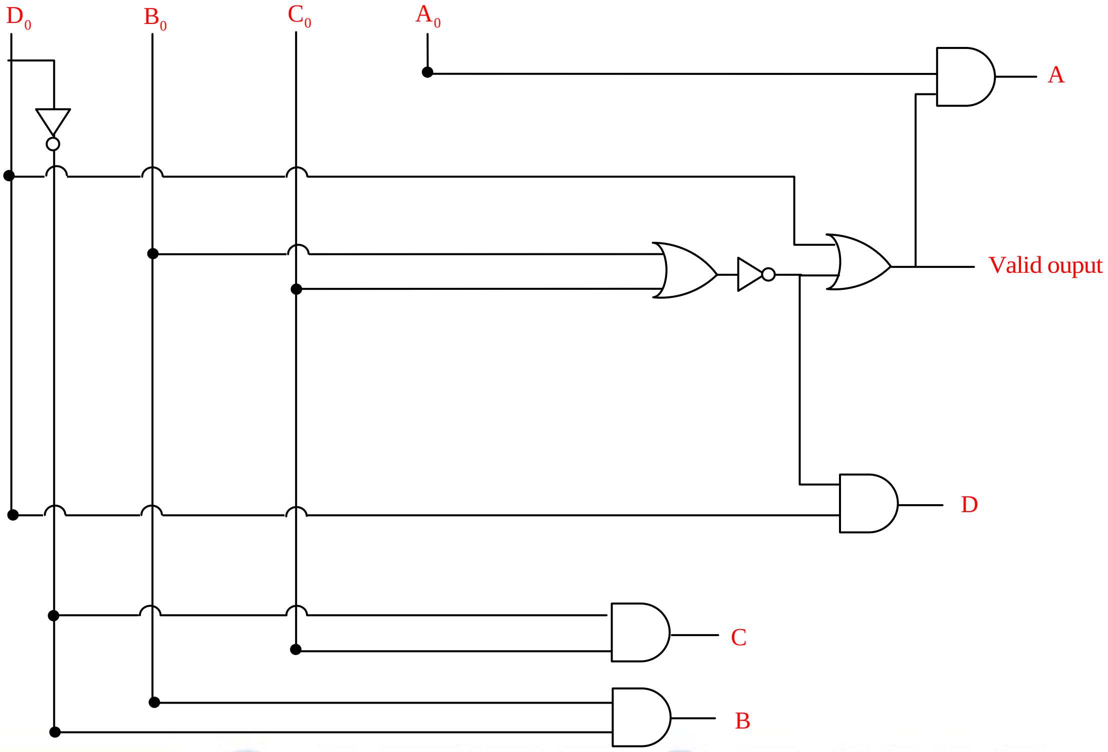
$$D = D_0\left(\bar{B}_0\bar{C}_0\right) = D_0.\left(\overline{B_0 + C_0}\right)$$

$$C = \bar{D}_0 C_0$$

$$B = \bar{D}_0 B_0$$

$$A = \bar{D}_0 A + \bar{C}_0 + \bar{B}_0 A_0 = A_0\left(\bar{D}_0 + \left(\overline{B_0 + C_0}\right)\right)$$

Implementing the above five output the logic circuit need minimum 8 no of gates as shown below.



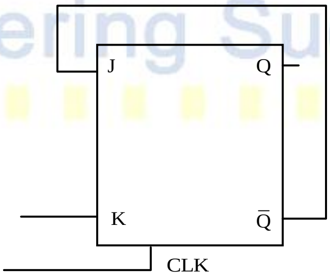
80. In the J-K flip-flop we have $J = \bar{Q}$ and K =1 as shown in the figure. Assuming the flip-flop was initially cleared and then clocked for 6 pulses, the sequence at the Q output will be

(A) 010000

(B) 011001

(C) 010010

(D) 010101



Key: (D)

Exp:

$J(\bar{Q})$	$K(1)$	Q	
–	–	0	Intially
1	1	1	1[st] clock
0	1	0	2[nd] clock
1	1	1	3[rd] clock
0	1	0	4[rth] clock
1	1	1	5[th] clock
0	1	0	6[th] clock

81. Which of the following sorting methods will be the best, if the number of swappings done, is the only measure of efficiency?

(A) Bubble sort (B) Quick sort

(C) Insertion sort (D) Selection sort

Key: (C)

82. In a circularly linked list organization, insertion of a record involves the modification of

(A) No pointer (B) 1 pointer (C) 2 pointers (D) 3 pointers

Key: (C)

Exp: Suppose we want to insert mode A to which we have pointer p, after pointer q then we will have the following operations

$p \rightarrow next = q \rightarrow next;$

$q \rightarrow next = p;$

$\Rightarrow$ Modification of two pointers

83. The average successful search time for sequential search on 'n' items is

(A) $\frac{(n+1)}{2}$ (B) $\frac{n}{2}$ (C) $\frac{(n-1)}{2}$ (D) $\log(n)+1$

Key: (A)

Exp: If the search key matches the very first item, with one comparison we can terminate. It it is second, two comparisons etc.

So, average is $\frac{(1+2+3+....+n)}{n}$ i.e., $\frac{(n+1)}{2}$

84. The speed mismatch between processor and memory in a computer is alleviated by using a small fast memory as an intermediate buffer between memory and processor. This buffer memory is known as

(A) Volatile ROM (B) Non-Volatile ROM

(C) Cache Memory (D) EPROM

Key: (C)

85. What is maximum number of nodes in a binary tree that has N levels, if the root level is zero?

(A) 2^{2N} (B) $2^{N+1}-1$ (C) $2^{N}-1$ (D) $2^{N}-2N$

Key: (B)

86. To arrange a binary tree in ascending order, we need

(A) Post order traversal only

(B) In order traversal only

(C) Pre order traversal only

(D) Post order traversal and Pre order traversal

Key: (C)

87. The method used for resolving data dependency conflict by the compiler itself is

(A) Delay load (B) Operand forwarding

(C) Pre-fetch target instruction (D) Loop buffer

Key: (A)

Exp: In case of delayed load technique the compiler detects the data conflict and recorder the instruction as necessary to delay the loading of the conflicting data by inserting no operation instructions.

88. The micro programs provided by a manufacturer to be used on his micro programmed computer are generally called

(A) Software (B) Netware

(C) Firmware (D) Hardware

Key: (C)

Exp: IBM uses the synonym for microcode or microprogram as firmware

89. Locality of reference concept will fall in which of the following cases? When there are

(A) Many conditional jumps (B) Many unconditional jumps

(C) Many operands (D) None of the above

Key: (B)

90. Consider the following statements regarding RESET instruction of 8085 microprocessor:

1. PC contents become 0000H.
2. All interrupts are enabled.
3. RESET OUT pin is at logic 0.

Which of the above statements is/are correct?

(A) 1 only (B) 2 only (C) 1 and 2 (D) 2 and 3

Key: (A)

Exp: When RESET instruction is executed, the PC contents 0000H, IR contents becomes 00H. All interrupts, except TRAP, are disabled by resetting.

91. In a microprocessor, the register which holds address of the next instruction to be fetched is

(A) Accumulator (B) Programmer counter

(C) Stack pointer (D) Instruction register

Key: (B)

92. The following sequence of instructions is executed by an 8085 microprocessor:

```
1000  LXI   SP   27FF
1003  CALL  1006
1006  POP   H
```

The contents of the stack pointer (SP) and the HL register pair on completion of execution of these instructions are

(A) SP = 27 FF, HL = 1003 (B) SP = 27 FD, HL = 1003

(C) SP = 27 FF, HL = 1006 (D) SP = 27 FD, HL = 1006

Key: (C)

Exp: 1000 LXI SP; 27FF ; $SP \leftarrow 27FF$

1003 CALL 1006 ; current contents are stored in stack and calls subroutine.

$SP \leftarrow SP - 2$

$SP \leftarrow 27FD$

1006 POP H ; $HL \leftarrow 1006$ and

$SP \leftarrow SP + 2$

$SP \leftarrow 27FF$

$\therefore$ SP = 27FF, HL = 1006

93. The semiconductor RAM of a digital computer has a word length of 16-bits and a capacity of 65,536 words. It has a cycle time of 80 ns. If the CPU is much faster than the memory, the time required to fill 1,024 bytes of this memory with all 0's will be

(A) 40.96 μs (B) 81.92 μs (C) 5.24 ms (D) 10.48 ms

Key: (A)

Directions:

*Each of the next **seven (07)** items consists of two statements, one labelled as 'Statement (I)' and the other as 'Statement (II)'. Examine these two statements carefully and select the answers 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 but Statement-II is not the correct explanation of Statement (I)

(C) Statement (I) is true but Statement (II) is false

(D) Statement (I) is false but Statement (II) is true

94. Statement (I) : A NAND gate represents a universal logic family

Statement (II) : Only two NAND gates are sufficient to accomplish any of the basic gates.

Key: (C)

95. Statement (I) : Digital ramp converter is the slowest ADC.

Statement (II) : It requires N^2 clock pulses for conversion

Key: (C)

96. Statement (I) : The β of a bipolar transistor is reduced, if the base width is increased

Statement (II) : The β of a bipolar transistor increases, if the doping concentration in the base is increased

Key: (C)

Exp: $\beta_{dc} = \frac{N_D}{N_A} \cdot \frac{D_{nB}}{D_{PE}} \cdot \frac{W_E}{W_B}$

$$\beta_{dc} \alpha \frac{1}{N_A \left(\text{Base doping concentration}\right)}$$

$$\beta_{dc} \alpha \frac{1}{W_B \left(\text{Base width}\right)}$$

97. Statement (I) : Space wave is used for propagation of FM broadcast system

Statement (II) : Several independent interference-free transmitters can be operated on the same frequency because of line-of-sight propagation.

Key: (B)

98. Statement (I) : In TE_{mn} mode Z component of magnetic field is non-zero

Statement (II) : In TE_{mn} modes Z component of electric field is non-zero

Key: (C)

Exp: In TE_{mn} modes Z-component of electric field is zero.

99. Statement (I) : On-chip cache memory is used for temporary storage of commonly used code/data copied from the main memory

Statement (II) : Provision of Cache memory eliminates the need for the processor to go off the chip to access the main memory thus improving the processor performance.

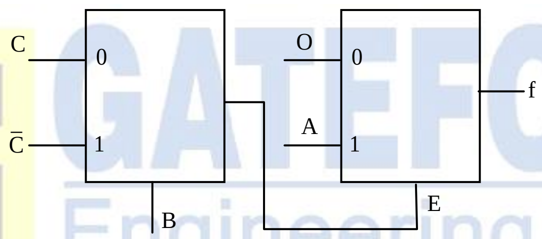
Key: (A)

100. Statement (I) : In the main memory of a computer, RAM is used as a short-term memory.

Statement (II) : RAM is a volatile memory.

Key: (A)

101. The Boolean function 'f' implemented as shown in the figure using two input multiplexes is



(A) $A\bar{B}C + AB\bar{C}$ (B) $ABC + A\bar{B}\bar{C}$ (C) $\bar{A}BC + AB\bar{C}$ (D) $\bar{A}\bar{B}C + \bar{A}B\bar{C}$

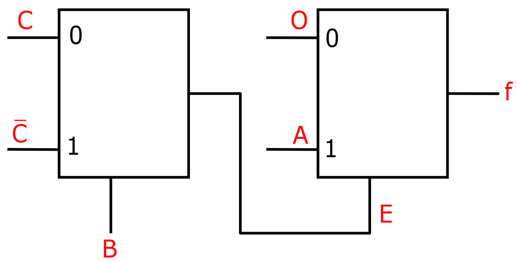
Key: (A)

Exp: $E = \bar{B}C + B\bar{C}$

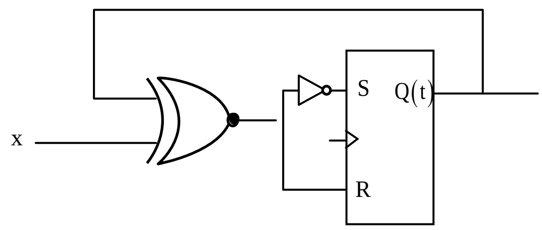
$f = O.\bar{E} + A.E = A.E$

$= A\left(\bar{B}C + B\bar{C}\right)$

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



102. Consider the circuit shown in the figure. The expression for the next state $Q(t+1)$ is



(A) $x\,Q(t)$ (B) $x \oplus Q(t)$ (C) $x\bar{Q}(t)$ (D) $x \odot Q(t)$

Key: (B)

103. The outputs Q and $\bar{Q}$ of master S-R flip-flop are connected to its R and S inputs respectively. The output Q when clock pulses are applied will be

(A) Permanently 0

(B) Permanently 1

(C) Fixed 0 or 1

(D) Complementing with every clock pulse

Key: (D)

104. Consider the following statements:

1. A flip-flop is used to store 1 bit of information.
2. Race around condition occurs in a J-K flip flop when both of its inputs are 1.
3. Master slave configuration is used in flip-flops to store 2 bits of information.
4. A transparent latch consists of D-type flip-flops.

Which of the above statements are correct?

(A) 1, 2 and 3 (B) 1, 3 and 4 (C) 1, 2 and 4 (D) 2, 3 and 4

Key: (C)

105. A circuit consists of two synchronously clocked J-K flip-flops connected as follows: $J_0 = K_0 = \bar{Q}_1,\ J_1 = Q_0, K_1 = \bar{Q}_0$. The circuit acts as a

(A) Counter of mod 2 (B) Counter of mod 3

(C) Shift-right register (D) shift–left register

Key: (B)

Exp:

$J_1(Q_0)$	$K_1(\bar{Q}_0)$	$J_0(\bar{Q}_1)$	$K_0(\bar{Q}_1)$	Q_1	Q_0
–	–	–	–	0	0 ← Initially
0	1	1	1	0	1
1	0	1	1	1	0
0	1	0	0	0	0

So, this is MOD-3 counter

106. A semiconductor RAM has a12-bit address register and an 8-bit data register. The total number of bits in the memory is

(A) 256 bits (B) 4, 096 bits

(C) 32, 768 bits (D) 10, 48, 576 bits

Key: (C)

107. When electromagnetic waves are propagated in a wave guide

(A) They travel along the walls of the waveguide

(B) They travel though the dielectric without touching the walls

(C) They are reflected from the walls but do not travel along the walls

(D) None of the above

Key: (C)

108. A dual slope analog to digital converter uses N-bit counter. When the input signal V_a is being integrated, the counter is allowed to count up to the value

(A) Equal to $2^N - 2$ (B) Equal to $2^N - 1$

(C) Proportional to V_a (D) Inversely proportional to V_a

Key: (B)

109. For a 5-bit ladder D/A converter which has digital input of 10101, the analog output value is (Assume 0 = 0V and 1 = +10V, R_f = 3R)

(A) -3.32 V (B) -4.32 V (C) -6.56 V (D) 7.48 V

Key: (C)

Exp: Given input is 10101

$$V_0 = \frac{-V_R.R_f}{R}\left[2^{-1}\times b_1 + 2^{-2}\times b_2 + 2^{-3}\times b_2 + 2^{-4}\times b_4 + 2^{-5}\times b_5\right]$$

$$= -10\left(2^{-1}\times 1 + 2^{-2}\times 0 + 2^{-3}\times 1 + 2^{-4}\times 0 + 2^{-5}\times 1\right)$$

$$= -10\left[\frac{1}{2}+\frac{1}{8}+\frac{1}{3^2}\right]$$

$$= -6.56V$$

110. A 5-bit D/A converter has a current output. If an output current I_{out} = 10 mA is produced for a digital input of 10100, the value of I_{out} for a digital input of 11101 will be

(A) 12.5 mA (B) 13.5 mA (C) 15.5 mA (D) 14.5 mA

Key: (D)

Exp: $I_{out} = K\times D$

Where : K = Resolution

D = Decimal equivalent of Binary inputs

$$10mA = K\times 20 \Rightarrow K = \frac{1}{2}mA$$

$$I_{out} = K\times D = \frac{1}{2}mA\times 29 = 14.5mA$$

111. What is the total memory range and memory map, if for a 16-bit address bus; $A_{15} = 1$, $A_{14} = 0$, and $A_{13} - A_{11}$ are connected to a 3-8 decoder input lines? A_{15} and A_{14} are connected to enable the decoder.

(A) 16K, 8000H –8FFFH (B) 2K, 8000H –BFFFH

(C) 16K, 8000H –BFFFH (D) 2K, 8000H –8FFFH

Key: (C)

Exp:

	A_{15}	A_{14}	A_{13}	A_{12}	A_{11}	A_{10}	A_9	A_8	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0
Initial address →	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Final address →	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1

∴ memory map is $(8000)_H$ to $(BFFF)_H$ with memory range –16k.

112. A unity feedback system has $G(s)=\frac{K(s+12)}{(s+14)(s+18)}$. What is the value of K to yield 10% error in steady state?

(A) 672 (B) 189 (C) 100 (D) 21

Key: (B)

Exp: A u.f.b system $G(s)=\frac{k(s+12)}{(s+14)(s+18)}$

Since the given system is of type-0, it will have finite steady state error only when step input have infinite steady state error only when step input is applied. So for the above w.r.t unit step $e_{ss}=\frac{1}{1+K_p}$ where $K_p=\lim_{s\to 0} G(s)=\frac{k}{21}$, $e_{ss}=\frac{1}{1+\frac{k}{21}}=\frac{21}{21+k}$

If we choose k = 1, $e_{ss}=\frac{21}{22}$

It is asked that for what value of k, we will have 10% error in steady state.

$$\left(\frac{21}{21+k}\right)=\frac{21}{22}\left(\frac{10}{100}\right)$$

$\Rightarrow 21+k=200 \Rightarrow k=189$

113. A unity feedback system has an open-loop transfer function $G(s)=\frac{K}{s(s+10)}$. If the damping ratio is 0.5, then what is the value of K?

(A) 150 (B) 100 (C) 50 (D) 10

Key: (B)

Exp: For a u.f.b system $G(s)=\frac{K}{s(s+10)}$

The characteristics equation of above $s^2+10s+k=0$.

$$\omega_n^2=k \Rightarrow \omega_n=\sqrt{k}$$

$$2\xi\omega_n=10 \Rightarrow \omega_n=\frac{10}{2\xi}=10$$

$\Rightarrow \quad \sqrt{k}=10 \quad \Rightarrow \quad k=100$

114. The loop transfer function of a system is $\frac{K}{s(s+1)(s+5)}$. The loop gain K is adjusted for inducing sustained oscillations. What is the value of K for this objective?

(A) 15 (B) 25 (C) 30 (D) 45

Key: (C)

Exp: Assuming the transfer function is unity feedback system, the characteristics equation is

$$s^3+6s^2+5s+k=0$$

For sustain oscillation, system should be in marginal stability.

So, k = 6 × 5 = 30

115. The phenomenon known as 'Early effect, in a bipolar transistor refers to a reduction of the effective base-width caused by

(A) Electron-hole recombination at the base

(B) The reverse-biasing of the base-collector junction

(C) The forward-biasing of the emitter-base junction

(D) The early removal of stored base charge during saturation to cut off switching

Key: (B)

Exp: The Early effect is the variation in the width of the base in a bipolar junction transistor (BJT) due to a variation in the applied base-to-collector voltage, a greater reverse bias across the collector-base junction, for example, increases the collector-base depletion width, decreasing the width of the charge neutral portion of the base.

116. The number of roots of the equation $2s^4+s^3+3s^2+5s+7=0$ which lie in the right half of s-plane is

(A) 0 (B) 1 (C) 2 (D) 3

Key: (C)

117. Thermal runaway in a transistor biased in the active region is due to

1. Heating of the transistor
2. Change in β due to increase in temperature
3. Change in reverse collector saturation current due to rise in temperature
4. Base emitter voltage V_{BE} which decreases with rise in temperature

Which of the above statements is/are correct?

(A) 1 and 2 (B) 2 and 3 (C) 3 only (D) 4 only

Key: (B)

Exp: When an input signal is applied, the output signal should not move the transistor either to saturation or to cut-off. However, this unwanted shift still might occur, due to the following reasons:

1. Parameters of transistors depend on junction temperature. As junction temperature increases, leakage current due to minority charge carriers (I_{CBO}) increases. As I_{CBO} increases, I_{CEO} also increases, causing an increase in collector current I_C. This produces heat the collector junction. This process repeats, and, finally, the Q-point may shift into the saturation region. Sometimes, the excess heat produced at the junction may even burn the transistor. This is known as thermal runaway.

2. When a transistor is replaced by another of the same type, the Q-point may shift, due to changes in parameters of the transistor, such as current gain (β) which varies slightly for each unique transistor and also temperature dependent

118. The majority carriers in an n-type semiconductor have an average drift velocity V_d in a direction perpendicular to a uniform magnetic field B . The electric field E induced due to Hall Effect acts in the direction

(A) $V_d \times B$ (B) $B \times V_d$ (C) Along V_d (D) Opposite to V_d

Key: (B)

119. When the number of poles is equal to the number of zeros, how many branches of root locus tend towards infinity?

(A) 1 (B) 2

(C) 0 (D) Equal to number of zeros

Key: (C)

Exp: No. of branches = No. of Poles – No. of Zero = 0

120. The open-loop transfer function of a unity feedback control system is $G(s)=\frac{1}{(s+2)^2}$.

The closed-loop transfer function will have poles at

(A) -2, -2 (B) -2, -1 (C) -2, $\pm j$ (D) -2, 2

Key: (C)

Exp: For a u.f.b system $G(s)=\frac{1}{(s+2)^2}$ the characteristics equation $(s+2)^2+1=s^2+2s+3=0$

the roots are $-2,\pm j$