

# ESE 2021 (Paper-2)

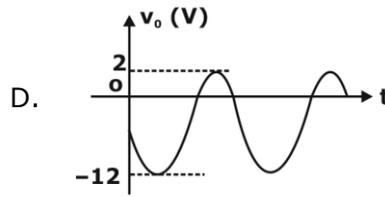
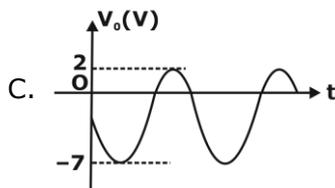
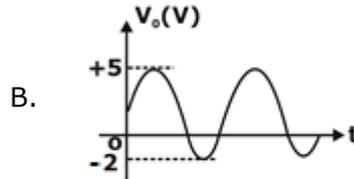
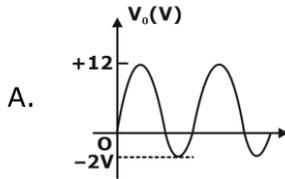
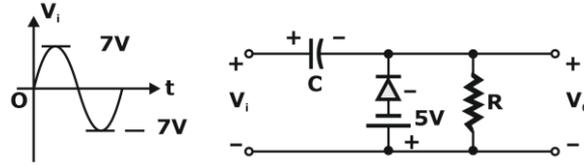
Electronics &  
Telecommunication Engineering

**18th July**

**SET-C**

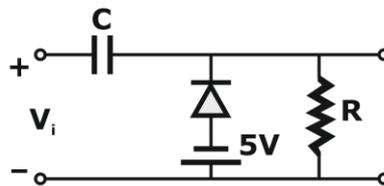
Questions with  
Detailed Solutions

1. A sinusoidal input is given to the network below. The output waveform is

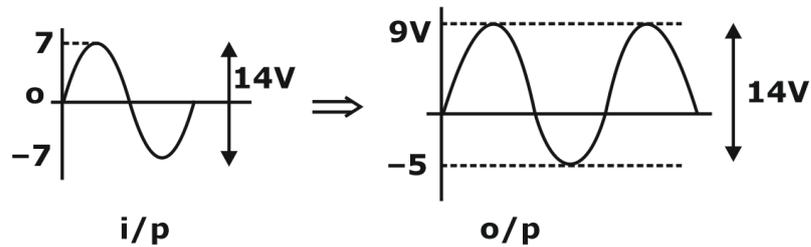


Ans. A

Sol.



It is +ve clamper and output is clamped at -5V:



Swing remains same i.e.  $V_{max} - V_{min} = 14V$

No one is correct

Best Answer A

2. For enhancement-type n-channel MOSFET with drain current  $I_D = 10mA$ ,  $V_{GS} = 8V$  and  $V_T = 2V$ , the device constant  $k$  is

A.  $0.139 \text{ mA/V}^2$

B.  $0.278 \text{ mA/V}^2$

C.  $0.387 \text{ mA/V}^2$

D.  $0.556 \text{ mA/V}^2$

Ans. B

Sol. In saturation Region

$$I_{DS} = \frac{\mu_n(C_{ox}W)}{2L}(V_{GS} - V_t)^2$$

$$I_D = K(8 - 2)^2$$

$$K = \frac{10mA}{36}$$

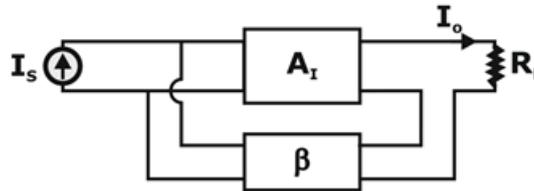
$$K = 0.278 \text{ mA/V}^2$$

3. Which one of the following statement is correct regarding shunt-series feedback amplifier topology?

- A. The currents are compared and the output voltages are sampled.
- B. The currents are compared and the output currents are sampled.
- C. The voltages are compared and the output currents are sampled.
- D. The voltages are compared and the output voltages are sampled.

Ans. B

Sol.



Series sampling means current sampling

Shunt mixing means current comparison

4. A Hartley oscillator uses  $L_1 = 2 \text{ mH}$  and  $L_2 = 1.5 \text{ mH}$ . The range of capacitance so that the frequency of oscillation can be varied between 1000 kHz to 2000 kHz are

- A.  $C_{max} = 7.2 \text{ pF}$  and  $C_{min} = 1.8 \text{ pF}$
- B.  $C_{max} = 9.2 \text{ pF}$  and  $C_{min} = 0.8 \text{ pF}$
- C.  $C_{max} = 7.2 \text{ pF}$  and  $C_{min} = 0.8 \text{ pF}$
- D.  $C_{max} = 9.2 \text{ pF}$  and  $C_{min} = 1.8 \text{ pF}$

Ans. A

Sol. For Hartley Oscillator

$$f_0 = \frac{1}{2\pi\sqrt{L_{eq}C}}$$

$$f_0^2 = \frac{1}{4\pi^2 L_{eq}C}$$

$$L_{eq} = L_1 + L_2$$

$$= (2 + 1.5) \text{ mH}$$

$$L_{eq} = 3.5 \times 10^{-3} \text{ H}$$

$$C = \frac{1}{4\pi^2 L_{eq} f_0^2}$$

$$C = \frac{1}{4\pi^2 (3.5m)^2 f_0^2} = \frac{7.2372}{f_0^2}$$

For  $f = 2000 \text{ kHz}$

$$C = \frac{7.2372}{(2000 \times 10^3)^2} = 1.81 \text{ pF}$$

For  $f = 1000 \text{ kHz}$

$$C = \frac{7.2372}{(1000 \times 10^3)^2} = 7.237 \text{ pF}$$

$$1.81 \text{ pF} \leq C \leq 7.237 \text{ pF}$$

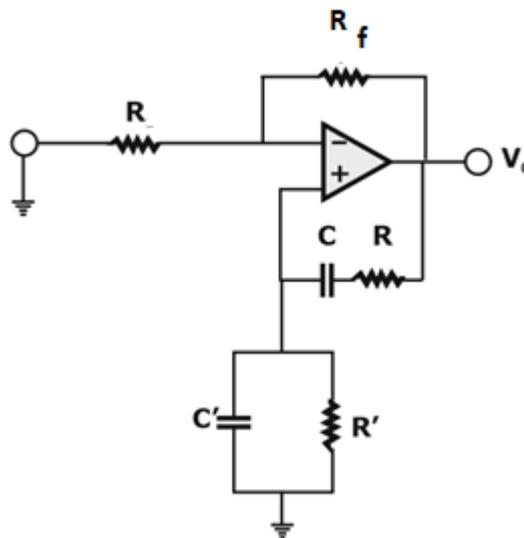
5. Which one of the following statements is correct regarding integrated circuit fabrication?
- A. IC offers increased reliability, improved performance, high speed and lower power consumption.
  - B. IC is a miniature, low cost electronic circuit fabricated on a multi crystal chip of silicon.
  - C. IC is a miniature, high cost electronic circuit fabricated on a multi crystal chip of silicon.
  - D. IC offers decreased reliability, improved performance, low speed and higher power consumption.

Ans. A

6. What is the value of capacitor of the Wien bridge oscillator at resonant frequency of 10 kHz with resistance of 100 kΩ?
- A. 149 pF
  - B. 159 pF
  - C. 169 pF
  - D. 189 pF

Ans. B

Sol.



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Wein Bridge Oscillator

$$f_o = \frac{1}{2\pi\sqrt{RR'CC'}} = \frac{1}{2\pi RC}$$

if  $R = R'$  ,  $C = C'$

$$10 \times 10^3 = \frac{1}{2\pi \times 100 \times 10^3 \times C}$$

$$C = \frac{1}{2\pi 10^5 \times 10^4} = 0.159 \times 10^{-9}$$

$$C = 159 \text{ pF}$$

7. A monolithic metal oxide semiconductor (MOS) non-polarized capacitor which is a parallel plate capacitor with SiO<sub>2</sub> as dielectric. A surface thin film of metal (aluminium) is the top plate. The bottom plate consists of the heavily doped n<sup>+</sup> region that is formed during emitter diffusion. What is the typical value of capacitance for an oxide thickness of 500 Å of this MOS capacitor?

A. 0.1 pF/mil<sup>2</sup>

B. 0.2 pF/mil<sup>2</sup>

C. 0.3 pF/mil<sup>2</sup>

D. 0.4 pF/mil<sup>2</sup>

Ans. D

Sol.  $C_{ox} = \frac{\epsilon_{ox}}{t_{ox}} = \frac{\epsilon_{ox}\epsilon}{t_{ox}}$   
 $= \frac{3.9 \times 8.85 \times 10^{-12}}{500 \times 10^{-10}} = \frac{34.515}{500} \times 10^{-12}$

$$C_{ox} = 0.069 \times 10^{-2} \text{ m}^2$$

$$\text{mil} = (0.0254) \times 10^{-3} \text{ m}$$

$$(\text{mil})^2 = (0.0254 \times 10^{-3})^2$$

$$= (0.00064 \times 10^{-6})\text{m}^2$$

$$C_{ox} = \frac{0.069 \times 10^{-2}}{\text{m}^2}$$

$$1\text{m}^2 = \frac{1}{0.64 \times 10^{-9}} (\text{mil})^2$$

$$C_{ox} = \frac{0.069 \times 10^{-2} \times 0.64 \times 10^{-9}}{(\text{mil})^2}$$

$$= 0.04416 \times 10^{-11}$$

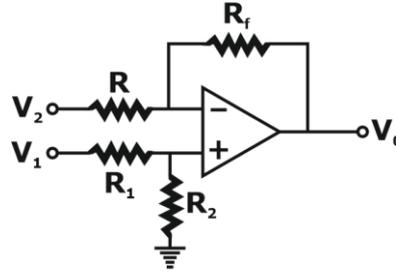
$$= \frac{0.4 \times 10^{-12}}{(\text{mil})^2} \text{ F}$$

$$C_{ox} = 0.4 \text{ pF/mil}^2$$

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8. For the given figure, the output voltage is



- A.  $V_0 = -\frac{R_f}{R} V_2 + \left(\frac{R+R_f}{R_1+R_2}\right) V_1$       B.  $V_0 = -\frac{R}{R_f} V_2 + \left(\frac{R+R_f}{R_f}\right) \left(\frac{R+R_f}{R_1+R_2}\right) V_1$   
 C.  $V_0 = -\frac{R_f}{R} V_2 + \left(\frac{R+R_f}{R_f}\right) \left(\frac{R_1+R_2}{R+R_f}\right) V_1$       D.  $V_0 = -\frac{R_f}{R} V_2 + \left(\frac{R+R_f}{R}\right) \left(\frac{R_2}{R_1+R_2}\right) V_1$

Ans. D

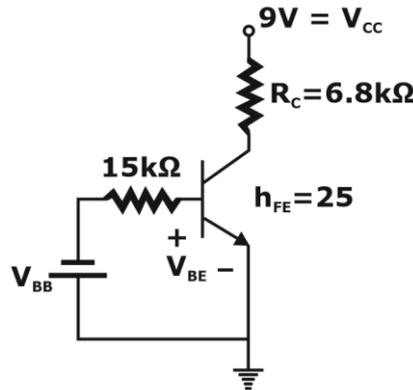
Sol. it is a differential Amplifier by using ideal op-amp.

9. In a BJT switching circuit, supply voltage is  $V_{CC} = 9\text{ V}$ , biasing resistors are  $R_B = 15\text{ k}\Omega$ ,  $R_C = 6.8\text{ k}\Omega$  and the transistor has an  $h_{FE}$  value of 25. What is the minimum input voltage required to switch the transistor into saturation when  $V_{CE} = 0.2\text{ V}$ ?

- A. 1.48 V      B. 0.78 V  
 C. 5 V      D. 2.5 V

Ans. A

Sol.



For saturation  $I_B \geq I_{Bmin}$

$$I_{Bmin} = \frac{I_{Csat}}{\beta} = \frac{1.294}{25} = \frac{22}{17} \times \frac{1}{25}$$

$$I_{Csat} = \frac{V_{CC} - V_{CEsat}}{R_C} = \frac{9 - 0.2}{6.8} = \frac{8.8}{6.8} = \frac{22}{17}$$

$$= 1.294$$

$$I_B = \frac{V_{BB} - V_{BE}}{15} \geq \frac{1.294}{25}$$

$$V_{BB} = \frac{1.294}{25} \times 15 + 0.7$$

$$V_{BB} = 1.4764 \cong 1.48\text{V}$$



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**Directions:** Each of the next six, (06) items consist of two statements, one labelled as 'Statement (I)' and the other labelled as 'Statement (II)'. You are to examine these two statement carefully and select the answer to these items using the codes given below:

**Codes:**

- A. Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I).
- B. Both Statement (I) and Statement (II) are individually true, 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.

- 10.** Statement (I): Ge and Si are said to have negative temperature coefficient of resistivity. Statement (II): Ge and Si shown a reduction in resistance with increase in temperature.

**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.

Ans. A

- 11.** Statement (I): A linear network which contains two or more independent sources can be analyzed to obtain the various voltages and branch currents by allowing the sources to act one at a time, then superposing the results. Statement (II): Superposition cannot be directly applied to the computation of the power.

**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.

Ans. B



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**12.** Statement (I): Metals are extremely good conductors of electricity and heat, and are not transparent to visible light.

Statement (II): Ceramics are compounds between metallic and non-metallic elements.

**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.

Ans. B

**13.** Statement (I): M-ary PSK can be used to transmit digital data over a non-linear bandpass channel, whereas M-ary QAM requires the use of a linear channel.

Statement (II): M-ary PSK and M-ary QAM are examples of non-linear modulation.

**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.

Ans. C

**14.** Statement (I): Linear system may have multiple equilibrium states.

Statement (II): If a system is BIBO stable, it must also be zero-input or asymptotically stable.

**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.

Ans. D

Sol. The linear system  $\dot{x} = Ax$  has an isolated equilibrium point at  $x = 0$  if  $\det A \neq 0$ , that is if  $A$  has no zero eigenvalues. Otherwise, the system has a continuum of equilibrium points. These are the only possible equilibrium patterns that a linear system may have.



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15. Statement (I): The total flux out of a closed surface is equal to the net charge enclosed within the surface.

Statement (II): An electric field is completely specified by intensity vector.

**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.

Ans. B

16. A current of 5 A in primary coil of a circuit is reduced to zero at a uniform rate in  $10^{-3}$  seconds. If coefficient of mutual inductance is 2 H, then the induced emf in the secondary coil is

A.  $10^{-4}$  V

B.  $10^4$  V

C.  $10^{-6}$  V

D.  $10^6$  V

Ans. B

Sol.  $V = M \frac{di}{dt}$

Here =  $M = 2$ ;  $di = 5$ ;  $dt = 10^{-3}$  seconds.

$$V = 2 \times \frac{5}{10^{-3}} = 10^4 \text{ V}$$

17. A wire of resistor  $10 \Omega$  is drawn out so that its length is increased to twice its original length.

Then the new resistance is

A.  $20 \Omega$

B.  $5 \Omega$

C.  $30 \Omega$

D.  $40 \Omega$

Ans. D

Sol.  $R_1 = \frac{\rho l_1}{A_1}$

$$R_2 = \frac{\rho l_2}{A_2}$$

$$l_2 = 2l_1, A_2 = \frac{A_1}{2}$$

$$R_2 = \frac{\rho \times 2l_1 \times 2}{\frac{A_1}{2}} = \frac{4\rho l_1}{A_1} = 4R_1 = 4 \times 10 = 40 \Omega$$

18. What is the magnitude of emf induced in a 200 turn coil with cross-sectional area of  $0.16 \text{ m}^2$ , if the magnetic field through the coil changes from  $0.10 \text{ Wb/m}^2$  to  $0.50 \text{ Wb/m}^2$  at a uniform rate over a period of 0.02 seconds?

A.  $-520 \text{ V}$

B.  $-640 \text{ V}$

C.  $-725 \text{ V}$

D.  $-815 \text{ V}$

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Ans. B

Sol. By Faradays Law

$$\text{Emf} = \frac{-Nd\phi}{dt}$$

$$\phi = B.A.$$

$$d\phi = \phi_2 - \phi_1 = B_2A - B_1A = A(B_2 - B_1)$$

$$= 0.16(0.5 - 0.1)$$

$$= 0.064$$

$$dt = 0.02 \text{ sec}$$

$$N = 200 \text{ turns}$$

$$\text{Emf} = -200 \times \frac{0.064}{0.02} = -640 \text{ V}$$

**19.** In an AC circuit, the voltage source V is as follows :  $V = 100 \sin (100t)$  volt. The rms value of voltage is

A. 35.35 V

B. 40.35 V

C. 80.7 V

D. 70.7 V

Ans. D

Sol. RMS value of a sinusoidal wave is given by

$$V_{\text{rms}} = \frac{1}{\sqrt{2}} \times V_m = \frac{1}{\sqrt{2}} \times 100 = 70.7 \text{ V}$$

**20.** Which one of the following statements is not correct regarding the characteristics of ideal transformer?

A. There is no leakage flux.

B. There are no losses in electric circuit or in magnetic circuit.

C. The resistance of both the windings is infinite.

D. The permeability of the core is infinite and zero reluctance.

Ans. C

Sol. The properties of an ideal transformer are

- The two windings of this transformer have small resistance.
- Because of the resistance, eddy current and hysteresis there are no losses in the transformer.
- The efficiency of this transformer is 100%
- The total flux generated in the transformer has restricted the core & connects with the windings.

Therefore, its flux & inductance leakage is zero.



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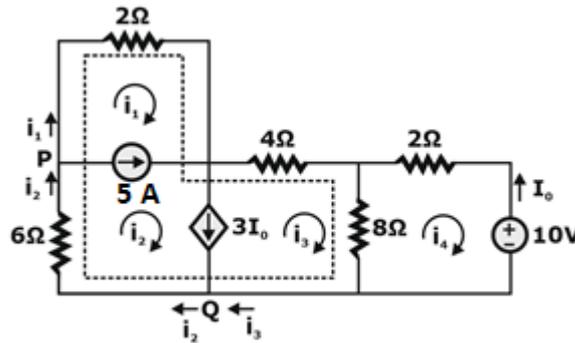
21. Which one of the following is not the indication of a fully-charged cell?
- A. Intensity
  - B. Gassing
  - C. Voltage
  - D. Specific gravity of the electrolyte

Ans. A

Sol. The indications of a fully charged cell (or battery) are

- (i) Voltage
- (ii) Specific gravity of electrolyte
- (iii) Gassing
- (iv) Colour of plates

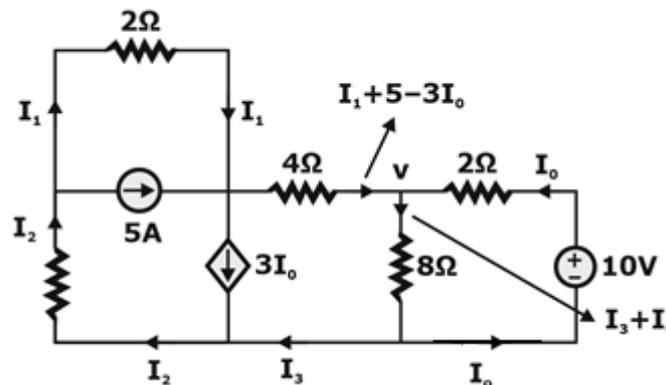
22. For the given circuit, the currents  $i_1$  and  $i_3$  are



- A.  $i_1 = -2.5\text{ A}$  and  $i_3 = 3.93\text{ A}$
- B.  $i_1 = 7.5\text{ A}$  and  $i_3 = -2.5\text{ A}$
- C.  $i_1 = 3.93\text{ A}$  and  $i_3 = 2.14\text{ A}$
- D.  $i_1 = -7.5\text{ A}$  and  $i_3 = 3.93\text{ A}$

Ans. D

Sol.



$$I_3 + I_0 = I_1 + 5 - 2I_0$$

$$3I_0 = I_1 - I_3 + 5 \dots (1)$$

$$\frac{V}{I_3 + I_0} = 8$$

$$V = 8I_3 + 8I_0$$

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Now,  $\frac{10 - 8I_3 - 8I_o}{2} = I_o$

$10 - 8I_3 = 10I_o$

$I_o = 1 - \frac{8}{10}I_3$

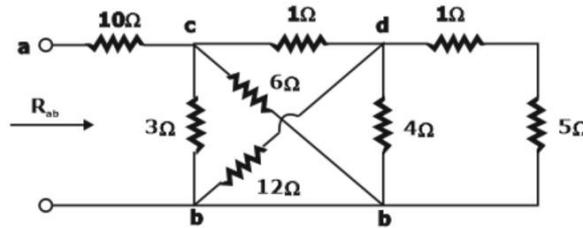
From (1)

$3 - \frac{24}{10}I_3 = I_1 - I_3 + 5$

$-2 = I_1 + 1.4I_3$

$I_1 = -(2 + 1.4I_3)$  option (D) satisfy

23. What is the equivalent resistance  $R_{ab}$  in the given circuit?



A. 34.08 Ω

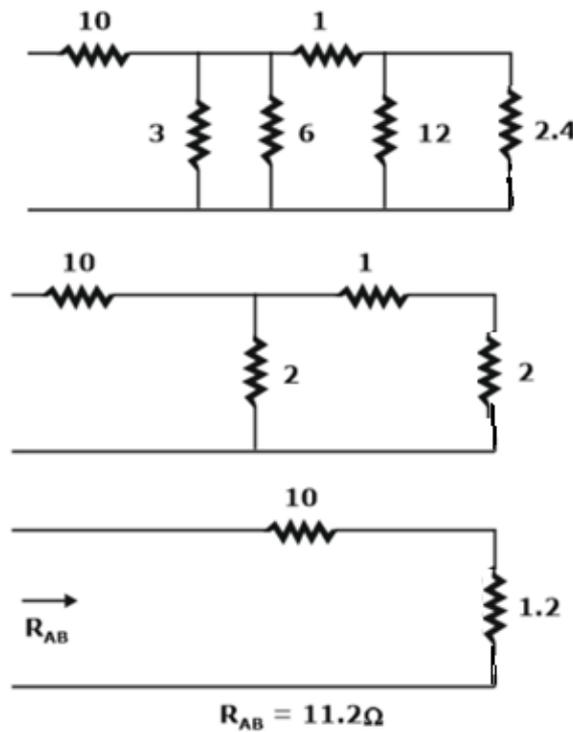
B. 11.20 Ω

C. 42.16 Ω

D. 17.82 Ω

Ans. B

Sol.



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24. Consider the following statements for inductors:

1. An inductor acts like a short circuit to DC.
2. The current through an inductor cannot change instantaneously.
3. The current through an inductor can change instantaneously.
4. An inductor acts like an open circuit to DC

Which of the above statements is/are correct?

- |           |                 |
|-----------|-----------------|
| A. 1 only | B. 1 and 2 only |
| C. 2 only | D. 3 and 4 only |

Ans. B

25. What is the phase angle between

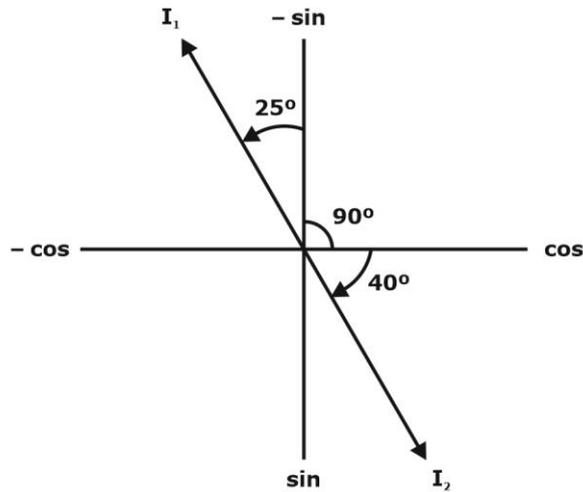
$$i_1 = -4 \sin (377t + 25^\circ) \text{ and}$$

$$i_2 = 5 \cos (377t - 40^\circ)?$$

- |  |  |
|--|--|
| A. $155^\circ$ , ( $i_1$ leads $i_2$ ) | B. $145^\circ$ , ( $i_2$ leads $i_1$ ) |
| C. $135^\circ$ , ( $i_1$ leads $i_2$ ) | D. $125^\circ$ , ( $i_2$ leads $i_1$ ) |

Ans. A

Sol.



$i_1$  leads  $i_2$  by  $155^\circ$

26. Which one of the following laws states that the line integral of the tangential component of H around a closed path is the same as the net current  $I_{enc}$  enclosed by the path?

- |                      |                         |
|----------------------|-------------------------|
| A. Biot-Savart's law | B. Lenz's law           |
| C. Gauss's law       | D. Ampere's circuit law |

Ans. D

Sol.  $\oint H \cdot dl = I_{enc}$  (ampere circuital law)



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Ans. C

Sol.  $I = 30.4 \text{ A}$

$$R = 0.105\Omega$$

Current less by 1.2%

Resistance high by 0.3%

$$P = I^2R$$

$$P_{\text{cat}} = \left( I + \frac{1.2}{100} I \right)^2 \times \left( R - \frac{0.3}{100} R \right)$$

$$= I^2 \left( 1 + \frac{1.2}{100} \right)^2 \times R \left( 1 - \frac{0.3}{100} \right)$$

$$= I^2R(1.021)$$

$$= I^2R \times \frac{102.1}{100}$$

**32.** The LVDT is used in an accelerometer to measure seismic mass displacements. The LVDT and signal conditioning outputs are 0.31 mV/mm with a  $\pm 20$  mm core displacement. The spring constant is 240 N/m and the core mass is 0.05 kg. The natural frequency and maximum measurable acceleration are respectively,

A. 69.3 rad/s and 69.3 m/s<sup>2</sup>

B. 69.3 rad/s and 96 m/s<sup>2</sup>

C. 15.59 rad/s and 96 m/s<sup>2</sup>

D. 15.59 rad/s and 31.18 m/s<sup>2</sup>

Ans. B

Sol. Natural frequency

$$K = 240 \text{ N/m}$$

$$V^2 = \frac{Kx^2}{M}$$

$$V = \sqrt{\frac{K}{m}} \times x$$

$$\frac{dy}{dx} = \sqrt{\frac{k}{m}} = 69.28 = 69.3$$

$$K = 240 \text{ N/m}, m = 0.05 \text{ kg}$$

For maximum acceleration

$$F = -kx$$

$$m \cdot a = -kx$$

$$a = -\frac{k}{m} \times (x)_{\text{max}} = \frac{-240 \times 100 \times 20}{5 \times 1000}$$

$$a = -48 \times 2 = -96 \text{ m/s}^2$$

$$|a| = 96 \text{ m/s}^2$$



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**38.** Which one of the following does not come under the category of ceramic material?

- A.  $Al_2O_3$
- B.  $SiO_2$
- C.  $Si_2N_4$
- D.  $SiC$

Ans. C

**39.** Consider the following statements corrosion of ceramic material:

1. Ceramic materials are much better suited to withstand most of these environments for reasonable time periods than are metals.
2. Corrosion of ceramic materials generally involves simple chemical dissolution, in contrast to the electrochemical processes found in metals.
3. Ceramic materials are not frequently used because of their non-resistance to corrosion

Which of the above statements is/are correct?

- A. 1 and 3 only
- B. 2 and 3 only
- C. 3 only
- D. 1 and 2 only

Ans. D

**40.** For a ferromagnetic material, which one of the following relationships is correct between magnetic flux density and magnetization

- A.  $B \cong 2\mu_0 M$
- B.  $B \cong \mu_0 M$
- C.  $B \cong \frac{\mu_0 M}{2}$
- D.  $B \cong \frac{\mu_0}{M}$

Ans. B

**41.** Which of the following statement is not correct regarding ferrites?

- A. Ferrites, with large magnetostrictive effects, are used in electromechanical transducers.
- B. Ferrites have very high resistivity.
- C. Hard magnetic ferrites are used for the manufacture of light weight permanent magnets.
- D. Soft magnetic materials can be used for making permanent magnets.

Ans. D

Sol. Magnetically hard materials are used to create permanent magnets.

**42.** Which one of the following materials displays the behavior of antiferromagnetic?

- A. Manganese oxide
- B. Iron
- C. Nickel
- D. Cobalt

Ans. A

**43.** Consider the following statement for superconductivity:

1. Superconducting magnets capable of generating high fields with low power consumption are currently being employed in scientific test and research equipment.
2. One of the potential applications of superconducting materials is electrical power transmission through superconducting materials — power losses would be extremely low, and the equipment would operate at low voltage levels.



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3. Type II superconductors are preferred over type I for most practical applications by virtue of their higher critical temperatures and critical magnetic fields?

Which of the above statement is/are correct?

- A. 1 only
- B. 2 and 3 only
- C. 3 only
- D. 1, 2 and 3

Ans. D

44. Which one of the following statement is not correct regarding the features of ceramics?

- A. Ceramics are hard, strong and dense.
- B. Ceramics are stronger in compression than in tension.
- C. Ceramics have very poor dielectric properties.
- D. Ceramics are weak in impact strength.

Ans. C

45. What is the packing efficiency of diamond?

- A. 0.17
- B. 0.34
- C. 0.24
- D. 0.48

Ans. B

46. Which one of the following has all the poles of the function lie on the  $j\omega$  axis?

- A. L-C function
- B. R-L function
- C. R-C function
- D. Y function

Ans. A

Sol. **Properties of LC Immittance Function:**

1. The LC Immittance Function is always a ratio of odd to even or even to odd polynomials.
2. The poles and zeros are simple. There are no multiple poles or zeros either at origin or infinity or at any point.
3. The poles and zeros are located on the  $j\omega$  axis only.
4. The poles and zeros interlace (alternate) each other on the  $j\omega$  axis.

47. Which one of the following is an LC immittance function?

- A.  $Z(s) = \frac{Ks(s^2+4)}{(s^2+1)(s^2+3)}$
- B.  $Z(s) = \frac{s^5+4s^3+5s}{3s^4+6s^2}$
- C.  $Z(s) = \frac{K(s^2+1)(s^2+9)}{(s^2+2)(s^2+10)}$
- D.  $Z(s) = \frac{2(s^2+1)(s^2+9)}{s(s^2+4)}$

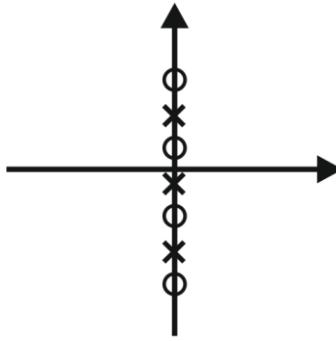
Ans. D



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Sol. For LC immittance function, poles & zeros should be alternate on  $j\omega$  axis this condition is only satisfied by option.

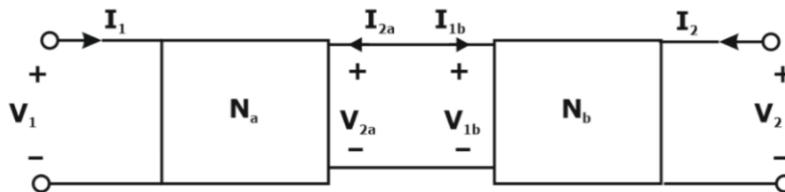


48. Which one of the following is not the property of positive real function?
- A. If  $F(s)$  is positive real, then  $\frac{1}{F(s)}$  is not a positive real.
  - B. The sum of positive real functions is positive real.
  - C. The poles and zeros of a positive real function cannot be in the right half of the S plane.
  - D. Only simple poles with real positive residues can exist on the  $j\omega$  axis.

Ans. A

Sol. Option A is correct for this, because if  $F(s)$  is positive real function then reciprocal of  $F(s)$  should also be positive real function.

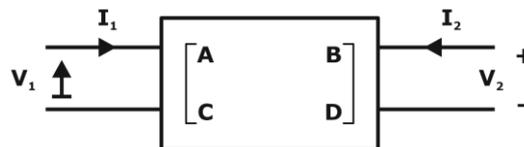
49. Which one of the following is the transmission matrix equation for network  $N_a$  if two network  $N_a$  and  $N_b$  are cascaded as shown in the figure?



- A.  $\begin{bmatrix} V_1 \\ I_1 \end{bmatrix} = \begin{bmatrix} A_a & B_a \\ C_a & D_a \end{bmatrix} \begin{bmatrix} -V_{2a} \\ I_{2a} \end{bmatrix}$
- B.  $\begin{bmatrix} V_1 \\ I_1 \end{bmatrix} = \begin{bmatrix} A_a & B_a \\ C_a & D_a \end{bmatrix} \begin{bmatrix} V_{2a} \\ -I_{2a} \end{bmatrix}$
- C.  $\begin{bmatrix} V_1 \\ I_1 \end{bmatrix} = \begin{bmatrix} A_a & B_a \\ C_a & -D_a \end{bmatrix} \begin{bmatrix} -V_{2a} \\ I_{2a} \end{bmatrix}$
- D.  $\begin{bmatrix} V_1 \\ I_1 \end{bmatrix} = \begin{bmatrix} A_a & B_a \\ -C_a & -D_a \end{bmatrix} \begin{bmatrix} V_{2a} \\ -I_{2a} \end{bmatrix}$

Ans. B

Sol.



$$V_1 = AV_2 - B I_2 \dots\dots\dots (i)$$

$$V_1 = CV_2 - D I_2 \dots\dots\dots (ii)$$

$$\begin{bmatrix} V_1 \\ I_1 \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix} \begin{bmatrix} V_2 \\ -I_2 \end{bmatrix}$$

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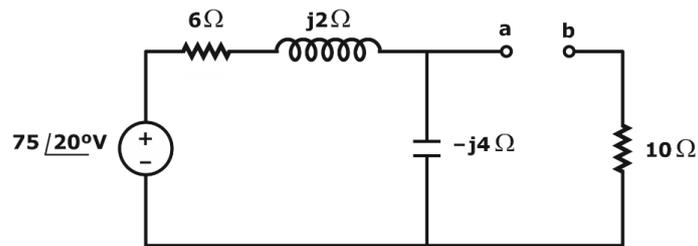
**50.** Which one of the following theorems becomes important if the circuit has sources operating at different frequencies?

- A. Norton theorem
- B. Thevenin theorem
- C. Superposition theorem
- D. Maximum power transfer theorem

Ans. C

Sol. Two different frequency signal only in superposition.

**51.** What is the value of  $Z^{th}$  at terminal a – b of the given Thevenin circuit?



- A.  $Z_{th} = (8 \cdot 4 - j1 \cdot 2)\Omega$
- B.  $Z_{th} = (10 \cdot 3 - j2 \cdot 3)\Omega$
- C.  $Z_{th} = (11 \cdot 3 - j2 \cdot 9)\Omega$
- D.  $Z_{th} = (12 \cdot 4 - j3 \cdot 2)\Omega$

Ans. D

Sol.  $(6 + 2j) \parallel (-4j) \Rightarrow \frac{(6 + 2j)(-4j)}{6 - 2j}$

$$Z_{TH} = \frac{(6 + 2j)(-4j)}{6 - 2j} + 10$$

$$Z_{TH} = \frac{(6 + 2j)^2 (-4j)}{36 + 4} + 10$$

$$= \frac{(36 - 4 + 24j)(-4j)}{40} + 10$$

$$= \frac{(32 + 24j)(-4j)}{40} + 10$$

$$= \frac{-32j + 24}{10} + 10$$

$$= -3.2j + 2.4 + 10$$

$$= 12.4 - 0.32j$$



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**52.** Consider the following statements for accuracy of the instrument:

1. The accuracy of the instrument may be specified in terms of limits of error.
2. The specification of a point accuracy given any information about the general accuracy of the instrument.
3. The best way to conceive the idea of accuracy is to specify it in terms of the true value of the quantity being measured.

Which of the above statements are correct?

- |                 |                 |
|-----------------|-----------------|
| A. 1 and 2 only | B. 1 and 3 only |
| C. 1, 2 and 3   | D. 2 and 3 only |

Ans. B

Sol. The accuracy of the instrument only at a particular point on its scale is known as point accuracy. It is important to note that this accuracy does not give any information about the general accuracy of the instrument. The uniform scale range determines the accuracy of a measurement.

**53.** Consider the following statements for deflection and null type instruments:

1. Deflection type of instruments are more accurate than null type of instruments.
2. Deflection type of instruments can be highly sensitive as compared with the null type of instruments.
3. Null type of instruments are more suitable for measurements under dynamic conditions than deflection type of instruments.

Which of the above statements are **not** correct ?

- |                 |                 |
|-----------------|-----------------|
| A. 1 and 2 only | B. 1 and 3 only |
| C. 1, 2 and 3   | D. 2 and 3 only |

Ans. C

Sol. **Comparison between null type and deflection type instruments:**

**Accuracy:**

- The accuracy of null type instruments is higher than that of deflection type. This is because the opposing effect is calibrated with the help of standards which have high degree of accuracy.
- Accuracy of deflection type instruments is dependent upon their calibration which depends upon the instrument constants which are normally not known to a high degree of accuracy.

**Sensitivity:**

- In the null type of instruments, the measured quantity is balanced out. This means the detector has to cover a small range around the balance (null) point and therefore can be made highly sensitive.
- Also, the detector need not be calibrated since it has only to detect the presence and direction of unbalance and not the magnitude of unbalance.
- A deflection type of instrument must be larger in size, more rugged, and thus less sensitive if it is to measure large.



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Sol. Counting time period

$$t_1 = \frac{1}{f_1} = \frac{1}{1\text{MHz} / 10^6} = 1 \text{ sec.}$$

Counting cycles  $n_1$

$$n_1 = f_{in} \times t_1 = 1512 \text{ cycles}$$

$$f_{\text{measured}} = 1.512 \text{ kHz}$$

**58.** Which of the following instruments have large scales for easy reading?

- A. Vacuum-tube voltmeter (VTVM) and a FET-input multimeter
- B. Vacuum-tube voltmeter (VTVM) and an analog electronic ammeter
- C. FET-input multimeter and an analog electronic ammeter
- D. FET-input multimeter and an analog electronic voltmeter

Ans. A

**59.** If a resistor is known to have a resistance of  $500\Omega$  with a possible error of  $\pm 50 \Omega$ , the  $\pm 50 \Omega$  is

- A. Relative error
- B. Absolute error
- C. Gross error
- D. Systematic error

Ans. B

**60.** Consider the following statements for dynamic characteristics of a measurement system:

1. Fidelity is defined as the degree to which a measurement system indicates changes in the measured quantity without any dynamic error.
2. Dynamic error is the difference between the true value of the quantity changing with time and the value indicated by the measurement system if no static error is assumed.
3. Measuring lag is the retardation in the response of a measurement system to changes in the measured quantity.

Which of the above statements are correct?

- A. 1 and 2 only
- B. 1 and 3 only
- C. 1, 2 and 3
- D. 2 and 3 only

Ans. C

Sol. Fidelity is defined as the rapidity with which a measurement system responds to changes in the measured quantity.

Measuring lag: It is the retardation or delay in the response of a measurement system to changes in the measured quantity.

Dynamic Error: The difference between the true values of the measured quantity to the value shown by the measuring instrument under varying conditions.

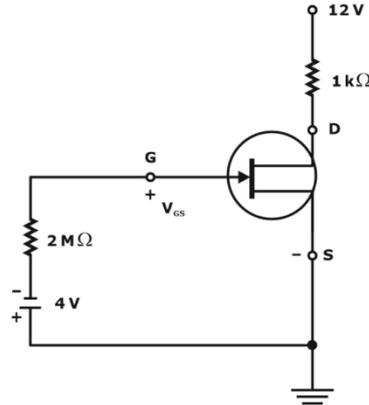
Speed of response: It is defined as the rapidity of the measurement system that responds to the changes in the measuring variable.



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**61.** The circuit given below is the fixed biasing of the n-channel JFET. The pinch-off voltage and the maximum drain-to-source current is  $-8\text{ V}$  and  $10\text{ mA}$  respectively. What are the values of  $V_{GSQ}$  and  $I_{DQ}$ , respectively?



- A.  $+ 4\text{V}$  and  $25\text{ mA}$
- B.  $+ 4\text{V}$  and  $2.5\text{ mA}$
- C.  $- 4\text{V}$  and  $25\text{ mA}$
- D.  $- 4\text{V}$  and  $2.5\text{ mA}$

Ans. D

Sol.  $V_{GS} = - 4\text{V}$

$$I_{DQ_{Max.}} = I_{DSS} = 10\text{ mA}$$

$$I_{DQ} = I_{DSS} \left[ 1 - \frac{V_{GS}}{V_P} \right]^2$$

$$= 10 \left[ 1 - \frac{-4}{-8} \right]^2 = 10 \left[ 1 - \frac{1}{2} \right]^2 = \frac{10}{4} = 2.5\text{ mA}$$

**62.** Consider the following statements regarding JFET:

1. The relationship between the drain current and gate-to-source voltage of a JFET is a nonlinear.
2. The minimum current for JFET occurs at pinch-off voltage defined by  $V_{GS} = V_P$ .
3. A current controlled device is one in which a current defines the operating conditions of the device.

Which of the above statements are correct?

- A. 1 and 2 only
- B. 1 and 3 only
- C. 1, 2 and 3
- D. 2 and 3 only

Ans. C

**63.** What is the maximum closed-loop voltage gain that can be used when the input signal varies by  $0.2\text{ V}$  in  $10\text{ }\mu\text{s}$  with slew rate of op-amp  $SR = 2\text{ V}/\mu\text{s}$ ?

- A. 40
- B. 50
- C. 80
- D. 100

Ans. D



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69. Consider the following statements regarding PROM/EPROM:

- 1. The erasable programmable ROM using ultraviolet erasing is known as EPROM.
- 2. The ROM that makes use of the electrical voltage for erasing is known as electrically alterable ROM.
- 3. A PROM can be programmed many times after fabrication.

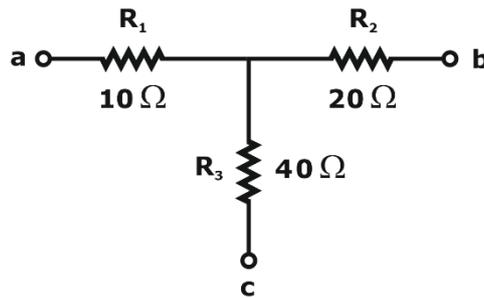
Which of the above statements are correct?

- A. 1 and 2 only
- B. 1 and 3 only
- C. 1, 2 and 3
- D. 2 and 3 only

Ans. A

Sol. Statement 1<sup>st</sup> and 2<sup>nd</sup> correct statement 3<sup>rd</sup> is wrong, because it is a nearly written just once and programmed electrically by the user at the time when the chip fabricated.

70. What are the values of  $R_a$ ,  $R_b$  and  $R_c$  respectively, after transforming the Wye network shown in the figure to a delta network?

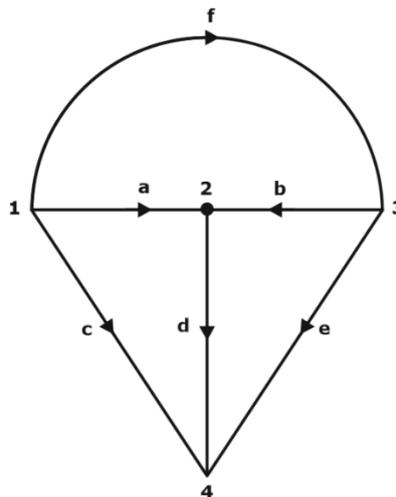


- A. 140  $\Omega$ , 70  $\Omega$ , 45  $\Omega$
- B. 70  $\Omega$ , 140  $\Omega$ , 35  $\Omega$
- C. 140  $\Omega$ , 70  $\Omega$ , 35  $\Omega$
- D. 40  $\Omega$ , 70  $\Omega$ , 25  $\Omega$

Ans. (both B & C are correct)

Sol. Both statements B and C are correct.

71. The number of links in the graph shown in the figure is



- A. 3
- B. 4
- C. 2
- D. 5

Ans. A

Sol. Link = B - N + 1

$$L = 6 - 4 + 1$$

$$L = 6 - 3 = 3$$

**72.** Which one of the following contains lesser number of nodes than the original graph?

- A. Proper subgraph
- B. Improper subgraph
- C. Planar graph
- D. Non-planar graph

Ans. A

**73.** Consider the following statements regarding duality:

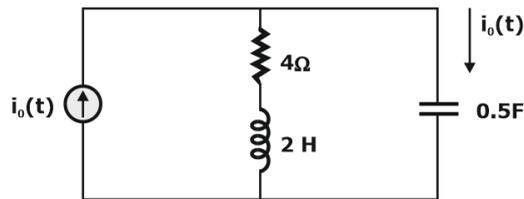
1. The dual networks are obtained for both AC and DC circuits and they are based on Kirchhoff's laws.
2. Dual circuits are not obtained in planar networks.
3. Two networks are said to be dual networks if mesh equations of one network have the same form as the nodal equations of the other.

Which of the above statements are correct?

- A. 1 and 2 only
- B. 1 and 3 only
- C. 2 and 3 only
- D. 1, 2 and 3

Ans. D

**74.** The current gain  $\frac{I_o(\omega)}{I_i(\omega)}$  for the given circuit is



- A.  $\frac{s(s+2)}{s^2+2s+1}$ , where  $s = j\omega$
- B.  $\frac{s(s+1)}{s^2+s+1}$ , where  $s = j\omega$
- C.  $\frac{s(s+2)}{s^2+2s+2}$ , where  $s = j\omega$
- D.  $\frac{s(s+2)}{s^2+s+2}$ , where  $s = j\omega$

Ans. A

Sol. 
$$\frac{4 + 2S}{4 + 2S + \frac{1}{5S}} \Rightarrow \frac{4 + 2S}{4 + 2S + \frac{3}{S}}$$

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

$$= \frac{S(S + 2)}{S + 2S + 1}$$

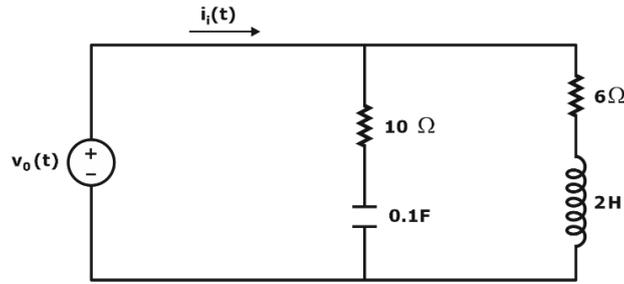


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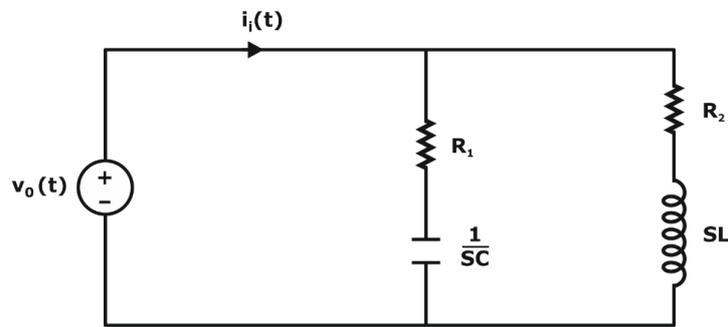
75. The poles and zeros of the given circuit are



- A. poles: - 0.683 and - 7.317  
Zeros: - 1 and - 3
- B. poles: - 0.483 and - 5.317  
Zeros: - 3 and - 4
- C. poles: - 0.383 and - 4.317  
Zeros: - 2 and - 3
- D. poles: - 0.583 and - 6.317  
Zeros: - 1 and - 4

Ans. A

Sol.



$$z = \left( R_1 + \frac{1}{SC} \right) || (R_2 + SL)$$

$$= \frac{\left( R_1 + \frac{1}{SC} \right) (R_2 + SL)}{\left( R_1 + \frac{1}{SC} \right) + (R_2 + SL)}$$

$$V_0(s) = I_1(s) \cdot z$$

$$\frac{V_0(s)}{I_1(s)} = z = \frac{(1 + SR_1C)(R_2 + SL) / SC}{[(1 + SR_1C) + SR_2C + S^2LC] / SC}$$

$$H(s) = \frac{(1 + 10 \times 0.1s)(6 + 2s)}{(1 + 10 \times 0.1s) + 5 \times 6 \times 0.1 + S^2 2 \times 0.1}$$

$$= \frac{2(s+1)(s+3)}{0.2s^2 + 1.6s + 1}$$

Poles are  $s = - 0.6833, -7.317$

Zeros are  $z = - 1, z = - 3$



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Ans. A

Sol. Statement-1: (correct)

TELNET is an application of TCP protocol true.

Statement-2: (correct)

Simple mail transfer protocol uses TCP.

Statement-3: (incorrect)

The Internet Protocol (IP) is not specially for routing. For that we use RIP, OSPF, and BGP.

**80.** If a cellular system has  $p$  number of co-channel interfering cells,  $S$  is the desired signal power from serving base station and  $I_p$  is interference power from  $p^{\text{th}}$  interfering co-channel cell base station, then what is the signal to interference ratio for a mobile receiver in the functioning cell?

A.  $\frac{S}{\sum_{i=1}^p I_p}$

B.  $\frac{2 \times S}{\sum_{i=1}^p I_p}$

C.  $\frac{\sum_{i=1}^p I_p}{S}$

D.  $\frac{S}{I_p}$

Ans. A

**81.** Which one of the following provides a reliable connection for the transfer of data between applications?

A. TCP

B. UDP

C. FTP

D. SMTP

Ans. A

Sol. TCP/IP provides a mechanism for transferring data between two applications, which can be running on different computers.

The transfer of data is bidirectional provided that the TCP/IP connection is maintained and no. data is lost.

**82.** For a GEO satellite, what is the free space loss ( $L_{\text{db}}$ ) at the equator in terms of carrier wavelength ( $\lambda$ )?

A.  $20 \log(\lambda) + 21.98$

B.  $-20 \log(\lambda) + 173.07$

C.  $20 \log(\lambda) - 173.07$

D.  $-20 \log(\lambda) + 21.98$

Ans. B



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Sol. Pathloss  $\left(\frac{4\pi d}{\lambda}\right)^2$

$$\text{Pathloss (dh)} = 10 \log \left[ \frac{4\pi d}{\lambda} \right]^2$$

$$= 20 \log \left[ \frac{4\pi d}{\lambda} \right]$$

$$= 20 \log [4\pi \times 36000] 10^3 - 20 \log [\lambda]$$

$$= 20 \log [144\pi \times 10^3] - 20 \log \lambda$$

$$\text{Pathloss (dh)} = -20 \log \lambda + 173.1$$

**83.** If  $R$  = Earth's radius,  $h$  = orbit height,  $\beta$  = coverage angle, and  $\theta$  = minimum elevation angle, then which one of the following relations is correct?

A.  $\frac{R}{R+h} = \frac{\cos(\beta + \theta)}{\cos(\theta)}$

B.  $\frac{R}{h} = \frac{\cos(\beta)}{\cos(\theta)}$

C.  $\frac{h}{R} = \frac{\cos(\beta + \theta)}{\cos(\beta)}$

D.  $\frac{R+h}{h} = \cos(\beta + \theta) - \cos(\theta)$

Ans. A

**84.** Consider the following statements for public circuit-switching network:

1. Private branch exchange (PBX) is an application of circuit switching.
2. A switching centre that directly supports subscribers is known as digital PBX.
3. The link between the subscriber and the network, is also referred to as the local loop.

Which of the above statements are correct?

A. 1 and 2 only

B. 1 and 3 only

C. 1, 2 and 3

D. 2 and 3 only

Ans. C

Sol. All the statements are true. no further explanation is required.

**85.** Consider the following statements regarding the cellular system/network:

1. Cellular systems use open-loop power control and closed-loop power control.
2. For F DMA system, the capacity of a cell is more as compared to the number of frequency channels allocated to it.
3. A cell has  $L$  potential subscribers and is able to handle  $N$  simultaneous users. If  $L > N$ , then the system is referred to as nonblocking.

Which of the above statements are **not** correct ?

A. 1 and 2 only

B. 1 and 3 only

C. 1, 2 and 3

D. 2 and 3 only

Ans. B



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Sol. CELLULAR SYSTEM USES OPEN LOOP. not both open loop and closed loop. so statement 1 is false

Number of subscribers (L) > number of users it can handle simultaneously (N). THEN IT IS A BLOCKING SYSTEM. SO statement 3 is also false.

- 86.** The fundamental parameter of a single-mode fiber is
- A. The core diameter and cladding diameter.
  - B. The mode-field diameter.
  - C. The cladding diameter.
  - D. The buffer coating diameter.

Ans. A

**87.** Consider the following statements regarding the advantages of optical fiber communication:

- 1. Enormous potential bandwidth.
- 2. Electrical isolation.
- 3. Immunity to interference and crosstalk.
- 4. System reliability and ease of maintenance.

Which of the above statements are correct?

- A. 1 and 4 only
- B. 2, 3 and 4 only
- C. 1, 2 and 3 only
- D. 1, 2, 3, 4

Ans. D

**88.** Express the Boolean function  $F = A + \bar{B}C$  as a sum of minterms?

- A.  $ABC + \bar{A}\bar{B}C$
- B.  $A\bar{B}C + \bar{A}BC + A\bar{B}\bar{C}$
- C.  $ABC + AB\bar{C} + A\bar{B}C + A\bar{B}\bar{C} + \bar{A}\bar{B}C$
- D.  $AB\bar{C} + A\bar{B}C + \bar{A}\bar{B}\bar{C}$

Ans. C

Sol.  $F = A + \bar{B}C$

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

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

**89.** Consider the following statements regarding n-channel JFET:

- 1. The maximum drain current  $I_{DSS}$  occurs when gate-to-source voltage  $V_{GS} = 0$  V and drain-to-source voltage  $V_{DS} \geq |V_P|$ . ( $V_P$  is pinch-off voltage).
- 2. For gate-to-source voltage  $V_{GS}$  less than the pinch-off level, the drain current is 0 A.
- 3. For all levels of  $V_{GS}$  between 0 V and the pinch-off level, the current  $I_D$  will range between  $I_{DSS}$  and 0 A, respectively.



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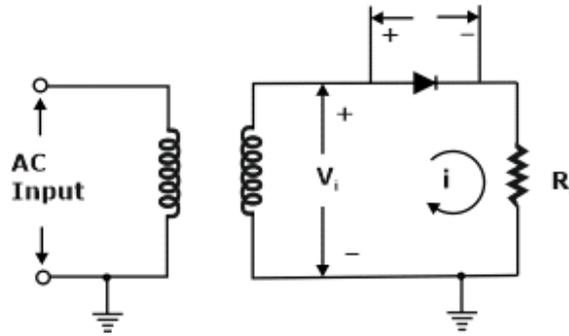
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Which of the above statements are correct?

- A. 1 and 2 only
- B. 1 and 3 only
- C. 1, 2 and 3
- D. 2 and 3 only

Ans. B

90. The circuit given below is a half wave rectifier. The internal resistance of a diode  $R_f$  is  $20 \Omega$  and load resistance  $R_L$  is  $1 \text{ k}\Omega$ . The input AC source with rms voltage is  $110 \text{ V}$ . What is the DC voltage across the diode?



- A. - 28.54 V
- B. - 38.54 V
- C. - 48.54 V
- D. - 58.54 V

Ans. C

Sol. 
$$\text{Avg.}[V_D] = \frac{-V_m}{\pi}$$

$$= \frac{-110\sqrt{2}}{3.14}$$

$$= - 49.54\text{V}$$

$\therefore R_f \ll R_L \Rightarrow$  Drop across diode is negligible.

91. At the higher frequencies, which one of the following becomes more confined to the region between the micro-strip and ground plane?

- A. Electric field
- B. Magnetic field
- C. Dispersion
- D. Skin effect

Ans. A

92. A magnetic field strength of  $5 \mu\text{A}/\text{m}$  is required at a point on  $\theta = \pi/2$ , which is  $2 \text{ km}$  from a half-wave dipole antenna in air. If the radiation resistance of the half-wave dipole antenna is  $73 \Omega$ , then the power radiated by this antenna (neglecting the ohmic loss) is

- A. 72 mW
- B. 144 mW
- C. 158 mW
- D. 316 mW

Ans. B



4. Mask-programmed ROMs are used in the applications where the system requires data to be stored and to be changed during the operation.

Which of the above statements are **not** correct ?

- A. 1 and 2 only
- B. 1, 3 and 4 only
- C. 1, 2 and 4 only
- D. 2, 3 and 4 only

Ans. \*

96. if each core in a 16-core processor has a yield of 90% and nothing else on the chip fails, what is the yield of the chip?

- A.  $(0.9)^8$
- B.  $(0.9)^{16}$
- C.  $(0.1)^8$
- D.  $(0.1)^{16}$

Ans. B

97. What is the simplified value of  $y(n)$ ,

$$y(n) = \sum_{n=-5}^5 \sin(2n)\delta(n+7) ?$$

- A.  $\sin 10$
- B.  $-\sin 10$
- C. 1
- D. 0

Ans. D

Sol. 
$$\sum_{n=-5}^5 \sin 2n \cdot \delta(n+7)$$

$\delta(n+7)$  is at  $n = -7$

$$n = -7 \notin [-5, 5]$$

$$\sum_{n=-5}^5 \sin 2n \cdot \delta(n+7) = 0$$

98. The energy of the signal  $x(n) = (-0.4)^n u(n)$  is

- A. 1/16
- B. 1/36
- C. 5/3
- D. 25/4

Ans. \*

Sol.  $x[n] = (-0.4)^n \cdot u[n]$

$$x[n]^2 = (0.16)^n \cdot u[n]$$

$$E = \sum_{n=-\infty}^{\infty} |x^2[n]|^2 = \sum_{n=0}^{\infty} (0.16)^n$$

$$= 1 + 0.16 + 0.16^2 + \dots$$

$$= \frac{1}{1 - 0.16}$$

$$E = \frac{25}{21} \text{ J}$$



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99. Consider the following statements for a system given by

$$y(n) = x(n) \sum_{k=-\infty}^{\infty} \delta(n - 3k)$$

1. The system is linear.
2. The system is non-linear.
3. The system is causal.
4. The system is non-causal.

Which of the above statements is/are correct?

- |                 |                 |
|-----------------|-----------------|
| A. 1 only       | B. 2 only       |
| C. 2 and 4 only | D. 1 and 3 only |

Ans. D

Sol.  $y[n] = x[n] \sum_{k=-\infty}^{\infty} \delta[n - 3k]$

(1) S/M is causal

as present O/P depends on present i/p

$$(2) a_1 y_1[n] = a_1 x_1[n] \sum_{k=-\infty}^{\infty} \delta[n - 3k]$$

$$a_2 y_2[n] = a_2 x_2[n] \sum_{k=-\infty}^{\infty} \delta[n - 3k]$$

$$y_A[n] = a_1 y_1[n] + a_2 y_2[n]$$

$$y_A[n] = [a_1 x_1[n] + a_2 x_2[n]] \sum_{k=-\infty}^{\infty} \delta[n - 3k]$$

$$y_A[n] = y_B[n] = T[a_1 x_1[n] + a_2 x_2[n]]$$

S/M is linear & causal.

100. Which one of the following is the zero-input response of the system

$$y[n] - 3y[n - 1] - 4y[n - 2] = 0$$

described by the homogeneous second-order difference equation if  $y[-2] = 0$  and  $y[-1] = 5$ ?

- |  |   |
|--|---|
| A. $y_{zi}(n) = (-1)^{n+1} + (-4)^{n+2}, n \geq 0$ | B. $y_{zi}(n) = (1)^{n+1} + (4)^{n+2}, n \geq 0$  |
| C. $y_{zi}(n) = (-1)^{n+1} + (4)^{n+2}, n \geq 0$  | D. $y_{zi}(n) = (1)^{n+1} + (-4)^{n+2}, n \geq 0$ |

Ans. C

Sol.  $y[n] - 3y[n - 1] - 4y[n - 2] = 0$

$$y(\tau) - 3[\tau^{-1}y(\tau) + y[-1]] - 4[\tau^{-2}y(\tau) + \tau^{-1}y(-1) + y(-\tau)] = 0$$

$$y(\tau) - 3\tau^{-1}y(\tau) - 15 - 4\tau^{-2}y(\tau) - 20\tau^{-1} = 0$$



**103.** An HR filter having numerator order M and denominator order N is to be realized using direct form II structure. How much total number of multiplication, additions and memory locations are required respectively?

- A. M+N, M+N and M+N
- B. M+N, M+N, and maximum of {M+N}
- C. M+N+1, M+N+1 and M+N
- D. M+N+1, M+N maximum of {M,N}

Ans. D

Sol: From direct form II realisation of IIR filter, if M and N are the orders of numerator and denominator or rational system respectively, then Max [M,N] memory location required. Direct form II requires same no. of addition and multiplication as that of direct form I.

**104.** In 8051, the accumulator register contains 80H and B register contains 8FH. The content of the accumulator and status of the carry flag after the addition operation are respectively.

- A. 0FH, 1
- B. 10FH, 0
- C. FFH, 1
- D. 10FH, 1

Ans. A

**105.** Which one of the following operations is not commutative?

- A. Scaling and reversal of a signal x[n]
- B. Scaling and folding of a signal x[n]
- C. Folding and time reversal of a signal x[n]
- D. Folding and time delaying of a signal x[n]

Ans. D

$$x[n] \xrightarrow{\text{fold}} x[-n] \xrightarrow[\text{delay } n_0]{} x[-n - n_0] = x[-n + n_0]$$

Sol.  $x[n] \xrightarrow[\text{delay } n_0]{} x[n - n_0] \xrightarrow{\text{fold}} x[-n - n_0]$   
 $\therefore \text{delay}(\text{fold}) \neq \text{fold}(\text{delay})$

**106.** Which one of the following systems provides a mechanism for translating program-generated addresses into correct main memory locations?

- A. Virtual memory system
- B. Main memory system
- C. Physical addresses system
- D. Memory space system

Ans. A

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**112.** The components of  $\vec{P} = 2\hat{a}_x - \hat{a}_z$  along  $\vec{Q} = 2\hat{a}_x - \hat{a}_y + 2\hat{a}_z$  is

- A.  $0.745\hat{a}_x + 0.298\hat{a}_y - 0.596\hat{a}_z$
- B.  $4\hat{a}_x - 2\hat{a}_y + 4\hat{a}_z$
- C.  $0.2222\hat{a}_x - 0.1111\hat{a}_y + 0.2222\hat{a}_z$
- D.  $0.4444\hat{a}_x - 0.2222\hat{a}_y + 0.4444\hat{a}_z$

Ans. D

Sol.  $P_Q = |P| \cos\theta \ a_Q$

$$\begin{aligned}
 &= (P \cdot a_Q) a_Q = \left( P \cdot \frac{Q}{|Q|} \right) \left( \frac{Q}{|Q|} \right) = \frac{(P \cdot Q)Q}{|Q|^2} \\
 &= \frac{(4 + 0 - 2)(2, -1, 2)}{4 + 1 + 4} = \frac{2}{9}(2, -1, 2) \\
 &= 0.4444 \bar{a}_x - 0.2222 \bar{a}_y + 0.4444 \bar{a}_z
 \end{aligned}$$

**113.** Consider the following equations with time factor  $e^{j\omega t}$ :

1.  $\oint D_s \cdot dS = \int \rho_{vs} \ dv$
2.  $\oint E_s \cdot d\ell = -j\omega B_s$
3.  $\oint B_s \cdot dS = 0$
4.  $\oint H_s \cdot dS = \int (J_s + j\omega D_s) \cdot d\ell$

Which of the above Time-Harmonic Maxwell's equations are correct?

- A. 1 and 2 only
- B. 1 and 3 only
- C. 1, 2 and 3 only
- D. 3 and 4 only

Ans. C

**114.** If  $\vec{A} = \rho \cos\phi \hat{a}_\rho + \sin\phi \hat{a}_\phi$ , then the surface integration of curl of  $\vec{A}$  (for  $30^\circ \leq \phi \leq 60^\circ$  and  $2 \leq \rho \leq 5$ ) is

- A. 6.750
- B. 4.941
- C. 0.732
- D. 1.765

Ans. B

Sol.

$$\begin{aligned}
 \nabla \times \vec{A} &= \frac{1}{\rho} \begin{vmatrix} \bar{a}_\rho & \rho \bar{a}_\phi & \bar{a}_z \\ \partial/\partial\rho & \partial/\partial\phi & \partial/\partial z \\ \rho \cos\phi & \rho \sin\phi & 0 \end{vmatrix} \\
 \nabla \times \vec{A} &= \frac{1}{\rho} [\bar{a}_z [\sin\phi + \rho \sin\phi]]
 \end{aligned}$$



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Now,

$$\begin{aligned} \iint (\nabla \times \mathbf{A}) \cdot \partial \mathbf{S} &= \int_2^5 \int_{30}^{60} \frac{1}{\rho} [\sin \phi + \rho \sin \phi] \bar{a}_z \cdot \rho \partial \phi \partial \rho \bar{a}_z \\ &= \int_2^5 \int_{30}^{60} [\sin \phi + \rho^2 \sin \phi] \partial \phi \partial \rho \\ &= \left[ 3 \times (-\cos 60 + \cos 30) \right] + \left[ \frac{21}{2} \times (-\cos 60 + \cos 30) \right] \\ &= 1.098 + 3.8432 = 4.941 \end{aligned}$$

**115.** Which one of the following is not the basic rule for boundary conditions at the surface between two different materials?

- A. The tangential components of electric field intensity are continuous across the boundary.
- B. The normal components of electric flux density are discontinuous at the boundary by an amount equal to the surface-charge density on the boundary.
- C. The tangential components of magnetic field intensity are discontinuous at the boundary by an amount equal to the surface-current density on the boundary.
- D. The normal components of electric field intensity are continuous across the boundary.

Ans. D

**116.** A uniform plane wave propagating in a medium has

$$\vec{E} = 2e^{-\alpha z} \sin(10^8 t - \beta z) \hat{a}_y \text{ V/m,}$$

If the medium is characterized by  $\epsilon_r = 1$ ,  $\mu_r = 20$  and  $\sigma = 3 \text{ S/m}$ . The values of  $\alpha$  and  $\beta$  are respectively,

- A. 30.70 Np/m, 30.70 rad/m
- B. 61.40 Np/m, 61.40 rad/m
- C. 122.80 Np/m, 122.80 rad/m
- D. 15.35 Np/m, 15.35 rad/m

Ans. B

Sol.

$$\frac{\sigma}{\omega \epsilon} = \frac{3}{10^8 \times 8.85 \times 10^{-12}} = 3389.83$$

$$\frac{\sigma}{\omega \epsilon} \gg 1,$$

Hence good conductor

$$\alpha = \beta = \sqrt{\frac{\omega \mu \sigma}{2}} = \sqrt{\frac{10^8 \times 4\pi \times 10^{-7} \times 20 \times 3}{2}} = 61.4 \text{ rad/m}$$



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**117.** A distortionless transmission line has the following parameters:

Characteristic impedance  $z_0 = 60\Omega$  wave velocity =  $0.6c$ , where  $c$  is the speed of light in a vacuum,  $\alpha = 20 \text{ mNp/m}$ . The values of transmission line parameters  $R$ ,  $L$ ,  $G$  and  $C$  at 100 MHz are respectively,

- A.  $1.2 \Omega/\text{m}$ ,  $333 \text{ nH/m}$ ,  $333 \mu\text{S/m}$ ,  $92.59 \text{ pF/m}$
- B.  $1.2 \Omega/\text{m}$ ,  $11 \text{ H/m}$ ,  $333 \mu\text{S/m}$ ,  $92.59 \text{ F/m}$
- C.  $2.4 \Omega/\text{m}$ ,  $333 \text{ nH/m}$ ,  $333 \mu\text{S/m}$ ,  $92.59 \text{ F/m}$
- D.  $2.4 \Omega/\text{m}$ ,  $111 \text{ H/m}$ ,  $333 \text{ S/m}$ ,  $92.59 \text{ pF/m}$

Ans. A

Sol. For distortion less

$$R/L = G/C$$

Only option (A) satisfying the condition

**118.** Consider the following statements regarding the Smith's chart:

1. Smith's chart is a graphical indication of the impedance of a transmission line and of the corresponding reflection coefficient as one moves along the line.
2.  $\lambda$  distance on the line corresponds to a  $720^\circ$  movement on the Smith's chart.
3. The admittance chart can be obtained by shifting each and every point on the impedance chart by  $90^\circ$ .
4. Counter-clockwise movement on the chart corresponds to moving towards the generator.

Which of the above statements are correct?

- A. 1 and 2 only
- B. 1 and 3 only
- C. 1, 2 and 4 only
- D. 2, 3 and 4 only

Ans. A

**119.** Consider the following statements regarding the load matching and impedance measurements:

1. A mismatched load can be properly matched to a line by inserting prior to the load a transmission line  $\lambda/4$  long
2. For matching of  $120 \Omega$  load to a  $75 \Omega$  line, the quarter-wave transformer must have a characteristic impedance of  $190 \Omega$
3. The main disadvantage of signal-stub matching is that it is a narrow-band or frequency-sensitive device.

Which of the above statements are not correct?

- A. 1 and 2 only
- B. 2 and 3 only
- C. 1 and 3 only
- D. 1, 2 and 3

Ans. A

Sol. Statement 1 and 2 are false



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**120.** Which of the following antennas are used directly as radiators aboard satellites to illuminate comparatively large areas of the Earth and they are widely used as primary feeds for reflector-type antennas both in transmitting and receiving modes?

- A. Dipole antennas
- B. End fire-array antennas
- C. Microstrip antennas
- D. Horn antennas

Ans. D

Sol. HORN ARE USED AS PRIMARY FEED

**121.** Which one of the following is correct for the given system?

$$y[n] = x[n] - x[n - 1]$$

- A. Time invariant and causal
- B. Time variant and non-causal
- C. Time variant and causal
- D. Time invariant and non-causal

Ans. A

Sol.  $y[n] = x[n] - x[n - 1]$

$$y_A[n] = y[n-k] = x[n-k] - x[n - k - 1] \quad \dots(1)$$

$$\text{and } y_B[n] = T\{x[n-k]\} = x[n-k] - x[n - k - 1] \quad \dots(2)$$

by (1) and (2)  $y_A[n] = y_B[n] \Rightarrow$  T.I.V S/m

and o/p depends only on present and past i/p sample, therefore causal.

Time-Invariant and causal System.

**122.** Two vectors  $V_1$  and  $V_2$  are orthogonal if their dot product is

- A. 1
- B. 0
- C. infinity
- D. 0.5

Ans. B

$$\bar{a} \cdot \bar{b} = |a| |b| \cos\theta$$

Sol. Orthogonal means  $\theta = 90$

$$\cos 90 = 0$$

$$\bar{a} \cdot \bar{b} = 0$$

**123.** A discrete-time LTI system with rational system function  $H(z)$  is causal if and only if

- A. the ROC is the exterior of a circle outside the outermost pole.
- B. the ROC is the interior of a circle outside the outermost pole.
- C. the ROC is the exterior of a circle outside the innermost pole.
- D. the ROC is the interior of a circle outside the innermost pole.

Ans. A

Sol.  $H(z)$  is causal if R.O.C is outside the outermost pole circle

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124. A feedback system has an open-loop transfer function of

$$G(s)H(s) = \frac{K(1-s)}{s(s^2+5s+9)}$$

By using the Routh criterion, the maximum value of K for the closed-loop system to be stable is

- A. 2.5
- B. 5
- C. 7.5
- D. 9

Ans. C

Sol.

$$s^3 + 5s^2 + 9s - KS + K = 0$$

$s^3$	1	9 - k
$s^2$	5	k
$s^1$	$45 - 5k - k$	0
$s^0$	5	
	k	

$45 - 5K - K > 0$
$45 - 6k > 0$
$k < 7.5$

For  $K_{max} = 7.5$

125. The steady-state error of type 1 system with input  $r(t) = t^2/2, t \geq 0$ , is

- A. 0
- B. 1/2
- C. 1
- D.  $\infty$

Ans. D

Sol. for type 1 system  $k_a = 0$ , steady state error for parabolic input =  $1/K_a$  so  $E_{ss} = \infty$  answer -D

126. Which one of the following statements is correct regarding constant N circles?

- A. The locus of constant, closed-loop magnitude frequency response for unity feedback systems.
- B. The locus of constant, closed-loop phase frequency response for unity feedback systems.
- C. A subsystem inserted into the forward or feedback path for the purpose of improving the transient response or steady-state error.
- D. A system that monitors its output and corrects for disturbances. It is characterized by feedback paths from the output.

Ans. B

Sol. Given a positive real value N representing a phase angle the point satisfying.

$$N = \arg \left[ \frac{G(s)}{1 + G(s)} \right] = \arg[G(s)] - \arg[1 + G(s)] = \arg|z| - \arg|1 + z|$$



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- 127.** Which one of the following digital modulation schemes has the bit error rate as  $\frac{1}{2} \operatorname{erfc} \left( \sqrt{\frac{E_b}{N_0}} \right)$ ?
- A. Coherent binary PSK
  - B. Coherent binary FSK
  - C. DPSK
  - D. Noncoherent binary FSK

Ans. A

- 128.** Which one of the following conditions is justifying a second order approximation?
- A. Closed-loop zeros near the closed-loop second order pole pair are nearly cancelled by the close proximity of higher order closed loop poles.
  - B. Closed-loop zeros cancelled by the close proximity of higher-order closed-loop poles are far removed from the closed-loop second order pole pair.
  - C. Closed-loop zeros near the closed-loop second-order pole pair are not cancelled by the close proximity of higher order closed loop poles.
  - D. Closed-loop zeros cancelled by the close proximity of higher-order closed-loop poles are far removed from the closed-loop second-order zero pair.

Ans. A

- 129.** Consider the following statements regarding the disadvantages of a passive lead network over an active PD controller:
1. No additional power supplies are required.
  2. Noise due to differentiation is reduced.
  3. Additional pole does not reduce the number of branches of the root locus that cross the imaginary axis into the right half-plane.
  4. Addition of the single zero of the PD controller tends to reduce the number of branches of the root locus that cross into the right half-plane.

Which of the above statements is/are correct?

- A. 1 only
- B. 2 only
- C. 3 and 4 only
- D. 1, 2 and 4 only

Ans. C

Sol. Advantage of PD

- (1) PD controller introduce zero in open loop-due to this zero root bend in LHP
- (2) PD controller introduce zero so additional pole does not cross the imaginary axis.

- 130.** Which one the following characteristics is correct regarding RISC processor?
- A. Relatively very large addressing modes
  - B. Multi-cycle instruction execution
  - C. All operations are not done within the registers of the CUP
  - D. Relatively few instructions



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Ans. D

Sol. Option (A) wrong

as RISC support less addressing mode option (B) wrong

It takes a single clock cycle to get executed

Option (C) wrong

Option (D) correct

It supports relatively less instruction.

Option (D) correct

**131.** Which one of the following instruction in a stack computer consists of an operation code only with no address field?

A. PUSH X

B. POP X

C. ADD

D. LOAD A

Ans. C

Sol. Operation type instruction does not recall the address field in this CPU organisation. This is because the operation is performed on the two operation that are on the top of the stack. ADD Instruction contains the opcode only with no address field.

**132.** Which one of the following statements is correct regarding arithmetic and logical operations?

A. When two 3-bit unsigned numbers are multiplied, the result is an 8-bit product that must be stored in three memory words.

B. When two 16-bit unsigned numbers are multiplied, the result is a 32-bit product that must be stored in two memory words.

C. Operations that are implemented in a computer with one machine instruction are said to be implemented by software.

D. Operations implemented by set of instructions that constituted a program are said to be implemented by hardware.

Ans. B

**133.** Which one of the following techniques the simplicity of the direct mapping technique in terms of determining the target set?

A. Set-associative-mapping technique

B. Set-associative-direct mapping technique

C. Direct mapping set technique

D. Indirect mapping set technique

Ans. A



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Sol. Set associative mapping is an enhanced form of direct mapping where the draw backs of direct mapping are removed. Set associative addresses the problem of possible thrashing in the direct mapping method.

**134.** Which one of the following memories is primarily used to store machine microcode, desktop bootstrap loaders, and video game cartridges?

- A. Mask-programmed ROM
- B. Static-RAM
- C. Dynamic-RAM
- D. Non-Programmed ROM

Ans. D

Sol. Non-programmed ROM is used to store machine microcode, desktop bootstrap loader, and video game cartridges.

When an system starts, following things takes place in a computer.

1. Powerup/Reboot causes instruction register to be loaded with a predefined memory location. It contains a jump instruction that transfer to the location of Bootstrap program. [Hardware doesn't know the as location and how to load it.]
2. This Bootstrap program, and machine microcode is in non-Programmed ROM, because RAM is in unknown state a system startup. ROM is convenient as it needs no initialization and can't be affected by virus.

So, bootstrap leader is required at the time of system startup and they reside in non-programmed ROM. Therefore, option D is the correct answer.

**135.** In which one of the following situations is the CPU often idle ?

- A. The speeds of the mechanical I/O devices are intrinsically slower than those of electronic devices.
- B. The speeds of the electromechanical I/O devices are intrinsically faster than those of electronic devices.
- C. The speeds of the electrical I/O devices are intrinsically slower than those of electronic devices.
- D. The speeds of the electrical I/O devices are intrinsically faster than those of electronic devices.

Ans. A

Sol. In a computer CPU and memory are electronic devices. I/O devices are electromechanical and electromagnetic devices, which are slower than CPU.

**136.** A white noise of magnitude  $0.001 \mu \text{ W/Hz}$  is applied to an RC low-pass filter of  $R = 1 \text{ k}\Omega$  and  $C = 0.1 \mu \text{ F}$ . The output noise power of the RC low-pass filter is

- A.  $0.5 \mu \text{ W}$
- B.  $1.5 \mu \text{ W}$
- C.  $2.5 \mu \text{ W}$
- D.  $3.5 \mu \text{ W}$



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Ans. B

Sol.

$$R = 1k\Omega$$

$$C = 0.1\mu\text{f}$$

$$f_c = \frac{1}{2\pi RC} = \frac{1}{2\pi \times 10^3 \times 0.1 \times 10^{-6}}$$

$$f_c = \frac{10^4}{2\pi}$$

$$P_{\text{output}} = f_c P_{\text{input}}$$

$$= \frac{10^4}{2\pi} \times 0.001 \mu\text{W}$$

$$= 1.59 \mu\text{W}$$

$$\approx 1.5 \mu\text{W}$$

Option B is correct.

**137.** The two random variables X and Y are uncorrelated if and only if their covariance is

A. 0

B. 1

C. -1

D. infinity

Ans. A

**138.** the antenna current of an AM transmitter is 8A when only the carrier signal is transmitted.

What is the antenna current when the carrier signal is modulated by sinusoidal signal  $V(t)$

$= 1.4 \sin(2\pi \times 500t)$  with modulation index 0.8?

A. 3.2 A

B. 7.2 A

C. 9.2 A

D. 11.2 A

Ans. C

Sol.  $I_c = 8 \text{ Amp}$

$$I_t = ?$$

$$I_t = I_c \sqrt{1 + \frac{\mu^2}{2}}$$

$$I_t = 8 \sqrt{1 + \frac{0.64}{2}}$$

$$I_t = 8 \sqrt{1.32}$$

$$= 8 \times [1.489]$$

$$I_t = 9.17 \text{ Amp}$$



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Ans. C

Sol.

$$|V_0|_{\max} = 0.11 \text{ Am}$$

$$\frac{\Delta}{2} = \frac{0.1}{100} \text{ Am}$$

$$\frac{\Delta}{2} = 0.001 \text{ Am}$$

$$\Delta = 0.002 \text{ Am}$$

$$\Delta = \frac{2\text{Am}}{L}$$

$$0.002 \text{ Am} = \frac{2\text{Am}}{L}$$

$$L = \frac{2}{0.002}$$

$$L = 1000$$

$$n = 10$$

**143.** Six analog information signals, each band-limited to 4 kHz, are required to be time-division multiplexed and transmitted by a TDM system. The minimum transmission bandwidth and the signalling rate of the PAM/TDM channel are respectively,

A. 24 kHz and 48 kbps

B. 24 kHz and 8 kbps

C. 48 kHz and 48 kbps

D. 48 kHz and 16 kbps

Ans. A

Sol.

$$R_b = Nf_s$$

$$\therefore f_s = 2 \times 4 \text{ kHz} = 8 \text{ kHz}$$

$$\therefore R_b = 6 \times 8 \text{ kHz}$$

$$= 48 \text{ kbps}$$

$$B_{\omega_{\min}} = \frac{R_b}{2} = \frac{48}{2} = 24 \text{ kHz}$$

**144.** A 2000 bps binary information data signal is required to be transmitted in half-duplex mode using BFSK digital modulation technique. If the separation between two carrier frequencies is 4000 Hz, then the minimum bandwidth of the BFSK signal is

A. 4 kHz

B. 6 kHz

C. 8 kHz

D. 12 kHz

Ans. C

Sol. For BFSK

$$\text{Bandwidth} = 2R_b + (f_H - f_L)$$

$$= 2 \times 2000 + 4000 = 8000 = 8 \text{ kHz.}$$



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**145.** If voice activity interference reduction factor is 2.5, antenna sectorization gain factor in 2.5 and interference increase factor is 1.6, then the performance improvement factor in CDMA digital cellular system is

- A. 1.2
- B. 2.5
- C. 3.1
- D. 3.9

Ans. D

Sol. Performance improvement force = Interference reduce force × Sectoral gain force / Interference increase factor

$$= \frac{2.5 \times 2.5}{1.6} = \frac{6.25}{1.6}$$

$$= 3.90$$

**146.** The temperature at a particular place varies between 14°C and 34°C. For the purpose of transmitting the temperature record of that place using PCM, the record is sampled at an appropriate sampling rate and the samples are quantized. If the error in representation of the samples due to quantization is not to exceed ± 1% of the dynamic range, what is the minimum number of quantization levels that can be used?

- A. 100
- B. 50
- C. 30
- D. 15

Ans. B

Sol.

$$\frac{A_m}{L} \leq 1\% \text{ of } 2A_m$$

$$\frac{A_m}{L} \leq \frac{2A_m}{100}$$

$$L \geq 50$$

**147.** A multimode step index fiber with a core diameter of 80 μm and a relative index difference of 1.5% is operating at a wavelength of 0.85 μm. If the core refractive index is 1.18, then the normalized frequency for the fiber is

- A. 37.9
- B. 75.8
- C. 151.6
- D. 303.2

Ans. B

Sol.  $d = 80 \times 10^{-6} \text{ m}$

$$\frac{n_1 - n_2}{n_1} = 1.5\%$$

$$\lambda = 0.85 \mu\text{m}$$

$$n_1 = 1.48$$

$$V_m = ?$$

$$\frac{1.48 - n_2}{1.48} = \frac{1.5}{100}$$

$$148 - 100n_2 = 1.5 \times 1.48$$

$$148 - 100n_2 = 2.22$$

$$100n_2 = 145.78$$

$$n_2 = 1.4578$$

$$\begin{aligned} V_m &= \frac{\pi d}{\lambda} \sqrt{n_1^2 - n_2^2} \\ &= \frac{\pi [80 \times 10^{-6}]}{0.85 \times 10^{-6}} \sqrt{(1.48)^2 - (1.4578)^2} \\ &= \frac{\pi \times 80 \times 100}{85} \sqrt{2.1904 - 2.12518} \\ &= 295.6 \sqrt{0.0653} \\ &= 295.6 [0.2555] \\ &= 75.53 \end{aligned}$$

**148.** The even and odd components of the signal  $x(t) = e^{-2t} \cos t$  are respectively,

- A.  $\cos 2t \cos t$  and  $-\sin 2t \cos t$
- B.  $\sinh 2t \sin t$  and  $-\cosh 2t \cos t$
- C.  $\cos 2t \sin t$  and  $-\sin 2t \cos t$
- D.  $\cosh 2t \cos t$  and  $-\sinh 2t \cos t$

Ans. D

Sol.  $x(t) = e^{-2t}$

$$x(-t) = e^{2t} \cos t$$

$$x_e(t) = \frac{x(t) + x(-t)}{2} \cos t \left( \frac{e^{-2t} + e^{+2t}}{2} \right)$$

$$x_e(t) = \cosh et. \cos t$$

$$x_o(t) = \frac{x(t) - x(-t)}{2}$$

$$x_o(t) = \frac{e^{-2t} \cos t - e^{2t} \cos t}{2}$$

$$= -\cos t \left( \frac{e^{2t} - e^{-2t}}{2} \right)$$

$$x_o(t) = -\sinh 2t. \cos t$$



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