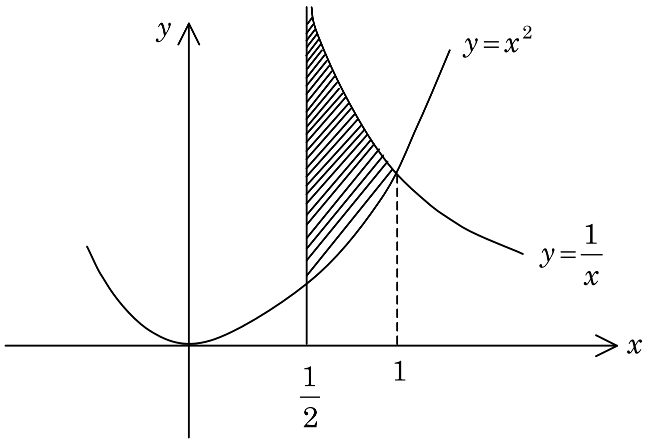
1. Find the area of the region bounded by the curves $y=x^2$, $y=1/x$ and $x=1/2$ (see in graphical representive figure)

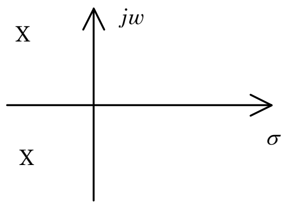


(a) $\ln 2-7/24$ (b) $\ln 2+7/24$ (c) $\ln 3-5/24$ (d) $\ln 3+5/24$

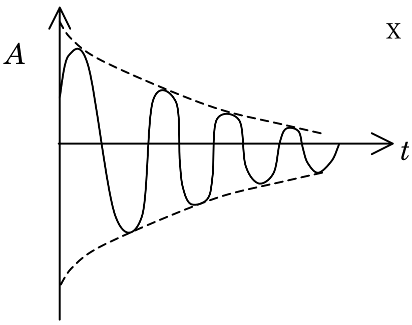
2. Find the Eigen values λ in the system $\begin{bmatrix}4 & 1\\ 3 & 2\end{bmatrix}\begin{bmatrix}x\\ y\end{bmatrix}=\lambda\begin{bmatrix}x\\ y\end{bmatrix}$

(a) 1 and 5 (b) 4 and 3 (c) 1 and 2 (d) 2 and 4

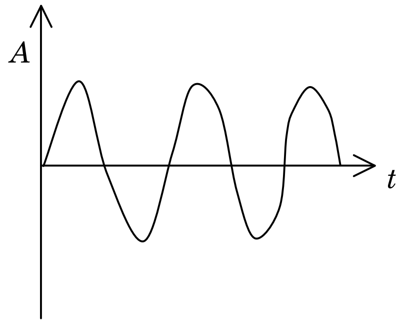
3. Find the transient response of a pair of complex poles as given below



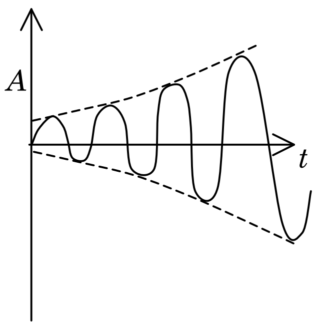
(a)



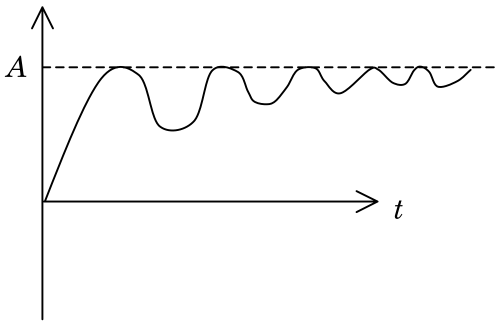
(b)



(c)



(d)



4. A random variable z, has a probability density function $f(z)$ where $f(z) = e^{-z}$ $0 \le z < \infty$, the probability of $0 \le z \le 2$ will be approximately

(a) 0.368 (b) 0.135

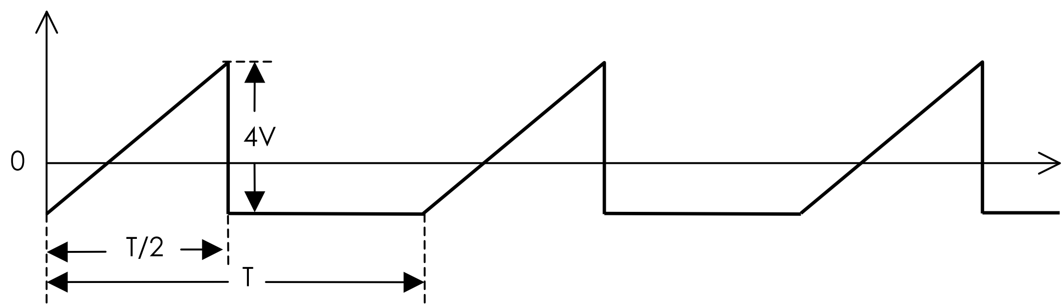
(c) 0.393 (d) 0.865

5. Evaluate $\lim_{x \to 2} \frac{\sqrt{x^2+5}-3}{x^2-2x}$

(a) 1/3 (b) ∞

(c) –3 (d) 0

6. What is the R.M.S of following waveform if the average value is zero?



(a) $\sqrt{17/3}\,V$ (b) $\sqrt{8/3}\,V$

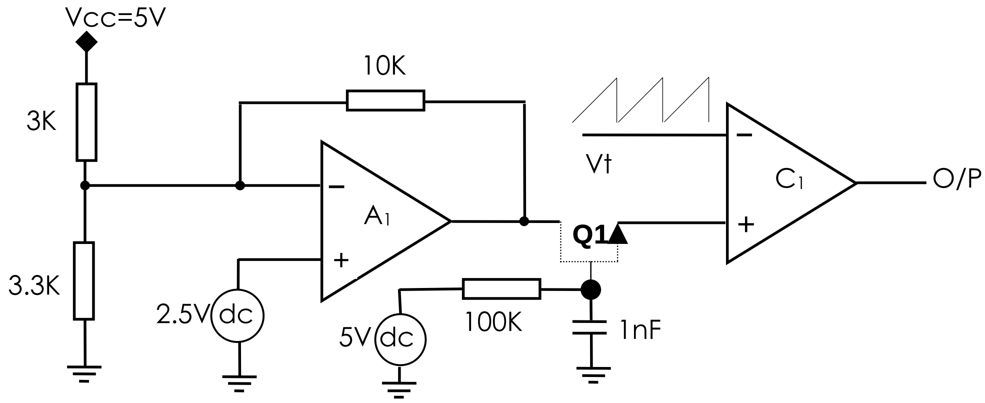
(c) $\sqrt{5/3}\,V$ (d) $\sqrt{1/3}\,V$

7. A radar system uses TWTA as high power RF source for transmitting 300W Peak Power. The efficiency of transmitter during pulse is 75% and the transmit duty is 25%. If the DC power required during pulse off period is 20W. The average power dissipation in TWTA is

(a) 81.25 W (b) 125 W

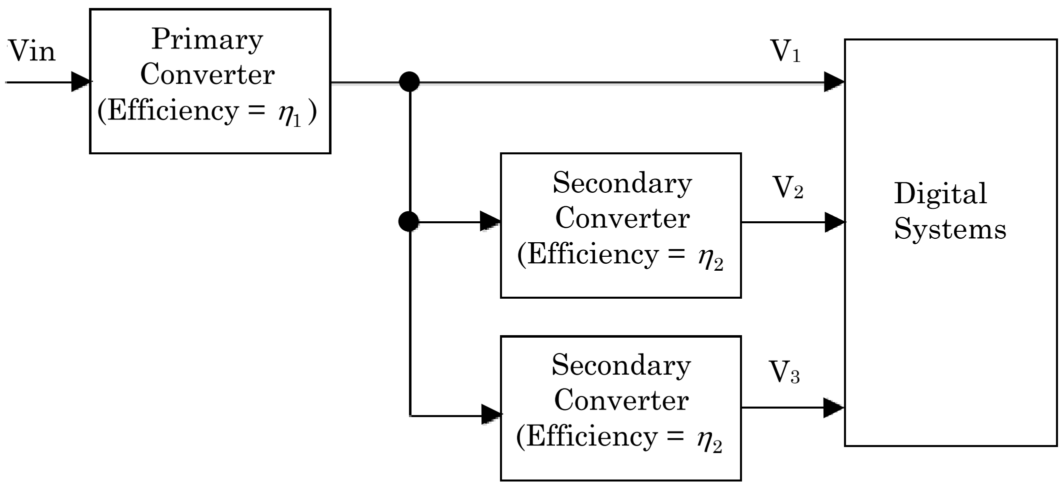
(c) 50 W (d) 40 W

8. The ramp signal (Vt : 0 to 5V) is compared with the Soft-Start Signal provided by N-channel MOSFET (Q_1) for Amplifier (A_1) output. If Q_1 having low threshold voltage of 0.7V and negligible ON resistance. What is the duty of output signal of comparator (C_1) after 100 μSec?



(a) 17.4 % (b) 34.8 % (c) 0 % (d) 50 %

9. A High speed digital Subsystem requires three voltages V_1, V_2 and V_3 with 1:2:1 power ratings respectively. The power supply is designed with the distribute power conversion scheme as shown in the following figure. What is the overall power conversion efficiency?

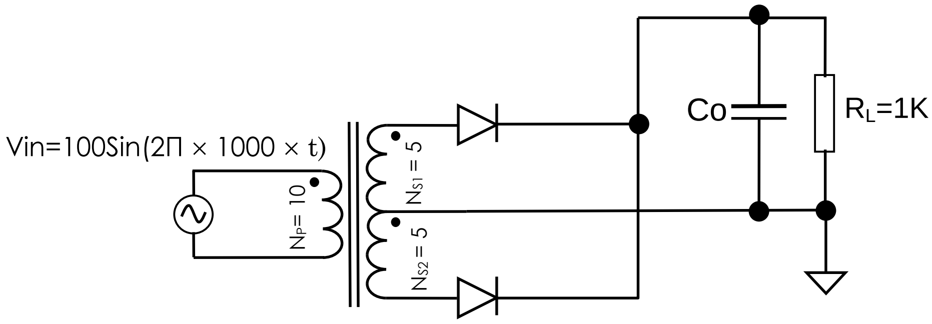


(a) $\dfrac{4\times\eta_1\times\eta_2\times\eta_3}{\eta_2\eta_3+2\times\eta_3+\eta_2}$ (b) $\dfrac{\eta_1\times\eta_2\times\eta_3}{\eta_2\eta_3+2\times\eta_3+\eta_2}$

(c) $\dfrac{4\times\eta_1\times\eta_2\times\eta_3}{\eta_2\eta_3+\eta_2+\eta_3}$ (d) $\dfrac{2\times\eta_1\times\eta_2\times\eta_3}{\eta_2\eta_3+\eta_2+\eta_3}$

10. If the transformer and diodes in the following circuit are ideal, Find out the value of Capacitor (Co) provides 5% ripple voltage across RL.

(Assume that $\text{Sin}^{-1}(0.95) \sim 2\pi/5$ in Radians $\ln(0.95) = -0.051$)



(a) 4.7 μF (b) 16.7 μF (c) 8.7 μF (d) 2.7 μF

11. Relationship between doppler frequency shifts of two radars A and B having 0.1 foot and 0.05 foot wavelengths, approaching the target at 1000 feet per second and 2000 feet per second rate respectively, will be

(a) Doppler frequency shift of radar A will be one-fourth of doppler frequency shift of radar B

(b) Doppler frequency shift of radar A will be one-half of doppler frequency shift of radar B

(c) Doppler frequency shift of radar A will be double of doppler frequency shift of radar B

(d) Doppler frequency shifts of radar A and radar B will be same

12. A sinusoidal input which can be reproduced in an OP-AMP without any distortion having slew rate of 10π V/μs and 5V peak output amplitude, has the maximum frequency of

(a) 1KHz. (b) 1MHz. (c) 31.42KHz. (d) 31.42MHz.

13. Which of the following is NOT a characteristic of Schottky Diode?

(a) Thermionic emission of carriers across Schottky barrier

(b) Current conduction in Schottky diodes is by majority carriers

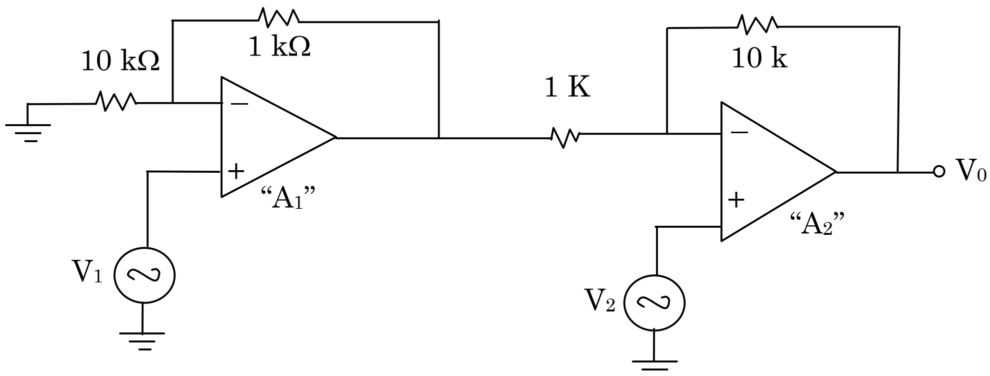
(c) Switching speed of Schottky diodes is less compared to p-n junction diodes

(d) Schottky diode comprises of Metal-Semiconductor junction

14. A Sensistor exhibits the following characteristics
    (a) Either increase or decrease in resistance value with increase in temperature based on the material type used in the thermistor
    (b) Always increase in resistance value with increase in temperature
    (c) Always decrease in resistance value with increase in temperature
    (d) No change in resistance value with temperature

15. When an electromagnetic wave is incident on an object having surface roughness comparable to the wavelength, then
    (a) Specular reflection occurs
    (b) Absorption occurs
    (c) Diffused scattering occurs
    (d) None of the above

16. For the following circuit, determine the output voltage 'V_0' in terms of input voltages V_1 and V_2, assuming A_1 and A_2 are ideal op-amps



    (a) $11\ V_2 - V_1$
    (b) $V_2 - 11V_1$
    (c) $11\ (V_2 - V_1)$
    (d) None of the above

17. Dominant mechanism for motion of charge carriers in forward and reverse biased silicon p-n junctions are
    (a) Drift in forward bias, diffusion in reverse bias
    (b) Diffusion in forward bias, drift in reverse bias
    (c) Diffusion in both forward and reverse bias
    (d) Drift in both forward and reverse bias

18. Which of the following is NOT true about opto-couplers?
   (a) It is a solid state device to isolate two parts of a circuit
   (b) It can act as an input device or output device but not both
   (c) Combines a Light Emitting Diode and a Photo Transistor in a single package
   (d) It prevents electrical noise or voltage transients of one circuit from integrating with other circuit

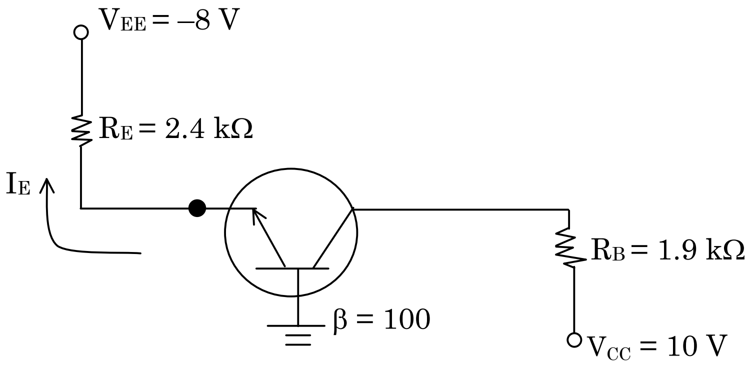
19. Which of the noise types is dominant in Metal Semiconductor Field Effect Transistor (MESFET) when compared to Bipolar Junction Transistor (BJT)?
   (a) Thermal Noise
   (b) Shot Noise
   (c) Flicker Noise
   (d) All of the above

20. Which factor determines the range resolution of a radar?
   (a) Size of the antenna
   (b) Bandwidth of the transmitted pulse
   (c) Power radiated form the antenna
   (d) Centre frequency of the radar

21. A signal having frequency component from DC-2KHz is to be Pulse code Modulated with a 6 bit Encoder. Minimum carrier bandwidth required is?
   (a) 4KHz.
   (b) 128KHz.
   (c) 16KHz.
   (d) 12KHz.

22. Which of the following is NOT true for Schmitt Trigger?
   (a) Schmitt trigger can be used as Sine-to-Square Wave Converter
   (b) Schmitt trigger uses OP-AMP in Open Loop Mode
   (c) Hysteresis exists in Schmitt Trigger
   (d) All of the above

23. For the silicon transistor shown in the figure below, the value of I_B is?



(a) 26.47 μA (b) 52.94 μA (c) 13.235 μA (d) 30.11 μA

24. Which one of the following statement is not true for static random access memory (SRAM)

(a) Static RAM stores data in the form of charge

(b) They have low capacity, but offer high speed

(c) It doesn't require periodic refreshing

(d) They are made up of six CMOS transistor

25. Which of the following statement is not true

(a) Autocorrelation function and energy spectral density forms a Fourier transform pair

(b) Autocorrelation function of a real valued energy signal is a real valued odd function

(c) The value of autocorrelation function of a power signal at the origin is equal to the average power of the signal

(d) Autocorrelation function is the inverse Fourier transform of power spectral density

26. The Eddy current loss is proportional to the

(a) Frequency

(b) Square of the frequency

(c) Cube of the frequency

(d) Square root of the frequency

27. The temperature below which certain materials are antiferromagnetic and above which they are paramagnetic is called
    - (a) Weiss temperature
    - (b) Curie temperature
    - (c) Neel temperature
    - (d) None of the above

28. In metals, the thermal conductivity K and electrical conductivity σ are related as $\frac{K}{\sigma T} = L$.

    L is known as
    - (a) Lattice constant
    - (b) Lorenz number
    - (c) Lanevin Function
    - (d) Larmor number

29. In a specimen of ferromagnetic material with saturation magnetization as 8000 Gauss, as the flux density is increased from 0 to 2.5 T, μ_r will
    - (a) Increase
    - (b) Decrease
    - (c) First decrease then increase
    - (d) First increase then decrease

30. The cavity magnetron uses strapping to
    - (a) Prevent mode jumping
    - (b) Prevent cathode back-heating
    - (c) Ensure bunching
    - (d) Improve the phase focussing effect

31. The TWT is sometimes preferred to the magnetron as a radar transmitter output tube because it is
    - (a) Capable of a larger duty cycle
    - (b) A more efficient amplifier
    - (c) More broadband
    - (d) Less noisy

32. One of the reason why conventional vacuum valve tubes not used at microwave frequencies is that their
    - (a) Noise increases
    - (b) It has less transit time
    - (c) Shunt capacitive reactance become too large
    - (d) Series induction reactance become too small

33. In a telecommunication trans-receive system, the transmitting antenna with antenna aperture of 1m is fed with 1W of power at 10GHz. The receive antenna with antenna aperture of 0.5m located at 1km away receives x mW of power. If the transmitting frequency changes to 20GHz, what will happen to receive power?

(a) Increase by 3dB (b) Increase by 6dB

(c) Decrease by 3dB (d) Decrease by 6dB

34. Find the maximum directivity of an antenna whose power density is given by $W_{rad} = \hat{a}_r \frac{A_0 \sin\theta}{r^2}$ W/m^2 where A_0 is peak value of power density. θ is the usual spherical coordinate and $\hat{ar}$ is the radial unit vector

(a) $4/\pi$ (b) $2/\pi$ (c) $3/\pi$ (d) $5/\pi$

35. A DC series motor is driven by a chopper circuit. The supply voltage is 220 V and the duty cycle is 25%. Determine the DC voltage applied to the motor

(a) 165 V (b) 55 V (c) 220 V (d) 110 V

36. A single-phase full-wave AC phase controller feeds power to a resistive load of 100 Ω from a 220 V, 50 Hz supply. What will be the R.M.S. output voltage at delay angles $\alpha_1 = \alpha_2 = \alpha = \pi/2$ of both transistors?

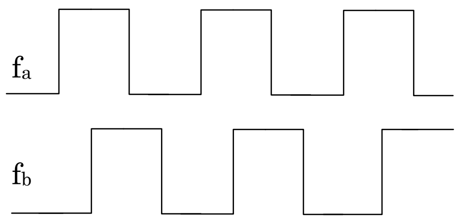
(a) $\frac{220}{\sqrt{2}}$ V (b) $\sqrt{2 \times 220}\,V$

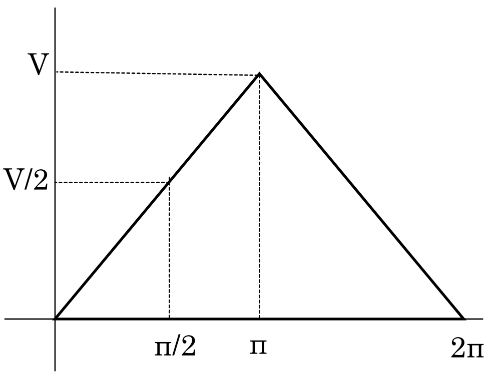
(c) $\sqrt{2} \times 110\,V$ (d) $\sqrt{2} \times 220\,V$

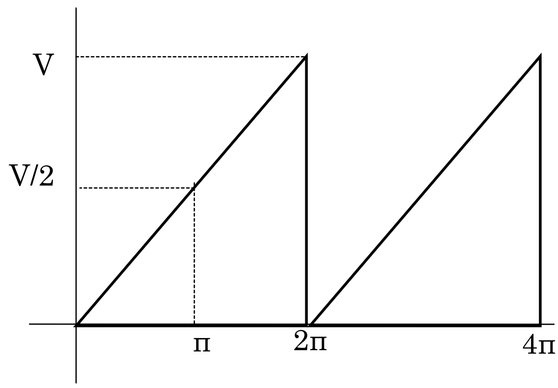
37. A half-wave rectifier is used to charge a 12 V battery through a resistance 'R'. The input transformer is fed by 34 V AC with turns ratio 2:1. Calculate the conduction period of the diode.

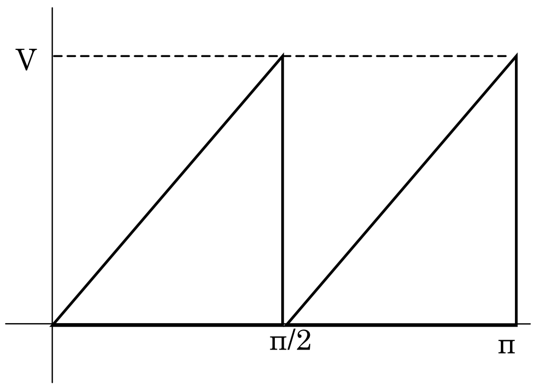
(a) 136° (b) 120° (c) 173° (d) 137°

38. Two signals f_a and f_b are given as input to EX-OR to measure phase difference. The average output voltage will be



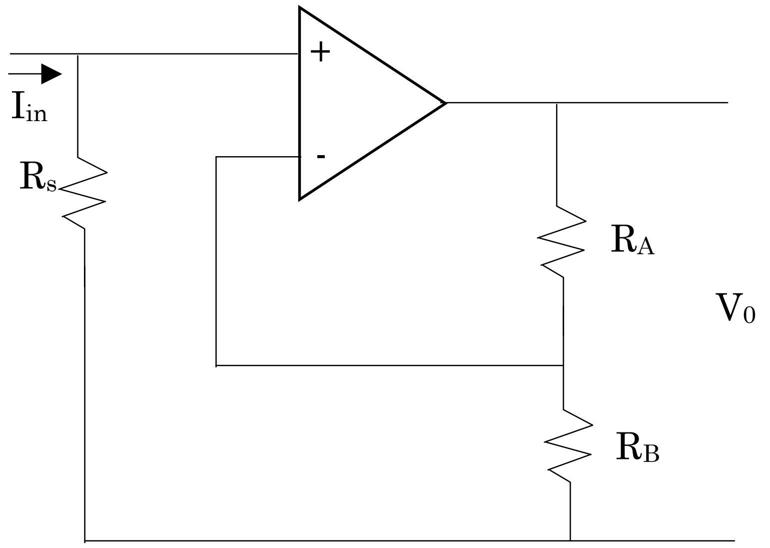
(a)


(b)


(c)


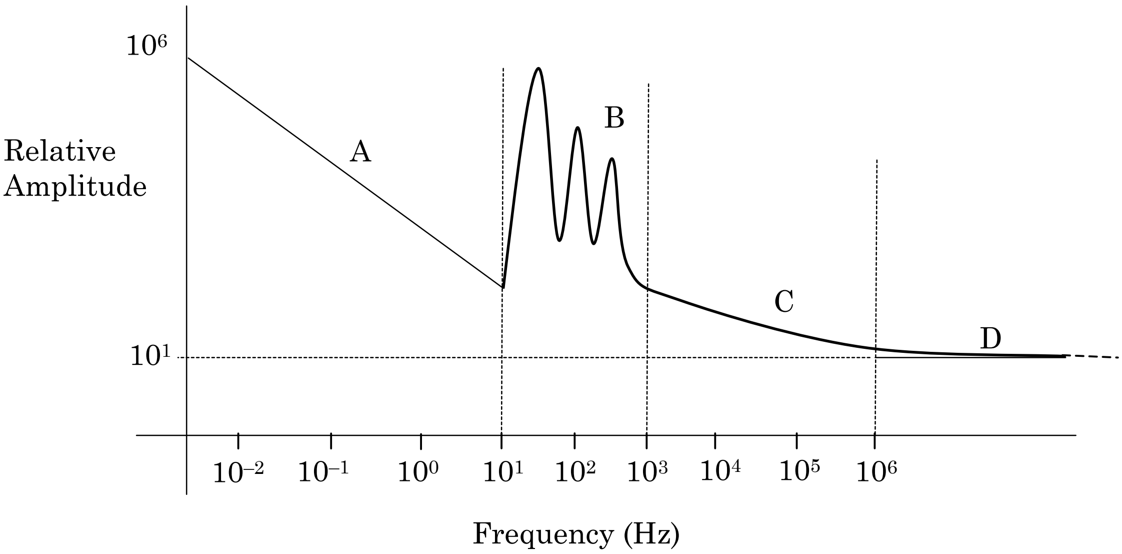
(d) None of the above

39. In the following circuit, find the output voltage V_0



(a) $(R_A/R_B) \times I_{in} \times R_s$
(b) $I_{in} \times R_s \times (1+R_A/R_B)$
(c) $(R_B/R_A) \times I_{in} \times R_s$
(d) $I_{in} \times R_s \times (1+R_B/R_A)$

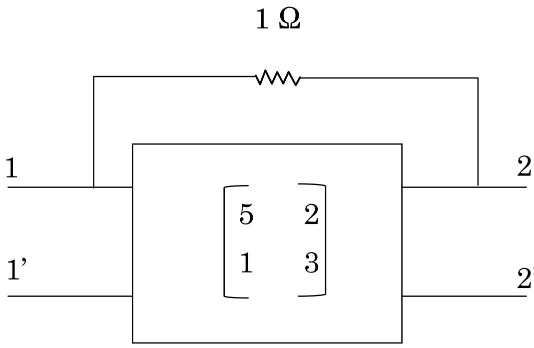
40. From the following Relative amplitude vs Frequency plot, identify the type of noise which the sections A, B, C & D depict.



(i) Thermal Noise
(ii) Power line pick up
(iii) Power supply (EPC) switching noise
(iv) 1/f noise

(a) A-i, B-ii, C-iii, D-iv
(b) A-ii, B-i, C-iv, D-iii
(c) A-iv, B-ii, C-iii, D-i
(d) A-iii, B-iv, C-ii, D-i

41. Y-parameter of a two port network is shown below. A 1 Ω resistor is connected to the network as shown. Find out the Y parameter of the whole network.



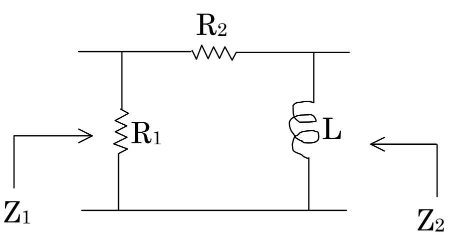
(a) $\begin{bmatrix} 6 & 1 \\ 0 & 4 \end{bmatrix}$

(b) $\begin{bmatrix} 6 & 3 \\ 2 & 4 \end{bmatrix}$

(c) $\begin{bmatrix} 4 & 1 \\ 0 & 2 \end{bmatrix}$

(d) $\begin{bmatrix} 3 & 1 \\ 1 & 2 \end{bmatrix}$

42. For the circuit shown below, $Z_1 = K_1 \times (s+2)/(s+5)$. Find Z_2, where K_1 and K_2 are constants containing circuit element values



(a) $K_2 \times s/(s+5)$

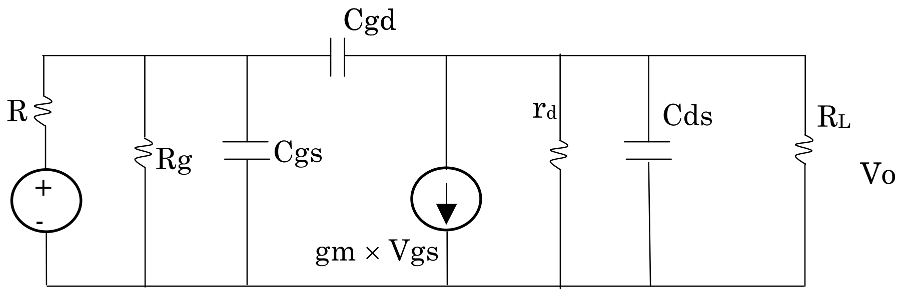
(b) $(s+5)/(s \times K_2)$

(c) $K_2 \times s/(s+6)$

(d) $(s+6)/(s \times K_2)$

43. Following is the small signal high frequency equivalent circuit of a common source amplifier. V_0/V_i will be of the form

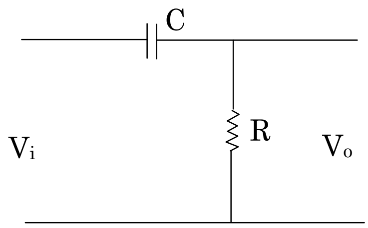
(K, z_1, a_0, a_1, a_2, a_3 are constants containing circuit elements)



(a) $K(s - z_1)/(a_0 + a_1 s + a_2 s^2)$ (b) $K.s/(a_0 + a_1 s + a_2 s^2 + a_3 s^3)$

(c) $K(s - z_1)/(a_0 + a_1 s)$ (d) $K/(a_0 + a_1 s)$

44. Phase of the transfer function of the following circuit is



(a) $\tan^{-1}(1/\omega RC)$ (b) $\tan^{-1}(\omega RC)$

(c) $\tan^{-1}(RC/\omega)$ (d) $\tan^{-1}(\omega/RC)$

45. The error in measurement of a dc voltmeter with input signal: 1.5 V, voltage range: 2 V, accuracy : ± (25 ppm of reading + 5 ppm of range) is

(a) $\pm 50\,\mu V$ (b) $\pm 30\,\mu V$

(c) $\pm 47.5\,\mu V$ (d) $\pm 10\,\mu V$

46. Consider the signal $X(t) = \begin{cases} 2\cos(t) + \cos(2t) & t < 0 \\ 2\sin(t) + \sin(2t) & t \geq 0 \end{cases}$

The signal $X(t)$ is:

(a) periodic with period = 2π (b) periodic with period = π

(c) non-periodic (d) periodic with period = $\pi/2$

47. The system $y(t) = x(2t) + 3$ is

(a) Linear and Time Invariant (b) Causal and Linear

(c) Non-Linear and Time Variant (d) Linear and memoryless

48. Consider the system $R[m] = \sum_{n=0}^{N-1} y[n]x[n-m]$ where $y[n]$ and $x[n]$ are real periodic signals with period *N*. The above output can be obtained using

(a) IFFT{FFT[Y] × conj(FFT[X])}

(b) IFFT{FFT[Y] × FFT[X]}

(c) IFFT{FFT[Y] × (FFT[–X])}

(d) IFFT{FFT[–Y] × (FFT[X])}

49. Consider the system defined by

$$\frac{d^2y}{dt^2} + (a+b)\frac{dy}{dt} + ab = x(t);\ a > 0,\ b > 0$$

can be realized using which impulse response function

(a) $h(t) = (e^{-at} + e^{-bt})u(t)$

(b) $h(t) = (e^{-at} \times e^{-bt})u(t)$

(c) $h(t) = (e^{at} + e^{-bt})u(t)$

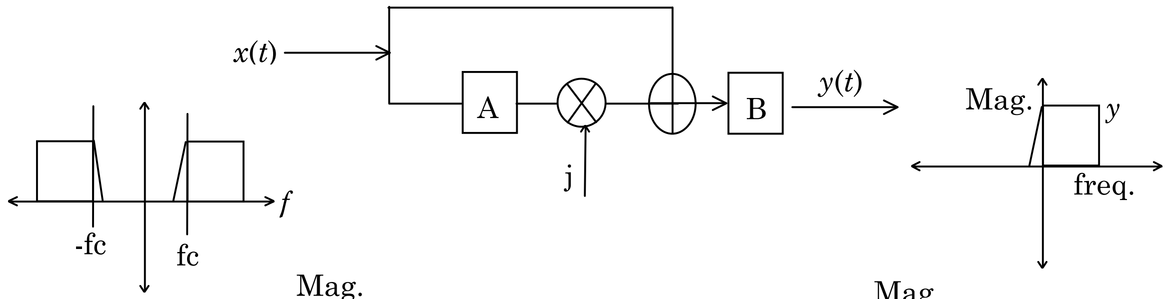
(d) $h(t) = e^{-(a+b)t}\,u(t)$

50. A continuous time signal has frequency content at f = 10MHz, 50MHz and 70MHz. The signal is sampled at sampling frequency of 56MHz. The frequency content of output will be

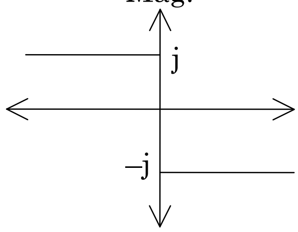
(a) 10MHz (b) 10MHz and 6MHz

(c) 10MHz, 6MHz and 14MHz (d) 46MHz

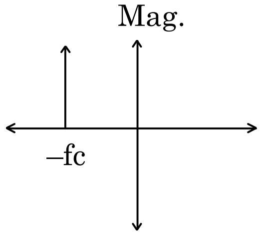
51. Consider the system with $x(t)$ as input and $y(t)$ as output. The frequency domain characteristics are shown in the figure. Which combination of A and B will give y as result?



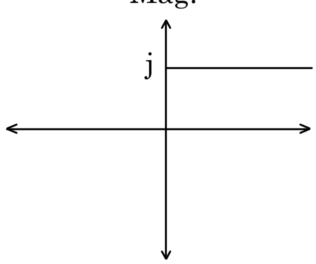
(a) A =



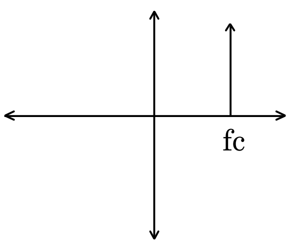
B =



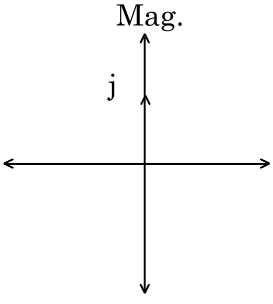
(b) A =



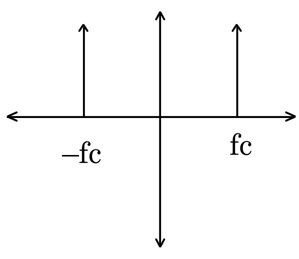
B =



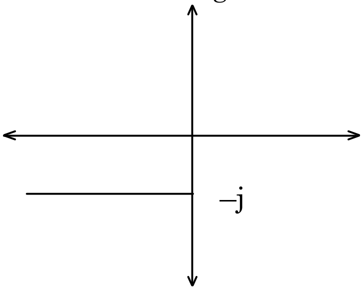
(c) A =



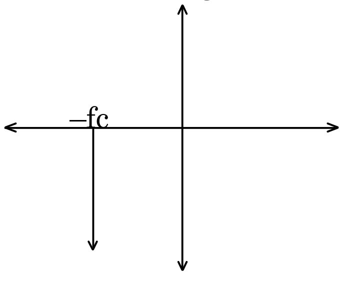
B =



(d) A =



B =



52. The R = 1/3 convolution encoder defined by transfer functions

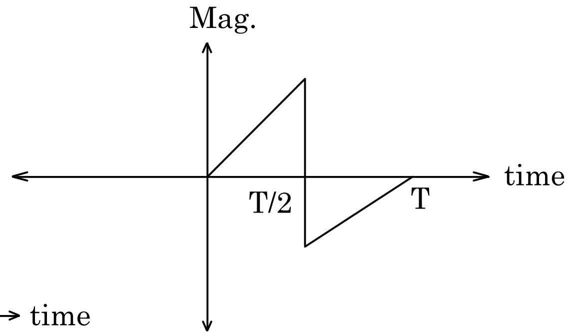
$H1(z) = 1 + z^{-1}$

$H2(z) = 1 + z^{-2}$

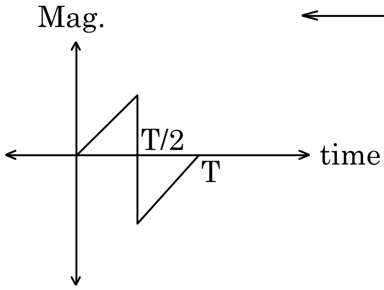
$H3(z) = 1 + z^{-1} + z^{-2}$ is

(a) recursive and K = 3
(b) systematic and K = 2
(c) non-recursive and K = 3
(d) non-recursive and K = 2

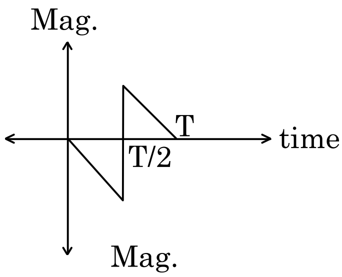
53. The match filter response for given signal sampled at t = T is



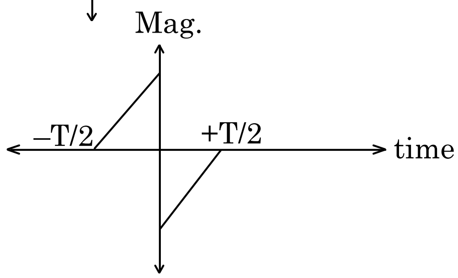
(a)



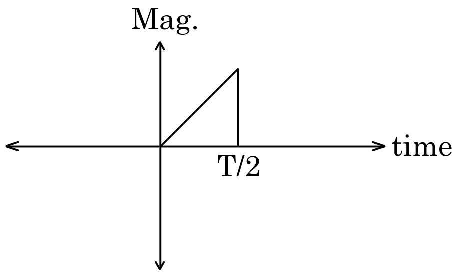
(b)



(c)

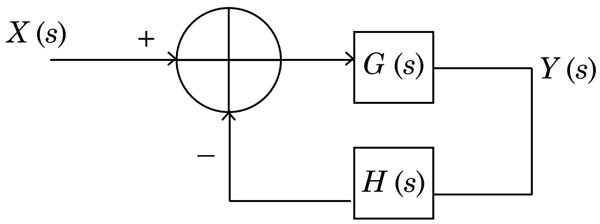


(d)



54. Characteristic equation of H(s) is given as
$3s^4 + 2s^3 + 5s^2 + s + 2 = 0$ is
(a) unstable
(b) stable
(c) all poles in right half plane
(d) unstable with only one pole in right half plane

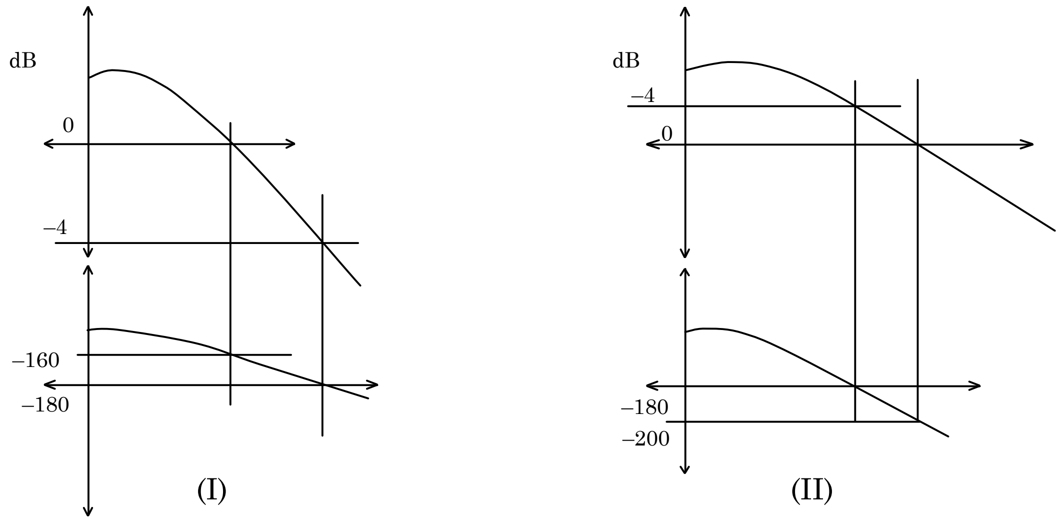
55. Consider the feedback system



$$G(S) = \frac{K(s+4)}{s(s+1)} \qquad H(s) = \frac{1}{s+2}$$

The value of gain for which system is marginally stable is
(a) K = 4 (b) K = 6 (c) K = 10 (d) K = 2

56. Consider the Bode plots (magnitude and phase) of two different open loop transfer functions of two unity feedback systems. The open loop transfer functions have poles in right half plane. The closed loop system formed from these open loop systems. Which of the following holds true?



(a) Closed loop system with I is stable and with II is unstable
(b) Closed loop systems using I and II both are unstable
(c) Closed loop system with I is unstable and II is stable
(d) Closed loop system with I and II are stable

57. The steady state response for an input X(s) = K/s to a system whose transfer function is H(s) in time domain is

H(s) = 1/((s+5)(s+2))

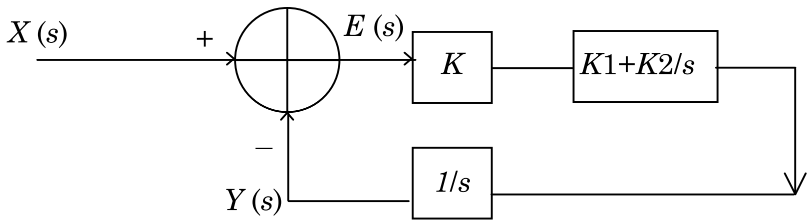
(a) K/10

(b) $e^{-5t}u(t)$

(c) $e^{-2t}u(t)$

(d) $(e^{-5t}+e^{-2t})u(t)$

58. Consider a closed loop stable phase locked loop system as shown in the diagram below



The system is capable of producing zero steady state error E(t) for

(a) Phase step only

(b) Constant velocity and phase step

(c) Acceleration

(d) Jerk

59. The modes in a reflex klystron

(a) Result from excessive oscillating frequencies of the cavity

(b) Correspond to different oscillating frequencies of the cavity

(c) Are caused by spurious frequency modulation

(d) All give much the same frequency but different transit times

60. A dielectric is subjected to alternating electric field. The dielectric losses are proportional to

(a) Real part of the dielectric constant

(b) Imaginary part of the dielectric constant

(c) Both Real and Imaginary part of the dielectric constant

(d) None of the above

61. The electric field of a linearly polarized electromagnetic wave is given by $E_i = \hat{a}_x E_0(x,y)e^{-jkz}$ is incident upon a linearly polarized antenna whose electric field polarization is expressed as $E_a = (\hat{a}_x + \hat{a}_y)\ E(r,\theta,\phi)$. Find the polarization loss factor.

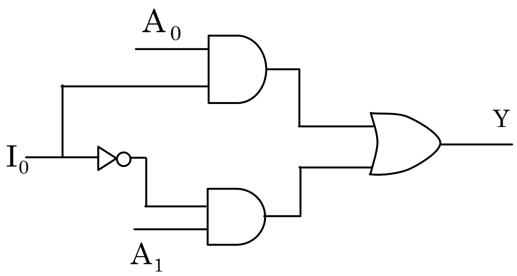
(a) 1/2 (b) 3/2 (c) 2/3 (d) 1/4

62. A lossless T-junction two way power divider has a source impedance, input transmission line impendence and o/p port load impendence of 50 Ω. Find the output characterization impedances so that the input power is divided in a 2:1 ratio.

(a) z_1 = 150 Ω, z_2 = 75 Ω (b) z_1 = 50Ω, z_2 = 100 Ω

(c) z_1 = 60Ω, z_2 = 120 Ω (d) z_1 = 30Ω, z_2 = 60 Ω

63. Following circuit implements a

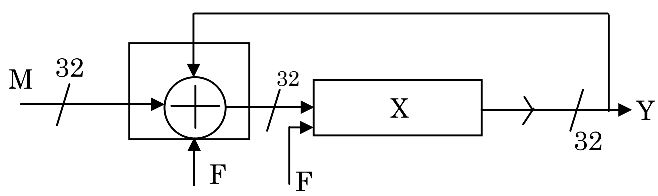


(a) De-Multiplexer (b) Multiplexer

(c) $Y = I_0\ (A_0 + A_1)$ (d) $Y = I_0\ (\overline{A_1} + A_0)$

64. The frequency of the output Y is

F : clock freq.
M : input
X : 32 bit register



(a) $\dfrac{MF}{2^{32}}$ (b) $\dfrac{2MF}{2^{32}}$

(c) $\dfrac{F}{2^{32}}$ (d) $\dfrac{2^{32}F}{M}$

65. Consider the output A and B with I_0, I_2, I_2 and I_3 as input

A = $\overline{I_3}\,\overline{I_2}\,I_1 + I_3$

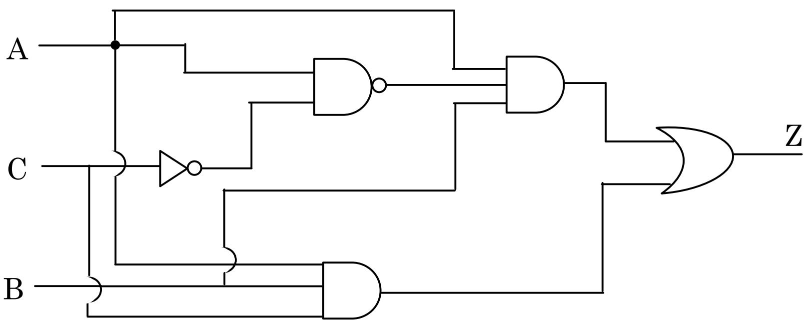
B = $\overline{I_3}\,I_1 + I_3$

The above circuit is

(a) 4:1 Multiplexer (b) De-Multiplexer

(c) BCD circuit (d) Priority Encoder

66.

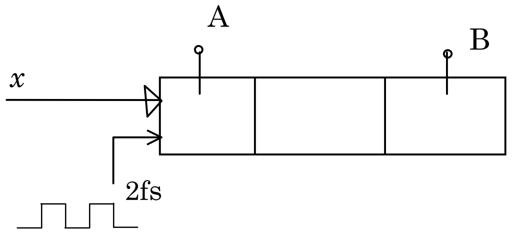


The output Z =

(a) $\overline{A\overline{C}}\ AB$ (b) ABC

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

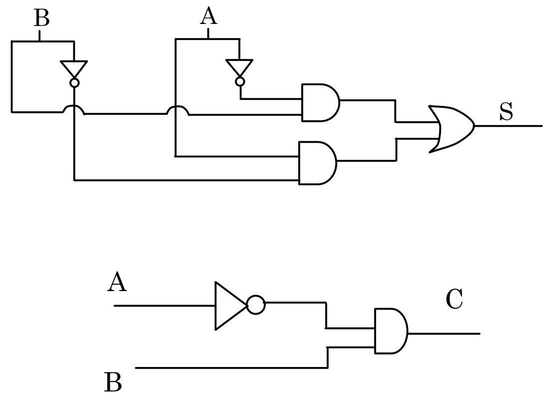
67. Consider the shift register



The frequency of signal x is fs and the shift register is clocked at the positive edge of 2fs. The time offset between A and B is

(a) 1/(2fs) (b) 1/fs (c) 3/(2fs) (d) 1/(4fs)

68. The circuit is formed as shown below. The output S and C implement



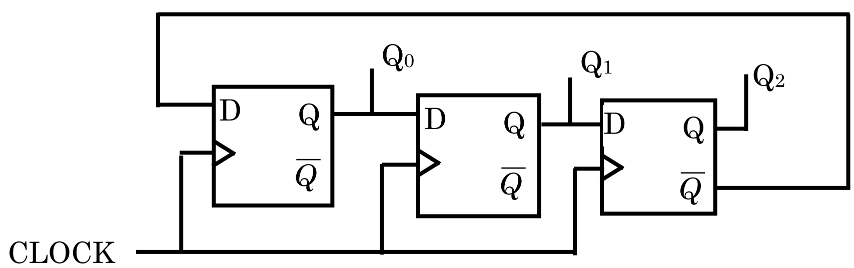
(a) Two bit adder with sum and carry respectively

(b) Two bit subtractor with sum and borrow respectively

(c) $S = AB + \overline{A}\,\overline{B}$; $C = \overline{A}\,B$

(d) None of the above

69. What is the value of the register formed from D flip-flops using Q_0, Q_1 and Q_2 as output $(Q_0\ Q_1\ Q_2)$ after 14 cycles



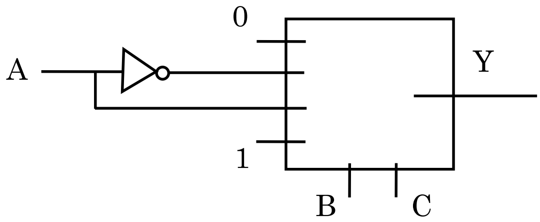
(a) 110

(b) 000

(c) 001

(d) 011

70. The 4:1 Multiplexer implemented as



Then Y =

(a) $\Sigma(1, 6, 3, 7)$ (b) $\Sigma(1, 2, 5, 7)$

(c) $\Sigma(2, 3, 4, 5)$ (d) $\Sigma(1, 3, 4, 7)$

71. In a digital circuit the set-up time violation can be fixed by

(a) Increasing the clock frequency

(b) Increasing the delay of data path logic

(c) Slowing the clock frequency

(d) None of the above

72. Number of J-K flip flops in modulo 16 binary up-counter are

(a) 16 (b) 4

(c) 8 (d) 2

73. The solid angle subtended by the sun as viewed from the earth is $\Omega = 4 \times 10^{-5}$ steradian. A microwave antenna designed to be used for studying the microwave radiation from the sun has a very narrow beam whose equivalent solid angle is approximately equal to that subtended by the sun. What is the approximate directivity, *D*?

(a) 10^5 (b) $\pi \times 10^5$

(c) $\pi \times 10^6$ (d) 10^6

74. A gain-standard horn is known to have a gain $G = 10$. It is being used to measure the gain of a large directional antenna by the comparison method. When the antenna being measured is connected to the receiver it is found to be necessary to insert an attenuator adjusted to attenuate by 23 dB in order to have the same receiver output that was observed with the horn connected. What is the gain of the large antenna?

(a) 13 dB
(b) 23 dB
(c) 33 dB
(d) 230 dB

75. A paraboloidal-reflector antenna is designed for operation at 3 GHz. Its largest aperture dimension is 20 feet. It is desired to build a scale model of this antenna with the largest aperture dimension scaled to 18 inches. At what frequency must this model be operated in order to have the same pattern as the full-size antenna?

(a) 10 GHz
(b) 20 GHz
(c) 40 GHz
(d) 4 GHz

76. An antenna has a radiation resistance of 72 Ω, a loss resistance of 8 Ω and power gain of 16. Calculate its directivity.

(a) 15.8
(b) 16.8
(c) 17.8
(d) 18.7

77. The current density at the surface of a thick metal plate is 100 A/m^2. What is the skin depth if the current density at a depth of 0.0059 cm is 0.272 A/m^2?

$$\begin{bmatrix} \ln(10) \approx 2.3 \\ \ln(2.72) \approx 1 \end{bmatrix}$$

(a) $5\,\mu$m
(b) $10\,\mu$m
(c) $15\,\mu$m
(d) $20\,\mu$m

78. An air filled rectangular waveguide R_1 is operating at the frequency 2 GHz and another air filled rectangular waveguide R_2 is operating at 4 GHz. The guide wavelengths of these waveguides at their respective frequencies are equal. If the cut-off frequency of waveguide R_1 is 1 GHz, what is the cut-off frequency of the waveguide R_2 in GHz?

(a) $\sqrt{10}$ (b) $\sqrt{11}$

(c) $\sqrt{12}$ (d) $\sqrt{13}$

79. An electromagnetic wave propagates through a lossless insulator with a velocity 1.5×10^{10} cm/s. Calculate the electric and magnetic properties of the insulator if its intrinsic impedance is 90π ohms.

(a) $\varepsilon_r = 2.66\, \mu_r = 1.5$

(b) $\varepsilon_r = 1.5\, \mu_r = 2.66$

(c) $\varepsilon_r = 1.2\, \mu_r = 2.0$

(d) $\varepsilon_r = 2.0\, \mu_r = 1.2$

80. A square waveguide carries TE_{11} mode whose axial magnetic field is given by $H_z = H_0 \times \cos\left(\pi x / \sqrt{8}\right) \times \cos\left(\pi y / \sqrt{8}\right)$ A/m, where waveguide dimensions are in cm. What is the cut-off frequency of the mode?

(a) 5.5 GHz

(b) 6.5 GHz

(c) 7.5 GHz

(d) 8.5 GHz
