ELECTRICAL ENGINEERING

PAPER–I

1. What is the force experienced per unit length by a conductor carrying 5 A current in positive Z direction and placed in a magnetic field $\bar{B} = \left(3\bar{a}_x + 4\bar{a}_y\right)$?

   a. $15\vec{a}_x + 20\vec{a}_y \ N/m$

   b. $-20\vec{a}_x + 15\vec{a}_y \ N/m$

   c. $20\vec{a}_x - 15\vec{a}_y \ N/m$

   d. $-20\vec{a}_x - 20\vec{a}_y \ N/m$

2. Plane z = 10 m carries surface charge density 20 nc/m^2. What is the electric field at the origin?

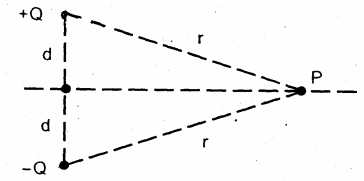
   a. $-10\hat{a}_z \ v/m$

   b. $-18\pi a_z \ v/m$

   c. $-72\pi\hat{a}_z \ v/m$

   d. $-360\pi\hat{a}_z \ v/m$

3. Consider the following diagram:



   Which of the following statements is correct?

   The electric field E at a point P due to the presence of dipole as shown in the above diagram (considering distance r >> distance d) is proportional to

   a. 1/r

   b. 1/r^2

   c. 1/r^3

   d. 1/r^4

4. What is the value of total electric flux coming out of a closed surface?

   a. Zero

   b. Equal to volume charge density

   c. Equal to the total charge enclosed by the surface

   d. Equal to the surface charge density

5. Two extensive homogenous isotropic dielectrics meet on a plane z = 0. for z ≥ 0, $\varepsilon r_1 = 4$ and for z ≤ 0, $\varepsilon r_2 = 2$ uniform electric field exists at z ≥ 0 as $\bar{E}_1 = 5\hat{a}_x - 2\hat{a}_y + 3\hat{a}_z$ kw/m. What is the value of $\bar{E}_2$ in the region z ≤ 0?

   a. $3\hat{a}_z$

   b. $5\hat{a}_x - 2\hat{a}_y$

   c. $6\hat{a}_z$

   d. $\hat{a}_x - \hat{a}_y$

6. What will be the reflected wave for an elliptically polarized wave incident on the interface of a die-electric at the Brewester angle?

   a. Elliptically polarized

   b. Linearly polarized

   c. Right circularly, polarized

   d. Left circularly polarized

7. A flat slab of dielectric, ε_r = 5 is placed normal to a uniform field with a flux density D = 1 Coulomb/m^2. The slab is uniformly polarized. What is the polarization P of the slab in Coulomb/m^2?

   a. 0.8

   b. 1.2

   c. 4

   d. 6

8. Which one of the, following gives the approximate value of the capacitance between two spheres, whose separation is very much larger than their radii R?

   a. $2\pi / \varepsilon_0 R$

   b. $2\pi\varepsilon_0 R$

   c. $2\pi\varepsilon_0 / R$

   d. $4\pi\varepsilon_0 / R$

9. Which one of the following is the correct electromagnetic wave equation in terms of vector potential A?

a. $\nabla^2 A - \frac{\partial^2 A}{\partial t^2} = -J$

b. $\nabla^2 A - \frac{\mu}{\varepsilon}\frac{\partial^2 A}{\partial t^2} = -\mu J$

c. $\nabla^2 A - \frac{\partial^2 A}{\partial t^2} = -\mu J$

d. $\nabla^2 A - \mu\varepsilon\frac{\partial^2 A}{\partial T^2} = -\mu j$

10. Which one of the following statements is correct?

The wavelength of a wave propagating in a wave guide is

a. Smaller than me free space wavelength
b. Greater than the free space wavelength
c. Directly proportional to the group velocity.
d. Inversely proportional to the phase velocity

11. Which one of the following statements is correct?

For a lossless dielectric medium, the phase constant for a traveling wave, β is proportional to

a. ε_r
b. $\sqrt{\varepsilon}$
c. $1/\varepsilon_r$
d. $1/\sqrt{\varepsilon_r}$

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

List I

A. Continuity equation
B. Ampere's law
C. Displacement current
D. Faraday's law

List II

1. $\nabla \times \bar{H} = J + \frac{\partial D}{\partial t}$
2. $\bar{J} = \frac{\partial \bar{D}}{\partial t}$
3. $\nabla \times \bar{E} = -\frac{\partial \bar{B}}{\partial t}$
4. $\nabla . \bar{J} = -\frac{\partial l_v}{\partial t}$

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

13. In a lossless medium the intrinsic impedance $\eta = 60\pi$ and $\mu_r = 1$. What is the value of the dielectric constant ε_r?

a. 2
b. 1
c. 4
d. 8

14. Match List I (Type of field denoted by $\bar{A}$). with List II (Behavior) and select the correct answer using the codes given below:

List I

A. A static electric field in a charge free region
B. A static electric field in a charged region
C. A steady magnetic field in a current carrying conductor
D. A time-varying electric field in a charged medium with time-varying magnetic field

List II

1. $\nabla A = 0$
   $\nabla \times \bar{A} \neq 0$
2. $\nabla . \bar{A} \neq 0$
   $\nabla \times \bar{A} = 0$
3. $\nabla . \bar{A} \neq 0$
   $\nabla \times \bar{A} \neq 0$
4. $\nabla . \bar{A} = 0$
   $\nabla \times \bar{A} = 0$

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

15. Which one of the following statements is correct?

A wave guide can be considered to be analogous to a

a. Low pass filter

b. High pass filter
c. Band pass fitter
d. Band stop filter

16. Consider the following statements about the effective length of a half wave dipole (Elevation angle θ is measured from the dipole axis)
1. Effective length is a function of θ.
2. Effective length is maximum for $\theta = \pi / 2$.
3. Maximum effective length is larger than physical length.
4. Effective length is the same for the antenna in transmitting and receiving modes.

Which of the statements given above are correct?
a. 1, 2 and 4
b. 2, 3 and 4
c. 1, 2 and 3
d. 1, 3 and 4

17. A lossless transmission line of length 50 cm with $L = 10\mu H / m$ C = 40 pF/m is operated at 30 MHz. What is its electric length (βl)?
a. 20λ
b. 0.2λ
c. 108°
d. 40π

18. Which one of the following statements is correct?
If the Fermi level ties midway between the conduction and valence bands, then the semiconductors
a. Intrinsic
b. Extrinsic
c. p-type
d. n-type

19. Which one of the following statements is correct?
Superconductors are popularly used for
a. Generating very strong magnetic field
b. Reducing i^2R losses
c. Generating electrostatic field
d. Generating regions free from magnetic field

20. Which one of the following is the correct expression for the propagation constant in a transmission line?
a. $(R - j\omega L)(G - j\omega C)$
b. $\sqrt{\dfrac{(R + j\omega L)}{(G - j\omega C)}}$
c. $\sqrt{\dfrac{(R + j\omega L)}{(G + j\omega C)}}$
d. $\sqrt{(R + j\omega L)(G + j\omega C)}$

21. On which of the following factors does the value of critical current density in a superconductor depend?
a. Temperature
b. Applied magnetic field
c. Temperature and applied magnetic field
d. Silsbee's rule

22. Match List I (Materials) with List Il (Equation/rule) and select the correct answer using the codes given below:

List I
A. Dielectric material
B. Ferromagnetic material
C. Conductors
D. Superconductor

List II
1. Debye equation
2. Curie Weiss law
3. Matthiessen's rule
4. Meissner effect

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

23. A dielectric material has the real part of the dielectric constant (ε_r) as 4 and its loss tangent is 0.004. What is the complex dielectric constant (ε_r^*) represented by?
a. 4 + j 0.016
b. 4 – 0.016
c. 4 + j 0.001
d. 4 – j 0.001

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

List I

A. Larmon frequency

B. Bohr magnetron

C. Magnetic induction

D. Curie-Weiss law

List II

1. $\chi = C/(T-\theta)$
2. $B = \mu_0 (H + M)$
3. $eh/4\pi\ m$
4. eB/2m

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

25. Which one of the following statements is not correct?

a. Vacuum can act as a dielectric material

b. Piezoelectric, materials can act as transducers

c. Quartz crystal is a ferroelectric material

d. The dielectric constant of diectrics depends on the frequency of the applied field

26. Which one of the following is the temperature below which certain material are ant ferromagnetic and above which they are paramagnetic?

a. Curie temperature

b. Neel temperature

c. Transition temperature

d. Weiss temperature

27. Match List I (Type of the material) with List II (Name of the material) and select the correct answer:

List I

A. Ferromagnetic

B. Soft magnetic

C. Hard magnetic

D. Semiconductor

List II

1. Rochelle salt
2. Alnico
3. Perm alloy
4. Ga As

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

28. Which one of the following statements is correct?

A ferrite core has lower specific eddy current loss compared to an iron core because the iron core has

a. Higher electrical resistance

b. Lower electrical resistance

c. Higher permeability

d. Lower permeability

29. In which one of the following ways can the Hall voltage across an impurity semiconductor crystal be increased?

a. By increasing the thickness of the crystal

b. By increasing the concentration of impurity atoms in the crystal

c. By increasing the width of the crystal

d. By increasing the current flowing through the crystal

30. Which one of the following statements is correct?

The Hall coefficient of an intrinsic semiconductor is

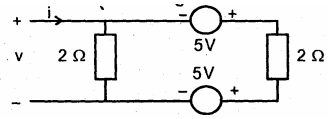
a. Positive

b. Negative

c. Zero

d. Infinite

31. Consider the following circuit:



Which one of the following statements is correct?

The circuit shown above is

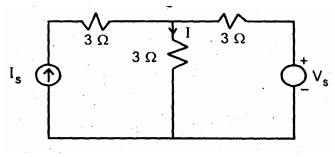
a. Passive and linear

b. Active and linear

c. Passive and non-linear

d. Active and non-linear

32. Consider the following circuit:



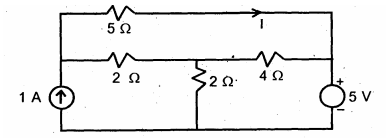
In the above circuit, when $V_s = 3V$, $I = 4A$, what is the value of I when V_s = 12V?

a. 5 A
b. 10 A
c. 15 A
d. 20 A

33. Three parallel resistive branches are connected across a. d.c. supply. What will be the ratio of the branch currents I_1:I_2:I_3 if the branch resistances are in the ratio R_1 : R_2 :R_3::2:4:6?

a. 3 :.2 : 6
b. 2:4:6
c. 6:3:2
d. 6:2:4

34. Consider the following circuit:



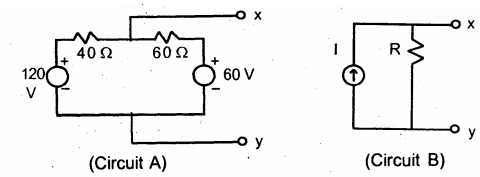
What is the value of current I in the 5Ω resistor in the above circuit?

a. 0A
b. 2A
c. 3A
d. 4A

35. A voltage source having an internal impedance of 8 + j6 ohms supplies power to a resistive load. What should be the load resistance for maximum power transferred to it?

a. 8 ohms
b. 6 ohms
c. 10 ohms
d. $\sqrt{10}$ ohms

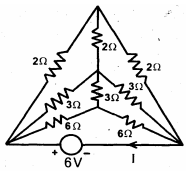
36. Consider the circuits A and B given below:



For what values respectively of I and R, the circuit B is equivalent to circuit A?

a. 3A, 40Ω
b. 4A, 24Ω
c. 1A,60Ω
d. 2A,100Ω

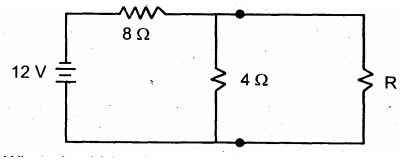
37. Consider the following circuit:



What is the value of current I in the above circuit?

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

38. Consider the following circuit:



What should be the value of resistance R, in the above circuit if it has to absorb the maximum power from the source?

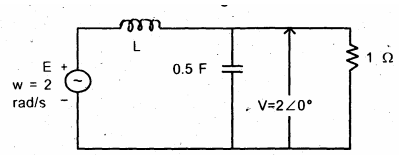
a. 8/3 ohms
b. 3/8 ohms
c. 4 ohms
d. 8 ohms

39. The transfer function of a system $Z(s) = \frac{V(s)}{I(s)} = \frac{s}{s+3}$. The system is at rest for the t < 0.

What will be the value of v(t) for t ≥ 0, if i(t) = 3u(t) , where u(t) is a unit step?

a. e^{-t}
b. $2e^{-3t}$
c. $3e^{-3t}$
d. $4e^{-t}$

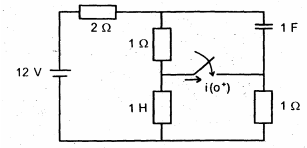
40. Consider the following circuit:



For the circuit shown above, by how much the voltage across the inductor leads the voltage across the capacitor?

a. 45°
b. 90°
c. 135°
d. 180°

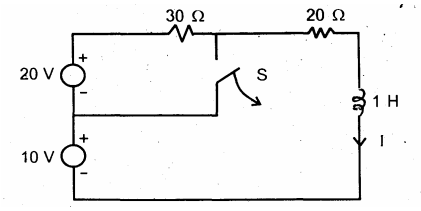
41. Consider the following circuit:



The circuit shown above is in steady state before closing the switch. What is the current $i(o^+)$ through the switch if the circuit is closed at t = 0?

a. – 4A
b. 0 A
c. 4 A
d. 12 A

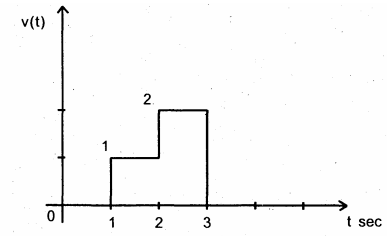
42. Consider the following circuit:



The circuit shown above attains a steady state with the switch S closed. What is the value of 1(t) for t ≥ 0, if the switch S is opened at t = 0?

a. $0.5+0.5\ e^{-50t}$
b. $0.6–0.1e^{-50t}$
c. $0.5–0.5e^{-50t}$
d. $0.6–0.6e^{-20t}$

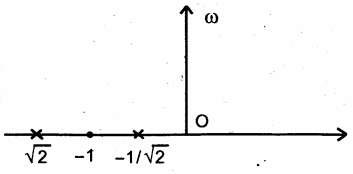
43. Consider the following diagram:



Which one of the following gives Lap lace transform of the wavelength v(t) shown in the above diagram?

a. $\left[e^{s}+e^{2s}+2e^{3s}\right]/s$
b. $\left[e^{s}+e^{2s}-2e^{3s}\right]/s$
c. $\left[e^{-s}+e^{-2s}-2e^{-3s}\right]/s$
d. $\left[e^{-s}+e^{-2s}+2e^{-3s}\right]/s$

44. Consider the following pole-zero diagram of a system function Z(s) = V(s)/I(s).



What will be the magnitude of the voltage phasor for i(t) = sin t?

a. 3/2
b. 1
c. 2/3
d. 1/3

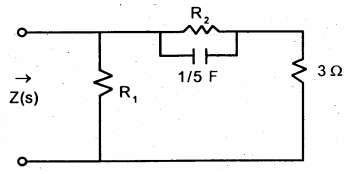
45. A balanced delta connected load has an impedance of $9\angle 30°$ ohms per phase. What is the impedance per phase of its equivalent star?

a. $27\angle 30°\Omega$
b. $27\angle 90°\Omega$
c. $3\angle 30°\Omega$
d. $3\angle 20°\Omega$

46. For a parallel RLC resonant circuit; the damped frequency is $\sqrt{8}$ r/s and bandwidth is 2 r/s. What is its resonant frequency?

a. 2
b. $\sqrt{7}$
c. $\sqrt{10}$
d. 3

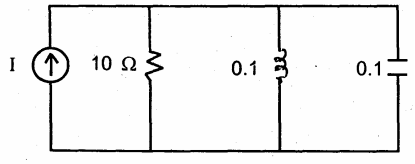
47. Consider the following circuit:



In the above circuit $Z(s)=2$ as $s\to\infty$ and Z (s) = 3 as $s\to 0$. What are, respectively the values of R_1 and R_2?

a. 6Ω, 3Ω
b. 4Ω, 2Ω
c. 3Ω, 6Ω
d. 6Ω, 2Ω

48. Consider the following circuit:



For the above circuit, the current source is sinusoidal with frequency equal to the resonant frequency of the circuit. What is the value of current through the resistor?

a. 0

b. 0.1 I

c. I

d. 10 I

49. In an a.c. series RLC circuit, the voltage across R and L is 20 V, voltage across L and C is 9V and voltage across RLC is 15V. What is the voltage across C?

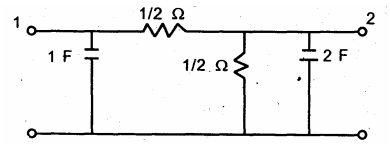
a. 7V

b. 12V

c. 16V

d. 21V

50. Consider the following circuit:



What is the short-circuit natural frequency at port 1 of the above circuit?

a. S + 2 = 0

b. S + 1 = 0

c. 2s + 1= 0

d. 2s + 3 = 0

51. Two resistors of equal value are connected in series across the lines B and C of a symmetrical 3-phase 400 – V system. What is the magnitude of the voltage between the line A and the junction of the resistors?

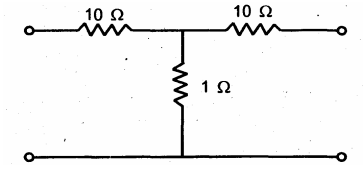
a. $400/\sqrt{3}$

b. $200\sqrt{3}$

c. $400/3$

d. $100\sqrt{3}$

52. Two identical T-sections, such as one shown below are connected in series.



What is the y_{11} of the combination?

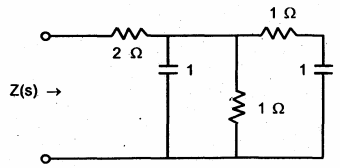
a. 11/240 ℧

b. 22/240 ℧

c. 11/360 ℧

d. 22/120 ℧

53. The realization of the driving points impedance function $Z(s)=(\alpha s^2+7s+3)/(s^2+3s+\beta)$ is shown in the circuit given below:



What are, respectively the values of α and β?

a. 5,2

b. 2,5

c. 2,3

d. 2,1

54. Impedance $Z(s)=[(s+3)(s+5)]/[(s+4)(s+6)]$ is realized in the Foster's second form. What will be the values, respectively of R and L in one of the series R-L branches?

a. 2Ω, 1/3 H

b. 2Ω, 4/3 H

c. 2Ω, 5/3H

d. 2Ω, 2/3H

55. Match List I (Accuracy) with List II (Type of the standard) and select the correct answer:

List I

A. Least accurate

B. More accurate

C. Much more accurate

D. Highest possible accurate

List II

1. Primary
2. Secondary
3. Working
4. International

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

56. Which one of the following statements is correct?

The application of the instrument in wrong manner in the procedure of measurement results in a/an

a. Systematic error
b. Random error
c. Gross error
d. Instrument error

57. A 0 to 200 V voltmeter has a guaranteed accuracy of 1% of full scale reading. The voltage measured by this instrument is 50 V. What is the limiting error?

a. 4%
b. 2%
c. 1%
d. 0.25%

58. Which one of the following statements correctly represents the systematic errors?

a. These errors can be calculated from the details of the instruments
b. These are the residual errors
c. These errors may occur under controlled conditions
d. These are the errors committed by the experiments

59. A resistor R is measured using the V-I method, with V read as 10.14 V and I as 5.07 mA. Which one of the following expresses the value of resistance?

a. 2 kΩ
b. 2.00 kΩ
c. 2000Ω
d. 2.0 kΩ

60. Which one of the following statements is correct?

The deflection of hot wire instrument depends on

a. r.m.s. value of the a.c. current
b. r.m.s. value of the a.c. voltage
c. average value of the a.c. current
d. average value of the a.c. voltage

61. Which one of the following materials is used in the fabrication of swamping resistance of a PMMC instrument?

a. Copper
b. Aluminium
c. Manganin
d. Tungsten

62. Which one of the following is basically a current sensitive instrument?

a. Permanent magnet moving coil instrument
b. Cathode ray oscilloscope
c. Electrostatic instrument
d. FET input electronic voltmeter

63. A d'Arsonval movement with internal résistance R = 100 Ω and full scale current of 1I mA is to be converted into (0 - 10) V range. What is the required resistance?

a. 10 Ω
b. 10100 Ω
c. 9900 Ω
d. 12000 Ω

64. Which one of the following types of instruments can be used to determine the r.m.s. value of a.c. voltage of high magnitude (10 kV) and of any wave shape?

a. Moving iron instruments
b. Dynamometer type instruments
c. Induction instruments
d. Electrostatic instruments

65. The battery cells in an electronic millimeter are required to measure which one of the following?

a. Resistance
b. Voltage
c. Current
d. Power

66. Which, one of the following methods decreases the error due to connections in a dynamometer type Wattmeter?

a. Using bifilar compensating Winding in place of current coil
b. Using non-inductive pressure coil circuit
c. Using a capacitor across a part of high resistance of pressure coil circuit
d. Using a swamping resistance

67. The power of a three-phase, three-wire balance system was measured by two-Wattmeter method. The reading of one of the Wattmeters was found to be double that of the other. What is the power factor of the system?

a. 1

b. 0.866
c. 0.707
d. 0.5

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

List I (Instruments)

A. Dynamometer instrument -
B. Thermocouple based instrument
C. Ramp generator
D. Weston Standard Cell

List II (Application)

1. True r.m.s. value mete
2. Transfer instrument between a.c. and d.c.
3. Time base of CRO
4. Standard of Electromotive force (Emf)

Codes;

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

69. Low resistance from few ohms down to one micro ohm is measured using which one of the following instructs merits?

a. Ohmmeter
b. A series type ohmmeter
c. A shunt type ohmmeter
d. A voltmeter and an ammeter

70. Which one of the following statements is correct? An electronic voltmeter is more reliable as compared to multimeter for measuring voltage across low impedance because

a. its sensitivity is high
b. it offers high input impedance
c. it does not alter the measured voltage
d. its sensitivity, and input impedance are high and do not alter the measured value

71. Which one of the following decides the precision of integrating digital voltmeter?

a. Reference voltage of analog comparator
b. Slope of the generated ramp
c. Width of the generated pulses
d. Electronic counter

72. Which one of the following statements is correct?

Spiral springs are used in instruments to

a. provide controlling torque
b. provide damping torque
c. lead the current to moving coil as well as to provide the controlling torque
d. provide linear deflection

73. Which one of the following decides the time of response of an indicating instrument?

a. Deflecting system
b. Controlling system
c. Damping system
d. Pivot and Jewel bearing

74. Which one of the following is measured by the loss of charge method?

a. Low R
b. High R
c. Low L
d. High L

75. Which one of the following gives Gauge factor of a strain gauge?

a. $\frac{\Delta L}{L} \Big/ \frac{\Delta R}{R}$
b. $\frac{\Delta R}{R} \Big/ \frac{\Delta L}{L}$
c. $\frac{\Delta R}{R} \Big/ \frac{\Delta D}{D}$
d. $\frac{\Delta R}{R} \Big/ \frac{\Delta \rho}{\rho}$

76. Which one of the following definition correctly, represents a data acquisition system (DAS)?

a. DAS is a group of electronic devices that are connected to perform the measurement and quantization of electrical Signals for digital processing
b. DAS is a group of devices that are connected t store different signals
c. DAS is a system to control a process
d. DAS is a signal conditioner

77. Match List I with List II and select the correct answer using the codes given below

List I (Transducer)

A. Piezo-electric crystal
B. Manometer
C. Resistance bridge
D. Resistance strain gage

List II (Parameter)

1. Static pressure measurement
2. Dynamic force measurement
3. Study of vibration of a cantilever
4. Vibration in position of slider by an external force changes the resistance

Codes;

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

78. Which one of the following thermocouples has the highest temperature measuring range?

a. Copper-Constantan
b. Iron-Constantan
c. Alumel-Chromel
d. Platinum Rhodium-Platinum

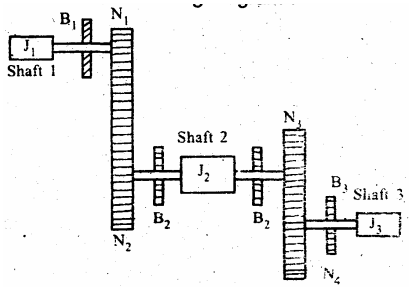
79. Consider the following elements:

1. Low pass filter
2. Signal transmission medium
3. Amplifier
4. Digital to analog convertor
5. Analog to digital convertor

Which one of the following sequences is the correct sequence for effective signal re-construction in a data acquisition and processing scheme?

a. 1-3-5-2-4
b. 3-1-5-2-4
c. 1-5-3-2-4
d. 3-5-1-4-2

80. Consider the following diagram:



For the multiple gear system shown above, which one of the following gives the equivalent inertia referred to shaft 1?

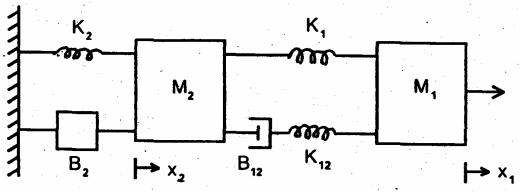
a. $J_1 + J_2\left(\frac{N_1}{N_2}\right)^2 + J_2\left(\frac{N_1N_3}{N_2N_4}\right)^2$

b. $J_1 + J_2\left(\frac{N_2}{N_1}\right)^2 + J_3\left(\frac{N_2N_4}{N_1N_3}\right)^2$

c. $J_1 + J_2\left(\frac{N_1}{N_2}\right)^2 + J_3\left(\frac{N_1N_2}{N_3N_4}\right)^2$

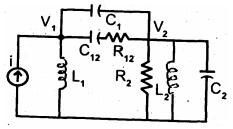
d. $J_1 + J_2\left(\frac{N_2}{N_1}\right)^2 + J_3\left(\frac{N_1N_2}{N_3N_4}\right)^2$

81. Consider the following mechanical system shown in the diagram:

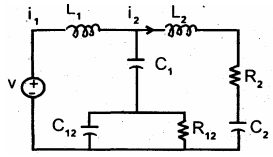


Which one of the following circuits shows the correct force- current analogous electrical circuit for the mechanical diagram shown above?

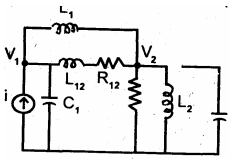
a.



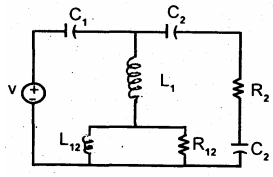
b.



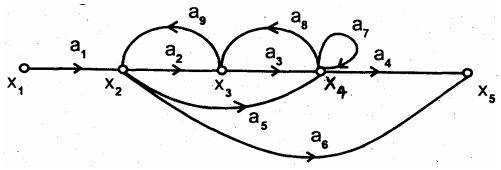
c.



d.



82. The signal flow graph for a certain feedback control system is given below:



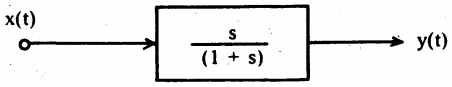
Now consider the following set of equations for the nodes:

1. $x_2 = a_1x_1 + a_9x_3$
2. $x_3 = a_2x_2 + a_8x_4$
3. $x_4 = a_3x_3 + a_5x_2$
4. $x_5 = a_4x_4 + a_6x_2$

Which of the above equations are correct?

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

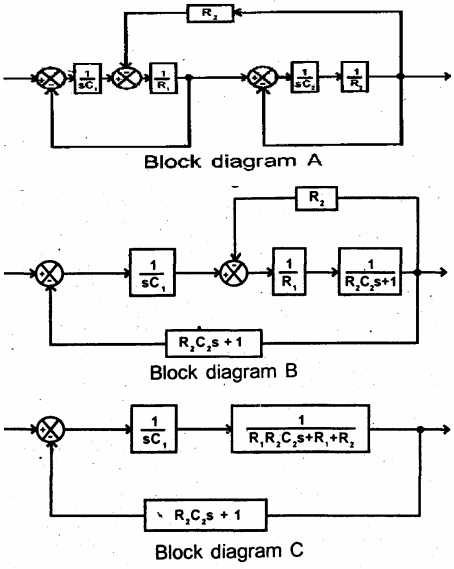
83. Consider the following system shown in the diagram:



In the system shown in the above diagram x(t) = sin t. What will be the response y(t) in the steady state?

a. $\sin(t-45°)\sqrt{2}$
b. $\sin(t+45°)\sqrt{2}$
c. $\sqrt{2}\,e^{-t}\sin t$
d. $\sin t - \cos t$

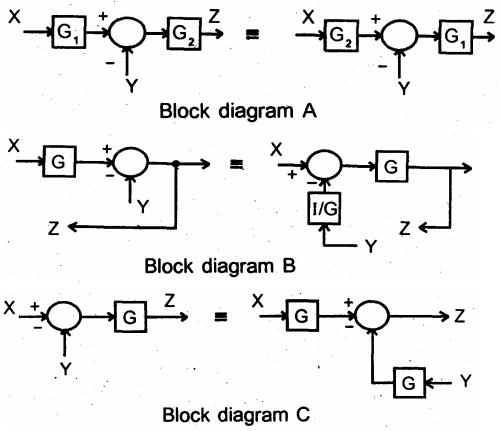
84. Consider the following three block diagram A, B and C shown below:



Which one of the following statements is correct in respect of the above block diagrams?

a. Only A and B are equivalent
b. Only A and C are equivalent
c. Only B and C are equivalent
d. A, B and c are equivalent

85. Consider the following three cases of block diagram algebra A, B and C



Which of the above relations are correct?

a. A and B
b. B and C
c. A and C
d. A, B and C

86. The damping ratio and natural, frequency of a second order system are 0.6 and 2 rad/s respectively. Which one of the following combinations gives the correct values of peak and setting time, respectively for the unit step response of the system?

a. 3.33 S and 1.95 S
b. 1.95 s and 3.33 S
c. 1.95 s and 1.5 s
d. 1.5 s and 1.95 S

87. Match List I (Type of plots) with List VII (Functions) and select the correct answer using the codes given below:

List I

A. Bode plots
B. Polar plots
C. Nyquist plots
D. Nichols chart

List II

1. Open loop response due to damped sinusoidal inputs as a function of complex frequency

2. Open loop response due to undamped sinusoidal as a function of real frequency
3. Closed loop response due to sinusoidal inputs as a function of real frequency
4. Open loop magnitude and phase angle responses for undamped sinusoidal inputs plotted separately as a function of real frequency

Codes;

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

88. A unity feedback control system has a forward loop transfer function as $\frac{e^{Ts}}{\left[s\left(s+1\right)\right]}$ Its phase value will be zero at frequency ω_1. Which one of the following equations should be satisfied by ω_1?

a. $\omega_1 = \cot\left(T\omega_1\right)$

b. $\omega_1 = \tan\left(T\omega_1\right)$

c. $T\omega_1 = \cot\left(\omega_1\right)$

d. $T\omega_1 = \tan\left(\omega_1\right)$

89. Consider the following transfer functions:

1. $1/(S^2+ S + 1)$
2. $4/(S^2 + 2S + 4)$
3. $2/(S^2 + 2S + 2)$
4. $1/(S^2 + 2S + 1)$
5. $3/(S^2 + 6S + 3)$

Which of the above transfer functions represent under damped second order systems?

a. 4 and 5

b. 1, 4 and 5

c. 1, 2 and 3

d. 1, 3 and 5

90. Which one of the following equations gives the steady-state error for a unity feedback system excited by $u_s\left(t\right)+t\,u_s\left(t\right)+\left[t^2u_s\left(t\right)/2\right]$

a. $\frac{1}{\left(2+K_p\right)}+\frac{1}{K_v}+\frac{1}{K_a}$

b. $\frac{1}{\left(1+K_p\right)}+\frac{1}{K_v}+\frac{2}{K_a}$

c. $\frac{1}{K_p}+\frac{1}{K_v}+\frac{1}{K_a}$

d. $\frac{1}{\left(1+K_p\right)}+\frac{1}{K_v}+\frac{1}{K_a}$

91. A control system is defined in S-domain. Following points regarding the poles of the transfer function obtained from the characteristic equation were noted

1. Poles with positive real part denote stable system.
2. Complex poles always occur in pairs. -
3. A pole S = - σ (σ > 0) means that the transient response contains exponential decay.

Which of the above are correct?

a. 1 and 2

b. 1 and 3

c. 2 and 3

d. 1, 2 and 3

92. Consider the following statements regarding advantages of using the generalized error coefficients

1. The generalized error coefficients provide a simple way of determining the nature of the response of a feedback control system to almost any arbitrary input.
2. The generalized error coefficients lead to the calculation of the steady-state response without actually solving the system differential equation.
3. The generalized error coefficients establish relationships among the various types of inputs.

Which of the above statements are correct?

a. 1, 2 and 3

b. 1 and 2

c. 2 and 3

d. 1 and 3

93. The Nyquist plot for the closed-loop control system with the loop transfer function G(S) H(S) = $\frac{100}{S\left(S+10\right)}$ is plotted. Then, the critical point (-1, j0) is

a. never enclosed

b. enclosed under certain conditions

c. just touched

d. enclosed

94. A minimum phase unity feedback system has a Bode plot with a constant slope of -20 db/decade for all frequencies. What is the value of the maximum phase margin for the system?

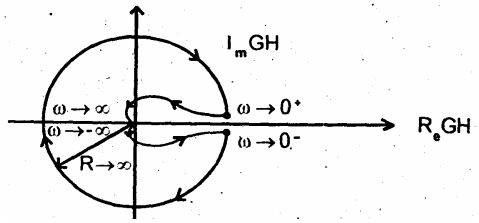
a. 0°

b. 90°

c. - 90°

d. 180°

95. Consider the following Nyquist plot of a feedback system having open loop transfer function GH(s) = (S + 1)1 [s^2(s - 2)] as shown in the diagram given below:



What is the number of closed loop poles in the right half of the s-plane?

a. 0

b. 1

c. 2

d. 3

96. Consider the following statements for a counterclockwise Nyquist path:

1. For a stable loop system, the Nyquist plot of G(s)H(s) should encircle (-1, j0) point as many times as there are poles of G(s)H(s) in the right half of the s-plane, the encirclements, if there are any must be made in the counterclockwise direction.
2. If the loop gain function G(s)H(s) is a stable function, the closed loop system is always stable.
3. If the loop gain function G(s)H(s) is a stable function, for a stable closed-loop system, the Nyquist plot of G(s)H(s) must not enclose the critical point (-1, j0).

Which of the statements given above is/are correct?

a. Only 1

b. 1 and 2

c. 1 and 3

d. Only 3

97. The characteristic equation for a third-order system is

$$q(s) = a_0 s^3 + a_1 s^2 + a_2 s + a_3 = 0$$

For the third-order system to be stable, besides that all the coefficients have to be positive, which one of the following has to be satisfied as a necessary and sufficient condition?

a. $a_0 a_1 \geq a_2 a_3$

b. $a_1 a_2 \geq a_0 a_3$

c. $a_2 a_3 \geq a_1 a_0$

d. Only 3

98. A control system has G(s)H(s) = K/[s(s + 4)(s^2 + 4s + 20)] (0 < K < ∞). What is the number of breakaway points in the root locus diagram?

a. One

b. Two

c. Three

d. Zero

99. Which one of the following is the correct expression for the transfer function of an electrical RC phase-lag compensating network?

a. $\frac{RCS}{(1+RCS)}$

b. $\frac{RC}{(1+RCS)}$

c. $\frac{1}{(1+RCS)}$

d. $\frac{S}{(1+RCS)}$

100. Which one of the following is not a correct reason to select feedback compensation over cascaded one?

a. No amplification is required as the energy transfer is from higher to lower level

b. Suitable devices are not available for compensation (series)

c. It is economical

d. Provides greater stiffness against load disturbances

101. For a unity feedback system, the origin of the s-plane is mapped in the z-plane by transformation $z = e^{ST}$ to which one of the following?

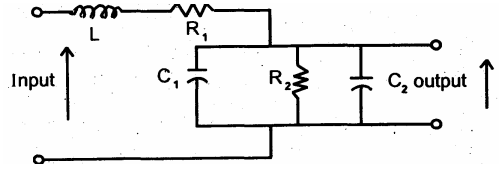
a. Origin

b. 1 + j0

c. – 1 + j0

d. 0 + j1

102. Consider the following network:



What is the minimum number of states of the network given above in order to determine the complete output of the network over all future time for a given input?

a. 0

b. 1

c. 2

d. 3

103. Match List I (Singular point) with List II (Phase portrait) and select the correct answer using the codes given below:

List I

A. Unstable focus

B. Stable focus

C. Stable node

D. Saddle

List II

1. A logarithmic spiral extending into the singular point
2. Trajectories approach singular point adjacent to straight line curve out and leave in vicinity of singular points
3. A logarithmic spiral extending out of the singular point
4. Trajectories are asymptotic to straight line

Codes;

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

104. About which one of the following is the phase-plane portrait for the non-linear system given by $\ddot{x} + f(x, \dot{x})$ and satisfying $f(x, \dot{x}) = f(-x, \dot{x})$ symmetrical?

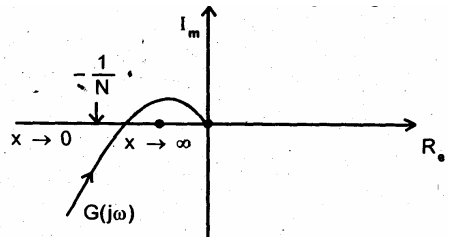
a. x-axis

b. $\dot{x}$-axis

c. Both the x and x axes

d. Neither x nor x axes

105. A unity feedback non-linear control system's plot for —1/N and G(jω) is shown in the diagram given below:



N is describing function of the non-linear device and G(s) is the transfer function of the linear plant. Which one of the following statements is correct? The limit cycle is

a. stable

b. unstable

c. critically stable

d. None of the above

106. Match List I (Name of the Component) with List II (Type of the Component) and select the correct answer using the codes given below:

List I

A. Amplidyne

B. Potentiometer

C. Stepper motor

D. AC Tacho-generator

List II

1. Rate feedback element
2. Actuator
3. Servo amplifier
4. Error detector

Codes;

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

107. Consider the following statements:

1. Servomotors have lighter rotor as compared to ordinary motors and hence lower inertia.
2. Back e.m.f. in field controlled d.c. motors acts as minor loop feedback and results in increased damping and improved transient response.
3. Permanent magnet d.c. servomotors can be used in either armature-controlled or field-controller modes.

Which of the above statements are not correct?

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

108. Match List I (Plot/Model) with List II (Related parameter) and select the correct answer using the codes given below:

List I

A. Root locus plot
B. Bode plot
C. Nyquist plot
D. Signal flow chart

List II

1. Comer frequency
2. Breakaway point
3. Critical point
4. Transmittance

Codes;

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

109. A 3-phase star-connected balanced load consumes P watts of power from a 400 V (line to line voltage) supply. if the same load is connected in delta across the same supply, what is the power consumption ?

a. P/13W
b. P W
c. $\sqrt{3}$ P W
d. 3 P W

110. Assertion (A): An intrinsic semi-conductor has low electrical conductivity. I-fence, it is normally not used in the device fabrication without damping.

Reason (R): Its electrical resistivity can be increased by raising its temperature.

a. Both A ‘and R are individually true and R is the correct explanation of A
b. Both A and R are individually 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): In a lossless transmission line the voltage and current distributions along the line are always Constant.

Reason (R): The voltage and current distributions in an open line are such that at a distance $\lambda/4$ from the load end, the line looks like a series resonant circuit.

a. Both A ‘and R are individually true and R is the correct explanation of A
b. Both A and R are individually 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): An electric or mechanical input makes the flux jump from one superconductor to another, generating large direct currents.

Reason (R): The electric resistivity of superconductors depends upon the magnetic field.

a. Both A ‘and R are individually true and R is the correct explanation of A
b. Both A and R are individually 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): Cryotron is a switch constructed out of superconducting materials.

Reason (R): Switching action is characteristic of superconductors only.

a. Both A ‘and R are individually true and R is the correct explanation of A
b. Both A and R are individually 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

114. Assertion (A): Soft magnetic material is used in making electromagnets.

Reason (R): Soft magnetic materials have a high coercive field.

a. Both A ‘and R are individually true and R is the correct explanation of A
b. Both A and R are individually 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

115. Assertion (A): If Thevenin’s equivalent of a circuit is known, its Norton equivalent is also known.

Reason (R): Noton’s equivalent is reciprocal of Thevenin’s equivalent.

a. Both A ‘and R are individually true and R is the correct explanation of A
b. Both A and R are individually 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

116. Assertion (A): An electronic voltmeter measures the voltage across a high resistance more accurately as compared to an ordinary multimeter.

Reason (R): The electronic voltmeter consists of a voltage amplifier which is not present in an ordinary multimeter.

a. Both A ‘and R are individually true and R is the correct explanation of A
b. Both A and R are individually 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

117. Assertion (A): Cathode ray oscilloscopes using CRT employing electrostatic deflection are used in laboratories for scientific measurements. -

Reason (R): CRT using electrostatic deflection systems has more deflection sensitivity as compared to CRT employing magnetic deflecting system.

a. Both A ‘and R are individually true and R is the correct explanation of A
b. Both A and R are individually 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

118. Assertion (A): A dual trace CR0 can display two input signals simultaneously.

Reason (R): A dual trace CRO uses a CRT having two electron guns to generate two electron beams simultaneously.

a. Both A ‘and R are individually true and R is the correct explanation of A
b. Both A and R are individually 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

119. Assertion (A): Data acquisition systems are used in a large and ever increasing number, of applications in a veriety of industrial and scientific areas.

Reason (R): Transducer converts the analog signal to a form acceptable by the A/P convertor.

a. Both A ‘and R are individually true and R is the correct explanation of A
b. Both A and R are individually 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

120. Assertion (A): An addition of real zero at s = - z_0 in the transfer function G(s) H(s) of a control system results in the increase of stability margin.

Reason (R): An addition of real zero at s = - z_0 in the transfer function G(s)H(s) will make the resultant root loci bend towards the left.

a. Both A ‘and R are individually true and R is the correct explanation of A
b. Both A and R are individually 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