

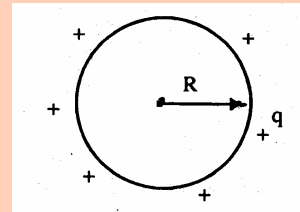
## ELECTRONICS AND TELECOMMUNICATION ENGINEERING

## PAPER-I

1. Let  $h(t)$  be the response of a linear system to unit impulse  $\delta(t)$ . Consider the following statements in this regard:
    1. If the system is causal,  $h(t) = 0$  for  $t < 0$ .
    2. If the system is time variable, then the response of the system to an input of  $\delta(t - T)$  is  $h(t - T)$  for all values of the constant  $T$ .
    3. If the system is non - dynamic, then  $h(t)$  is of the form  $A \delta(t)$ , where the constant  $A$  depends on the system.
 Of these statements
    - a. 1 and 2 are correct
    - b. 1 and 3 are correct
    - c. 2 and 3 are correct
    - d. 1, 2 and 3 are correct
  2. Which one of the following systems is non linear[  $y(t)$  output ;  $x(t)$  = input]
    - a.  $y(t) = 2x(t-1) - 3x(t-2) + x(t-3)$
    - b.  $y(t) = 5x(t)$
    - c.  $y(t) = 2x(t-1) - x(t-2) - x(t-4)$
    - d.  $y(t) = 2x(t) + 3.6$
  3. Which one of the following difference equations is non-recursive? [ $Y(k)$  = output ;  $u(k)$  = input]
    - a.  $y(k+2) + 2y(k+1) - 3y(k) = u(k+1)$
    - b.  $y(k+1) + y(k) = u(k+1) + 2u(k) + u(k-1)$
    - c.  $y(k+1) + y(k) = u(k+1) + u(k) + u(k-1)$
    - d.  $y(k+1) + y(k) = u(k+1) + 3u(k) + u(k-1)$
  4. Of the following transfer functions of second order linear time invariant systems, the under damped system is represented by
    - a.  $H(s) = \frac{1}{s^2 + 4s + 4}$
    - b.  $H(s) = \frac{1}{s^2 + 5s + 4}$
    - c.  $H(s) = \frac{1}{s^2 + 4.5s + 4}$
    - d.  $H(s) = \frac{1}{s^2 + 5s + 4}$
  5. A periodic voltage having the Fourier series  $v(t) = 1 + 4 \sin \omega t + 2 \cos \omega t$  volts is applied across a one - ohm resistor. The power dissipated in the one – ohm resistor is
    - a. 1W
    - b. 11W
    - c. 21W
    - d. 24.5W
  6. Let  $F(\omega)$  be the Fourier transform of a function  $f(t)$  ; then  $F(0)$  is
    - a.  $\int_{-\infty}^{\infty} f(t) dt$
    - b.  $\int_{-\infty}^{\infty} 1 f(t) 1^2 dt$
    - c.  $\int_{-\infty}^{\infty} 1 t f(t) 1^2 dt$
    - d.  $\int_{-\infty}^{\infty} t f(t) dt$
  7. Given that the Fourier transform of  $f(t)$  is  $f(j\omega)$ , which of the following pairs of functions of time and the corresponding Fourier transforms are correctly matched?
    1.  $f(t+2)$ ..... $e^{12\omega} F(j\omega)$
    2.  $f(-0.5t)$ ..... $2F(-2j\omega)$
    3.  $\int_{-\infty}^t f(t) dt$  ..... $F(j\omega) \left[ \frac{1}{j\omega} + \pi \delta(\omega) \right]$
- Select the correct answer using the codes given below:  
Codes:  
a. 1 and 2

- b. 1 and 3  
c. 2 and 3  
d. 1,2 and 3
8. The impulse response of a single - pole system would approach a non-zero constant as  $t \rightarrow \infty$  if and only if the pole is located in the s-plane  
a. On the negative real axis  
b. At the origin  
c. On the positive real axis  
d. On the imaginary axis
9. If  $x(t)$  and  $\frac{dx(t)}{dt}$  are Laplace transformable and  $\lim_{t \rightarrow \infty} x(t)$  exists, then  $\lim_{t \rightarrow \infty} x(t)$  is equal to  
a.  $\lim_{t \rightarrow \infty} sX(S)$   
b.  $\lim_{t \rightarrow 0} sX(S)$   
c.  $\lim_{t \rightarrow \infty} \frac{X(S)}{s}$   
d.  $\lim_{t \rightarrow 0} \frac{X(S)}{s}$
10. If  $f_1(t)$  and  $f_2(t)$  are duration - limited signals such that  
 $f_1(t) \neq 0$  for  $1 < t < 3 = 0$  elsewhere  
 $f_2(t) \neq 0$  for  $5 < t < 7 = 0$  elsewhere  
Then the convolution of  $f_1(t)$  and  $f_2(t)$  is zero everywhere except for  
a.  $1 < t < 7$   
b.  $3 < t < 5$   
c.  $5 < t < 21$   
d.  $6 < t < 10$
11. The impulse response of a causal, linear time - invariant, continuous - time system is  $h(t)$ . The output  $y(t)$  of the same system to an input  $x(t)$ , where  $x(t) = 0$  for  $t < -2$ , is  
a.  $\int_0^t h(\tau) \times (t - \tau) d\tau$   
b.  $\int_{-2}^t h(\tau) \times (t - \tau) d\tau$   
c.  $\int_{-2}^{t-2} h(\tau) \times (t - \tau) d\tau$   
d.  $\int_0^{t+2} h(\tau) \times (t - \tau) d\tau$
12. If  $a(n)$  is the response of a linear, time invariant, discrete -time system to a unit step input, then the response of the same system to a unit impulse input is  
a.  $\frac{d}{dn}[a(n)]$   
b.  $n a(n)$   
c.  $a(n) - a(n-1)$   
d.  $a(n+1) - 2a(n) + a(n-1)$
13. If the function  $H_1(z) = (1 + 1.5z^{-1} - z^{-2})$  and  $H_2(z) = (z^2 + 1.5z - 1)$  then  
a. The poles and zeros of the functions will be the same.  
b. The poles of the functions will be identical but not zeros.  
c. The zeros of the functions will be identical but not the poles.  
d. Neither the poles. Nor the zeros of the two functions will be identical
14. The spectral density of a random signal is given by  $\pi[\delta(\omega - \omega_0) + \delta(\omega + \omega_0)]$   
The auto - correlation function of the signal is  
a.  $\cos \omega_0 \tau$   
b.  $\sin \omega_0 \tau$   
c.  $\cos[(\omega - \omega_0) \tau]$   
d.  $\sin[(\omega - \omega_0) \tau]$
15. The auto - correlation of a wide - sense stationary random process is given by  $e^{-2|\tau|}$ . The peak value of the spectral density is  
a. 2  
b. 1  
c.  $e^{-1/2}$   
d. e
16. The covariance function,  $C_x(\tau)$ , of a stationary stochastic process,  $x(t)$ , is said to be positive definite. This means that  
a.  $C_x(\tau) \geq 0$  for all  $\tau$   
b.  $\int_{-\infty}^{\infty} C_x(\tau) d\tau \geq 0$   
c.  $\int_{-\infty}^{\infty} C_x(\tau) \exp(-j\omega\tau) d\tau \geq 0$

- d.  $C_x(0) \geq 0$
17. The depth of penetration or skin depth for an electromagnetic field of frequency 'f' in a conductor of resistivity  $\rho$  and permeability  $\mu$  is
- Inversely proportional to  $\rho$  and f and directly proportional to  $\mu$ .
  - Directly proportional to  $\rho$  and inversely proportional to f and  $\mu$ .
  - Directly proportional to f and inversely proportional to  $\rho$  and  $\mu$
  - Inversely proportional to  $\rho$  and  $\mu$  and directly proportional to f
18. An isolated sphere in air has a radius equal to  $1/4\pi\epsilon_0$  meter, its capacitance will be
- $\pi F$
  - 1F
  - $4\pi F$
  - $\frac{1}{4\pi} F$
19. The displacement flux density at a point on the surface of a perfect conductor is  $\vec{D} = 2(\hat{a} - \sqrt{3}\hat{a}) \text{ C/m}^2$  and is pointing away from the surface. The surface charge density at the at point ( $\text{C/m}^2$ ) will be
- 2
  - 2
  - 4
  - 4
20. The torque (in N - m) acting on a circular current loop of radius 1 mm, in the xy - plane, connected at the origin and with current 0.1 A flowing in the sense of increasing  $\phi$  in a magnetic field  $B = 10^{-5} (2\hat{a}_x - 2\hat{a}_y + \hat{a}_z) \text{ Wb/m}^2$  is:
- $-2 \times 10^{-12} (2\hat{a}_x - 2\hat{a}_y + \hat{a}_z)$
  - $2 \times 10^{-12} \pi (\hat{a}_x + \hat{a}_y)$
  - $10^{-12} \pi$
  - $-10^{-12} \pi$
21. The given figure shows the surface charge distribution of q coulombs/m<sup>2</sup>. What is the force on a unit charge placed the centre of circle?



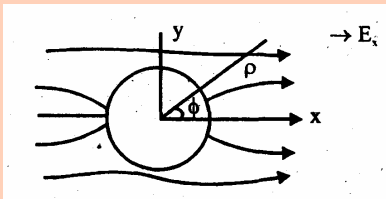
- Zero
  - $\frac{q}{4\pi R^2} N$
  - $\frac{q^2}{4\pi R^2} N$
  - $\frac{q^2}{4\pi R^2} N$
22. Consider an arbitrary distribution of conducting bodies in a charge - free space. According to the uniqueness theorem, which of following are required to be specified in order that the field is uniquely determined everywhere?
- Total charge on each conductor.
  - Potential at each conductor surface.
  - Potential at some of the conductors and total charge on the remainder.
  - Total charge as well as potential gradient on each conductor surface.
- Select the correct answer using the codes given below:
- Codes:
- 1 and 3
  - 2 and 4
  - 1,2 and 3
  - 1, 2,3and 4
23. A transmission line of characteristic impedance  $Z_0 = 50 \text{ ohms}$ , phase velocity  $v_p = 2 \times 10^8 \text{ m/s}$ , and length  $l = 1 \text{ m}$  is terminated by a load  $Z_L = (30 - j40) \text{ ohms}$ . The input impedance of the line for a frequency of 100 MHz will be
- $(30 + j40) \text{ ohms}$
  - $(30 - j40) \text{ ohms}$
  - $(50 + j40) \text{ ohms}$
  - $(50 - j40) \text{ ohms}$
24. A line of characteristic impedance  $z_0$  ohms, phase velocity  $v_p = 2 \times 10^8 \text{ m/s}$  and length  $l = 2 \text{ m}$  is terminated by a load impedance  $z_L$  ohms. The reflection coefficients at the input end and load end

are respectively  $\Gamma_1$  and  $\Gamma_R$ . The ratio  $\frac{\Gamma_1}{\Gamma_R}$

for a frequency of 50 MHz will be

- 1
- 1
- $\sqrt{-1}$
- 2

25. Consider a conducting cylinder along the z-axis in a uniform field  $\vec{E} = \hat{x}E_x$  as shown in the given figure. The P- component of electric field strength in the region outside the cylinder is given by (a = radius of cylinder surface)



- $E_\rho = \left( \frac{a^2}{\rho^2} + 1 \right) E_x \cos \phi$
- $E_\rho = \left( \frac{a^2}{\rho^2} + 1 \right) E_x \sin \phi$
- $E_\rho = (\rho^2 + a^2) E_x \sin \phi$
- $E_\rho = \left( \frac{\rho^2 + a^2}{\rho^2 a^2} \right) E_x \sin \phi$

26. A point charge 'q' is situated at a distance 'd' from the centre of a grounded conducting sphere of radius 'R' ( $d > R$ ). The value of the image charge is 'q' at a distance 'b' from the centre. The quantities 'q' and 'b' will be respectively

- $-(R/d)q$  and  $R^2/d$
- $-(R^2/d)q$  and  $d^2/R$
- $(R/d)q$  and  $R^2/d$
- $-(R/d)q$  and  $d^2/R$

27. The intensity of radiation of a dipole depends strongly on frequency. If, at a frequency f, the intensity of radiation is 'I', then at a frequency of f/2, the intensity will be

- I/2
- I/4
- I/8
- I/16

28. The ratio of the directivity of an end-fire antenna to that of a broad-side antenna is

- 2
- 3
- 4
- 5

29. In an isotropic inhomogeneous dielectric medium, free of charges and currents, 'the wave equation for electric field having harmonic time dependence of  $\exp(j\omega t)$  is given by ( $k^2 = \omega^2 \mu \epsilon$ ):

- $\nabla^2 \vec{E} + \frac{\nabla \epsilon}{\epsilon} + k^2 \vec{E} = 0$
- $\nabla^2 \vec{E} + \nabla \epsilon (\nabla \cdot \vec{E}) + k^2 \vec{E} = 0$
- $\nabla^2 \vec{E} + \nabla \left( E + \frac{\nabla \epsilon}{\epsilon} \right) + k^2 \vec{E} = 0$
- $\nabla^2 \vec{E} + \vec{E} \times \frac{\nabla \epsilon}{\epsilon} + k^2 \vec{E} = 0$

30. A uniform plane wave is incident from free space ( $z < 0$ ) normally on an isotropic perfect dielectric medium ( $z > 0$ ), characterized by the permittivity matrix

$$[\epsilon] = \epsilon_0 \begin{bmatrix} 4 & 0 & 0 \\ 0 & 9 & 0 \\ 0 & 0 & 4 \end{bmatrix} \text{ and } \mu = \mu_0$$

The electric field of the incident wave is  $E_1 = E_0 \cos(\omega t - \beta z) \hat{a}_y$  where  $\omega = 3 \times 10^9 \pi$  and  $\beta = 10\pi$ . The electric field of the transmitted wave  $E_1$  is given by

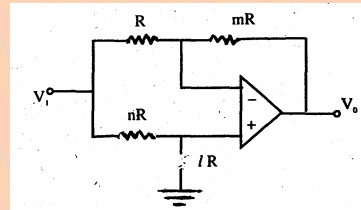
- $\frac{2}{3} E_0 (\cos \omega t - \beta z) \hat{a}_x$
- $\frac{2E_0}{3} \cos(\omega t - 2\beta z) \hat{a}_x$
- $\frac{1}{2} E_0 (\cos \omega t - \beta z) \hat{a}_y$
- $\frac{1}{2} E_0 \cos(\omega t - 3\beta z) \hat{a}_y$

31. For transmission of wave from a dielectric medium of permittivity  $\epsilon_1$  into a dielectric medium of lower permittivity  $\epsilon_2$  ( $\epsilon_1 > \epsilon_2$ ) the critical angle of incidence  $\theta_c$  (relative to the interface) is given by

- a.  $\sin^{-1} \sqrt{\frac{\epsilon_2}{\epsilon_1}}$
- b.  $\cos^{-1} \sqrt{\frac{\epsilon_2}{\epsilon_1}}$
- c.  $\tan^{-1} \sqrt{\frac{\epsilon_2}{\epsilon_1}}$
- d.  $\sin^{-1} \left( \frac{\epsilon_2}{\epsilon_1} \right)$
32. For incidence from dielectric medium 1 ( $\epsilon_1$ ) on to dielectric medium 2 ( $\epsilon_2$ ), the Brewster angle  $\theta_p$  and the corresponding angle of transmission  $\theta_t$  for  $\frac{\epsilon_1}{\epsilon_2} = 3$  will be respectively.
- a.  $30^\circ$  and  $30^\circ$
- b.  $30^\circ$  and  $60^\circ$
- c.  $60^\circ$  and  $30^\circ$
- d.  $60^\circ$  and  $60^\circ$
33. For the dominant mode, in a rectangular waveguide with breadth 10cm, the guide wavelength for a signal of 2.5 GHz will be
- a. 12 cm
- b. 15 cm
- c. 18 cm
- d. 20cm
34. The degenerate modes in a waveguide are characterized by
- a. Same cut-off frequencies but different field distributions
- b. Same cut-off frequencies and same field distributions
- c. Different cut-off frequencies but same field distributions
- d. Different cut-off frequencies and different field distributions
35. For TM waves in a parallel plate waveguide, the minimum attenuation arising from imperfect conductors would occur at a frequency of ( $f_c$  is the cut-off frequency)
- a.  $3 f_c$
- b.  $\sqrt{3} f_c$
- c.  $2 f_c$
- d.  $\sqrt{2} f_c$
36. For a rectangular waveguide ( $a \times b$ ,  $a > b$ ) to support only the  $TE_{10}$  mode at wavelength  $\lambda$ . Which one of the following pairs of inequalities is to satisfied?
- a.  $b < \lambda < 2b$ ;  $\lambda > 2a$
- b.  $b < \lambda < 2b$ ;  $\lambda < 2a$
- c.  $a < \lambda < 2a$ ;  $\lambda > 2b$
- d.  $a < \lambda < 2a$ ;  $\lambda < 2b$
37. Which one of the following types of hollow cavity resonators of the same surface area would have the highest Q factor?
- a. Spherical cavity made of copper
- b. Spherical cavity made of silver
- c. Cylindrical cavity made of copper
- d. Cylindrical cavity made of silver
38. The sinusoidal time - varying vector field  $\vec{F} = 2 \cos(\omega t + 30^\circ) \hat{a}_x + 2 \cos(\omega t - 30^\circ) \hat{a}_y$
- a. Elliptically polarized
- b. Circularly polarized
- c. Linearly polarized
- d. Unpolarized
39. For a uniform plane wave of frequency  $10^9$  Hz propagating in a good conductor, the field undergoes a change in phase by  $2\pi$  radians over a distance of 1m. the field is attenuated by a factor of  $1/e$  at a distance of
- a.  $\frac{1}{2\pi} m$
- b.  $\frac{1}{\pi} m$
- c.  $\pi m$
- d.  $2\pi m$
40. The sum of two oppositely rotating circularly polarized, waves of equal amplitude will be
- a. A circularly polarized wave
- b. A linearly polarized wave
- c. An elliptically polarized wave
- d. An unpolarized wave
41. The ground wave gradually disappears as one moves away from the transmitter because of

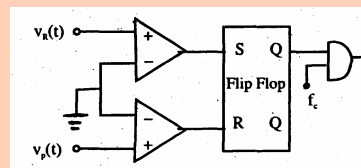


- a. Loss of line of sight conditions  
b. Interference from the sky waves  
c. Maximum single hop distance limitation  
d. Finite conductivity of the earth's surface
42. The sensitivity of a voltmeter using 0 to 5 mA meter movement is  
a. 50 ohm/volt  
b. 100 ohm/volt  
c. 200 ohm/volt  
d. 500 ohm/volt
43. Two sinusoidal signals having the same amplitude and frequency are applied to the X and Y inputs of a CRO. The observed Lissajous figure is a straight line. The phase shift between the two signals would be  
a. Zero  
b. 90 degrees  
c. Either zero or 180 degrees  
d. Either 90 degrees or 270 degrees
44. If a dynamometer type wattmeter is connected in an ac circuit, the power indicated by the wattmeter will be  
a. Volt - ampere product  
b. Average power  
c. Peak power  
d. Instantaneous power
45. DC voltage of the order a few mV can be measured accurately using a/an  
a. Moving coil voltmeter  
b. Null-balancing potentiometer  
c. Moving iron voltmeter  
d. Electrostatic voltmeter
46. On a voltage scale, zero dBm in a 600-ohm system would refer to  
a. 1.732 V  
b. 1.0V  
c. 0.7746 V  
d. 0.5. V
47. The "accuracy" of a measuring instrument is determined by the  
a. Closeness of the value indicated by it to the correct value of the measured  
b. Repeatability of the measured value  
c. Speed with which the instrument's reading approaches the final value  
d. Least change in the value of the measured that could be detected by the instrument
48. Two resistors  $R_1=36$  ohm and  $R_2=75$  ohms, each having tolerance of  $\pm 5\%$  are connected in series. The value of the resultant resistance will be  
a.  $111 \pm 0$  ohm  
b.  $111 \pm 2.778$  ohm  
c.  $111 \pm 5.55$  ohm  
d.  $111 \pm 7.23$
49. In the circuit shown, it is required that  $V_0 = V_1$  the values of  $l, m, n$  are respectively. (x represents don't care condition)



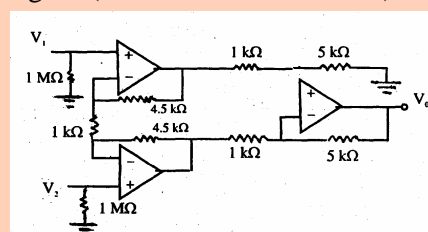
- a. 0,1,1  
b.  $\infty, x, x$   
c.  $x, \infty, x$   
d. 0,x, $\infty$

50. Part of a digital phase meter is shown in the figure. If the input signals are  $v_R(t) = V_R \sin \omega t$  and  $v_p(t) = V_p \sin(\omega t + 30^\circ)$  the reading of the meter will be



- a.  $30^\circ$   
b.  $330^\circ$   
c.  $150^\circ$   
d.  $210^\circ$

51. Consider the following statements in respect of the circuit shown in the given figure (assume ideal OP- AMP)

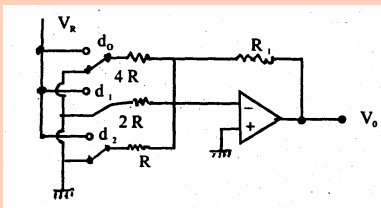


1. The common mode input impedance is  $1/2 \text{ M}\Omega$
2. The differential mode input impedance is  $2 \text{ M}\Omega$ .
3. The differential mode gain is 50.
4. The common mode gain is zero.

Of these statements

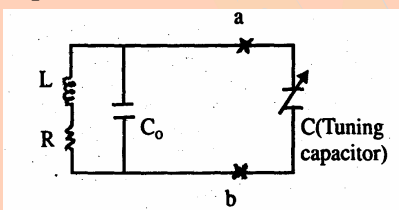
- a. 1, 2, 3 and 4 are correct
- b. 1, 2 and 3 are correct
- c. 2, 3 and 4 are correct
- d. 1 and 4 are correct

52. A 3-bit weighted resistor DAC shown in the figure has  $V_R = 2\text{V}$  and  $R_1/R = 2$ . For an input of 100 the output will be



- a.  $-2\text{V}$
- b.  $-4\text{V}$
- c.  $2\text{V}$
- d.  $4\text{V}$

53. In the given circuit,  $C_0$  is the distributed capacitance of the coil and  $C$  is the tuning capacitor. If  $C = C_1$  for the fundamental frequency and  $C = C_2$  for the second harmonic, then the value of  $C_0$  can be expressed as

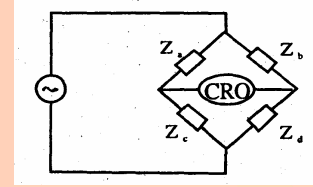


- a.  $C_0 = \frac{C_1 - 2C_2}{3}$
- b.  $C_0 = \frac{C_1 - 4C_2}{3}$
- c.  $C_0 = \frac{C_1 - C_2}{3}$
- d.  $C_0 = C_1 - 2C_2$

54. Given

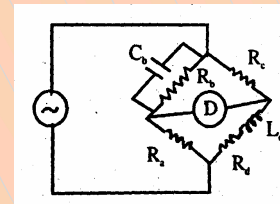
$$\begin{aligned} Z_a &= 100 \angle 50^\circ \\ Z_b &= 300 \angle -90^\circ \\ Z_c &= 200 \angle 0^\circ \end{aligned}$$

The value of  $Z_d$  for the bridge shown in the figure to be balanced is



- a.  $600 \angle -40^\circ$
- b.  $600 \angle 140^\circ$
- c.  $600 \angle -140^\circ$
- d.  $150 \angle 40^\circ$

55. For the ac bridge circuit shown in the figure, at balance, the value of  $R_d$ ,  $L_d$  and  $Q_d$  will be respectively:



- a.  $\frac{R_a}{R_c} R_b; \frac{R_a R_c}{C_b}; \omega C_b R_b$
- b.  $\frac{R_b}{R_a} R_c; \frac{R_a R_c}{C_b}; \omega C_b R_b$
- c.  $\frac{R_b}{R_a} R_c; R_a R_c C_b; \omega C_b R_c$
- d.  $\frac{R_a}{R_b} R_c; R_a R_c C_b; \omega C_b R_b$

56. Wagner's earth devices are used in ac bridge circuits to

- a. Eliminate the effect of earth capacitance
- b. Eliminate the effect of inter-component capacitances
- c. Eliminate the effect of stray electrostatic fields
- d. Shield the bridge elements

57. An LVDT is used to measure displacement. The output of the LVDT is connected to a voltmeter of range 0 to 5 V through an amplifier having a gain of 250. For a displacement of 0.5 mm, the output to the LVDT is 2 mV. The sensitivity of the instrument would be;

- a. 0.1 V/mm
- b. 0.5 V/mm

- c. 1 V/mm  
d. 5 V/mm
58. It is required to measure temperature in the range of  $1300^{\circ}\text{C}$  to  $1500^{\circ}\text{C}$ . The most suitable thermocouple to be used as a transducer would be
- Chromel – constantan
  - Iron – constantan
  - Chromel – alumel
  - Platinum – rhodium
59. Strain sensing transducers are made of various materials in- various sizes and shapes. The sensitivity of a strain gauge is expressed in terms of a gauge factor. For a certain application, a gauge factor of 100 is desired. The proper strain gauge to be used in this case would be
- Constantan strain gauge
  - Nichrome - V strain gauge
  - Semiconductor strain gauge
  - Platinum - tungsten alloy strain gauge
60. An angular position is to be measured using a transducer. Which of the following types of transducers can be used for this purpose?
1. Circular potentiometer
  2. LVDT
  3. E - pick off.
  4. Synchro.
- Select the correct answer using the codes given below:
- Codes:
- 1, 2, 3 and 4
  - 2 and 3
  - 1, 2 and 4
  - 1 and 4
61. Bridge circuits using resistance temperature detectors (RTD's) in temperature measurements usually employ the "three lead system" so as to obtain
- Higher sensitivity
  - Better impedance matching
  - Compensation for the signal wire resistance to the detector
  - Reduction in power consumption
62. Which one of the following additional devices is required in order to measure pressure using LVDT?
- Strain gauge
  - Bourden tube
  - Bourden tube
  - Rotameter
63. A resistance wire strain gauge with a gauge factor of 2 is bonded to a steel structural member subjected to a tensile stress of 100 mega Newtons/metre<sup>2</sup>. The modulus of elasticity of steel is 200 Giga Newtons per square meter. The percentage change in gauge resistance due to the applied stress is
- 0.1
  - 0.2
  - 0.4
  - 0.5
64. A variable reluctance type tachometer has 180 teeth on rotor. The speed of the shaft on which it is mounted is 1200 rpm. The frequency of the output pulses is
- 1800 per second
  - 3600 per second
  - 4800 per second
  - 5600 per second
65. The Q factor of an inductor would be higher if it is made of
- Thinner wire
  - Longer wire
  - Shorter wire
  - Thicker wire
66. The coding system typically used in digital telemetry is
- PPM (Pulse position modulation)
  - PAM (Pulse amplitude modulation)
  - PCM (Pulse code modulation)
  - PDM (Pulse duration modulation)
67. **Assertion (A):** In Hall effect, the open circuit transverse voltage developed by a current – carrying semiconductor with a steady magnetic field' imposed perpendicular to the current direction has opposite signs for n-type and P-type semiconductors.



**Reason (R):** The magnetic field pushes both the holes and the conduction electrons in the same direction.

- Both A and R are true and R is the correct explanation of A
- Both A and R are true but R is NOT a correct explanation of A
- A is true but R is false
- A is false but R is true

68. **Assertion (A):** At high temperatures, the avalanche breakdown voltage is higher.

**Reason (R):** At high temperatures mean free paths of electrons and holes are shorter, therefore a larger field is required to cause ionization.

- Both A and R are true and R is the correct explanation of A
- Both A and R are true but R is NOT a correct explanation of A
- A is true but R is false
- A is false but R is true

69. The transfer function of an active network with gain 'K' is given by:

$$\frac{V_2(s)}{V_1(s)} = \frac{K}{s^2 C^2 R^2 + sCR(3-K) + 1}$$

**Assertion (A):** The network is unstable for all values of K.

**Reason (R):** The poles of the network function depend on the parameter K.

- Both A and R are true and R is the correct explanation of A
- Both A and R are true but R is NOT a correct explanation of A
- A is true but R is false
- A is false but R is true

70. **Assertion (A):** For a non - dynamic linear time - invariant system, the output equation in its state variable description simplifies to  $Y = Du$ , Where D is a constant matrix and Y and u are the output and input vectors respectively.

**Reason (R):** The state vector X is zero for a non - dynamic system.

- Both A and R are true and R is the correct explanation of A
- Both A and R are true but R is NOT a correct explanation of A
- A is true but R is false

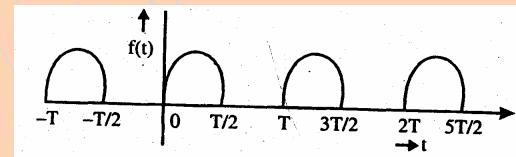
d. A is false but R is true

71. **Assertion (A):** For a linear time- invariant system, more than one choice may exist for the state vector but the system matrix 'A' would be the same for all the choices.

**Reason (R):** The 'A' matrix uniquely determines the system characteristic equation. Which should be the same irrespective of the choice of the state vector.

- Both A and R are true and R is the correct explanation of A
- Both A and R are true but R is NOT a correct explanation of A
- A is true but R is false
- A is false but R is true

72. **Assertion (A):** For the half - wave rectified sine wave  $f(t)$  shown in the figure, the only sine term present in its trigonometric form of Fourier series is the fundamental.



**Reason (R):** The odd part of  $f(t)$  is a pure sinusoid of the fundamental frequency.

- Both A and R are true and R is the correct explanation of A
- Both A and R are true but R is NOT a correct explanation of A
- A is true but R is false
- A is false but R is true

73. **Assertion (A):** A linear, time - invariant discrete - time system having the system function  $H(z) = \frac{z}{z + \frac{1}{2}}$  is a stable system.

**Reason (R):** The pole of  $H(z)$  is in the left- half plane for a stable system.

- Both A and R are true and R is the correct explanation of A
- Both A and R are true but R is NOT a correct explanation of A
- A is true but R is false
- A is false but R is true

74. Match List - I (Crystal type) with List - II (Name of the solid) and select the correct

answer using the codes given below the Lists:

**List I**

- A. Ionic
- B. Covalent
- C. Metallic
- D. Van der Waal's

**List II**

- 1. Solid argon
- 2. Copper
- 3. Silicon
- 4. Sodium chloride

	A	B	C	D
a.	3	4	2	1
b.	4	3	1	2
c.	3	4	1	2
d.	4	3	2	1

75. Match List -I (Material) with List -II (Electrical conductivity in mho/m) and select the correct answer using the codes given below the Lists:

**List I**

- A. Copper
- B. Aluminum
- C. Nickel

**List II**

- 1.  $2 \times 10^7$
- 2.  $1.03 \times 10^7$
- 3.  $3.5 \times 10^7$

Codes:

	A	B	C
a.	3	1	2
b.	1	3	2
c.	3	2	1
d.	1	2	3

76. The carrier mobility in a semiconductor is  $0.4 \text{ m}^2/\text{Vs}$ . Its diffusion constant at 300 K will be (in  $\text{M}^2/\text{s}$ )

- a. 0.43
- b. 0.16
- c. 0.04
- d. 0.01

77. In a piezoelectric crystal, application of a mechanical stress would produce
- a. Plastic deformation of the crystal

- b. Magnetic dipoles in the crystal
- c. Electrical polarization in the crystal
- d. Shift in the Fermi level

78. The relative dielectric constant of barium titanate at  $100^\circ\text{C}$  is about

- a. 1
- b. 5
- c. 50
- d. 2000

79. Consider the following materials:

- 1. Nickel
- 2. Silver
- 3. Oxygen
- 4. Aluminum

The correct sequence of these materials in DECREASING order of their magnetic permeability is

	A	B	C	D
a.	1	4	3	2
b.	1	4	2	3
c.	4	1	3	2
d.	4	1	2	3

80. A vacuum parallel plate capacitor is charged. The field between the plates is  $2 \times 10^4 \text{ V/m}$ . If the space between the plates is filled with a material of relative dielectric constant of 10.0, then the value of the field in the dielectric will be

- a.  $2 \times 10^3 \text{ V/m}$
- b.  $\frac{2}{\sqrt{10}} \times 10^4 \text{ V/m}$
- c.  $2 \times \sqrt{10} \times 10^4 \text{ V/m}$
- d.  $2 \times 10^5 \text{ V/m}$

81. Some ceramic superconductors become superconducting

- a. Below liquid helium temperature
- b. Between liquid helium and liquid nitrogen temperatures
- c. Above liquid nitrogen temperature but below room temperature
- d. Above room temperature

82. GaAs has an energy gap of 1.43 eV. The optical cut-off wavelength of GaAs would lie in the

- a. Visible region of the spectrum

- b. Infrared region of the spectrum  
 c. Ultraviolet region of the spectrum  
 d. Far ultraviolet region of the spectrum
83. The real parts of the relative dielectric constant and loss tangent of Teflon are 2.1 and  $5 \times 10^{-4}$  at 100 Hz respectively. The imaginary part of the dielectric constant at 100 Hz is
- $1.05 \times 10^{-3}$
  - $2.1 \times 10^{-3}$
  - $5 \times 10^{-3}$
  - $1.05 \times 10^{-2}$
84. If the critical magnetic field for aluminum is  $7.9 \times 10^3$  amp/turn, then the current flowing through a long thin wire of aluminum of diameter  $10^{-3}$  m will be
- 25 amp
  - 50 amp
  - 100 amp
  - 1000 amp
85. At very high temperatures, the extrinsic semiconductors become intrinsic because
- Of drive- in diffusion of do pants and carriers
  - Band to band transition dominates over impurity ionization
  - Impurity ionization dominates over band to band transition
  - Band to band transition is balanced by impurity ionization
86. Which of the following elements act as donor impurities?
- Gold
  - Phosphorus
  - Boron
  - Antimony
  - Arsenic
  - Indium.
- Select the correct answer using the codes given below:  
 Codes:
- 1, 2 and 3
  - 1, 2, 4 and 6
  - 3,4,5and 6
  - 2,4 and 5
87. Consider the following statements regarding a semiconductor:
- Acceptor level lies close to the valence band.
  - Donor level lies close to the valence band
  - n-type semiconductor behaves as a conductor at zero Kelvin.
  - p-type semiconductor behaves as an insulator at zero Kelvin
- Of these statements
- 2 and 3 are correct
  - 1 and 3 are correct
  - 1 and 4 are correct
  - 3 and 4 are correct
88. In a p - n junction, the space charge capacitance is proportional to  $V^{-n}$  where V is the applied bias voltage and 'n' is a constant.
- The value of 'n' for step, linearly graded and diffused junctions would be respectively
- $\frac{1}{2}, \frac{1}{3}, \frac{1}{2.5}$
  - $\frac{1}{3}, \frac{1}{2}$  and  $\frac{1}{2.5}$
  - $\frac{1}{2}, \frac{1}{2.5}$  and  $\frac{1}{3}$
  - $\frac{1}{3}, \frac{1}{2.5}$  and  $\frac{1}{2}$
89. Match List- I (Models of BJT) with -II (Applications) and select the correct answer using the codes given below the Lists:
- List I**
- Hybrid model
  - Hybrid pi-model
  - S. parameter model
  - Ebers- Moll model
- List II**
- Microwave measurements
  - Coupled diode
  - Low frequency
  - High frequency
- Codes:
- |   |   |   |   |
|---|---|---|---|
| A | B | C | D |
|---|---|---|---|

- a. 4 3 1 2  
 b. 3 4 2 1  
 c. 3 4 1 2  
 d. 4 3 2 1

90. What is the correct sequence of the following steps in the fabrication of a monolithic, bipolar junction transistor?

1. Emitter diffusion
2. Base diffusion
3. Buried layer formation
4. Epi - layer formation.

Select the correct answer using the codes given below:

Codes:

- a. 3, 4, 1, 2  
 b. 4, 3, 1, 2  
 c. 3, 4, 2, 1  
 d. 4, 3, 2, 1

91. The threshold voltage of an n - channel enhancement mode MOSFET is 0.5 V. when the device is biased at a gate voltage of 3 V, pinch - off would occur at a drain voltage of

- a. 1.5V  
 b. 2.5V  
 c. 3.5V  
 d. 4.5V

92. The zero gate bias channel resistance of a junction field effect transistor is 750 ohms and the pinch - off voltage is 3 V. For a gate bias of 1.5 V and very low drain voltage, the device would behave as a resistance of

- a. 320 ohms  
 b. 816 ohms  
 c. 1000 ohms  
 d. 1270 ohms

93. Consider the following statements:

The turn - off time of an SCR can be reduced by

1. Quick withdrawal of the gate voltage..
2. Reducing life - time by doping with gold.
3. Applying a negative voltage pulse to the gate.

Of these statements

- a. 1, 2 and 3 are correct  
 b. 1 and 2 are correct  
 c. 1 and 3 are correct  
 d. 2 and 3 are correct

94. In a wafer, a junction depth of  $x_1$  is achieved by a constant source diffusion process of 1 hour diffusion time. How long should the diffusion process continue, if a junction depth of  $2x_1$  is to be achieved?

- a. 2 hours  
 b. 4 hours  
 c. 5 hours  
 d. 7 hours

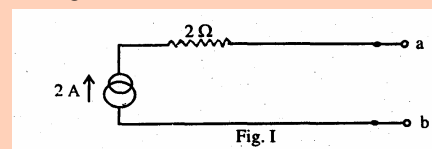
95. For a photo induced current  $I_\lambda$ , the collector current of a phototransistor will be

- a.  $(h_{fe} + 1)I_\lambda$   
 b.  $\frac{I_\lambda}{h_{fe} + 1}$   
 c.  $h_{fe} I_\lambda$   
 d.  $\frac{I_\lambda}{h_{fe}}$

96. Given that the band gap of cadmium sulphide is 2.5 eV, the maximum photon for electron-holepair generation will be

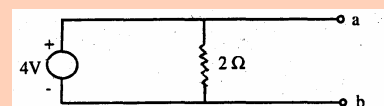
- a. 5400  $\mu\text{m}$   
 b. 540  $\mu\text{m}$   
 c. 5400 Å  
 d. 540 Å

97. A dc current source is connected as shown in Fig. I:

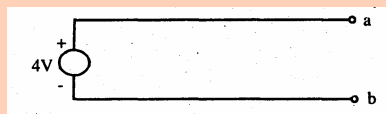


The Thevenin's equivalent of the network at terminals a-b

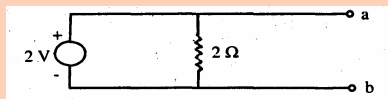
a. Will be



b. Will be



c. Will be

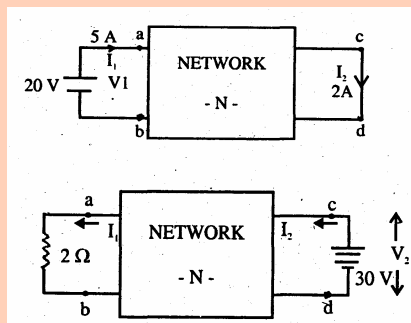


d. Is NOT feasible

98. A battery charger can drive a current of 5 A into a 1 ohm resistance connected at its output terminals. If it is able to charge an ideal 2V battery at 7A rate, then its Thevenin's equivalent will be

- 7.5 V in series with 0.5 ohm
- 12.5 V in series with 1.5 ohms
- 7.5 V in parallel with 0.5 ohm
- 12.5 V in parallel with 1.5 ohms

99. Two sets of measurements on a linear passive two - port network are shown in the following figures:



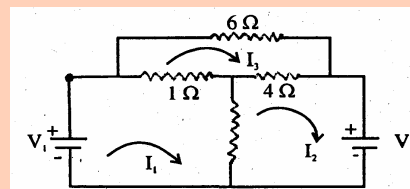
The current flowing through the 2 - ohm resistor is

- 2A
- 1A
- 0.5 A
- zero

100. For a connected planar graph of 'V' vertices and 'e' edges, the number of meshes is

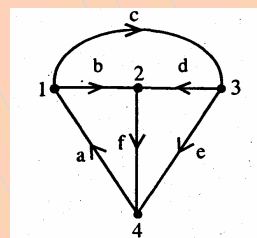
- $e - v$
- $v - 1$
- $e - v - 1$
- $e - v + 1$

101. A network is shown in the given figure. Which one of the following equations would represent the equation for loop 3?



- $-I_1 + 4I_2 + 11I_3 = 0$
- $I_1 + 4I_2 + 11I_3 = 0$
- $-I_1 - 4I_2 + 11I_3 = 0$
- $I_1 + 4I_2 + 6I_3 = 0$

102. For the graph shown in the given figure, one set of fundamental cut-sets would be



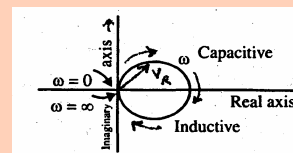
- abc; cde, afe
- afdc, cde, abde
- cbfe, afe, bdf
- cbd, abde, cde

103. A particular current is made up of two components: a 10 A dc and a sinusoidal current of peak value of 14.14 A. The average value of the resultant current is

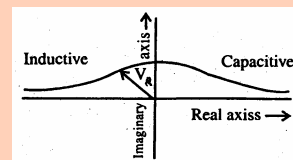
- Zero
- 24.14 A
- 10A
- 14.14A

104. The locus of the tip of the voltage phasor ( $V_R$ ) across the resistance (R) in series RLC resonant circuit is given by

a.

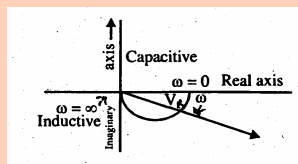


b.

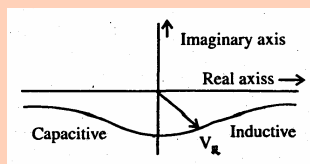


c.

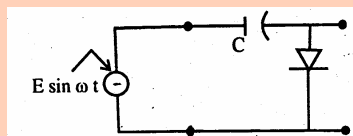




d.



105. In the circuit given, the voltage across the diode (assumed to be an ideal one) is:



- a. Zero  
b.  $-E + E \sin \omega t$   
c.  $E - E \sin \omega t$   
d. Half sinusoids

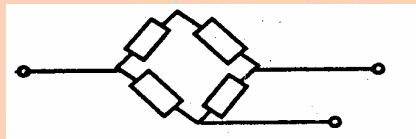
106. Match List - I with List - II and select the correct answer using the codes given below the lists:

#### List I

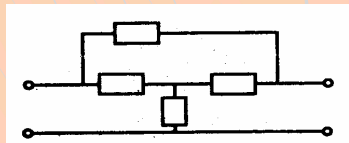
- A. Bridged T-network  
B. Twin T-network  
C. Lattice network  
D. Ladder network

#### List II

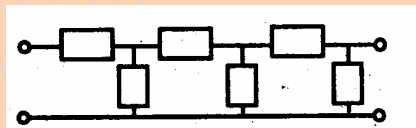
1.



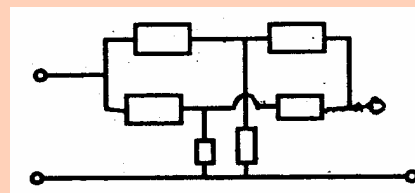
2.



3.



4.

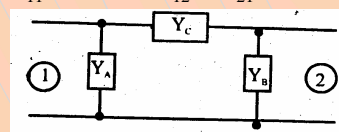


Codes:

	A	B	C	D
a.	2	4	3	1
b.	4	2	1	3
c.	4	2	3	1
d.	2	4	1	3

107. In respect of the 2-port network shown in the figure, the admittance parameters are:

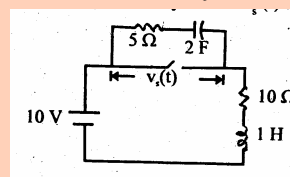
$$Y_{11} = 8 \text{ mho}, Y_{12} = Y_{21} = 6 \text{ mho} \text{ and } Y_{22} = \text{mho}$$



The values of  $Y_A$ ,  $Y_B$  and  $Y_C$  (in units of mho) will be respectively

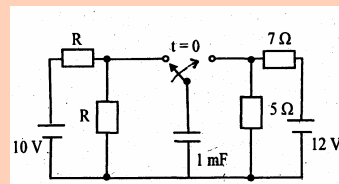
- a. 2, 6 and  $-6$   
b. 2, 6 and 0  
c. 2, 0 and 6  
d. 2, 6 and 8

108. In the network shown, the switch is opened at  $t = 0$ . Prior to that, the network was in the steady - state.  $v_s(t)$  at  $t = 0^+$  is.



- a. 0  
b. 5V  
c. 10V  
d. 15V

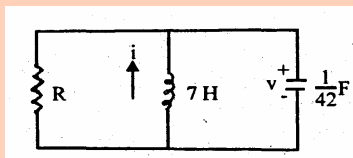
109. In the network shown in the figure, the switch had remained closed for a long time on the 10 V source side. If at time  $t = 0$ , it is changed to the 12V side, then after one time constant, the voltage across  $5\Omega$  in the circuit will be



- a. 5V

- b.  $5e^{-1}V$   
 c. 10 V  
 d. 12V

110. For the circuit shown in the figure, the value of R for critical damping will be



- a. 10.5 ohm  
 b. 6 ohm  
 c. 3.5 ohm  
 d. 3 ohm

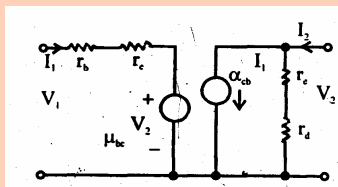
111. The transfer function,

$$T(s) = \frac{s}{s+a}$$

is that of

- a. Low - pass filter  
 b. Notch filter  
 c. High - pass filter  
 d. Band- pass filter

112. The model of a transistor in the commonemitter connection is shown in the following figure:



Match List - I (Parameters) with list - II (Values) and select the correct answer using the codes given below the lists:

#### List I

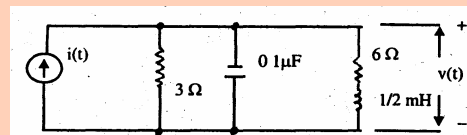
- A.  $h_{22}$   
 B.  $h_{11}$   
 C.  $h_{21}$

#### List II

1.  $r_b + r_e$   
 2.  $\alpha_{cb}$   
 3.  $\frac{1}{r_e + r_d}$

	A	B	C
a.	3	1	2
b.	1	3	2
c.	2	3	1
d.	3	2	1

113. In the circuit shown,  $i(t)$  is a unit step current. The steady-state value of  $v(t)$  is

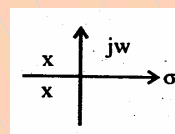


- a. 2v  
 b. 3v  
 c. 6v  
 d. 9v

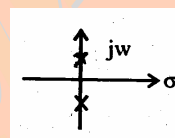
114. The pole locations of three network and their impulse responses  $h(t)$  are shown in List I with List-II respectively. Match List I with List II and select the correct answer

#### List I

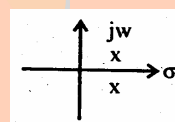
A.



B.

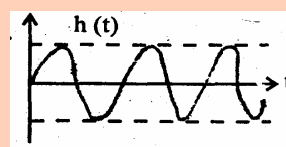


C.

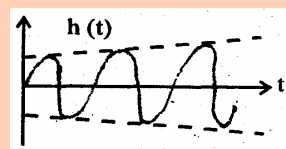


#### List II

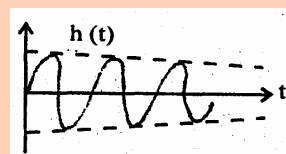
1.



2.



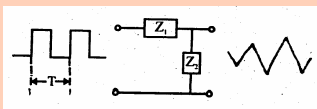
3.



	A	B	C
a.	1	2	3

- b. 2 1 3  
 c. 3 1 2  
 d. 3 2 1

115.  $Z_1$  and  $Z_2$  in the figure shown represent L, C or R. For the transformation of a square wave of period 'T' into a triangular wave. The values of  $Z_1$ ,  $Z_2$  and L/R or RC as the case may be, should be

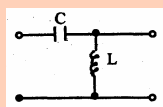


- a.  $Z_1 = R, Z_2 = L$  and  $\frac{L}{R} \ll T$   
 b.  $Z_1 = L, Z_2 = R$  and  $\frac{L}{R} \ll T$   
 c.  $Z_1 = R, Z_2 = C$  and  $RC \gg T$   
 d.  $Z_1 = C, Z_2 = R$  and  $RC \ll T$

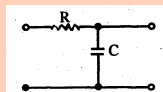
116. Match List - I with List - II and select the correct answer using the codes given below the Lists:

**List I**

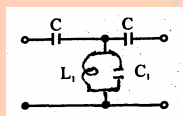
A.



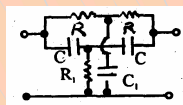
B.



C.



D.



**List II**

1. Band reject (notch) filter
2. Band - pass filter
3. High - pass filter
4. Low - pass filter

	A	B	C	D
a.	3	4	2	1
b.	3	4	1	2
c.	4	3	1	2

- d. 4 3 2 1

117. Consider the following from the point of view of possible realization as driving - point impedances using passive elements:

1.  $\frac{1}{s(s+5)}$
2.  $\frac{s+3}{s^2(s+5)}$
3.  $\frac{s^2+3}{s^2(s^2+5)}$
4.  $\frac{s+5}{s(s+3)}$

Among these

- a. 1, 2 and 4 are realizable
- b. 1, 2 and 3 are realizable
- c. 3 and 4 are realizable
- d. None is realizable

118. An RC driving - point impedance function has zeros at  $s = -2$  and  $s = -5$ . The admissible poles for the function would be

- a.  $s = 0; s = -6$
- b.  $s = -1; s = -3$
- c.  $s = 0; s = -1$
- d.  $s = -3; s = -4$

119. Two networks are cascaded through an ideal buffer. If  $t_{d1}$  and  $t_{d2}$  are the delay times of the networks, then the overall delay of the two networks together will be

- a.  $\sqrt{t_{d1}t_{d2}}$
- b.  $\sqrt{t_{d1}^2 + t_{d2}^2}$
- c.  $t_{d1} + t_{d2}$
- d.  $\frac{t_{d1} + t_{d2}}{2}$

120. Two networks are cascaded through an ideal buffer. If  $t_{r1}$  and  $t_{r2}$  are the rise times of the two network, then the overall rise time of the two networks together will be

- a.  $\sqrt{t_{r1}t_{r2}}$
- b.  $\sqrt{t_{r1}^2 + t_{r2}^2}$
- c.  $t_{r1} + t_{r2}$
- d.  $\frac{t_{r1} + t_{r2}}{2}$