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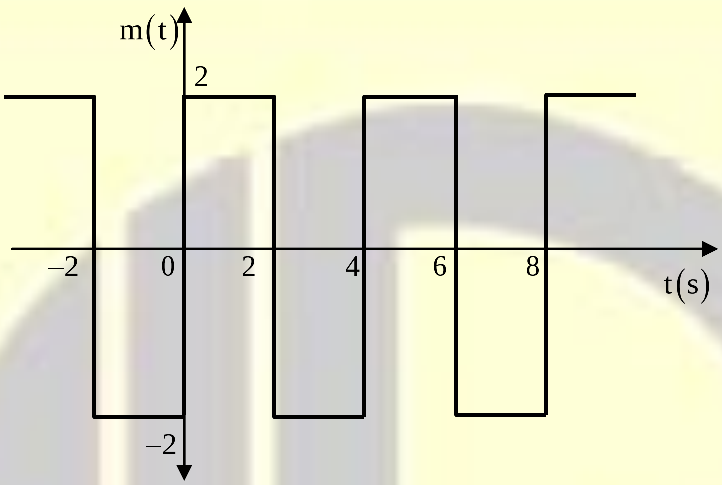
1. The signal m(t) as shown is applied both to a phase modulator (with K_p as the constant) and a frequency modulator with (K_f as the frequency constant) having the same carrier frequency. The ratio $\frac{K_p}{K_f}$ (in rad Hz^{-1}) for the same maximum phase deviation is



(A) 8π (B) 4π (C) 2π (D) π

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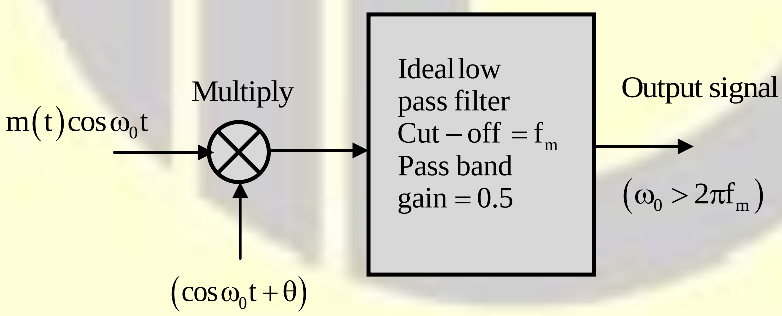
2. A message m(t) band limited to the frequency f_m has a power of P_m. The power of the output signal in the figure is



(A) $\frac{(P_m \cos\theta)}{2}$ (B) $\frac{(P_m \sin^2\theta)}{2}$ (C) $\frac{P_m}{4}$ (D) $\frac{(P_m \cos^2\theta)}{4}$

---

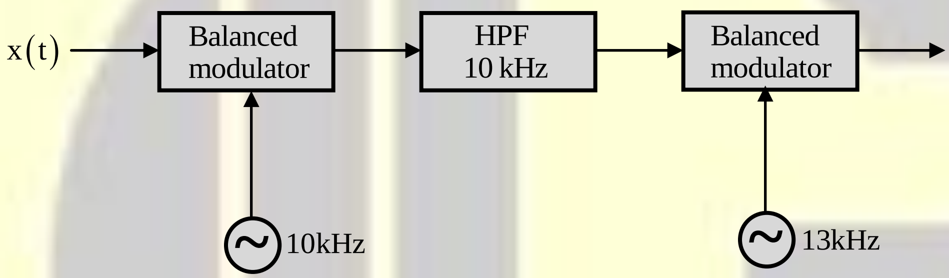
3. The input x(t) and output y(t) of a system are related as

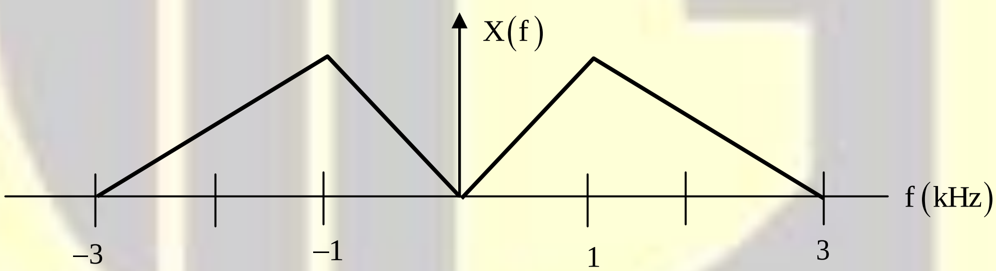
$$y(t)=\int_{-\infty}^{t} x(t)\cos(4t)dt$$

The system is

(A) time-invariant and stable
(B) stable and not time-invariant
(C) time-invariant and not stable
(D) not time-invariant and not stable

4. Consider a system shown in the figure. Let X(f) and Y(f) denote the Fourier transforms of x(t) and y(t), respectively. The ideal HPF has the cut-off frequency 10 kHz.





The positive frequencies where Y(f) has spectral peaks are

(A) 1 kHz and 24 kHz
(B) 2 kHz and 24 kHz
(C) 1 kHz and 14 kHz
(D) 2 kHz and 14 kHz

5. Let $x(t) = \text{rect}\left(t - \frac{1}{2}\right)$ where $\text{rect}(t) = 1 \text{ for } -\frac{1}{2} \le t \le \frac{1}{2}$ and zero otherwise, then Fourier transform of $x(t) + x(-t)$ will be given by

(A) $\text{sinc}\left(\frac{\omega}{2}\right)$

(B) $2\,\text{sinc}\left(\frac{\omega}{2}\right)$

(C) $2\,\text{sinc}\left(\frac{\omega}{2}\right)\cos\left(\frac{\omega}{2}\right)$

(D) $2\,\text{sinc}\left(\frac{\omega}{2}\right)\sin\left(\frac{\omega}{2}\right)$

---

6. A signal $x(t) = \text{sinc}(\alpha t)$, where α is a real constant, is the input to a linear time invariant system whose impulse response is $h(t) = \text{sinc}(\beta t)$, where β is a real constant. If $\min(\alpha, \beta)$ denote the minimum of α and β and similarly, $\max(\alpha, \beta)$ denotes the maximum of α and β, and K is a constant, which one of the following statements is true about the $\left(\text{here}, \text{sinc}(x) = \frac{\sin(\pi x)}{\pi x}\right)$ output of the system?

(A) It will be of the form $K\ \text{sinc}(\gamma t)$ where $\gamma = \min(\alpha, \beta)$

(B) It will be of the form $K\ \text{sinc}(\gamma t)$ where $\gamma = \max(\alpha, \beta)$

(C) It will be of the form $K\ \text{sinc}(\alpha t)$

(D) It cannot be a sinc type of signal

---

7. A message signal given by $m(t) = \left(\frac{1}{2}\right)\cos(\omega_1 t) - \left(\frac{1}{2}\right)\sin(\omega_2 t)$ is amplitude modulated with a carrier of frequency ω_c to generate $s(t) = [1 + m(t)]\cos(\omega_c t)$. What is the power efficiency achieved by the modulation scheme?

(A) 8.33% (B) 11.11% (C) 20% (D) 25%

---

8. If E_b, the energy per bit of a binary digital signal, is 10^{-5} Ws (watt second) and the one-sided power spectral density of the white noise, $N_o = 10^{-6}\ \text{W Hz}^{-1}$, then the output SNR of the matched filter is

(A) 26 dB (B) 10 dB (C) 20 dB (D) 13 dB

---

9. At a given probability of error, binary coherent FSK is inferior to binary coherent PSK by

(A) 6 dB (B) 3 dB (C) 2 dB (D) 0 dB

---

10. If z_0 is a zero of a (real-valued) linear-phase FIR filter then following is/are also zero/zeros of a (real-valued) linear-phase FIR filter,

(A) z_0^* (B) $\frac{1}{z_0}$ (C) $\frac{1}{z_0}, z_0^*$ and $\frac{1}{z_0^*}$ (D) $\frac{1}{z_0}$ and $\frac{1}{z_0^*}$

---

11. What will be the minimum numbers of tap require to realize a FIR filter having $f_{pass} = 10\,\text{kHz}$ and $f_{stop} = 15\,\text{kHz}$, 0.1 dB pass band ripple and 60 dB attenuation in stop band. Sampling frequency is 200kHz.

(A) 110 (B) 100 (C) 90 (D) 120

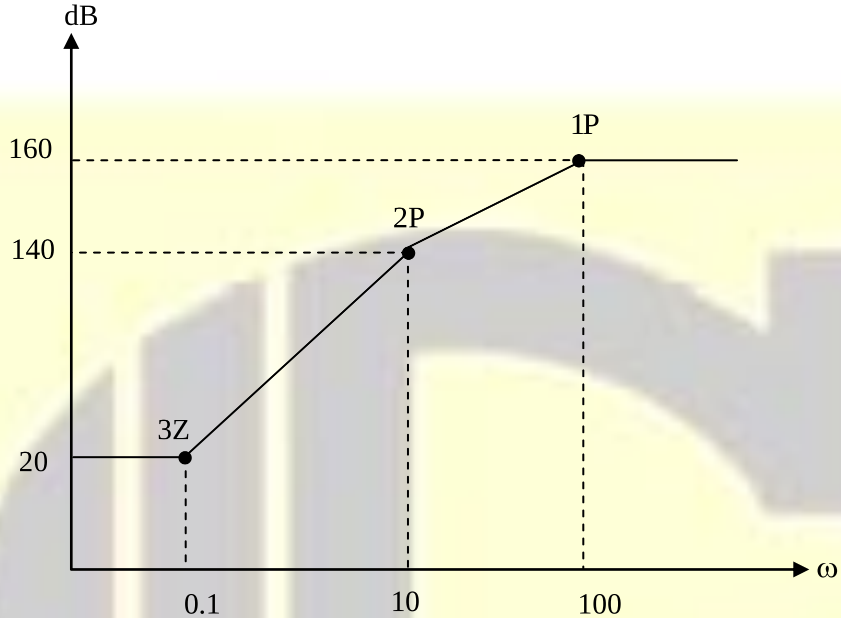
---

12. The system with the transfer function $\frac{Y(s)}{X(s)} = \frac{s}{s+p}$ has an output $y(t) = \cos\left(2t - \frac{\pi}{3}\right)$ for the input signal $x(t) = p\cos\left(2t - \frac{\pi}{2}\right)$. Then, the system parameter p is

(A) $\sqrt{3}$ (B) 1 (C) $\frac{2}{\sqrt{3}}$ (D) $\frac{\sqrt{3}}{2}$

---

13. The approximate Bode magnitude plot of a minimum-phase system is shown in the figure. The transfer function of the system is

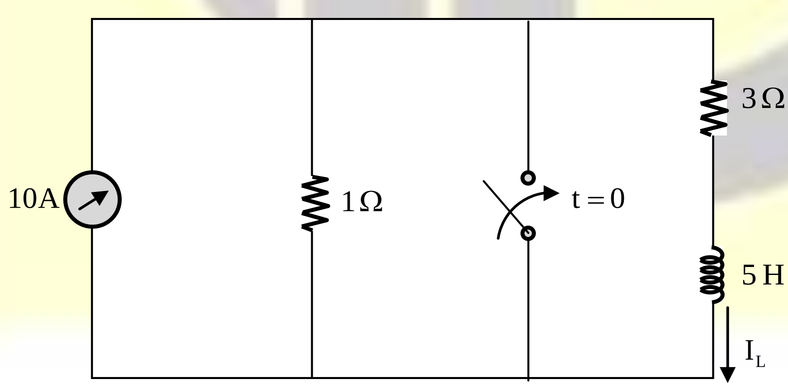


(A) $10^8 \frac{(s+0.1)^2}{(s+10)^2(s+100)}$ (B) $10^7 \frac{(s+0.1)^3}{(s+10)^2(s+100)}$

(C) $10^8 \frac{(s+0.1)^3}{(s+10)^2(s+100)}$ (D) $10^7 \frac{(s+0.1)^2}{(s+10)^2(s+100)}$

---

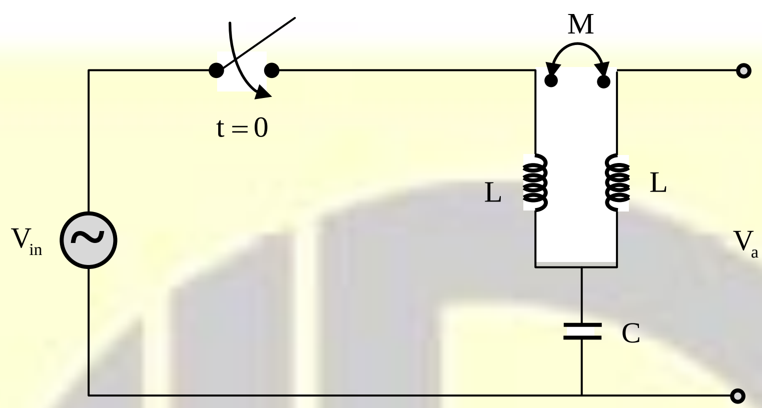
14. For the circuit of the figure the inductor current I_L just before t = 0 is



(A) 10 A (B) 6 A (C) 4 A (D) 2 A

---

15. The network shown in below figure consists of two coupled coils and a capacitor. At t = 0, the switch is closed connecting a voltage generator, $V_{in} = V\sin\left(\frac{t}{\sqrt{MC}}\right)$. What will be the value of $\frac{dV_a}{dt}(0+)$?



(A) $\left(\frac{V}{L}\right)\sqrt{\frac{M}{C}}$ (B) $\left(\frac{V}{L}\right)$ (C) 0 (D) $\left(\frac{V}{L}\right)\left(\frac{M}{C}\right)$

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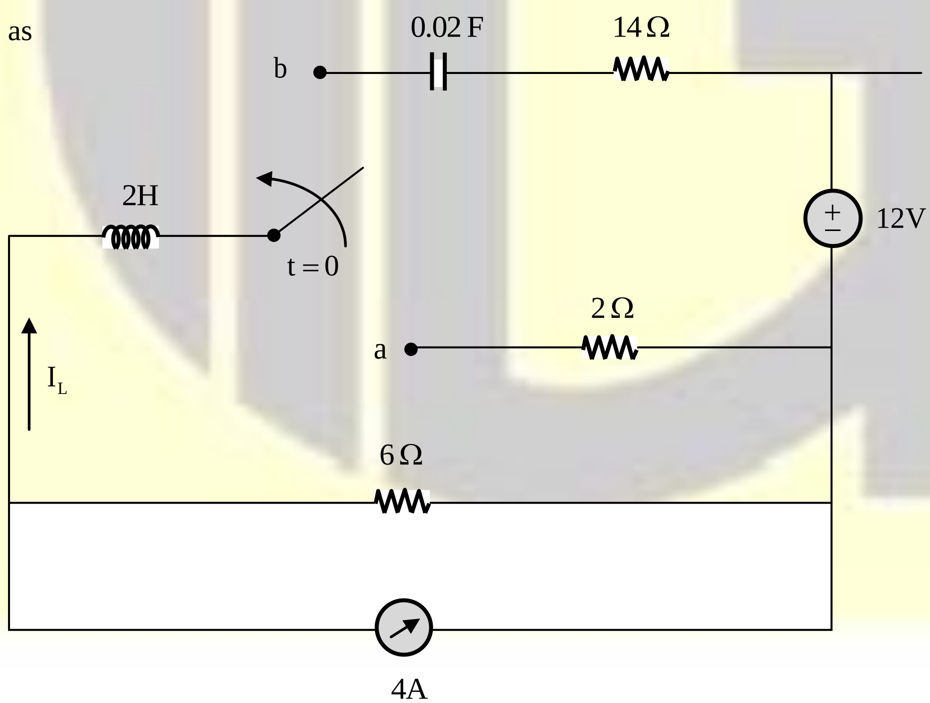
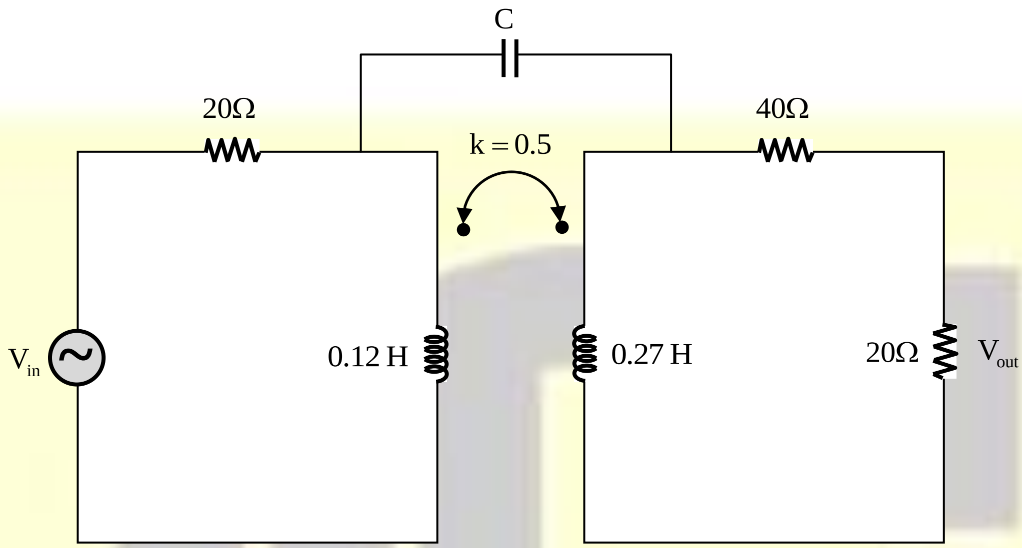
16. In the network shown below, switch is moved from position a to b at t = 0. The current $I_L(t)$ for $t > 0$ is given as



(A) $(4-6t)e^{4t}A$ (B) $(3-6t)e^{-4t}A$

(C) $(3-9t)e^{-5t}A$ (D) $(3-8t)e^{-5t}A$

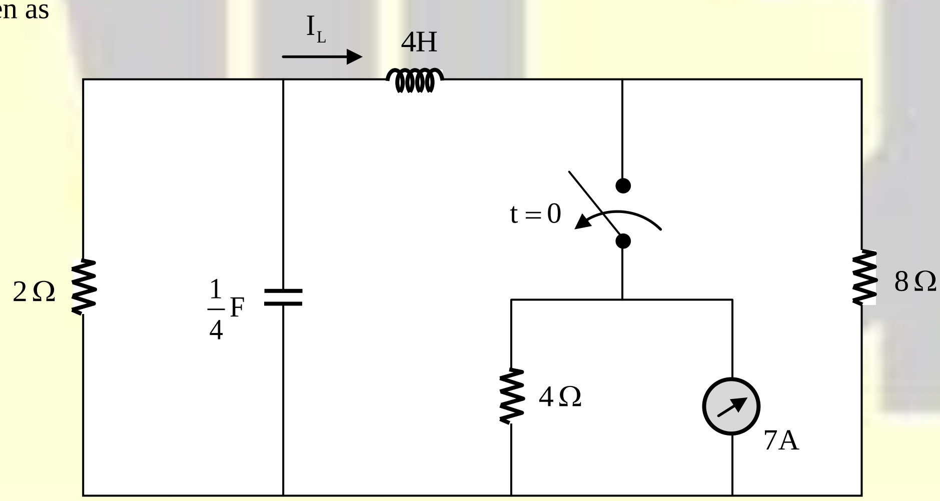
17. The voltage gain $\frac{V_{out}}{V_{in}}$ of a circuit shown below is zero. If $\omega = 333.33 \text{ rad s}^{-1}$, the value of C is



(A) 3.33 mF (B) 33.33 mF (C) 3.33 μF (D) 33.33 μF

---

18. In the network shown below, switch is opened at t = 0 after long time. The current $I_L(t)$ for t > 0 is given as



(A) $e^{-2t}(2\cos t + 4\sin t)A$ (B) $e^{-2t}(3\sin t - 4\cos t)A$

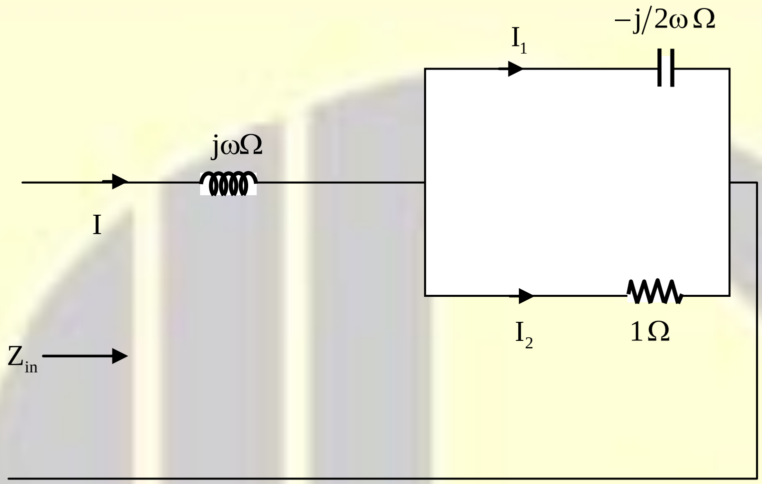
(C) $e^{-2t}(-4\sin t + 2\cos t)A$ (D) $e^{-2t}(2\sin t - 4\cos t)A$

---

19. The Q-factor of a RLC circuit is 5 at its resonance frequency of 1 kHz. Find the bandwidth of the circuit.

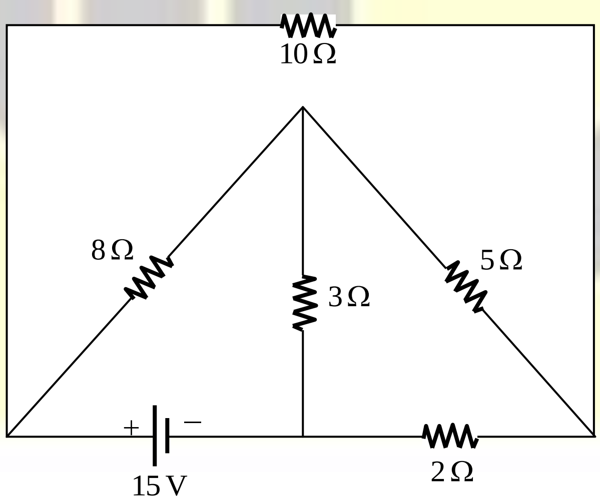
(A) 100 Hz (B) 200 Hz (C) 400 Hz (D) 50 Hz

20. For the circuit shown in the figure, find the frequency at which this circuit will be at resonance.



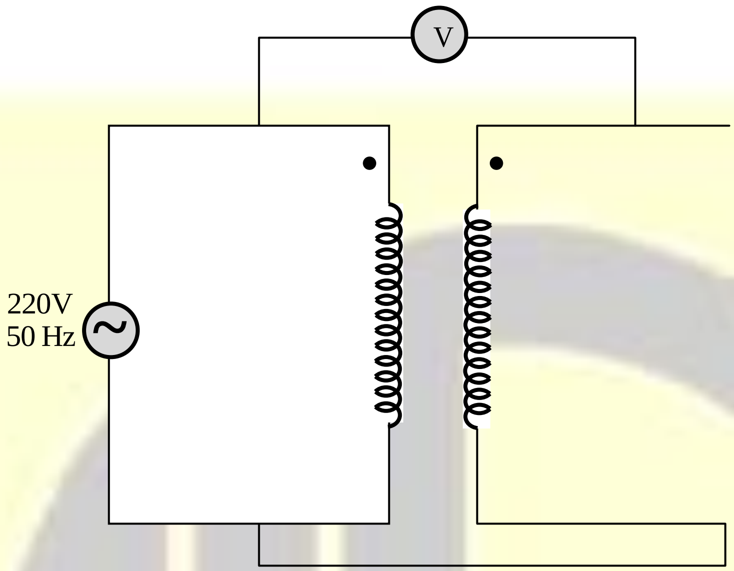
(A) $1\,\text{rad s}^{-1}$ (B) $2\,\text{rad s}^{-1}$ (C) $0.25\,\text{rad s}^{-1}$ (D) $0.5\,\text{rad s}^{-1}$

21. What is the power loss in the $10\,\Omega$ resistor in the network shown in figure?



(A) 15.31 W (B) 15.13 W (C) 12.3 W (D) 13.2 W

22. The voltmeter in the circuit shown in the figure is ideal. The transformer has two identical windings with perfect coupling. The reading on the voltmeter will be



(A) 440V (B) 220V (C) 110V (D) zero

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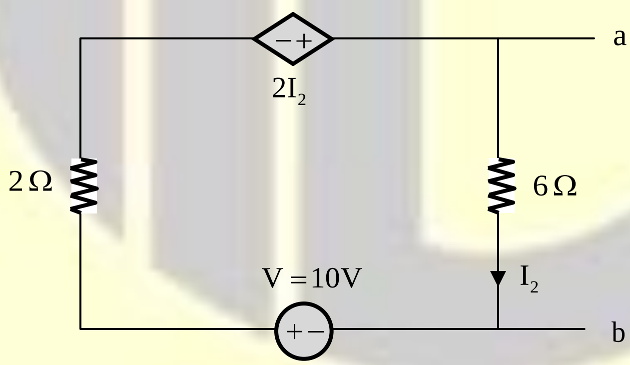
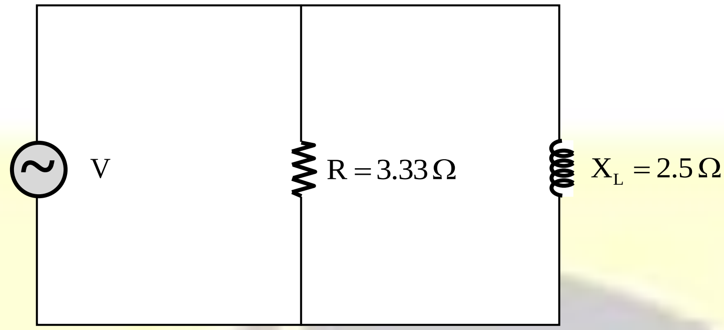
23. The Thevenin's equivalent circuit of the network shown in the figure is across ab is



(A) 1Ω (B) 2Ω (C) 3Ω (D) 4Ω

---

24. The average power consumed by the following circuit is



$V_{rms} = 20\angle 53.13°V$

(A) 100 W (B) 110 W (C) 120 W (D) 160 W

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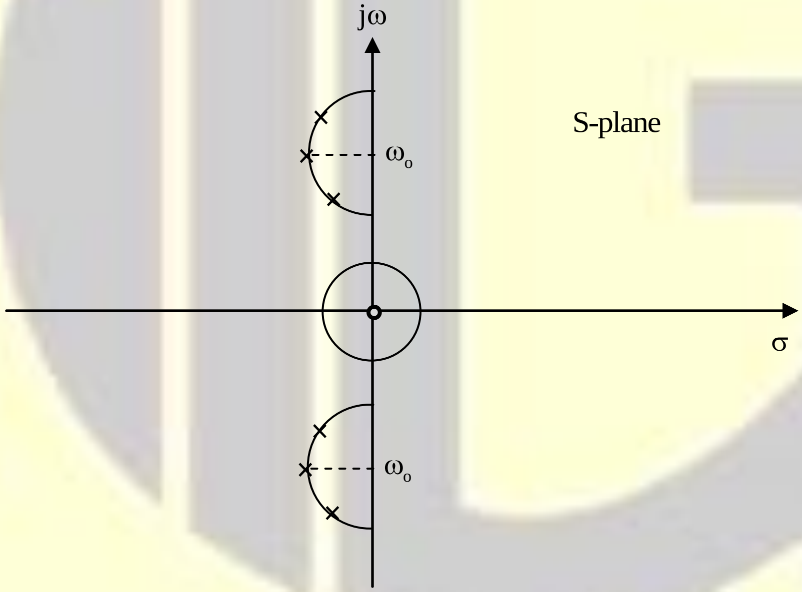
25. The given figure shows the pole zero pattern of a filter in the S-plane. The filter in question is a



(A) Band elimination filter (B) Band pass filter

(C) Low pass filter (D) High pass filter

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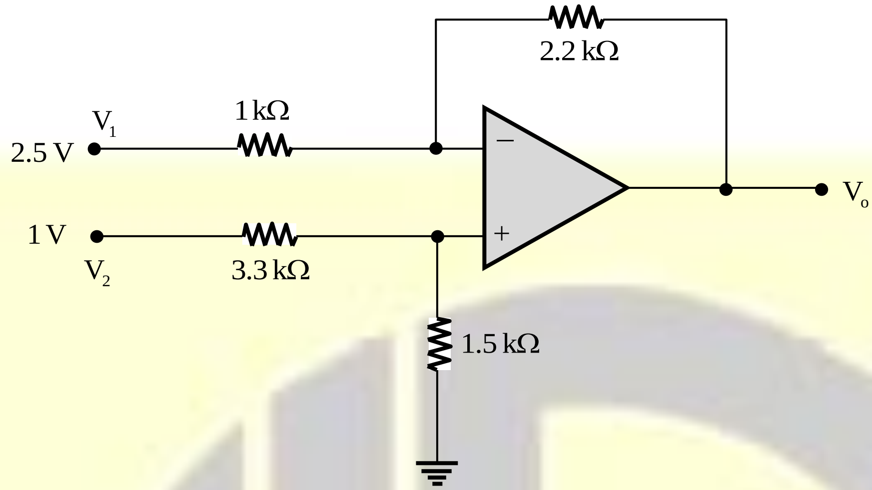
26. Output voltage V_0 of the circuit shown in the figure is (the input voltages are $V_1 = 2.5\text{ V}$ and $V_2 = 1\text{V}$)



(A) 4.0 V (B) – 4.0 V (C) – 4.5 V (D) 4.5 V

---

27. Without any additional circuitry an 8: 1 MUX can be used to obtain.

(A) some but not all Boolean functions of 3 variables

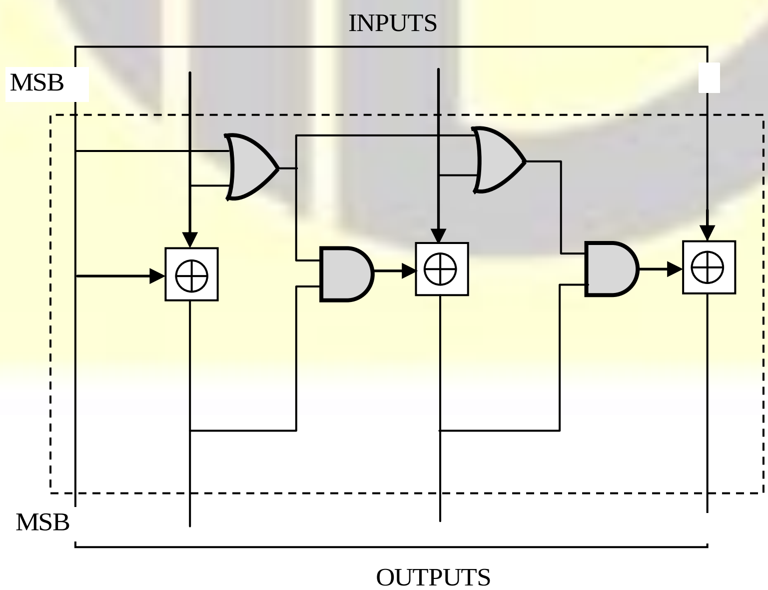
(B) all function of 3 variables but none of 4 variables

(C) all functions of 3 variables and some but not all of 4 variables

(D) all functions of 4 variables

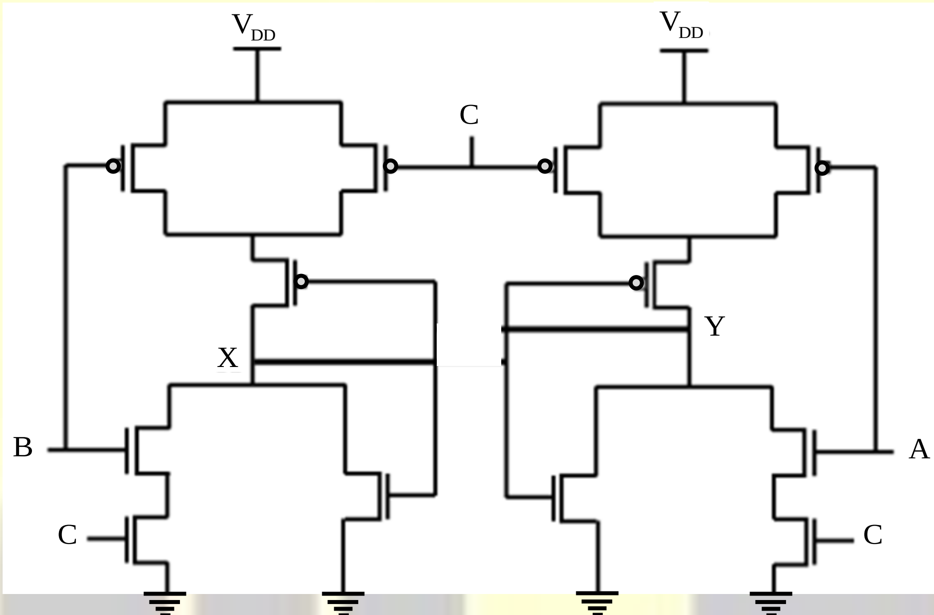
---

28. The circuit shown in the figure converts



(A) BCD to binary code (B) binary to excess-3 code
(C) excess-3 to Gray code (D) Gray to binary code

29. The following CMOS transistor based circuit with A, B, C as input and X, Y as output represents which circuit?

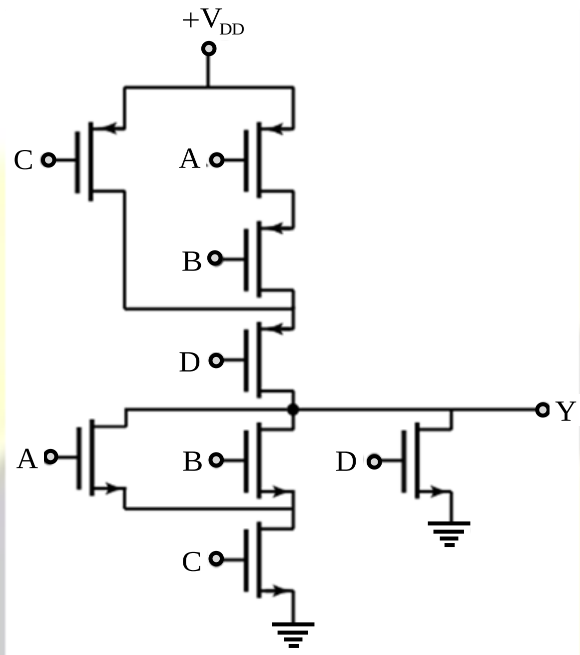


(A) Positive edge trigger JK flip-flop (B) Negative edge trigger JK flip-flop
(C) Positive edge trigger SR flip-flop (D) None of these

30. Minimum number of complementary CMOS transistors pair will be required to implement function, $F = ABC + \overline{(A+B+C)}$ are

(A) 6 (B) 7 (C) 8 (D) 9

31. The CMOS circuit shown below implements the function



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

---

32. If input to T flip-flop is 200 Hz signal, then what will be the output signal frequency it four T flip-flops are connected in cascade

(A) 200 Hz (B) 50 Hz (C) 800 Hz (D) None of these

---

33. Simplify the function represented in sum of min-terms:

$F(A,B,C,D,E)=\Sigma(0,1,2,3,8,9,16,17,20,21,24,25,28,29,30,31)$

(A) $A\bar{D}+(\overline{C+D})+\bar{A}\bar{B}\bar{C}+(\overline{\bar{A}+\bar{B}+\bar{C}})$

(B) $A\bar{D}E+\overline{(C+E)}D+\bar{A}\bar{B}\bar{C}D+AE\bar{C}$

(C) $A\bar{D}B+\overline{(C+B)}+\bar{C}\bar{D}\bar{E}+(\overline{\bar{B}+\bar{C}+\bar{D}})$

(D) $A\bar{C}+\overline{(D+E)}+\bar{A}\bar{E}+(\overline{\bar{C}+\bar{D}+\bar{E}})$

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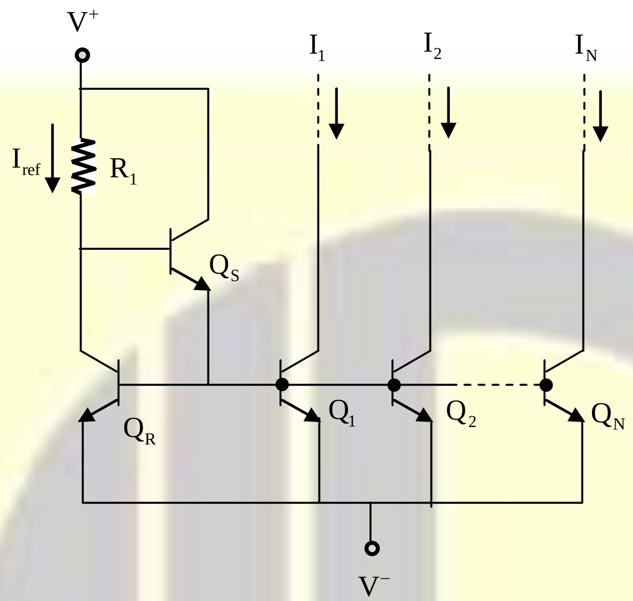
34. All transistor in the N output current mirror in the figure are matched with a finite gain β and early voltage $V_A = \infty$. The expression for load current is



(A) $\dfrac{I_{ref}}{\left(1+\dfrac{(1+N)}{\beta(\beta+1)}\right)}$ (B) $\dfrac{I_{ref}}{\left(1+\dfrac{N}{\beta(\beta+1)}\right)}$ (C) $\dfrac{\beta I_{ref}}{\left(1+\dfrac{(1+N)}{\beta(\beta+1)}\right)}$ (D) $\dfrac{\beta I_{ref}}{\left(1+\dfrac{N}{\beta(\beta+1)}\right)}$

---

35. Class C amplifier operates

(A) entire cycle of input signal

(B) half of the cycle of input signal

(C) slightly more than half of the cycle of input signal

(D) less than half of the cycle of input signal

---

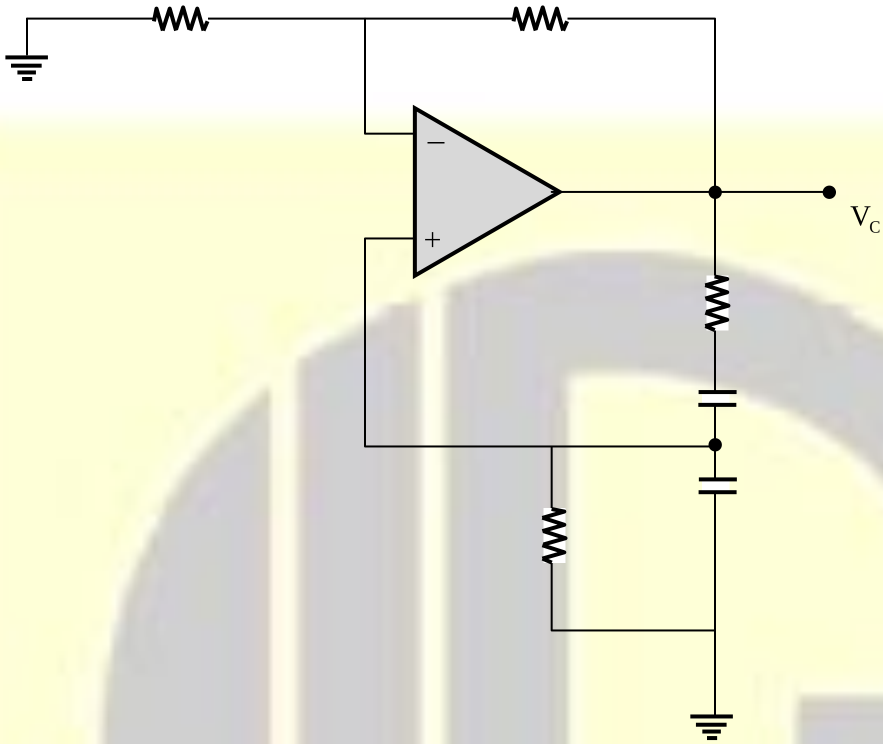
36. A particular amplifier circuit used for frequency doubling is

(A) push-push (B) push-pull

(C) pull-push (D) pull-pull

---

37. The configuration of the given figure is a



(A) Precision integrator
(B) Hartley oscillator
(C) Butterworth high pass filter
(D) Wein bridge oscillator

---

38. For current flowing through semiconductor, which of the following statement is true?

(A) Only conduction current
(B) Only diffusion current
(C) Conduction current + Diffusion current
(D) None of these

---

39. Which of the following statements is true for programmable logic array (PLA)?

(A) Fixed AND array and fused programmable OR array
(B) Fused programmable AND array and fixed OR array
(C) Fused programmable AND array and fused programmable OR array
(D) None of these

---

40. When transistors are used in digital circuits they usually operate in the

(A) active region (B) breakdown region

(C) saturation and cut-off regions (D) linear region

---

41. Two initially identical samples A and B of pure germanium are doped with donors to concentrations of 1×10^{20} and 3×10^{20}, respectively. If the hole concentration in A is 9×10^{12}, then the hole concentration in B at the same temperature will be

(A) $3\times10^{12}\,m^{-3}$ (B) $7\times10^{12}\,m^{-3}$

(C) $11\times10^{12}\,m^{-3}$ (D) $27\times10^{12}\,m^{-3}$

---

42. The built-in potential (diffusion potential) in a p-n junction

(A) is equal to the difference in the Fermi level of the 2 sides, expressed in volts

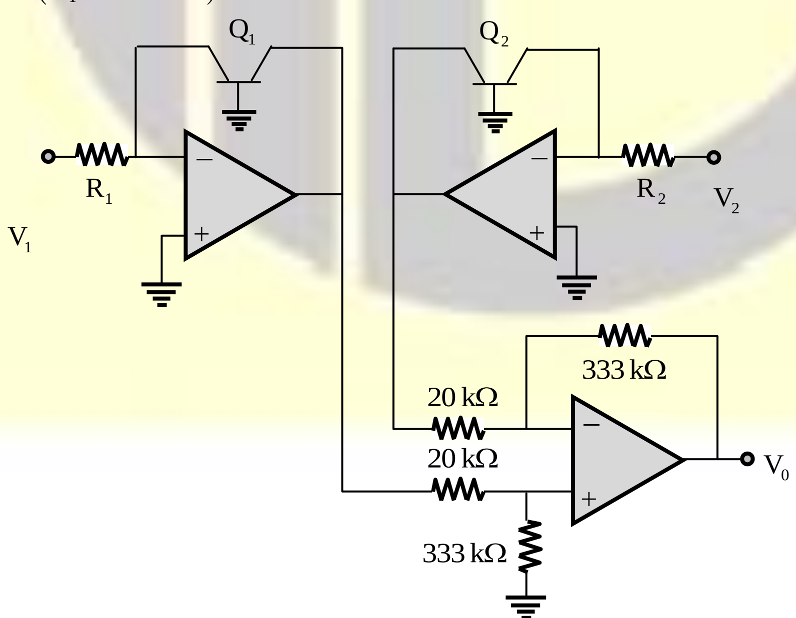
(B) increase with the increase in the doping levels of the two sides

(C) increase with the increase in temperature

(D) all of these

---

43. Transistors Q_1 and Q_2 are identical and $\beta >> 1$ in the current shown in the figure below. The output voltage is $\left(V_T = 0.026\,V\right)$



(A) $2\log_{10}\left(\frac{V_2}{V_1}\frac{R_1}{R_2}\right)$ (B) $\log_{10}\left(\frac{V_2}{V_1}\frac{R_1}{R_2}\right)$

(C) $2.3\log_{10}\left(\frac{V_2}{V_1}\frac{R_1}{R_2}\right)$ (D) $4.6\log_{10}\left(\frac{V_2}{V_1}\frac{R_1}{R_2}\right)$

---

44. Consider following 8085 microprocessor program:

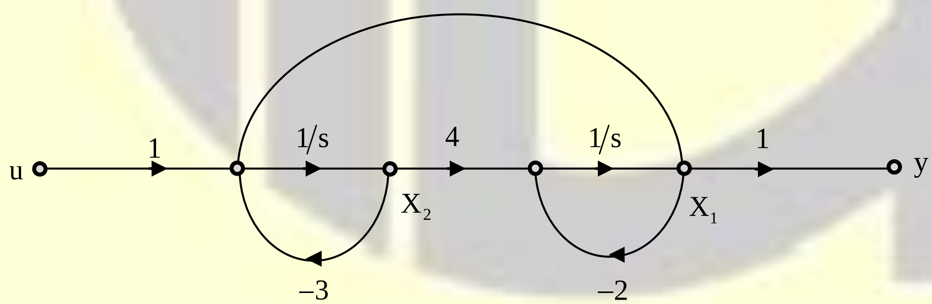
```
MVI  A,  DATA1
ORA  A
JM   DISPLAY
OUT  PORT1
CMA
DISPLAY: ADI 01H
OT    PORT1
HLT
```

If DATA1= A7H, the output at PORT1 is

(A) A7H (B) 58H (C) 00H (D) 59H

---

45. From the figure, obtain state equation:



(A) $[\dot{X}] = \begin{bmatrix} 0 & -3 \\ -2 & 4 \end{bmatrix}[X] + \begin{bmatrix} 0 \\ 1 \end{bmatrix}u$ (B) $[\dot{X}] = \begin{bmatrix} -2 & 4 \\ 0 & -3 \end{bmatrix}[X] + \begin{bmatrix} 0 \\ 1 \end{bmatrix}u$

(C) $[\dot{X}] = \begin{bmatrix} 0 & -3 \\ -2 & 4 \end{bmatrix}[X] + \begin{bmatrix} 1 \\ 0 \end{bmatrix}u$ (D) $[\dot{X}] = \begin{bmatrix} -2 & 4 \\ 0 & -3 \end{bmatrix}[X] + \begin{bmatrix} 1 \\ 0 \end{bmatrix}u$

---

46. In an ADC, the minimum effective number of bits (ENOB) requires to represent each quantization level to achieve signal to noise and distortion ration (SINAD) of 70 dB is

(A) 8 bits (B) 10 bits (C) 11 bits (D) 12 bits

---

47. Two isotropic antennas are separated by a distance of two wavelengths. If both the antennas are fed with currents of equal phase and magnitude, the numbers of lobes in the radiation pattern in the horizontal plane are

(A) 2 (B) 4 (C) 6 (D) 8

---

48. The half-power beam width (HPBW) of an antenna in the two orthogonal planes are 120° and 40°, respectively. The directivity of the antenna is approximately equals to

(A) 10 dB (B) 6.5 dB (C) 12 dB (D) 8.5 dB

---

49. Two resistors R_1 and R_2 $(\text{in } \Omega)$ at temperatures T_1K and T_2K, respectively, are connected in series. Their equivalent noise temperature is

(A) $T_1 + T_2$ (B) $R_1T_1 + R_2T_2$ (C) $\frac{(R_1T_1 + R_2T_2)}{(R_1R_2)}$ (D) $\frac{(R_1T_1 + R_2T_2)}{(R_1 + R_2)}$

---

50. The Gray code for $(A5)_{16}$ is equivalent to

(A) 10010101 (B) 11010101

(C) 11011111 (D) 11011011

---

51. In direct broadcast system (DBS),

(A) MPEG-2 is used for video compression

(B) MPEG-2 is used for video enhancing

(C) MPEG-2 is used for audio compression

(D) none of these

---

52. If analog sampling frequency of a band limited signal is doubled, then the corresponding digital sampling frequency will be

(A) π (B) 2π (C) $\frac{\pi}{2}$ (D) None of these

---

53. In communication system, if for a given rate of information transmission requires channel bandwidth B_1 and signal-to-noise ratio SNR_1. If the channel bandwidth is doubled for same rate of information, then the new signal-to-noise ratio will be

(A) SNR_1 (B) $2SNR_1$ (C) $\sqrt{SNR_1}$ (D) $\frac{SNR_1}{2}$

---

54. Output SNR of a 10 bit PCM was found to be 30 dB, desired SNR is 42 dB. To achieve desired SNR by increasing the number of quantization levels, then new levels will be

(A) 256 (B) 512 (C) 2018 (D) 1024

---

55. Let Y(k) be the 5-point DFT of the sequence $y(n) = \{1\,2\,3\,4\,5\}$. What is the 5-point DFT of the sequence Y(k)?

(A) [15 – 2.5 + 3. 4j – 2.5 + 0.81j – 2.5 – 0.81j – 2.5 – 3.4j]

(B) [1 5 4 3 2]

(C) [5 25 20 15 10]

(D) [5 4 3 2 1]

---

56. Let A be the series

$$\sum_{n=1}^{\infty} \frac{(-1)^n}{\log(n+2)}$$

and B be the series

$$\sum_{n=2}^{\infty} \left(\frac{3n-4}{3k+2}\right)^{\frac{(n+1)}{3}}$$

for real numbers. Then which of the following is true?

(A) Both the series A and B are divergence

(B) Both the series A and B are convergent

(C) Series A is convergent and series B is divergent

(D) Series A is conditionally convergent and series B is divergent

---

57. A test has 5 multiple-choice questions. Each question has 4 answer options (A, B, C, D). What is the probability that a student will choose "B" for at least three questions if he/she leaves no questions bank?

(A) 1/1024 (B) 1/64 (C) 53/512 (D) 29/128

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58. The DTFT of a sequence x[n] is given by $X\left(e^{j\omega}\right)$. Since $X\left(e^{j\omega}\right)$ is period function of ω, it can be expressed classical Fourier series as,

$$X\left(e^{j\omega}\right)=\sum_{n=-\infty}^{\infty}C_n e^{jn\omega_0\omega}$$

where ω_0 is a fundamental frequency. Which of the following statement is correct?

(A) $\omega_0=\pi, C_n=-x[n]$

(B) $\omega_0=\pi, C_n=x[-n]$

(C) $\omega_0=1, C_n=x[-n]$

(D) $\omega_0=1, C_n=-x[-n]$

---

59. Evaluate: $\int_0^1 \frac{\ell n(x+1)}{x^2+1}dx$

(A) $\pi\ell n\sqrt{2}$ (B) $\frac{\pi}{8}\ell n2$ (C) $2\pi\ell n\sqrt{2}$ (D) $\ell n\sqrt{2}$

---

60. Fourier transform of a real and odd function is

(A) real and odd

(B) real and even

(C) imaginary and odd

(D) imaginary and even

---

61. Let F(w) be the Fourier transform of a function f(t). The F(0) is

(A) $\int_{-\infty}^{\infty} f(t)dt$ (B) $\int_{-\infty}^{\infty} |f(t)|^2 dt$

(C) $\int_{-\infty}^{\infty} |t.f(t)|^2 dt$ (D) $\int_{-\infty}^{\infty} t.f(t)dt$

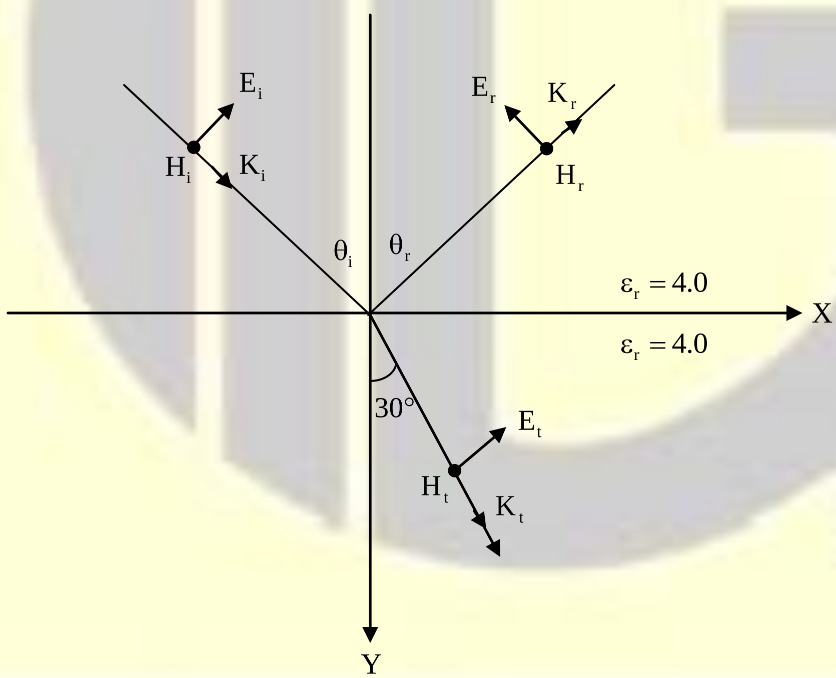
---

62. Laplace transform of $e^{-at}f(t)$ is

(A) $F(s)e^{at}$ (B) $F(s-a)$ (C) $F(s+a)$ (D) $\frac{F(s)}{s}+a$

---

63. A monochromatic plane wave of wavelength $500\,\mu m$ is propagating in the direction as shown in the figure below, $\vec{E}_i, \vec{E}_r$ and $\vec{E}_t$ denotes incident, reflected and transmitted electric field vectors associated with the wave.



The expression for $\vec{E}_t$ and $\vec{E}_r$ are

(A) $\frac{E_o}{\sqrt{2}}\left(\hat{a}_x - \hat{a}_y\right)e^{-j\frac{2\pi\times10^4(x+y)}{5\sqrt{2}}}\,Vm^{-1}$ and $0.10\frac{E_o}{\sqrt{2}}\left(\hat{a}_x + \hat{a}_y\right)e^{-j\frac{2\pi\times10^4(x-y)}{5\sqrt{2}}}\,Vm^{-1}$

(B) $\frac{E_o}{\sqrt{2}}\left(\hat{a}_x - \hat{a}_y\right)e^{-j\frac{2\pi\times10^4(x+y)}{5\sqrt{2}}}\,Vm^{-1}$ and $-0.10\frac{E_o}{\sqrt{2}}\left(\hat{a}_x + \hat{a}_y\right)e^{-j\frac{2\pi\times10^4(x-y)}{5\sqrt{2}}}\,Vm^{-1}$

(C) $\frac{E_o}{\sqrt{2}}\left(\hat{a}_x - \hat{a}_y\right)e^{-j\frac{2\pi\times10^8(x-y)}{5\sqrt{2}}}\,Vm^{-1}$ and $\frac{E_o}{\sqrt{2}}\left(\hat{a}_x - \hat{a}_y\right)e^{-j\frac{2\pi\times10^4(x+y)}{5\sqrt{2}}}\,Vm^{-1}$

(D) $\frac{E_o}{\sqrt{2}}\left(\hat{a}_x - \hat{a}_y\right)e^{-j\frac{2\pi\times10^8(x+y)}{5\sqrt{2}}}\,Vm^{-1}$ and $\frac{E_o}{\sqrt{2}}\left(\hat{a}_x + \hat{a}_y\right)e^{-j\frac{2\pi\times10^4(x-y)}{5\sqrt{2}}}\,Vm^{-1}$

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64. Indicate which one of the following modes does not exist in a rectangular resonant cavity?

(A) TE_{10} (B) TE_{011} (C) TM_{10} (D) TM_{111}

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65. A long solenoid of radius R, having N turns per unit length carries a time dependent current $I(t) = I_0\sin(\omega t)$. The magnitude of induced electric field at a distance R/2 radially from the axis of the solenoid is

(A) $\frac{R}{2}\mu_0 NI_0\omega\cos(\omega t)$ (B) $\frac{R}{4}\mu_0 NI_0\omega\cos(\omega t)$

(C) $\frac{R}{2}\mu_0 NI_0\omega\sin(\omega t)$ (D) $\frac{R}{4}\mu_0 NI_0\omega\sin(\omega t)$

---

66. Penetration depth of magnetic field inside a superconductor is

(A) always zero (B) London depth of penetration

(C) skin depth of penetration (D) inside full bulk of material

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67. A parallel plate air-filled capacitor has plate area of $10^{-4}m^2$ and plate separation of $10^{-3}m$. It is connected to a 2V, 1.8 GHz source. The magnitude of the displacement current is $\left(\varepsilon_0 = \frac{1}{36}\pi\times10^{-9}\,Fm^{-1}\right)$

(A) 200 mA (B) 20 mA (C) 20 A (D) 2 mA

68. Two rectangular waveguide have dimensions of 1cm × 0.5 cm and 1 cm × 0.25 cm, respectively. Their respective cut-off frequencies will be

(A) 15 GHz and 30 GHz (B) 30 GHz and 60 GHz

(C) 15 GHz and 15 GHz (D) 30 GHz and 30 GHz

---

69. Which of the following has the highest skin depth?

(A) AI (B) Ag (C) Au (D) Cu

---

70. The electric field vector of a wave is given as

$$\vec{E} = E_0 e^{j(\omega t + 3x - 4y)}, \frac{8\hat{a}_x + 6\hat{a}_y + 5\hat{a}_z}{\sqrt{125}} Vm^{-1}$$

Its frequency is 10 GHz. The phase velocity in Y-direction will be

(A) $2 \times 10^{10}\, m\, s^{-1}$ (B) $1.5 \times 10^{10}\, m\, s^{-1}$

(C) $1.85 \times 10^{10}\, m\, s^{-1}$ (D) $1.25 \times 10^{10}\, m\, s^{-1}$

---

71. The electric field of a plane wave propagation in a lossless non-magnetic medium is given by the following equation

$$\vec{E}(z,t) = 3\cos\left(2\pi \times 10^9 t + \beta z\right)\hat{a}_x + 2\cos\left(2\pi \times 10^9 t + \beta z + \frac{\pi}{2}\right)\hat{a}_y$$

The type of wave polarization is

(A) right-hand elliptical (B) right-hand circular

(C) left-hand elliptical (D) left-hand circular

---

72. A ring of radius R carries a linear charge density λ. It is rotating with angular speed ω. The magnetic field at its center is

(A) $\frac{3\mu_0\lambda\omega}{2}$ (B) $\frac{\mu_0\lambda\omega}{2}$ (C) $\frac{\mu_0\lambda\omega}{\pi}$ (D) $\mu_0\lambda\omega$

---

73. A transmission line with a characteristic impedance of $100\,\Omega$ is used to match a $50\,\Omega$ section to a $200\,\Omega$ section. If the matching is to be done both at 500 MHz and 1.2 GHz, the length of the transmission line can be approximately,

(A) 1.75 m (B) 1.0 m (C) 1.35 m (D) 1.5 m

---

74. System has some poles lying on imaginary axis is

(A) unconditionally stable (B) conditionally stable

(C) unstable (D) marginally stable

---

75. The open-loop DC gain of a unity negative feedback system with closed loop transfer function $\frac{(s+4)}{(s^2+7s+13)}$ is

(A) 4/13 (B) 4 (C) 4/9 (D) 13

---

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

(A) –1 (B) 0 (C) 1 (D) ∞

---

77. A system has fourteen poles and two zeros. Its high frequency asymptote in its magnitude plot having a slope of

(A) $-40\text{ dB decade}^{-1}$ (B) $-240\text{ dB decade}^{-1}$

(C) $-280\text{ dB decade}^{-1}$ (D) $-320\text{ dB decade}^{-1}$

---

78. Consider a unity feedback system having an open loop transfer function

$$G(j\omega)=\frac{k}{j\omega(j0.2\omega+1)(j0.05\omega+1)}$$

Find open loop gain (k) with gain margin of 20 dB

(A) 5.2 (B) 2.5 (C) 0.1 (D) 2.25

79. The open loop transfer function of a unity feedback system is

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

The range of K for which the system is stable is

(A) $\frac{21}{44} > K > 0$ (B) $13 > K > 0$

(C) $\frac{21}{44} < K < \infty$ (D) $-6 < K < \infty$

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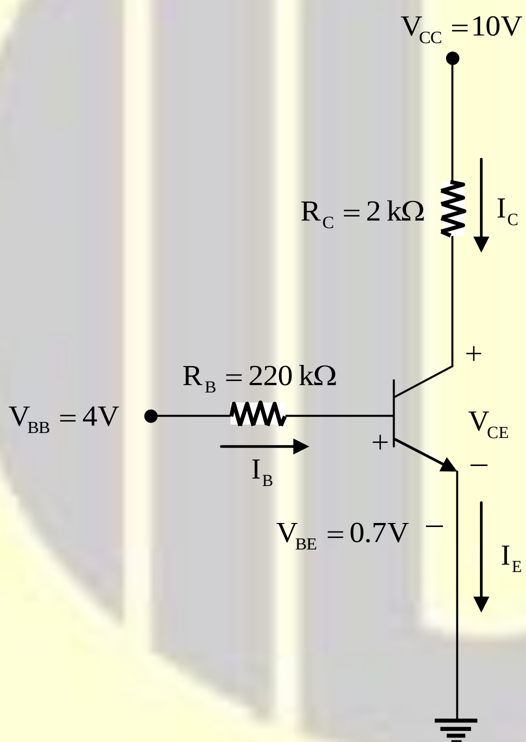
80. For the CE (common-emitter) circuit shown, what will be the value of I_E and V_{CE} ?



(A) 3mA, 3V (B) 4 mA, 4V

(C) 3.02 mA, 4.2 V (D) 3.02 mA, 4V
