ELECTRICAL ENGINEERING

PAPER-I

1. Digital data acquisition systems are used
   1. Only when the output of the transducers is in digital form
   2. When physical process being monitored is slowly varying (narrow bandwidth)
   3. When low accuracy can be tolerated
   4. When high accuracy and low per channel cost is required

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

2. Match list I with list II and select the correct answer:

   List I (Terms)
   A. Precision
   B. Accuracy
   C. Resolution
   D. Static sensitivity

   List II (Its meaning)
   1. The smallest change in the input quantity which can be detected with its certainty
   2. Closeness of the reading with its true value
   3. Measure of reproducibility of the measurements
   4. Ratio of infinitesimal change in output to infinitesimal change in input

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

3. The modern standard of time is
   a. A second defined as 1/86,400 of a mean solar day
   b. A second defined as time constant of an RC series circuit having R = 2 MΩ, C = 500 pF
   c. A second which is duration of 9 192631770 periods of radiation corresponding to the transition between the two hyperfine levels of the fundamental state of the atom cesium 133.
   d. A second defined as 1/31556925.9747 of the time required by the earth to orbit the sun in the year 1900

4. Match List I (Error parameters) with list II (Values) and select the correct answer: (σ is the standard deviation of Gaussian error):

   List I
   A. Precision index
   B. Probable error
   C. Error limit
   D. Pak probability density of error

   List II
   1. $0.67\,\sigma$
   2. 3σ
   3. $0.39/\sigma$
   4. $0.71/\sigma$

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

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

   List I (Bridge)
   A. Maxwell's bridge
   B. Hay's bridge
   C. Schering bridge
   D. Wien bridge

   List II (Parameter to be measured)
   1. Frequency
   2. Inductance of medium Q-coils ($1 < Q < 10$)
   3. Inductance of high-Q coils ($Q > 10$)
   4. Capacitance

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

6. Which of the following are the characteristics of a thermocouple type of indicating instrument?

1. Its accuracy is very high, as high as about 1 percent.
2. It has a linear scale because a d' Arsonval movement is used for measuring the output.
3. It is an RF instrument and can be used for frequency up to about 50 MHz.
4. It cannot be damaged by overloads.

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

7. Consider the following equations which can be derived from the ac bridges shown in the Figure I and Figure II by assuming $\Delta L/L = 0.1$ and $R = wL$:

1. $v_{01} = v_{02}$
2. $v_{01} = 0.05v_s$
3. $v_{01} = 0.1v_s$
4. $v_{02} = 0.05v_s$
5. $v_{02} = 0.1v_s$

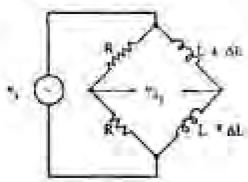


Figure-I

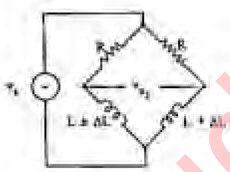


Figure-II

The correct derived equations from these figures of ac bridges are

a. 1,3 and 4
b. 2,4 and 5
c. 2 and 5
d. 1, 3 and 5

8. Which one of the following statements correctly represents the post acceleration in a Cathode-Ray Tube?

a. It provides deflection of the beam
b. It increases the brightness of the trace if the signal frequency is higher than 10 MHz
c. It accelerates the beam before deflection
d. It increases the brightness of the trace of low frequency signal

9. If the Q-factor of a coil is measured by varying the frequency, then

a. The plot between Q and frequency is linear
b. The value of Q initially decreases with increase of frequency and afterwards it will increase with increase of frequency
c. The value of Q initially increases with increase of frequency and afterwards it will decrease with increase of frequency
d. The Q-factor remains constants irrespective of value of frequency

10. Consider the following statements:

The value of earth resistance depends upon

1. Shape of electrode
2. Depth to which the electrode is driven into earth
3. Specific resistance of soil
4. Material of electrode

Which of the following statements is correct?

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

11. Which of the following electronic instruments (or equipment) can be used to measure correctly the fundamental frequency component of a waveform and its higher harmonics?

1. Cathode ray oscilloscope
2. Vacuum tube voltmeter
3. Spectrum analyzer
4. Distortion factor meter

Select the correct answer using the codes given below:

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

12. In a single-phase power factor meter, the controlling torque is

a. Provided by spring control
b. Provided by gravity control
c. Provided by stiffness of suspension
d. Not required

13. Which one of the following transducers can be used for measurement of pressures as high as 100,000 atmosphere?

a. Mcleod gauge
b. Pirani gauge
c. Bridgman gauge

d. Knudsen gauge

14. A dc circuit can be represented by an internal voltage source of 50 V with an output resistance of 100 k Ω. In order to achieve accuracy better than 99% for voltage measurement across its terminals, the voltage measuring device should have a resistance of at least

a. 10 MΩ

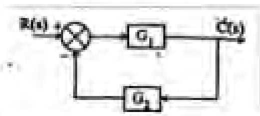
b. 1 M Ω

c. 10 kΩ

d. 1 kΩ

15. Consider the following blocks diagrams:

1.



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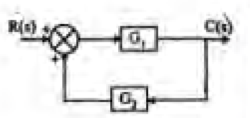

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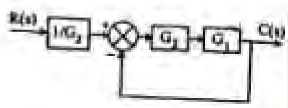

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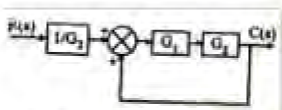


Which of these block diagrams can be reduced to transfer function $\frac{C(s)}{R(s)} = \frac{G_1}{1-G_1G_2}$?

a. 1 and 3

b. 2 and 4

c. 1 and 4

d. 2 and 3

16. In electrodynamometer type watt meters, the inductance of pressure coil produces error. The error is

a. Constant irrespective of the power factor of the load

b. Higher at higher power factor loads

c. Higher at lower power factor loads

d. Highest at unity power factor loads

17. An analogue voltage signal whose highest significant frequency is 1 kHz is to be coded with a resolution of 0.01 percent for a voltage range of 0 – 10 V. The minimum sampling frequency and the minimum number of bits should respectively be

a. 1 kHz and 12

b. 1 kHz and 14

c. 2 kHz and 12

d. 2 kHz and 14

18. An ac voltmeter using full-wave rectification and having a sinusoidal input has an ac sensitivity equal to

a. 1.414 times dc sensitivity

b. dc sensitivity

c. 0.90 times dc sensitivity

d. 0.707 times dc sensitivity

19. Consider the following statements in connection with measurement of temperature:

1. A thermistor is highly sensitive as compared with platinum resistance thermometer.
2. The resistance of a thermistor is solely a function of its absolute temperature whether the source of heat is external, internal or both.
3. A thermistor has linear resistance temperature characteristics.
4. Most thermistors exhibit negative resistance temperature coefficient.

Which of these statements are correct?

a. 1,2 and 3

b. 1,2 and 4

c. 2,3 and 4

d. 1,3 and 4

20. Time division multiplexing is used when the data to be transmitted is

a. Slow changing

b. Of small bandwidth

c. Slow changing and has a small bandwidth

d. Fast changing and has a wide bandwidth

21. If an induction type energy meter runs fast, it can be slowed down by

a. Lag adjustment

b. Light load adjustment

c. Adjusting the position of braking magnet and moving it closer from the centre of the disc

d. Adjusting the position of braking magnet and moving it away from the centre of the disc

22. The circuit generally used in digital instruments to convert sine waves into rectangular pulses is a

a. Saw tooth generator

b. Differential amplifier

c. Sample and hold circuit

d. Schmitt trigger

23. Spectrum analyzer is a combination of
a. Narrow band super heterodyne receiver and CR0
b. Signal generator and CR0
c. Oscillator and wave analyzer
d. VTVM and CR0

24. Total number of electrons that can be accommodated in various electron states in a valence band of a given solid is equal to
a. Atomic number of the solid
b. Half the number of atoms in the solid
c. The number of atoms in the solid
d. Twice the number of atoms in the solid

25. Consider the following properties pertaining to an alloy used as a precision resistor:
1. Uniform resistance
2. Stable resistance
3. Zero or low temperature coefficient of resistivity
Which of these properties are desirable?
a. 1,2 and 3
b. 1 and 2
c. 1 and 3
d. 2 and 3

26. By inserting a slab of dielectric material between the plates of a parallel plate capacitor, the energy stored in the capacitor has increased three times. The dielectric constant of the material is
a. 9
b. 3
c. 1/3
d. 1/9

27. When a dielectric is subjected to an alternating electric field, of angular frequency 'ω', its power loss is proportional to
a. ω
b. ω^2
c. $1/\omega$
d. $1/\omega^2$

28. For a given dielectric, with increase in temperature the ionic polarizability
a. Increases
b. Decreases
c. Remains same
d. Fluctuates

29. A piezoelectric crystal has an Young's modulus of 130 GPa. The uniaxial stress that must be applied to increase its polarization from 500 to 510 C m^{-2} is
a. 1.171GPa
b. 1.182GPa
c. 2.6 GPa
d. 2.55 GPa

30. When temperature bf a conductor is approaching zero Kelvin, the mean free path of the free electrons in the conductor is proportional to
a. T
b. T^3
c. $(1/T)^{1/3}$
d. $1/T^3$

31. In a conductor of size 20 mm × 10 mm × 10 mm, the wavelength of the slowest moving free electron is
a. 5 mm
b. 10 mm
c. 20 mm
d. 40 mm

32. The conductivity of a conducting material on being subject to critical magnetic field changes to
a. Normal state
b. Unstable state
c. Temperature-independent state
d. Temperature-dependent state

33. A large value of the exchange interaction energy in a ferromagnetic material implies
a. Large saturation magnetization
b. High Curie temperature
c. High melting point
d. Large diamagnetic susceptibility

34. Which one of the following pairs is NOT correctly matched?
a. Copper : Diamagnetic
b. Sodium : Anti ferromagnetic
c. Iron : Ferromagnetic
d. Ferrite : Ferromagnetic

35. Ferromagnetic behavior is shown by those transition meals where the ratio of the atomic diameter to 3d orbital diameter is
a. In the range of 0.5 to 1
b. In the range of 1 to 1.5
c. In the range of 1.5 to 2
d. Greater than 2

36. Ferrites can be considered as mixed oxides of metals A and B having inverse spinel structure. Their formula can be written as
a. ABO_2
b. A_2BO_2
c. AB_2O_3
d. AB_2O_4

37. Match List I (Magnetic materials) with List II (Main applications) and select the correct answer:

List I

A. Ni-Zn ferrite
B. Co-Sm alloy
C. Yttrium Iron Garnet
D. Mg-Zn ferrite

List II

1. Recording head
2. Permanent Magnets
3. Audio & TV transformers
4. Memory cores
5. Microwave isolators

	A	B	C	D
a.	3	4	5	2
b.	1	2	3	4
c.	3	2	5	4
d.	1	4	3	2

38. For a semiconductor, which one of the following statements is NOT correct?

a. When an electron and a hole recombine, energy must be liberated
b. Electrons in the conduction band can acquire a net acceleration from a field because there are empty energy levels available
c. An electron in the valence band cannot be accelerated by the field unless there are empty energy levels available
d. Holes cannot be accelerated by the field unless there are empty energy levels available

39. Consider the following statement:

Extrinsic semiconductors show high electrical conductivity because the impurities are

1. Of high conductivity
2. Highly mobile
3. Highly charged

Which of these statements are NOT correct?

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

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

List I

A. Ga-As
B. Nichrome
C. Quartz
D. Si

List II

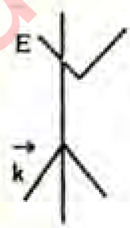
1. Integrated Circuit
2. Laser
3. Busbar
4. Heating element
5. Oscillator

	A	B	C	D
a.	2	4	5	1
b.	1	5	3	2
c.	2	5	3	1
d.	1	4	5	2

41. Consider the following energy-momentum (E-k) curves labelled as 1, 2, 3 and 4 of different semiconductors:

1.

2.



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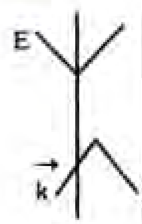

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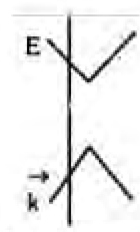


Sets of direct and indirect gap curves are respectively

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

42. Match List I (p - n junction devices) with List II (Application) and select the correct answer:

List I

A. Zener Diode
B. Pin Diode
C. Tunnel Diode
D. Varactor Diode

List II

1. Fast-switching circuits
2. Microwave switches
3. Local oscillators for radars
4. Frequency converters
5. Voltage regulators

	A	B	C	D
a.	5	2	1	4
b.	1	2	5	4
c.	5	3	1	2
d.	1	3	5	2

43. The open circuit impedance of a certain length of a lossless line is 100Ω. The short circuit impedance of the same line is also 100Ω. The characteristic impedance of the line is

a. $100\sqrt{2}\Omega$
b. 50 Ω
c. $100/\sqrt{2}\Omega$
d. 100 Ω

44. **Assertion (A):** The relationship between Magnetic Vector potential A and the Current density J in free space is $\nabla\times(\nabla\times\bar{A})=\mu_0\bar{J}$. For a magnetic field in free space due to a dc or slowly varying current is $\nabla^2\bar{A}=-\mu_0\bar{J}$

Reason (R): For magnetic field due to dc or slowly varying current $\nabla\cdot\bar{A}=0$.

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

45. Given that $\nabla\times\bar{H}=\bar{J}+\frac{\partial\bar{D}}{\partial t}$

Assertion (A): In the equation, the additional term $\frac{\partial\bar{D}}{\partial t}$ is necessary.

Reason (R): The equation will be consistent with the principle of conservation of charge.

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

46. **Assertion (A):** When there is no charge in the interior of a conductor the electric field intensity is infinite.

Reason (R): As per Gauss's law the total outward electric flux through any closed surface constituted inside the conductor must vanish.

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

47. **Assertion (A):** The solution to the wave equation at the critical diffracting condition in a crystal yields standing waves.

Reason (R): Standing waves have periodic variation both in amplitude as well as in the electron probability density in the crystal.

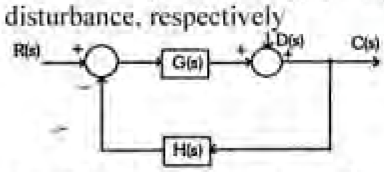
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is NOT the correct explanation of A
c. A is true but R is false
d. A is false but R is true

48. **Assertion (A):** For a system to be stable, all coefficients of the characteristic polynomial must be positive.

Reason(R): All positive coefficients of the characteristic polynomial of a system is a sufficient condition for stability.

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

49. In the feedback system C(s), R(s) and D(s) are the system output, input and disturbance, respectively



Assertion (A): For the system $\frac{C(s)\{R(s)+D(s)\}}{R(s)D(s)}=\frac{1+G(s)}{1+G(s)H(s)}$

Reason (R): Transfer function of a system is defined as the ratio of output Lap lace transform and input Lap lace transform setting other inputs and the initial conditions to zero.

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

50. **Assertion (A):** The number of separate loci of the closed loop system corresponding to

$$G(s)H(s)=\frac{K(s+4)}{s(s+1)(s+3)}$$ is three.

Reason (R) : Number of separate loci is equal to number of finite poles of G(s) H(s) if the latter is more than the number of finite zeros of G(s) H(s).

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

51. **Assertion (A):** The current in a constant inductive system does not change instantaneously.

Reason (R): In constant inductive system the flux linkage is conserved initially.

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

52. **Assertion (A):** Equivalent network obtained from $\Delta - Y$ transformation relationships in general is valid only for one frequency.

Reason (R): The impedances involved in $\Delta - Y$ vary with frequency.

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

53. **Assertion (A):** Norton theorem is applied to a network for which no equivalent Thevenin's network exists.

Reason (R): Norton's Theorem enables one to calculate quickly current and voltage in a particular branch of interest in a complicated network.

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

54. **Assertion (A):** A unit current impulse applied to a capacitor of 'C' farads instantly inserts 1/2C Joules of energy in it.

Reason (R): A unit current impulse has infinite current for zero duration and encloses a charge of one coulomb in it.

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

55. **Assertion (A):** In resistance potentiometers used for measurement of displacement, sensitivity and linearity are conflicting requirements.

Reason (R): The voltmeter used for measurement of output voltage of the potentiometer has, a finite resistance which causes loading effects.

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

56. **Assertion (A):** In good quality magnetic cassette tape recorders, ac bias is provided to recording head for better recording and reproduction.

Reason (R): The use of ac bias avoids the nonlinear characteristic of the B-H curve of the recording head.

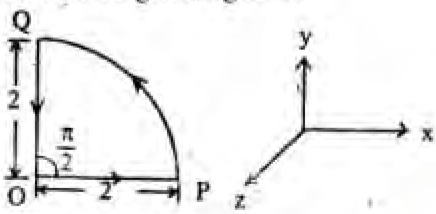
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is NOT the correct explanation of A
c. A is true but R is false
d. A is false but R is true

57. **Assertion (A):** In digital transducers used for measurement of displacement, it is quite common to use Gray Code instead of natural binary code.

Reason (R): Grey code is used for overcoming the inherent disadvantages of a natural binary code. These include errors that are caused on account of even slight misalignment which may cause change of decimal number thereby changing the number of bits. Gray code does not sufer from this disadvantage.

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

58. If $\bar{A} = \hat{a}_r + \hat{a}_\phi + \hat{a}_z$, the value of $\oint \bar{A}.\bar{dl}$ around the closed circular quadrants shown in the given figure is

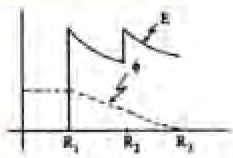


a. π
b. $\frac{\pi}{2}+4$
c. $\pi+4$
d. $\frac{\pi}{2}+2$

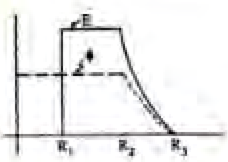
59. A coaxial cable has two concentric dielectrics separated by a sheath as shown in the given figure. The distribution of electric field 'E' and potential 'ϕ' in the coaxial' cable exist as

a.

b.



c.



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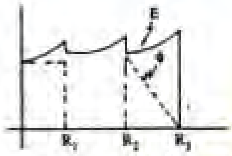
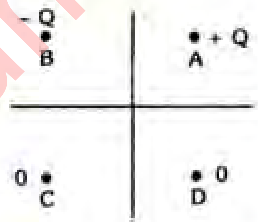


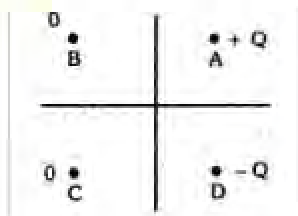
60. A point charge +Q is brought near a corner of two right angle conducting planes which are at zero potential as shown in the given Figure I. Which one of the following configurations describes the total effect of the charges for calculating the actual field in the first quadrant?

Figure 1

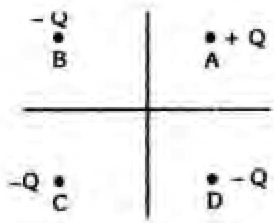
a.



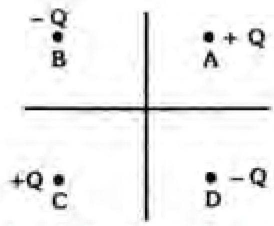
b.



c.



d.

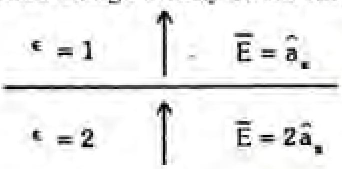


61. Plane defined by $z = 0$ carry surface current density $2\hat{a}_x\ A/m$. The magnetic intensity 'H_y' in the two regions $-\alpha < z < 0$ and $0 < z < \alpha$ are respectively

a. $\hat{a}_y$ and $-\hat{a}_y$
b. $-\hat{a}_y$ and $\hat{a}_y$
c. $\hat{a}_x$ and $-\hat{a}_x$
d. $-\hat{a}_x$ and $\hat{a}_x$

62. A solid cylindrical conductor of radius 'R' carrying a current 'I' has a uniform current density. The magnetic field intensity '$\overline{H}$' inside the conductor at the radial distance 'r' (r < R) is
a. Zero
b. $I / 2\pi r$
c. $Ir / 2\pi R^2$
d. $IR^2 / 2\pi r^3$

63. The electric field across a dielectric-air interface is shown in the given figure. The surface charge density on the interface is

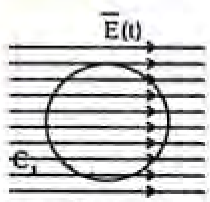


a. $-4 \in_0$
b. $-3 \in_0$
c. $-2 \in_0$
d. $- \in_0$

64. When air pocket is trapped inside a dielectric of relative permittivity '5', for a given applied voltage across the dielectric, the ratio of stress in the air pocket to that in the dielectric is equal to
a. 1/5
b. 5
c. 1+5
d. 5-1

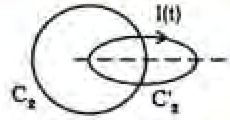
65. Consider coils C_1, C_2, C_3 and C_4 (shown in the following figures) which are placed in the time-varying electric field $\overline{E}(t)$ and electric field produced by the coils C'_2, C'_3 and C'_4 carrying time varying current I(t) respectively:

1.



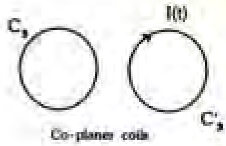
Time varying electric field $\overline{E}(t)$ parallel to the plane of coil C_1

2.



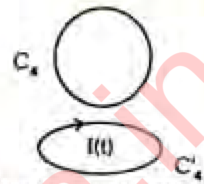
Coil planes are orthogonal

3.



Co-planer coils

4.



Coil-planes are orthogonal

The electric field will induce an emf in the coils
a. C_1 and C_2
b. C_2 and C_3
c. C_1 and C_3
d. C_2 and C_4

66. A circular loop is rotating about the y-axis as a diameter in a magnetic field $\overline{B} = B_0 \sin \omega t \ \hat{a}_x \ Wb/m^2$. The induced emf in the loop is
a. Due to transformer emf only
b. Due to motional emf only
c. Due to a combination of transformer and motional emf
d. Zero

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

List I (Law/quantity)
A. Gauss's law
B. Ampere's law
C. Faraday's law
D. Poynting vector

List II (Mathematical expression)
1. $\nabla . \overline{D} = \rho$
2. $\nabla \times \overline{E} = -\frac{\partial \overline{B}}{\partial t}$
3. $S = \overline{E} \times \overline{H}$
4. $\overline{F} = q\left(\overline{E} + \overline{v} \times \overline{B}\right)$
5. $\nabla \times \overline{H} = \overline{J}_c + \frac{\partial \overline{D}}{\partial t}$

	A	B	C	D
a.	1	2	4	3
b.	3	5	2	1

c.	1	5	2	3
d.	3	2	4	1

68. In the relation $S = \frac{1+|\Gamma|}{1-|\Gamma|}$; the values of S and Γ (Where S stands for wave ratio and Γ is reflection coefficient), respectively, very as
a. 1 to 1 and –1 to 0
b. 1 to ∞ and –1 to +1
c. –1 to +1 and 1 to ∞
d. –1 to 0 and 0 to 1

69. In the source free wave equation
$$\nabla_2 \overline{E} - \mu_0 \in_0 \mu \in \frac{\partial^2 \overline{E}}{\partial t^2} - \mu_0 \mu \sigma \frac{\partial \overline{E}}{\partial t} = 0$$
The term responsible for the attenuation of the wave is
a. $\mu_0 \mu \sigma \frac{\partial \overline{E}}{\partial t}$
b. $\mu_0 \in_0 \mu \in \frac{\partial^2 \overline{E}}{\partial t^2}$
c. $\nabla_2 \overline{E}$
d. $\mu_0 \mu \sigma \frac{\partial \overline{E}}{\partial t}$ and $\mu_0 \in_0 \mu_0^2 \frac{\partial^2 E}{\partial t^2}$

70. Three media are characterized by
1. $\in_r = 8, \mu_r = 2, \sigma = 0$
2. $\in_r = 1, \mu_r = 9, \sigma = 0$
3. $\in_r = 4, \mu_r = 4, \sigma = 0$

$\in_r$ is relative permittivity, μ_r is relative permeability and σ is conductivity.
The value of the intrinsic impedances of the media 1,2 and 3 respectively are
a. 188 Ω, 377Ω and 1131Ω
b. 377Ω, 113Ω and 188Ω
c. 188Ω, 1131Ω and 377Ω
d. 1131Ω , 188Ω and 377Ω

71. A plane em wave $\left(\overline{E_i}\,\overline{H_i}\right)$ traveling in a perfect dielectric medium of surge impedance 'Z' strikes 2Z. If the refracted em wave is $\left(\overline{E_r}\,\overline{H_r}\right)$, the ratios of E_t / E_r and E_t / H_t are respectively
a. 1/3 and 3/2.
b. 3/2 and 1/3
c. 3/4 and 3/2
d. 3/4 and 2/3

72. For a perfect conductor, the field strength at a distance equal to the skin depth is X% of the field strength at its surface. The value 'X%' is
a. Zeno
b. 50%
c. 36%
d. 26%

73. Consider the following statements:
The characteristic impedance of a transmission line can increase with the increase in
1. Resistance per unit length
2. Conductance per unit length
3. Capacitance per unit length
4. Inductance per unit length

Which of these statements are correct?
a. 1 and 2
b. 2 and 3
c. 1 and 4
d. 3 and 4

74. Match List I (Physical action or activity) with List II (Category of system) and select the correct answer:

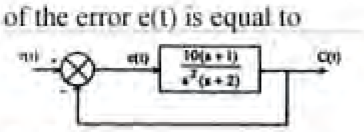
List I
A. Human respiration system
B. Pointing of an object with a finger
C. A man driving a car
D. A thermostatically controlled room heater

List II
1. Man-made control system
2. Natural including biological control system
3. Control system whose components are both manmade and natural

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

75. The Lap lace transform of a transportation lag of 5 seconds is
a. $\exp(-5s)$
b. $\exp(5s)$
c. $\frac{1}{s+5}$
d. $\exp\left(\frac{-s}{5}\right)$

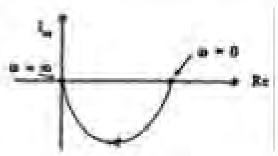
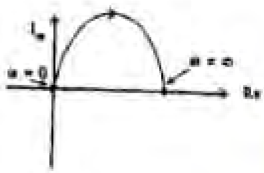
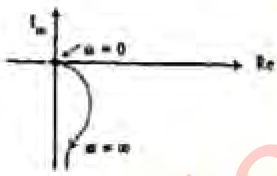
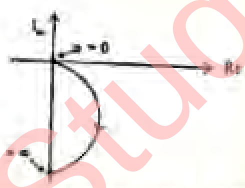
76. In the system shown in the given figure $r(t) = 1 + 2t \, (t \geq 0)$. The steady-state value of the error e(t) is equal to



a. Zero

b. 2/10
c. 10/2
d. Infinity

77. The phase angle of the system $G(s) = \frac{s+5}{s^2+4s+9}$ varies between
a. 0° and 90°
b. 0° and –90°
c. 0° and –180°
d. –90° and –180°

78. The transfer function of a certain system is given by $G(s) = \frac{s}{(1+s)}$
The Nyquist plot of the system is
a.

b.

c.

d.


79. A second order control system is defined by the following differential equation:
$$4\frac{d^2c(t)}{dt^2} + 8\frac{dc(t)}{dt} + 16c(t) = 16u(t)$$
The damping ratio and natural frequency for this system are respectively
a. 0.25 and 2 rad/s
b. 0.50 and 2 rad/s
c. 0.25 and 4 rad/s
d. 0.50 and 4 rad/s

80. The steady state en-or due to a ramp input for a type two system is equal to
a. Zero
b. Infinite
c. Non-zero number
d. Constant

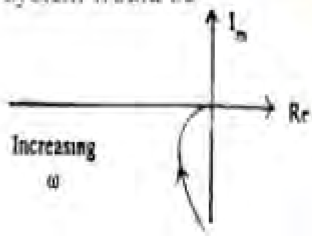
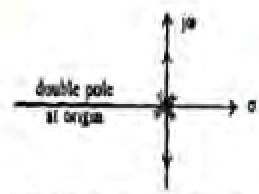
81. The Nyquist plot of a servo system is shown in the Figure I. The root loci for the system would be


Figure-I

a.

b.

c.


d. None of the drawn plot of (a), (b), (c) of the question

82. The characteristic equation of a feedback control system given by $s^3 + 5s^2 + (K+6)s + K = 0$. In the root loci diagram, the asymptotes of the root loci for large 'K' meet at a point in the s-plane whose coordinates are
a. (2, 0)
b. (–1, 0)
c. (–2, 0)
d. (–3, 0)

83. The open loop transfer function of a unity feedback system is given by $\frac{K}{s(s+1)}$. If the value of gain K is such that the system is critically damped, the closed loop poles of the system will lie at
a. – 0.5 and 0.5

b. $\pm j0.5$
c. 0 and -1
d. $0.5 \pm j\,0.5$

84. If the Nyquist plot cuts the negative real axis at a distance of 0.4, then the gain margin of the system is
a. 0.4
b. -0.4
c. 4%
d. 2.5

85. The transfer function of a phase lead compensator is given by $\frac{1+aTs}{1+Ts}$ where $a > 1$ and $T > 0$. The maximum phase shift provided by such a compensator is
a. $\tan^{-1}\left(\frac{a+1}{a-1}\right)$
b. $\tan^{-1}\left(\frac{a-1}{a+1}\right)$
c. $\sin^{-1}\left(\frac{a+1}{a-1}\right)$
d. $\sin^{-1}\left(\frac{a-1}{a+1}\right)$

86. Consider the single input, single output system with its state variable representation:

$$\dot{X} = \begin{bmatrix} -1 & 0 & 0 \\ 0 & -2 & 0 \\ 0 & 0 & -3 \end{bmatrix} X + \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix} U$$

$$Y = \begin{bmatrix} 1 & 0 & 2 \end{bmatrix} X$$

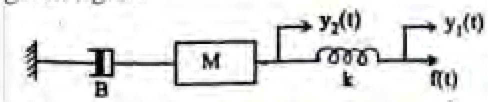
The system is
a. Neither controllable nor observable
b. Controllable but not observable
c. Uncontrollable but observable
d. Both controllable and observable

87. A particular control system is described by the following state equations:

$$\dot{X} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} U \text{ and } Y = \begin{bmatrix} 2 & 0 \end{bmatrix} X$$

The transfer function of this system is:
a. $\frac{Y(s)}{U(s)} = \frac{1}{2s^2+3s+1}$
b. $\frac{Y(s)}{U(s)} = \frac{2}{2s^2+3s+1}$
c. $\frac{Y(s)}{U(s)} = \frac{1}{s^2+3s+2}$
d. $\frac{Y(s)}{U(s)} = \frac{2}{s^2+3s+2}$

88. The mechanical system is shown in the given figure



The system is described as
a. $M\frac{d^2y_1(t)}{dt^2} + B\frac{dy_1(t)}{dt} = k\left[y_2(t) - y_1(t)\right]$
b. $M\frac{d^2y_2(t)}{dt^2} + B\frac{dy_2(t)}{dt} = k\left[y_2(t) - y_1(t)\right]$
c. $M\frac{d^2y_1(t)}{dt^2} + B\frac{dy_1(t)}{dt} = k\left[y_1(t) - y_2(t)\right]$
d. $M\frac{d^2y_2(t)}{dt^2} + B\frac{dy_2(t)}{dt} = k\left[y_1(t) - y_2(t)\right]$

89. A linear time invariant system, initially at rest when subjected to a unit step input gave response. $c(t) = te^{-t}\ (t \geq 0)$.
The transfer function of the system is
a. $\frac{s}{(s+1)^2}$
b. $\frac{1}{s(s+1)^2}$
c. $\frac{1}{(s+1)^2}$
d. $\frac{1}{s(s+1)}$

90. A synchro transmitter consists of a
a. Salient pole rotor winding excited by an ac supply and a three-phase balanced stator winding
b. Three-phase balance stator winding excited by a three- phase balanced ac signal and rotor connected to a dc voltage source
c. Salient pole rotor winding excited by a dc signal
d. Cylindrical rotor winding and a stepped stator excited by pulses

91. The torque-speed characteristic .of two-phase induction motor is largely affected by
a. Voltage
b. R/X and speed
c. X/R
d. Supply voltage frequency

92. Match List I (Nature of eigen value) with List II (Nature of singular point) for

linearised autonomous second order system and select the correct answer:

List I

A. Complex conjugate pair
B. Pure imaginary pair
C. Real and equal but with opposite sign
D. Real, distinct and negative

List II

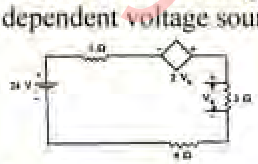
1. Centre
2. Focus point
3. Saddle point
4. Stable node
5. Unstable node

	A	B	C	D
a.	1	5	3	4
b.	2	1	3	4
c.	2	1	4	3
d.	1	5	4	3

93. In order to use Routh Hurwitz Criterion for determining the stability of sampled data system, the characteristic equation $1 + G(z)H(z) = 0$ should be modified by using bilinear trans form of
a. $z = r + 1$
b. $z = r - 1$
c. $z = \frac{r-1}{r+1}$
d. $z = \frac{r+1}{r-1}$

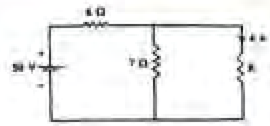
94. The system matrix of a discrete system is given by
$$A = \begin{bmatrix} 0 & 1 \\ -3 & -5 \end{bmatrix}$$
The characteristic equation is given by
a. $Z^2 + 5z + 3 = 0$
b. $Z^2 - 3z - 5 = 0$
c. $Z^2 + 3z + 5 = 0$
d. $Z^2 + z + 2 = 0$

95. The current in the given circuit with a dependent voltage source is



a. 10A
b. 12A
c. 14 A
d. 16A

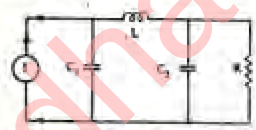
96. The value of resistance 'R' shown in the given figure is



a. 3.5Ω
b. 2.5Ω
c. 1Ω
d. 4.5Ω

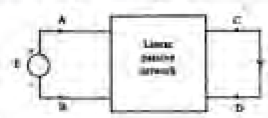
97. An electric circuit with 10 branches and 7 nodes will have
a. 3 loop equations
b. 4 loop equations
c. 7 loop equations
d. 10 loop equations

98. For the circuit shown in the given figure, the current through L and the voltage across C^2 are respectively



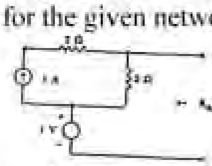
a. zero and RI
b. I and zero
c. zero and zero
d. I and RI

99. For the circuit shown in the given figure, when the voltage E is 10 V, the current i is 1 A. If the applied voltage across terminal C-D is 100 V, the short circuit current flowing through the terminal A-B will be



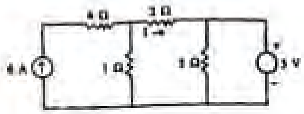
a. 0.1A
b. 1A
c. 10A
d. 100A

100. The Thevenin's equivalent resistance R_{th} for the given network is



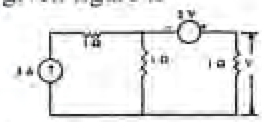
a. 1Ω
b. 2Ω
c. 4Ω
d. Infinity

101. For the circuit shown in the given figure the current I is given by



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

102. The value of V in the circuit shown in the given figure is



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

103. The Norton's equivalent of circuit shown in Figure I is drawn in the circuit shown in Figure II. The values of 'I_{Sc} and R_{eq} in Figure II are respectively

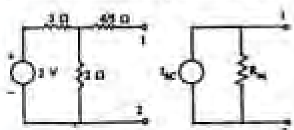
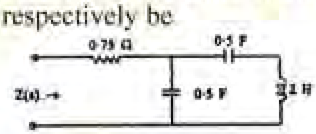


Figure I Figure II

a. 5/2 A and 2 Ω
b. 2/5 A and 1 Ω
c. 4/5 A and 12/5Ω
d. 2/5 A and 2Ω

104. A pole of driving point admittance function implies
a. Zero current for a finite value of driving voltage
b. Zero voltage for a finite value of driving current
c. An open circuit condition
d. None of (a), (b) and (c) mentioned in the question

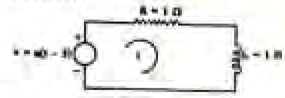
105. The driving point function of the circuit shown in the given figure when s→0 and s→∞, (the elements are normalized) will respectively be



a. 1/s and 2/s
b. 1/s and 0.75
c. 0.75 and 2/s
d. 2/sand 0.75

106. The response I of a network is expressed by the differential equation $d^2i/dt^2 + i = v$. If $v = Ae^{2t}$, the dominant solution of I for t > 0 is of the nature.
a. K_1e^t
b. K_1e^{-t}
c. K_1e^{2t}
d. $K_2\cos t + K_3\sin t$

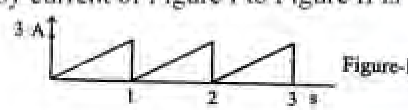
107. A unit step u(t−5) is applied to the RL network

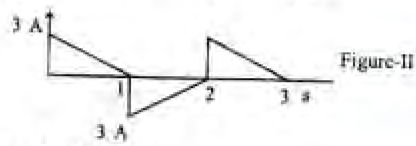


The current i is given by
a. $1-e^{-t}$
b. $\left[1-e^{-(t-5)}\right]u(t-5)$
c. $\left(1-e^{-t}\right)u(t-5)$
d. $1-e^{-(t-5)}$

108. The response of an initially relaxed system to a unit ramp excitation is$\left(t+e^{-t}\right)$. Its step response will be
a. $1/2t^2 - e^{-t}$
b. $1-e^{-t}$
c. $-e^{-t}$
d. t

109. Two current wave forms as shown in the figure I and figure II, are passed through identical resistors of 1Ω. The ratio of heat produced in these resistors in a given time by current of Figure I to Figure II is



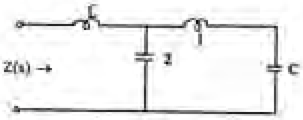


a. 2 : 1
b. 1 : 2
c. 1 : 1
d. $1:\sqrt{2}$

110. The response of a network is $i(t) = K\,t\,e^{-\alpha t}$ for $t \ge 0$ where α is real positive. The value of 't' at which the i(t) will become maximum, is
a. α
b. 2α
c. $1/\alpha$
d. α^2

111. Cauer and Foster forms of realizations are used only for
a. Driving point reactance functions
b. Transfer reactance functions v
c. Driving point impedance functions
d. Transfer impedance functions

112. For the given driving point impedance function $Z(s)=\dfrac{4s^4+7s^2+1}{s(2s^2+3)}$, the circuit realization is shown in the given figure. Then the values of L and C are respectively



a. 0.5 and 5
b. 2 and 1
c. 4 and 1
d. 4 and 3

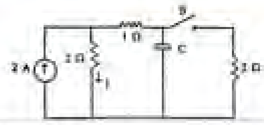
113. The h parameters h_{11} and h_{22} are related to z and y parameters as
a. $h_{11} = z_{11}$ and $h_{22} = 1/z_{22}$
b. $h_{11} = z_{11}$ and $h_{22} = y_{22}$
c. $h_{11} = 1/y_{11}$ and $h_{22} = 1/z_{22}$
d. $h_{11} = 1/y_{11}$ and $h_{22} = y_{22}$

114. The driving point impedance $Z(s)=\dfrac{s+2}{s+3}$. The system is initially at rest. For a voltage signal of unit step, the current i(t) through the impedance Z is given by
a. $2-e^{-t}$
b. $3/2-1/2e^{-3t}$
c. $3/2-1/2e^{-2t}$
d. $3-2e^{-3t}$

115. If $i=-10e^{-2t}$, the voltage of the source of the given circuit, V_s is given by

a. $-10e^{-2t}$
b. $-20e^{-2t}$
c. $20e^{-2t}$
d. $-30e^{-2t}$

116. The steady state in the circuit, shown in the given figure is reached with S open. S is closed at t = 0. The current I at t = 0^+ is



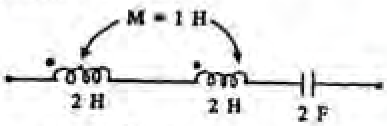
a. 1A
b. 2A
c. 3A
d. 4A.

117. The system function $H(s)=\dfrac{1}{s+1}$. For an signal cos t, the steady state response is
a. $1/\sqrt{2}\cos\left(t-\dfrac{\pi}{4}\right)$
b. $\cos t$
c. $\cos\left(t-\dfrac{\pi}{4}\right)$
d. $1/\sqrt{2}\cos t$

118. The value of the capacitance 'C' in the given ac circuit to make it a constant resistance circuit OR for the supply current to be independent of its frequency is

a. 1/16 F
b. 1/12 F
c. 1/8 F
d. 1/4 F

119. The resonant frequency of the given series circuit is



a. $1/2\pi\sqrt{3}Hz$
b. $1/4\pi\sqrt{3}Hz$
c. $1/4\pi\sqrt{2}Hz$
d. $1/\pi\sqrt{2}Hz$

120. The transfer function $\dfrac{V_2(s)}{V_1(s)}=\dfrac{10s}{s^2+10s+100}$ is for an active
a. Low pass filter
b. Band pass filter
c. High pass filter
d. All pass filter