

# ELECTRICAL ENGINEERING

## PAPER-I

- A potential field is given by  $V = 3x^2y - yz$ . Which of the following is NOT true?

  - At the point (1, 0, -1),  $V$  and the electric field  $\vec{E}$  vanish
  - $x^2y = 1$  is an equipotential line in the  $xy$ -lane
  - The equipotential surface  $V = 8$  passes through the point  $P(2, -1, 4)$
  - A unit normal to the equipotential surface  $V = -8$  at  $P$  is  $(-0.83\hat{x} + 0.55\hat{y} + 0.07\hat{z})$
- The relation between electric intensity  $E$ , voltage applied  $V$  and the distance  $d$  between the plates of a parallel plate condenser is

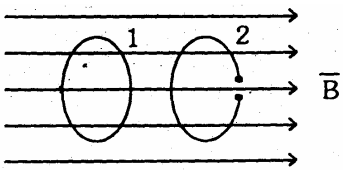
  - $E = V/d$
  - $E = V \times d$
  - $E = V/(d)^2$
  - $E = V \times (d)^2$
- Ohm's law in point form in field theory can be expressed as

  - $V = RI$
  - $\vec{J} = \vec{E} / \sigma$
  - $\vec{J} = \sigma \vec{E}$
  - $R = \rho l / A$
- The magnetic flux through each turn of a 100 turn coil is  $(t^3 - 2t)$  milli-Webers where  $t$  is in seconds. The induced e.m.f. at  $t = 2s$  is

  - 1V
  - 1V
  - 0.4 V
  - 0.4 V
- If a vector field  $B$  is solenoidal, which of these is true?

  - $\oint_L \vec{B} \cdot d\vec{l} = 0$
  - $\oint_S \vec{B} \cdot d\vec{s} = 0$
  - $\nabla \times \vec{B} = 0$
  - $\nabla \cdot \vec{B} \neq 0$
- A medium behaves like dielectric when the

  - displacement current is just equal to the conduction current
  - displacement current is less than the conduction current
  - displacement current is much greater than the conduction current
  - displacement current is almost negligible
- Two conducting coils 1 and 2 (identical except that 2 is split) are placed in a uniform magnetic field which decreases at a constant rate as in the figure. If the planes of the coils are perpendicular to the field lines, the following statements are made:


  - an e.m.f. is induced in, the split coil 2
  - e.m.f. is induced in both coils
  - equal Joule heating occurs in both coils
  - Joule heating does not occur in any coil

Which of the above statements is/are true?

  - 1 and 4
  - 2 and 4
  - 3 only
  - 2 only
- For linear isotropic materials, both  $\vec{E}$  and  $\vec{H}$  have the time dependence  $e^{j\omega t}$  and regions of interest are free of charge. The value of  $\nabla \times \vec{H}$  is given by

  - $\sigma \vec{E}$
  - $j\omega \epsilon \vec{E}$
  - $\sigma \vec{E} + j\omega \epsilon \vec{E}$
  - $\sigma \vec{E} - j\omega \epsilon \vec{E}$

9. Which of the following equations is/are not Maxwell's equation(s)?

1.  $\nabla \cdot \bar{J} = -\frac{\partial I_V}{\partial t}$
2.  $\nabla \cdot \bar{D} = I_V$
3.  $\nabla \cdot \bar{E} = -\frac{\partial \bar{B}}{\partial t}$
4.  $\oint \bar{H} \cdot d\bar{l} = \oint \left( \sigma \bar{E} + \varepsilon \frac{\partial \bar{E}}{\partial t} \right) \cdot d\bar{s}$

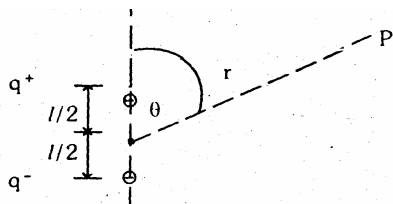
Select the correct answer using the codes given below:

- a. 2 and 4
  - b. 1 alone
  - c. 1 and 3
  - d. 1 and 4
10. In free space
- $$\bar{H}(z, t) = 0.10 \cos(4 \times 10^7 t - \beta z) T_x \text{ A/M.}$$

The expression for  $\bar{E}(z, t)$  is

- a.  $\bar{E}(z, t) = 37.7 \cos(4 \times 10^7 t - \beta z) T_y$
- b.  $\bar{E}(z, t) = 2.65 \times 10 \cos(4 \times 10^7 t - \beta z) T_z$
- c.  $\bar{E}(z, t) = 37.7 \cos(4 \times 10^7 t - \beta z) T_x$
- d.  $\bar{E}(z, t) = -37.7 \cos(4 \times 10^7 t - \beta z) T_y$

- 11.



Consider the arrangement of two equal and opposite charges of magnitude  $q$  separated by an infinitesimal distance  $l$  as shown in the figure given above. If  $\bar{a}_r$  is the unit vector in the direction  $r$  and  $\bar{a}_\theta$  is the unit vector in the direction  $\theta$ , the electric field at the point P is

- a.  $\frac{-2q / \cos \theta}{4\pi\epsilon r^3} \bar{a}_r - \frac{q / \sin \theta}{4\pi\epsilon r^3} \bar{a}_\theta$
- b.  $\frac{-2q / \cos \theta}{4\pi\epsilon r^3} \bar{a}_r + \frac{q / \sin \theta}{4\pi\epsilon r^3} \bar{a}_\theta$
- c.  $\frac{2q / \cos \theta}{4\pi\epsilon r^3} \bar{a}_r + \frac{q / \sin \theta}{4\pi\epsilon r^3} \bar{a}_\theta$
- d.  $\frac{2q / \cos \theta}{4\pi\epsilon r^3} \bar{a}_r - \frac{q / \sin \theta}{4\pi\epsilon r^3} \bar{a}_\theta$

12. A plane wave whose electric field is given by  $\bar{E} = 100 \cos(\omega t - 6\pi x) \hat{z}$  passes normally from a material 'A' having  $\epsilon_r = 4, \mu_r = 1$  and  $\sigma = 0$  to a material 'B' having  $\epsilon_r = 9, \mu_r = 4$  and  $\sigma = 0$ . Match items in List I with List II and select the correct answer:

List I

- A. Intrinsic impedance of medium 'B'
- B. Reflection coefficient
- C. Transmission Coefficient
- D. Phase shift constant of medium 'A'

List II

1.  $6\pi$
2.  $80\pi$
3.  $1/7$
4.  $8/7$

Codes;

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

13. In free space  $E(z, t) = 50 \cos(\omega t - \beta z) \bar{a}_x$  A/m and  $H(z, t) = 5/12\pi \cos(\omega t - \beta z) \bar{a}_y$  A/m. The average power crossing a circular area of radius  $\sqrt{24}$  m in plane  $z =$  constant is
- a. 200 W
  - b. 250 W
  - c. 300 W
  - d. 350 W

14. A copper wire carries a conduction current of 1.0 A at 50 Hz. For copper wire  $\epsilon = \epsilon_0, \mu = \mu_0, \sigma = 5.8 \times 10^8$  mho/m. What is the displacement current in the wire?
- a.  $2.8 \times 10$  A
  - b.  $4.8 \times 10$  A
  - c. 1 A
  - d. It cannot be calculated with the given data

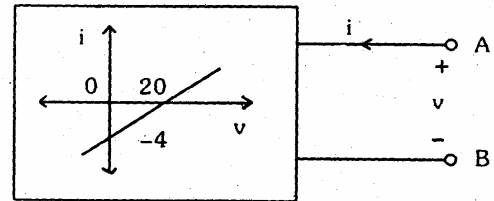
15. If  $\bar{A}$  and  $\bar{J}$  are the vector potential and current density vectors associated with a coil, then  $\int \bar{A} \cdot \bar{J} dv$  has the units of
- a. Flux-linkage
  - b. Power
  - c. Energy

- d. Inductance
16. A transmission line has R, L G and C distributed parameters per unit length of the line,  $\gamma$  is the propagation constant of the line. Which expression gives the characteristic impedance of the line?
- $\frac{\gamma}{R + j\omega L}$
  - $\frac{R + j\omega L}{\gamma}$
  - $\frac{G + j\omega C}{\gamma}$
  - $\sqrt{\frac{G + j\omega C}{R + j\omega L}}$
17. Which of the following equations is correct?
- $a_x \times a_x = |a_x|^2$
  - $(a_x \times a_y) + (a_y \times a_x) = 0$
  - $a_x \times (a_y \times a_z) = a_x \times (a_z \times a_y)$
  - $a_r \cdot a_\theta + a_\theta \cdot a_r = 0$
18. Match List I with List II and select the correct answer:  
List I (Term)
- Curl  $(\vec{F}) = 0$
  - Div  $(\vec{F}) = 0$
  - Div Grad  $(\phi) = 0$
  - Div div  $(\phi) = 0$
- List II (Type)
- Laplace equation
  - Irrotational
  - Solenoidal
  - Not defined
- |    | A | B | C | D |
|----|---|---|---|---|
| a. | 2 | 3 | 1 | 4 |
| b. | 4 | 1 | 3 | 2 |
| c. | 2 | 1 | 3 | 4 |
| d. | 4 | 3 | 1 | 2 |
19. Assuming the Fermi level  $E_F$  to be independent of temperature,  $E_F$  may be defined as the level with an occupancy probability of
- 0%
  - 50%
  - 75%
  - 100%
20. Which of the following has the greatest mobility?
- Positive ion
  - Negative ion
  - Electron
  - Hole
21. Match List I (Type of the material) with List II (Name of the material) and select the correct answer:  
List I
- Ferroelectric material
  - Piezoelectric material
  - Soft magnetic material
  - Hard magnetic material
- List II
- Permalloy
  - BaTiO<sub>3</sub> ceramic
  - KH<sub>2</sub>PO<sub>4</sub>
  - Tungsten steel
- Codes;
- |    | A | B | C | D |
|----|---|---|---|---|
| a. | 3 | 2 | 1 | 4 |
| b. | 1 | 4 | 3 | 2 |
| c. | 3 | 4 | 1 | 2 |
| d. | 1 | 2 | 3 | 4 |
22. On the application of the field  $\vec{E}$ , the modified field due to polarization P in solids and liquids having cubic symmetry is given by
- $\vec{E} + \frac{\vec{P}}{\epsilon_0}$
  - $\vec{E} - \frac{\vec{P}}{\epsilon_0}$
  - $\vec{E} + \frac{\vec{P}}{3\epsilon_0}$
  - $\vec{E} - \frac{\vec{P}}{3\epsilon_0}$
23. The complex dielectric constant of a material is given by the expression :  
 $\epsilon = \epsilon' - j\epsilon''$
- If a parallel plate capacitor with area 'A' and separation 'd' is formed with this material as a dielectric, the loss factor will be
- $(A\epsilon') / (d\epsilon'')$
  - $\epsilon'' / \epsilon'$

- c.  $\tan^{-1}[(A\varepsilon')/(d\varepsilon'')]$   
 d.  $\tan^{-1}[(A\varepsilon'')/(A\varepsilon')]$
24. At optical frequencies, the major contribution to the total polarization comes from  
 a. space charge polarization  
 b. orientation polarization  
 c. ionic polarization  
 d. electronic polarization
25. Which of the following insulating materials has the least affinity for moisture?  
 a. Cotton  
 b. Paper  
 c. Asbestos  
 d. Mica
26. Which of the following statements is NOT true?  
 a. Superconductors show perfect diamagnetism  
 b. Superconductors have almost zero resistivity  
 c. The external magnetic field has no effect on superconductors  
 d. Entropy increases on going from superconducting state to normal state
27. The transition temperature of Mercury at which it becomes superconductive is  
 a.  $4.12^\circ\text{F}$   
 b.  $4.12^\circ\text{C}$   
 c.  $4.12\text{ K}$   
 d.  $41.2\text{ K}$
28. de Brogue wavelength associated with a material particle is  
 a. inversely proportional to its energy  
 b. directly proportional to its momentum  
 c. directly proportional to its energy  
 d. inversely proportional to its momentum
29. Which one of the following materials can not be used for permanent magnets?  
 a. Alnico  
 b. Barium Ferrite  
 c. Carbon-steel  
 d. Iron-Cobalt alloy
30. Upto about 4% silica is added in iron to be used as a soft magnetic material. The major reason for this is to

- a. increase permeability of the material  
 b. increase electrical resistivity of the material  
 c. increase the coercive force  
 d. increase the saturation flux density
31. Which of the following is piezoelectric material?  
 a. Quartz  
 b. Silica sand  
 c. Corundum  
 d. Polystyrene

32.



The resistance seen from the terminals A and B of the device whose characteristic is shown in the figure is

- a.  $-5\ \Omega$   
 b.  $-1/5\ \Omega$   
 c.  $1/5\ \Omega$   
 d.  $5\ \Omega$

33.

The Fig. 1 shows a network, in which the diode is an ideal one.

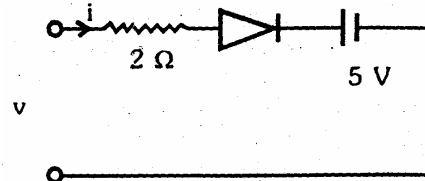
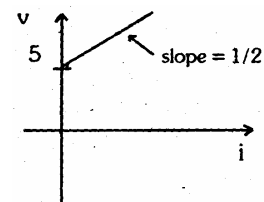


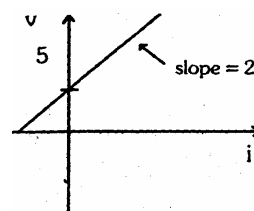
Fig. 1

the terminal  $v - I$  characteristics of the network is given by

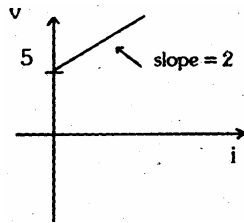
a.



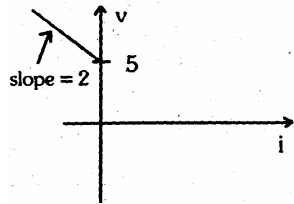
b.



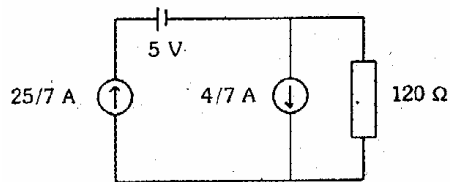
c.



d.



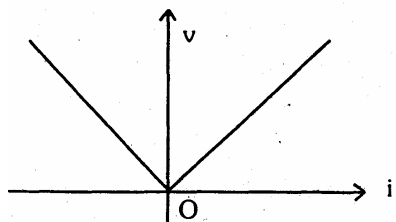
34.



The current through 120 ohm resistor in the circuit shown in the figure is

- 1 A
- 2 A
- 3 A
- 4 A

35.



The v-i characteristic of an element is shown in the figure given above. The element is

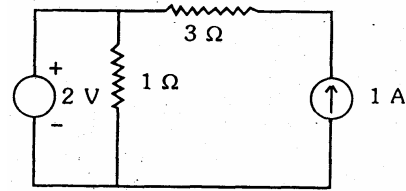
- non-linear, active, non-bilateral
- linear, active, non-bilateral
- non-linear, passive, non-bilateral
- non-linear, active, bilateral

36. If the combined generator and. line impedance is  $(5 + j10)$  ohm, then for the maximum power transfer to a load impedance from a generator of constant generated voltage, the load impedance is given by which, one of the following

- $(5 + j 10) \Omega$
- $(5 - j 10) \Omega$
- $(5 + j 5) \Omega$
- $5 \Omega$

37. Superposition theorem is not applicable for
- voltage calculation
  - bilateral elements
  - power calculations
  - passive elements

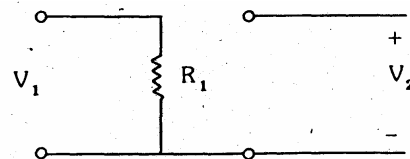
38.



For the circuit given in figure above the power delivered by the 2 volt source is given by

- 4 W
- 2 W
- 2 W
- 4 W

39.



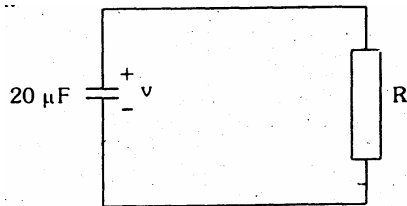
The (y) parameters of the network given in Fig. 1 are given by

- $\begin{bmatrix} R_1^{-1} & R_1^{-1} \\ R_1^{-1} & R_1^{-1} \end{bmatrix}$
- $\begin{bmatrix} 0 & R_1^{-1} \\ R_1^{-1} & R_1^{-1} \end{bmatrix}$
- $\begin{bmatrix} R_1^{-1} & 0 \\ 0 & 0 \end{bmatrix}$
- $\begin{bmatrix} R_1^{-1} & 0 \\ R_1^{-1} & 0 \end{bmatrix}$

40. The impulse response of an LTI system is given by  $5u(t)$ . If the input to the system is given by  $\varepsilon^{-t}$  then the output of the system is given by

- $5(1 - \varepsilon^{-t})u(t)$
- $(1 - 5\varepsilon^{-t})u(t)$
- $1 - 5\varepsilon^{-t}u(t)$
- $5u(t) - \varepsilon^{-t}$

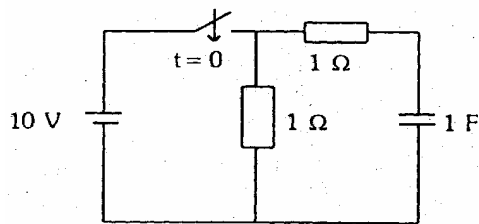
41.



For the circuit shown in the given figure, if  $C = 20 \mu\text{F}$ ,  $v(0) = -50 \text{ V}$  and  $dv(0)/dt = 500 \text{ V/S}$ , then  $R$  is

- 5 K
- 3 K
- 5 K
- 10 K

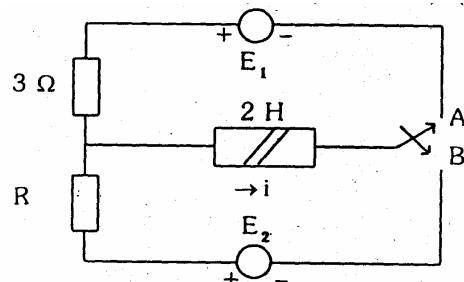
42. In the circuit shown in the given figure, the switch is closed at  $t = 0$ .



The current through the capacitor will decrease exponentially with a time constant

- 0.5 s
- 1 s
- 2 s
- 10 s

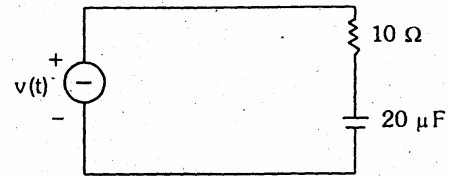
43. In the circuit shown in the given figure, the switch is moved from position A to B at time  $t = 0$ . The current  $i$  through the inductor satisfies the following conditions  $i(0) = -8 \text{ A}$ ,  $di/dt(t = 0) = 3 \text{ A/s}$ ,  $i(\infty) = 4 \text{ A}$ .



The value of  $R$  is

- 0.5 ohm
- 2 ohm
- 4 ohm
- 12 ohm

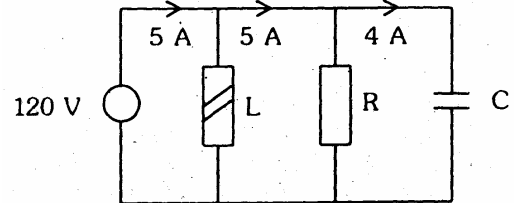
44. In the given RC circuit, the current  $i(t) = 2 \cos 5000 t \text{ A}$ .



The applied voltage  $v(t)$  is

- $28.28 \cos(5000 t - 45^\circ) \text{ V}$
- $28.28 \cos(5000 t + 45^\circ) \text{ V}$
- $28.28 \sin(5000 t - 45^\circ) \text{ V}$
- $28.28 \sin(5000 t + 45^\circ) \text{ V}$

45. In the circuit shown in the given figure,



The current through the inductor  $L$  is

- 0 A
- 3 A
- 4 A
- 8 A

46. A parallel circuit consists of two branches. One branch has  $R_L$  and  $L$  connected in series and the other branch has  $R_C$  and  $C$  connected in series. Consider the following statements:

- The two branch currents will be in quadrature if  $R_L R_C = L/C$
- The impedance of the whole circuit is independent of frequency, if  $R_L = R_C$  and  $\omega = 1/\sqrt{LC}$
- The circuit is in resonance for all the frequencies if  $R_L = R_C$ 
  - The two branch currents will be in phase at  $\omega = 1/\sqrt{LC}$

Which of the above statements are correct?

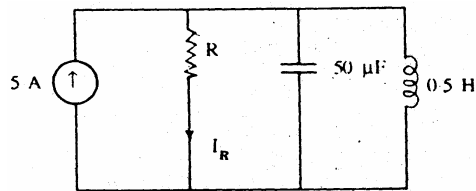
- 1 and 2
- 2 and 3
- 1 and 3
- 3 and 4

47. Three currents  $i_1$ ,  $i_2$  and  $i_3$  are approaching a node. If  $i_1 = 10 \sin(400t + 60^\circ) \text{ A}$ , and  $i_2 = 10 \sin(400t - 60^\circ) \text{ A}$  then  $i_3$  is
- 0
  - $10(\sin 400t) \text{ A}$
  - $-10(\sin 400t) \text{ A}$

d.  $-5\sqrt{3}(3\sin 400t)A$

48. At resonant frequency a R-L-C series circuit draws maximum current due to the reason that
- the difference between capacitance reactance and inductance reactance is zero
  - the impedance is more than the resistance
  - the voltage across the capacitor equals the applied voltage
  - the power factor is less than unity

49.



In the given circuit, at resonance,  $I_R$  in Amperes is equal to

- 0
  - 10
  - 5
  - 0.5
50. Consider the following statements about the quality factor of a R - L - C circuit:
- For the critically damped circuit, the quality factor  $Q = \frac{1}{2}$
  - Higher the value of quality factor higher will be the bandwidth of the circuit
  - Higher the value of quality factor lower will be the bandwidth of the circuit
  - For under damped circuits the value of  $Q$  is greater than  $\frac{1}{2}$
- Which of these statements are correct?
- 1 and 2
  - 1 and 3
  - 2 and 4
  - 1, 3 and 4
51. When two - Wattmeter method of measurement of power is used to measure power in a balanced three phase circuit; if the Wattmeter reading is zero, then
- power consumed in the circuit is zero
  - power factor of the circuit is zero
  - power factor is unity
  - power factor is 0.5

52. The inductance matrix of a system of two mutually coupled inductors shown in Fig.

$$L = \begin{bmatrix} 5 & -4 \\ -4 & 7 \end{bmatrix}$$

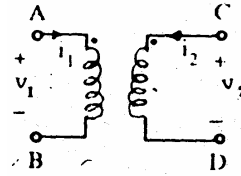


Fig. 1

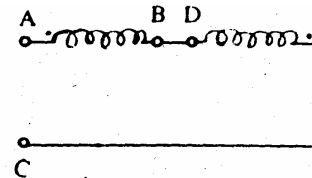


Fig. 2

When the inductors are connected as shown in Fig 2 the equivalent inductance of the system is given by

- 20 H
  - 4 H
  - 16 H
  - 8 H
53. Consider the following statements about the D'Arsonval Movement :
- It is best suited for d.c. current measurement
  - It responds to the average value of current
  - It measures the r.m.s. value of a.c. currents
  - It could be used for power measurements
- Which of these statements is/are correct?
- Only 1
  - 1 and 2
  - 2 and 3
  - 1, 2, 3 and 4
54. Two meters X and Y require 40 mA and 50 mA, respectively, to give full-scale deflection, then
- sensitivity can not be judged with given information
  - both are equally sensitive
  - X is more sensitive
  - Y is more sensitive
55. What is the correct sequence of the following types of ammeters and voltmeters with increasing accuracy?
- Moving iron

2. Moving-coil permanent magnet  
3. Induction

Select the correct answer using the codes given below

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

56. The total current  $I = I_1 + I_2$  in a circuit is measured as  $I_1 = 150 \pm 1A, I_2 = 250 \pm 2A$ , where the limits of error are given as standard deviations.  $I$  is measured as
- a.  $(400 \pm 3)A$   
b.  $(400 \pm 2.24)A$   
c.  $(400 \pm 1/5)A$   
d.  $(400 \pm 1)A$

57. Match List I with List II and select the correct answer e:

List I (Device/network)

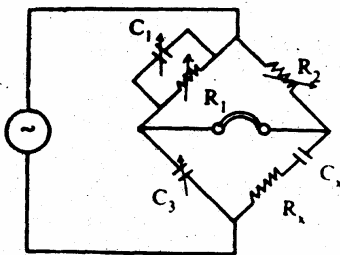
- A. Twin-T network  
B. Shielded decade capacitance box  
C. Wagner earthing arrangement  
D. Inter bridge transformer

List II (Application)

1. For use in accurate a.c. bridge  
2. For realizing frequency selective amplifier  
3. To match impedance and block d.c. noise in a.c. bridge  
4. For minimizing earth capacitance leakage

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

58. For the bridge shown in the given figure,



at balance the values of  $R_x$ ,  $C_x$  and  $Q_x$  will be

- a.  $R_x = C_1R_2/C_3, C_x = R_1C_3/R_2, Q_x = \omega C_1R_1$

- b.  $R_x = C_1R_2/C_3, C_x = R_1C_3/R_2, Q_x = 1/\omega C_1R_1$   
c.  $R_x = C_1R_1/C_3, C_x = R_2C_3/R_1, Q_x = 1/\omega C_1R_1$   
d.  $R_x = C_1R_1/C_3, C_x = R_2C_3/R_1, Q_x = \omega C_1R_1$

59. The reflecting mirror mounted on the moving coil of a vibration galvanometer is replaced by a bigger size mirror. This will result in

- a. lower frequency of resonance & lower amplitude of vibration  
b. lower frequency of resonance but the amplitude of vibration is unchanged  
c. higher frequency of resonance & lower amplitude of vibration  
d. higher frequency of resonance but the amplitude of vibration is unchanged

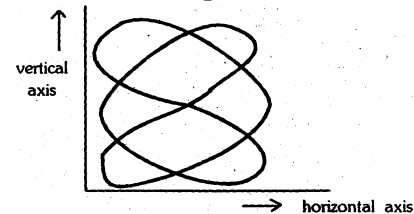
60. Consider the following statements associated with moving iron instruments

- These can be used in d.c. as well. a.c. circuits
- The scale is non-uniform
- The moving iron is placed in a field of a permanent magnet

Which of these statements are correct?

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

61. A screen pattern oscillogram, shown in the given figure is obtained when a sine-wave signal of unknown frequency is connected to the vertical input terminals, and at the same time, a 600 Hz sine-wave voltage is connected to the horizontal input terminals of an oscilloscope



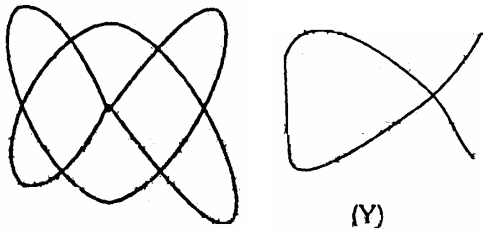
What is the value of unknown frequency?

- a. 300 Hz  
b. 400 Hz  
c. 600 Hz  
d. 900 Hz

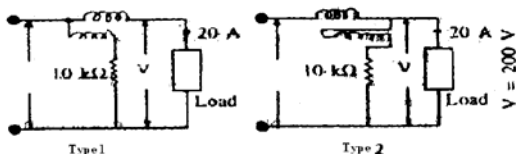
62. Which of the following statements is NOT correct for a storage type oscilloscope?



- a. The storage target is a conductive mesh covered with magnesium fluoride.
- b. Secondary emission electrons etch a positively charged pattern
- c. The flood guns used for display, emit high velocity electrons
- d. The flood guns are placed between the deflection plates and storage target
63. In an oscilloscope, two Lissajous figure (X) and (Y) are observed. This indicates that ratio of vertical input signal frequency to that of horizontal input frequency are



- a.  $5/3$  for X and  $3/2$  for Y
- b.  $3/2$  for X and  $5/3$  for Y
- c.  $5/3$  for X and  $5/3$  for Y
- d.  $3/2$  for X and  $3/2$  for Y
64. A spring controlled moving iron voltmeter draws a current of 1 mA for full scale value of 1000 V. If it draws a current of 0.5 mA, the meter reading is
- a. 25 V
- b. 50 V
- c. 100 V
- d. 200 V
65. In the measurement of power on balanced load by two-Wattmeter method in a 3-phase, circuit, the readings of the Wattmeter are 3 kW and 1 kW respectively, the latter being obtained after reversing the connections to the current coil. The power factor of the load is
- a. 0.277
- b. 0.554
- c. 0.625
- d. 0.866
66. Two types of connections of Wattmeter pressure coil are shown in the figure,



The value of the Wattmeter current coil resistance  $r$ , which makes the connection errors the same in the two cases is

- a.  $0.05 \Omega$
- b.  $0.1 \Omega$
- c.  $0.01 \Omega$
- d.  $0.125 \Omega$
67. In calibration of a dynamometer Wattmeter by potentiometer, phantom loading arrangements is used because
- a. The arrangement gives accurate results
- b. The power consumed in calibration work is minimum
- c. The method gives quick results
- d. The onsite calibration is possible
68. The accuracy of Kelvin's double bridge for the measurement of low resistance is high because the bridge
- a. User two pairs of resistance arms
- b. Has medium value resistance in the ratio arms
- c. Uses a low resistance link between standard and test resistances
- d. Uses a null indicating galvanometer
69. An imperfect capacitor is represented by a capacitance  $C$  in parallel with a resistance  $R$ . The value of its dissipation factor  $\tan \delta$  is
- a.  $\omega C R$
- b.  $\omega^2 C R$
- c.  $1/\omega^2 C R$
- d.  $1/\omega C R$
70. An energy-meter having a meter constant of 1200 rev per kWh is found to make 5 revolutions in 75s. The load power is
- a. 500 W
- b. 100 W
- c. 200 W
- d. 1000 W
71. Which one of the following statements is NOT true?
- a. Potentiometric Linear displacement can give high output signal
- b. Linear variable differential transformer has low output impedance
- c. Synchros and resolvers have low accuracy
- d. Eddy current proximity transducers are non-contact type transducers

72. Match List I with List II and select the correct answer:

List I (Transducer)

- A. Mercury in glass thermometer
- B. Platinum resistance thermometer
- C. Thermocouple with led compensation,
- D. Optical radiation pyrometer

List II (Range of temperature)

- 1. Can be used upto  $300^{\circ}\text{C}$  in normal conditions
- 2. Can be used upto  $900^{\circ}\text{C}$  with sufficient accuracy
- 3. Can be used upto  $1400^{\circ}\text{C}$
- 4. Can be used for temperatures upto several thousand degrees

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

73. Match list I with List II and select the correct answer

List I (Instrument)

- A. McLeod gage
- B. Turbine meter
- C. Pyrometer
- D. Synchros

List II (Measurand)

- 1. Temperature
- 2. Pressure.
- 3. Flow
- 4. Displacement

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

74. In a stroboscopic method of rotational speed measurement of a machine shaft,

$N$  = the machine shaft speed of rotation of the shaft in revolutions 1mm.

$n$  = No. of paints on the circuit pattern

$F$  = No of flash per mm.

The speed of rotation  $N$  will be

- a.  $N = F + n$
- b.  $N = F - n$
- c.  $N = F/n$
- d.  $N = F.n$

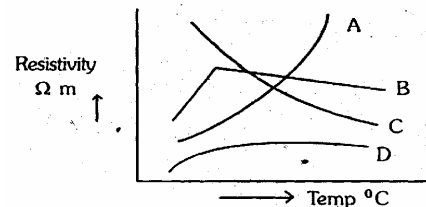
75. To reduce the effect of noise level, 100 sets of data are averaged. The averaged data set will have a noise level reduced by a factor of

- a. 10
- b.  $10\sqrt{2}$
- c.  $50\sqrt{2}$
- d. 100

76. Which of the following transducers is classified as an active transducer?

- a. Metallic strain gauge
- b. Capacitive microphone
- c. LVDT
- d. Piezoelectric transducer

- 77.



Which curve in the given figure represents resistance temperature characteristics of a thermistor?

- a. Curve A
- b. Curve B
- c. Curve C
- d. Curve D

78. A 1 cm piezoelectric transducer having a  $g$ -coefficient of  $58 \text{ V/kg/m}^2$  is subjected to a constant pressure of  $10^7 \text{ kg/m}^2$  for about 15 minutes. The Piezo voltage developed by the transducer will be

- a. 116 mV
- b. 58 mV
- c. 29 mV
- d. 0 mV

79. If  $K$  is the number of parity bits provided with a message, the numbers of errors which can be detected are?

- a.  $K$
- b.  $K - 1$
- c.  $K + 1$
- d. dependent upon the number of bits in the message also

80. Which of the following are the characteristics of closed-loop systems?

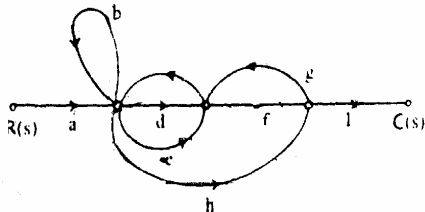
- 1. It does not compensate for disturbances

2. It reduces the sensitivity of plant-parameter variations
3. It does not involve output measurements
4. It has the ability to control the system transient response

Select the correct answer using the codes given below:

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

81.



The number of forward paths and the number of non-touching loop pairs for the signal flow graph given in the figure are respectively,

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

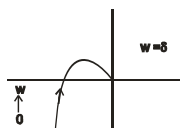
82. List I and List II show the transfer function and polar plots respectively. Match List I with list II and select the correct answer:

List I

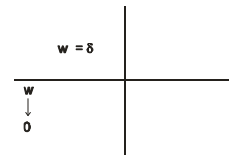
- A.  $\frac{1}{s(1+sT)}$
- B.  $\frac{1}{(1+sT_1)(1+sT_2)}$
- C.  $\frac{1}{s(1+sT_1)(1+sT_2)}$
- D.  $\frac{1}{s^2(1+sT_1)(1+sT_2)}$

List II

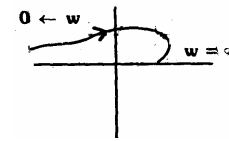
1.



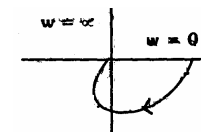
2.



3.



4.



Codes;

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

83. Match List I with List II and select the correct answer:

List I (Property)

- A. Relative stability
- B. Speed of response
- C. Accuracy
- D. Sensitivity

List II (Specification)

1. Rise time
2. Velocity error constant
3. Return difference
4. M-peak

Codes;

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

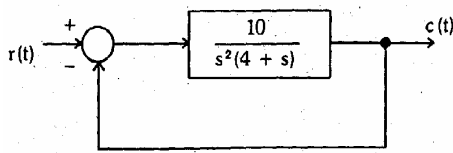
84. Given the transfer function

$$G(s) = \frac{121}{s + 13.2s + 121}$$

of the following characteristics does it have?

- a. Over damped and settling time 1.1s
- b. Under damped and settling time 0.6s
- c. Critically damped and settling time 0.8s
- d. Under damped and settling time 0.707s

85.



The steady-state error resulting from an input  $r(t) = 2 + 3t + 4t^2$  for given state is

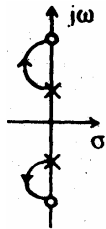
- a. 2.4
- b. 4.0
- c. Zero
- d. 3.2

86. If a ramp input is applied to Type-2 system, the steady-state error is

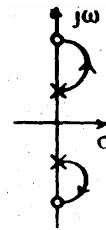
- a. positive constant
- b. negative constant
- c. zero
- d. positive infinity

87. Identify the correct root locus from the figures given below referring to poles and zeros at  $\pm j 8$  and  $\pm j 10$  respectively of  $G(s)H(s)$  of a single-loop control system.

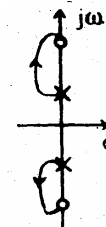
a.



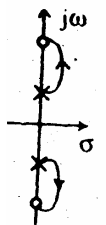
b.



c.



d.



88. Which of the following are the characteristics of the root locus of

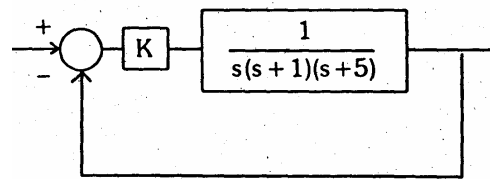
$$G(s) = \frac{K(s+5)}{(s+1)(s+3)}$$

- 1. It has one asymptote
- 2. It has intersection with j w-axis
- 3. It has two real axis intersections
- 4. It has two zeros at infinity

Select the correct answer using the codes given below

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

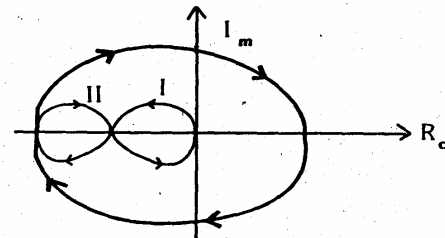
89.



The closed loop system shown above becomes marginally stable if the constant K is chosen to be

- a. 10
- b. 20
- c. 30
- d. 40

90.



Consider the Nyquist diagram for given  $KG(s)H(s)$ . The transfer function  $KG(s)H(s)$  has no poles and zeros in the right half of s-plane. If the  $(-1, j0)$  point is located first in region I and then in region II, the change in stability of the system will be from

- a. unstable to stable
- b. stable to stable
- c. unstable to unstable
- d. stable to unstable

91. The characteristic equation of a system is given by  $3s^4 + 10s^3 + 5s^2 + 2 = 0$ . This system is

- Stable
- Marginally stable
- Unstable
- Neither (a), (b) nor (c)

92. Match List I with List II and select the correct answer:

List I

- Phase lag controller
- Addition of zero at origin
- Derivative output compensation
- Derivative error

List II

- Improvement in transient response
- Reduction in steady-state error
- Reduction in settling time
- Increase in damping constant

Codes;

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

93. Indicate which one of the following transfer functions represents phase lead compensator?

- $\frac{s+1}{s+2}$
- $\frac{6s+3}{6s+2}$
- $\frac{s+5}{3s+2}$
- $\frac{s+8}{s+5s+6}$

94. A transfer function of a control system does not have pole-zero cancellation. Which one of the following statements is true?

- System is neither controllable nor observable
- System is completely controllable and observable
- System is observable but uncontrollable
- System is controllable but unobservable

95. A linear time invariant system is described by the following dynamic equation

$$\frac{dx(t)}{dt} = Ax(t) + Bu(t)$$

$$y(t) = Cx(t)$$

$$\text{Where } A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}, B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}, C = [1 \quad 1]$$

The system is

- Both controllable and observable
- Controllable but unobservable
- Observable but uncontrollable
- Both uncontrollable and unobservable

96. The state-space representation in phase-variable form for the transfer function

$$G(s) = \frac{2s+1}{s^2+7s+9}$$

$$\text{a. } x = \begin{bmatrix} 0 & 1 \\ -9 & -7 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u; y = [1 \quad 2] x$$

$$\text{b. } x = \begin{bmatrix} 1 & 0 \\ -9 & -7 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u; y = [0 \quad 1] x$$

$$\text{c. } x = \begin{bmatrix} -9 & 0 \\ 1 & -7 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u; y = [2 \quad 0] x$$

$$\text{d. } x = \begin{bmatrix} -9 & 0 \\ 1 & 0 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u; y = [1 \quad 2] x$$

$$97. \text{ Let } X = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} U$$

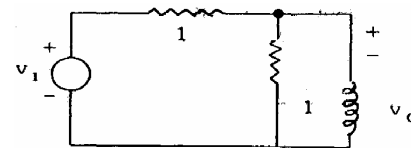
$$Y = [b \quad 0] X$$

Where b is an unknown constant

This system is

- Observable for all values of b
- Unobservable for all values of b
- Observable for all non-zero values of b
- Unobservable for all non-zero values of b

98.



Select the correct transfer function  $v_0(s)/v_1(s)$  from the following for the given network.

$$\text{a. } \frac{2}{s(s+1)}$$

b.  $\frac{s}{(s+2)}$

c.  $\frac{s}{(2s+1)}$

d.  $\frac{2s}{(s+1)}$

99. Which one of the following statements is INCORRECT with reference to pneumatic system?

- Operating pressure is low compared to hydraulic system
- Leaks can create problems as well as fire hazards
- They are insensitive to temperature changes
- High compressibility of air results. in longer time delays

100. Consider the following statements regarding A.C. servo- motor

- The torque-speed curve has negative slope
- It is sensitive to noise
- The rotor has high resistance and low inertia
- It has slow acceleration

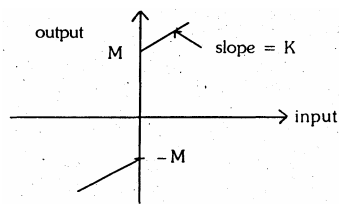
Which of the following are the characteristics of A.C. servo-motor as control component?

- 1 and 2
- 2 and 3
- 1 and 3
- 2 and 4

101. Backlash in a stable control system may cause

- under damping
- over damping
- high level oscillations
- low level oscillations

102.



The describing function of relay nonlinearity is  $4M/X$  :  $M$  = Magnitude of relay,  $X$  = Magnitude of input.

The describing function of given nonlinearity will be

a.  $\frac{4MK}{\pi x}$

b.  $K + \frac{4M}{\pi x}$

c.  $\frac{4M\sqrt{1-K^2}}{\pi x}$

d.  $\frac{4M}{\pi Kx}$

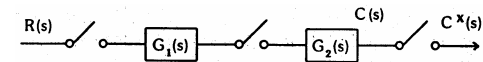
103. Consider the following statements

- If the input is a sine wave of radian frequency  $\omega$ , the output in general is non-sinusoidal containing frequencies which are multiple of  $\omega$
- The jump resonance may occur
- The system exhibits self-sustained oscillation of fixed frequency and amplitude
- The response to a particular test signal is a guide to the behaviour to other inputs

Which of the above statements are correct and peculiar to nonlinear system?

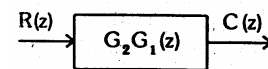
- 1, 3 and 4
- 2, 3 and 4
- 1, 2 and 3
- 1, 2 and 4

104. For the given sampled-data system

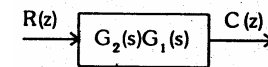


The z-transform is

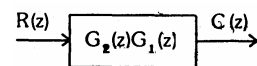
a.



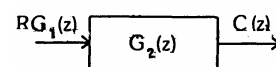
b.



c.



d.



105. The output of first order hold between two consecutive sampling instants is a

- Constant
- Quadratic function

- c. Ramp function  
d. Exponential function
106. match List I with List II and select the correct answer:  
List I (Elements)  
A. Controller  
B. Sampler  
C. Hold  
List II  
1. A/D converter  
2. Computer  
3. D/A converter
- |    | A | B | C |
|----|---|---|---|
| a. | 3 | 1 | 2 |
| b. | 2 | 3 | 1 |
| c. | 3 | 2 | 1 |
| d. | 2 | 1 | 3 |
107. Assertion (A):  $\oint \vec{B} \cdot \vec{ds} = 0$  where  $B =$  magnetic flux density  $\vec{ds} =$  vector with direction normal to surface element  $ds$ .  
Reason (R): Tubes of magnetic flux have no sources or sinks.  
a. Both A & B are true and R is the correct explanation of A  
b. Both A & R are true but R is NOT the correct explanation of A  
c. A is true but R is false  
d. A is false but R is true
108. Consider a plane electromagnetic wave incident normally on the surface of a good conductor. The wave has an electric field of amplitude 1 (V/m) and the skin depth for the conductor is 10 cm.  
Assertion (A): The amplitude of electric field is  $(1/e^2)$  (V/m) after the wave has travelled a distance of 20 cm in the conductor.  
Reason (R): Skin depth is the distance in which the wave amplitude decays to  $(1/e)$  of its value at the surface  
a. Both A & B are true and R is the correct explanation of A  
b. Both A & R are true but R is NOT the correct explanation of A  
c. A is true but R is false  
d. A is false but R is true
109. Assertion (A): When an alternating field is applied to a dielectric, the relative permittivity is a complex quantity.  
Reason (R): The imaginary part of the relative permittivity is responsible for dielectric loss.  
a. Both A & B are true and R is the correct explanation of A  
b. Both A & R are true but R is NOT the correct explanation of A  
c. A is true but R is false  
d. A is false but R is true
110. Assertion (A): A doped semiconductor will behave as a perfect insulator at zero Kelvin but its electrical conductivity will rise if the temperature is slowly increased above zero Kelvin.  
Reason (R): The rise in electrical conductivity is mainly, due to increased ionization as the temperature is raised above zero Kelvin.  
a. Both A & B are true and R is the correct explanation of A  
b. Both A & R are true but R is NOT the correct explanation of A  
c. A is true but R is false  
d. A is false but R is true
111. Assertion (A): Node-voltage analysis of networks is a method that used Kirchoff's current law to obtain a set of simultaneous equations that, when solved, will provide information concerning the magnitudes and phase angles of the voltages across each branch.  
Reason (R): The ideal generator maintains a constant voltage amplitude and wave-shape regardless of the amount of current it supplied to the circuit.  
a. Both A & B are true and R is the correct explanation of A  
b. Both A & R are true but R is NOT the correct explanation of A  
c. A is true but R is false  
d. A is false but R is true
112. Assertion (A): All networks made up of passive, linear time invariant elements are reciprocal.  
Reason (R): Passivity and time-invariance of elements do not guarantee reciprocity of the network.  
a. Both A & B are true and R is the correct explanation of A  
b. Both A & R are true but R is NOT the correct explanation of A

- c. A is true but R is false  
d. A is false but R is true
113. Assertion (A): Transfer impedance of network is always the reciprocal of its transfer admittance.  
Reason (R): The impedance of a network is the reciprocal of its admittance.
- Both A & B are true and R is the correct explanation of A
  - Both A & R are true but R is NOT the correct explanation of A
  - A is true but R is false
  - A is false but R is true
114. Assertion (A): There are pulsations in power of a balanced three-phase system.  
Reason (R): The three-phase generators produce sinusoidal voltages and current.
- Both A & B are true and R is the correct explanation of A
  - Both A & R are true but R is NOT the correct explanation of A
  - A is true but R is false
  - A is false but R is true
115. Assertion (A): A full-wave rectifier type a.c. voltmeter reads the true rms value of the input waveform.  
Reason (R): The full wave rectifier type a.c. voltmeter has a rectifier unit first which feeds its output to the PMMC indicative instrument.
- Both A & B are true and R is the correct explanation of A
  - Both A & R are true but R is NOT the correct explanation of A
  - A is true but R is false
  - A is false but R is true
116. Assertion (A): A four-arm 'Wien' bridge network is sometimes used in feedback circuit of tuned amplifier.  
Reason (R): The balance equation of such a Wien bridge contains 'frequency' term along with arm parameters.
- Both A & B are true and R is the correct explanation of A
  - Both A & R are true but R is NOT the correct explanation of A
  - A is true but R is false
  - A is false but R is true
117. Assertion (A): A spectrum analyzer displays the frequency spectrum of a signal on the CRT screen.  
Reason (R): It uses a sweep voltage generator to sweep the electron beam as well as the input signal.
- Both A & B are true and R is the correct explanation of A
  - Both A & R are true but R is NOT the correct explanation of A
  - A is true but R is false
  - A is false but R is true
118. Assertion (A): A system may have no steady state error to a step input, but the same system may exhibit non zero steady state error to ramp input.  
Reason (R): The steady state error of a system depends on the 'type' of the open loop transfer function.
- Both A & B are true and R is the correct explanation of A
  - Both A & R are true but R is NOT the correct explanation of A
  - A is true but R is false
  - A is false but R is true
119. Assertion (A): Relative stability of a system reduces due to the presence of transportation lag.  
Reason (R): Transportation lag can be conveniently handled by Bode plot.
- Both A & B are true and R is the correct explanation of A
  - Both A & R are true but R is NOT the correct explanation of A
  - A is true but R is false
  - A is false but R is true
120. Assertion (A): If any one of the state variables is independent of the control  $u(t)$ , the process is said to be completely uncontrollable.  
Reason (R): There is no way of driving this particular state variable to a desired state in finite time by means of a control effort.
- Both A & B are true and R is the correct explanation of A
  - Both A & R are true but R is NOT the correct explanation of A
  - A is true but R is false
  - A is false but R is true