ABDUL SATTAR

DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO

T.B.C. : P-RSR-L-RRA **Test Booklet Series**

Serial 10441

A

TEST BOOKLET

ELECTRICAL ENGINEERING

Paper I

Time Allowed : Two Hours ***Maximum Marks : 200***

INSTRUCTIONS

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET DOES ***NOT*** HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.
2. ENCODE CLEARLY THE TEST BOOKLET SERIES **A, B, C,** OR **D** AS THE CASE MAY BE IN THE APPROPRIATE PLACE IN THE ANSWER SHEET.
3. *You have to enter your Roll Number on the* Test Booklet in the Box provided alongside. ***DO NOT*** write ***anything else*** on the Test Booklet. 003720
4. This Test Booklet contains **120** items (questions). Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose ***ONLY ONE*** response for each item.
5. You have to mark all your responses ***ONLY*** on the separate Answer Sheet provided. See directions in the Answer Sheet.
6. All items carry equal marks.
7. Before you proceed to mark in the Answer Sheet the response to various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions sent to you with your Admission Certificate.
8. After you have completed filling in all your responses on the Answer Sheet and the examination has concluded, you should hand over to the Invigilator ***only the Answer Sheet.*** You are permitted to take away with you the Test Booklet.
9. Sheets for rough work are appended in the Test Booklet at the end.
10. **Penalty for wrong answers :**
    THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE IN THE OBJECTIVE TYPE QUESTION PAPERS.
    (i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third (0·33)** of the marks assigned to that question will be deducted as penalty.
    (ii) If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that question.
    (iii) If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.

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1. The following equation is ***not*** valid for magneto-static field in inhomogeneous magnetic materials :

(a) $\nabla . B = 0$

(b) $\nabla . H = 0$

(c) $\nabla \times A = B$
(A is magnetic vector potential)

(d) $\nabla \times H = J$

2. The normal components of electric flux density across a dielectric-dielectric boundary

(a) Are discontinuous

(b) Are continuous

(c) Depend on the magnitude of the surface charge density

(d) Depend on electric field intensity

3. The electric field intensity phasor of an EM wave in free space is $E = 10e^{-j4y}\, a_x$ V/m. The angular frequency ω, in radian per second, is

(a) $4 \times 3 \times 10^8$

(b) $4y \times 3 \times 10^8$

(c) $t \times 3 \times 10^8$

(d) $10 \times 3 \times 10^8$

4. In free space $\overline{H}$ field is given as
$\overline{H}(Z, t) = -\frac{1}{6\pi} \cos(\omega t + \beta Z)\, \overline{a}_y$.
$\overline{E}(Z, t)$ is

(a) $20 \cos(\omega t + \beta Z)\, \overline{a}_x$

(b) $20 \cos(\omega t + \beta Z)\, \overline{a}_z$

(c) $20 \sin(\omega t + \beta Z)\, \overline{a}_y$

(d) $20 \sin(\omega t + \beta Z)\, \overline{a}_x$

5. Screw projecting into the waveguide is

(a) Capacitive discontinuity

(b) Inductive discontinuity

(c) May be capacitive or inductive depending upon the position inside the guide

(d) None of the above

6. Depth of penetration δ is equal to $\frac{\lambda}{2\pi}$ for

(a) Good insulator

(b) Good conductor

(c) Lossy medium

(d) Low values of λ

7. When a plane wave propagates in a dielectric medium

(a) The average electric energy and the average magnetic energy densities are not equal

(b) The average electric energy and the average magnetic energy densities are equal

(c) The net average energy density is finite

(d) The average electric energy density is not dependent on the average magnetic energy density

8. A transmission line is distortionless if

(a) $RG = LC$

(b) $RC = GL$

(c) $\frac{R}{C} = \frac{G}{L}$

(d) $R = G$

9. If the maximum and minimum voltages on a transmission line are 4 V and 2 V, respectively, for a typical load, VSWR is

(a) 1·0

(b) 0·5

(c) 2·0

(d) 8·0

10. For a lossy transmission line, the characteristic impedance does ***not*** depend on

(a) The operating frequency of the line

(b) The conductivity of the conductors

(c) Conductivity of the dielectric separating the conductors

(d) Length of the line

11. A higher directivity is specified by
(a) High gain high bandwidth
(b) Low gain high bandwidth
(c) High gain low bandwidth
(d) Low gain low bandwidth

12. A lossless transmission line of characteristic impedance 300 Ω and length $\frac{\lambda}{2}$ is shorted at one end and is terminated in its characteristic impedance at the other. The input impedance measured at the mid section of the line is
(a) 0 Ω
(b) 100 Ω
(c) 300 Ω
(d) 150 Ω

13. The Fermi level in an n-type semiconductor at zero degree Kelvin lies
(a) Below the donor level
(b) Half-way between the conduction band and the donor level
(c) Half-way between the conduction band and the valence level
(d) Close to the valence band

14. According to free electron theory, electrons in a metal are subjected to
(a) Constant potential
(b) Sinusoidal potential
(c) Square wave potential
(d) Non-periodic potential

15. Controlled addition of group III element to an elemental semiconductor results in the formation of
(a) Intrinsic semiconductor
(b) n-type semiconductor
(c) p-type semiconductor
(d) Degenerate semiconductor

16. Phonons (Quanta of lattice vibration) obey
(a) Maxwell distribution
(b) Maxwell-Boltzmann distribution
(c) Fermi-Dirac distribution
(d) Bose-Einstein distribution

17. The Fermi energy E_F of a metal is proportional to (n is the number of free electrons per unit volume of the metal) as
(a) n^2
(b) $n^{\frac{1}{2}}$
(c) $n^{\frac{2}{3}}$
(d) $n^{\frac{3}{2}}$

18. If w is the width of the depletion region in a p – n junction, the transition capacitance is proportional to
(a) w
(b) w^2
(c) 1/w
(d) $1/w^2$

19. The temperature coefficient of a resistance of a doped semiconductor is
(a) Always positive
(b) Always negative
(c) Zero
(d) Positive or negative depending on the level of doping

20. The current flow in a semiconductor is due to
1. Drift current
2. Displacement current
3. Diffusion current
(a) 1, 2 and 3
(b) 1 and 2 only
(c) 1 and 3 only
(d) 2 and 3 only

21. Materials in superconducting state have the property of

(a) Absorbing magnetic field

(b) Repelling magnetic field

(c) Absorbing electric field

(d) Repelling electric field

22. A superconductor may be used for generating

(a) Voltage

(b) Pressure

(c) Temperature

(d) Magnetic field

23. As temperature falls below the transition temperature, the value of critical magnetic field of a superconductor

(a) Remains unchanged

(b) Increases

(c) Decreases

(d) First increases, reaches a peak and then decreases

24. The energy gap of a superconductor

(a) Is independent of temperature

(b) Increases with temperature

(c) Is maximum at a critical temperature

(d) Is minimum at a critical temperature

25. Which of the following properties is *not* correct for a superconductor in its superconducting stage ?

(a) Its resistivity is zero

(b) Magnetic flux density inside the conductor is zero

(c) Its relative permeability is unity

(d) Its magnetic susceptibility is negative

26. Lead

1. Is not used to form cable sheaths.
2. Is least affected by sea water.
3. Has good malleable and ductile properties.
4. Will not alloy with many other metals.

(a) 1 and 2 are correct

(b) 2 and 3 are correct

(c) 3 and 4 are correct

(d) 1 and 4 are correct

27. The geometrical configuration of one molecule of C_{60}-buckminsterfullerene contains

(a) 12 hexagons and 20 pentagons of Carbon atoms

(b) 20 hexagons and 12 pentagons of Carbon atoms

(c) 20 hexagons and 20 pentagons of Carbon atoms

(d) 12 hexagons and 12 pentagons of Carbon atoms

28. Heating a permanent magnet results in the loss of magnetic behaviour because

(a) The atoms start vibrating

(b) The magnetic dipoles start vibrating

(c) The magnetic dipoles start realigning

(d) The atoms start conducting

29. Paramagnetic susceptibility of a material

(a) Increases linearly with temperature

(b) Decreases linearly with temperature

(c) Increases linearly with (1/T)

(d) Decreases linearly with (1/T)

30. The magnetic domains, during the process of magnetization of ferromagnetic materials,

(a) Only expand

(b) Rotate first and then expand

(c) Expand first and then rotate

(d) Neither rotate nor expand

31. If the domain walls in a magnetic material can easily be moved, the material displays

(a) High flux density

(b) High permeability

(c) Permanent magnetic behaviour

(d) High permittivity

32. Magnetic field of Earth has no vertical component at

(a) Magnetic poles

(b) Magnetic equator

(c) Latitude 45°

(d) Longitude 45°

33. Match List I with List II and select the correct answer using the code given below the lists :

List I	*List II*
A. Magnetic induction	1. Bohr magneton
B. Magnetic field	2. Tesla
C. Magnetic moment	3. Henry/metre
D. Permeability	4. Ampere/metre

Code :

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

34. Soft iron is used to manufacture electro-magnets because it has

(a) High retentivity

(b) High coercive field

(c) Low retentivity

(d) Low coercive field

35. Consider the following statements with regards to soft iron :

1. It is a magnetic material.
2. It conducts electricity.
3. It is an alloy of iron and copper.
4. It is used to make permanent magnets.

Which of these statements are correct ?

(a) 1 and 2

(b) 2 and 3

(c) 3 and 4

(d) 1 and 4

$C = \frac{\epsilon A}{d}$

36. A permeable substance is one

(a) Which is strong magnetic

(b) Which is weak magnetic

(c) Which is a good conductor

(d) Through which magnetic lines of force can pass easily

37. High permittivity ceramic is used for capacitors of

(a) A few pF to a few hundred pF

(b) A few μF to a few hundred μF

(c) A few nF to a few hundred nF

(d) A few mF to a few hundred mF

38. The commercial thermopiles are formed by

(a) Series of Si-Al thermocouples in an IC by doping Al layers on p-type Si on n-type Si epitaxial layers

(b) Series of Cu-W thermocouple strips

(c) Piezoelectric material strips piled together

(d) Series of bismuth-telluride couples

39. Match List I with List II and select the correct answer using the code given below the lists :

List I	*List II*
A. Porcelain	1. Used for high frequency applications
B. Steatite	2. Used in capacitors to be operated at high frequencies
C. Mica	3. Used for insulators
D. Rutile	4. Releases water when heated

Code :

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

40. Diamagnetic materials possess

(a) Permanent dipoles

(b) Induced dipoles

(c) Both permanent and induced dipoles

(d) No dipoles

41. In the power measurement by ammeter-voltmeter method, if the voltmeter is connected across the load, then the value of the power will be

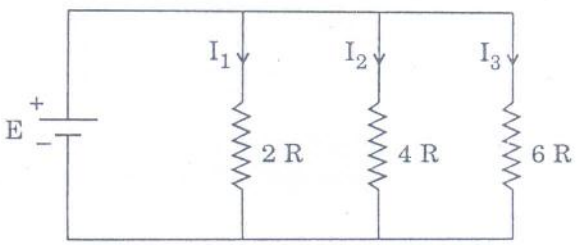
(a) The power consumed by the load

(b) The sum of power consumed by the load and ammeter

(c) The sum of power consumed by the load and voltmeter

(d) The sum of power consumed by the load, ammeter and voltmeter

42.



Three parallel branches of resistors are connected across a dc source as shown in the figure. What is $I_1 : I_2 : I_3$?

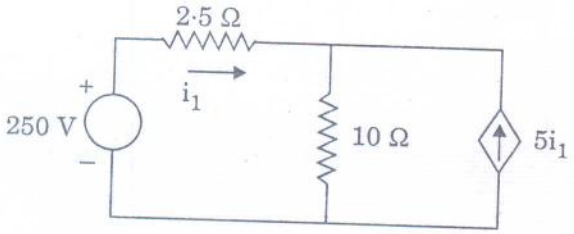
(a) 3 : 2 : 6

(b) 2 : 4 : 6

(c) 6 : 3 : 2

(d) 6 : 2 : 4

43.



In the circuit shown, the current i_1 is

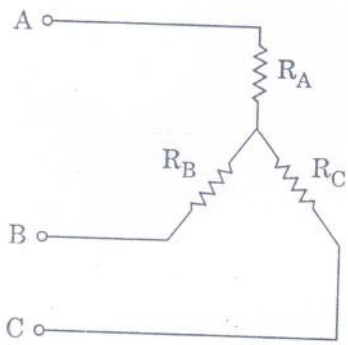
(a) 4 A

(b) 2 A

(c) 4·76 A

(d) 20 A

44.



The following are the results of tests conducted on the above star-connected load :

The resistance between A and B with C open : 12 Ω

The resistance between B and C with A open : 22 Ω

The resistance between C and A with B open : 18 Ω

The individual resistances of R_A, R_B and R_C are, respectively,

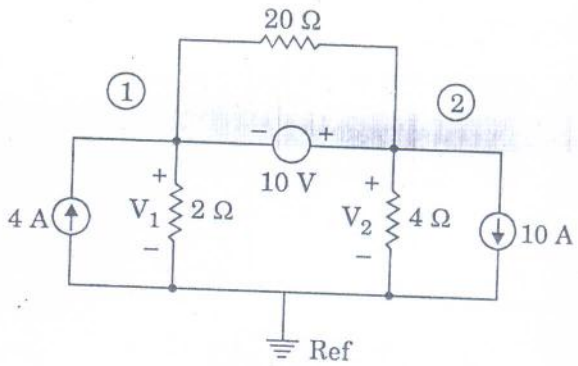
(a) 8 Ω, 14 Ω and 4 Ω

(b) 10 Ω, 2 Ω and 8 Ω

(c) 4 Ω, 8 Ω and 14 Ω

(d) 6 Ω, 6 Ω and 8 Ω

45.



When KCL is applied at the super node in the above circuit, the current equation in terms of node voltages V_1 and V_2 is

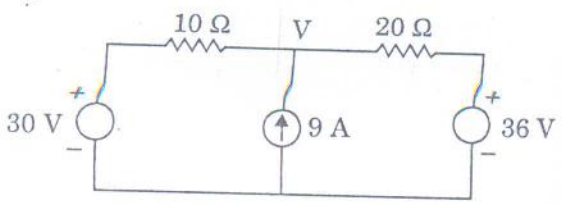
(a) $-6 = \frac{V_1}{2} + \frac{V_2}{4}$

(b) $4 = \frac{V_1 - V_2}{2} + \frac{V_1 - V_2}{20}$

(c) $4 = \frac{V_1}{2} + \frac{V_1 - V_2}{20}$

(d) $4 = \frac{V_1}{2} + \frac{V_2}{4}$

46.



The node voltage V in the circuit is

(a) 6 V

(b) 30 V

(c) 36 V

(d) 92 V

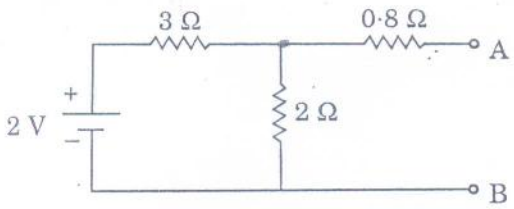
47. Match List I with List II and select the correct answer using the code given below the lists :

	List I	List II
A.	Equivalent circuit	1. Superposition
B.	Linearity	2. Norton's
C.	Bilateral	3. Tellegen's
D.	Structure	4. Reciprocity

Code :

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

48.



The Norton equivalent between A and B for the circuit is

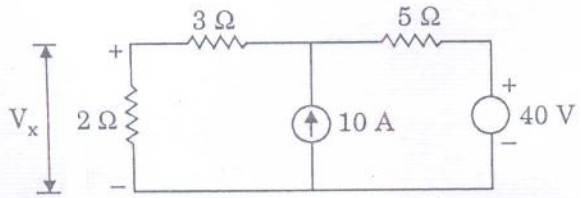
(a) 2 A and 2·5 Ω

(b) 0·5 A and 1 Ω

(c) 1 A and 2 Ω

(d) 0·4 A and 2 Ω

49.



The voltage V_x across the 2 Ω resistance in the circuit is

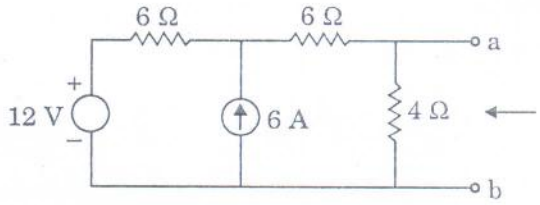
(a) 16 V

(b) 60 V

(c) 18 V

(d) 10 V

50.



Thevenin equivalent circuit to the left of the terminals a and b in the circuit, has equivalent voltage source V_{th} and equivalent resistance R_{th}, respectively, as

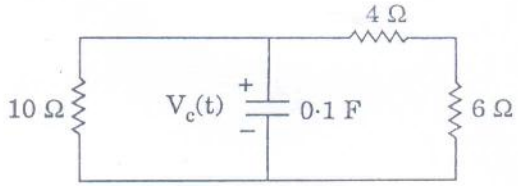
(a) 12 V and 16 Ω

(b) 20 V and 4 Ω

(c) 12 V and 12 Ω

(d) 12 V and 3 Ω

51.



In the circuit, if $V_c(0) = 25$ V, the expression for $V_c(t)$ for $t > 0$ is

(a) $V_c(t) = 20\ e^{-0.4t}$ V

(b) $V_c(t) = 25\ e^{-0.4t}$ V

(c) $V_c(t) = 20\ e^{-2.5t}$ V

(d) $V_c(t) = 25\ e^{-2t}$ V

52. A 0·2 H inductor with an initial current of 4 A is in parallel with a resistor of 100 Ω. The current at 0·8 ms is

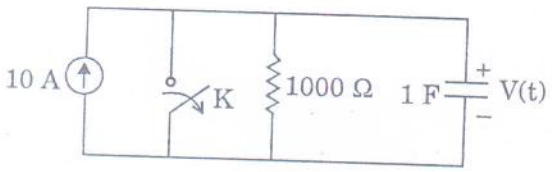
(a) $4\ e^{-0.4}$ A

(b) $4\ e^{-16\times10^{-6}}$ A

(c) $4\ e^{-0.4\times10^{-3}}$ A

(d) $4\ e^{-16\times10^{-3}}$ A

53.



In the above network, the switch K is opened at t = 0. Then $\frac{dV}{dt}$ at $t = 0^+$ is

(a) 1000 V/sec

(b) 100 V/sec

(c) 10 V/sec

(d) 1 V/sec

54. For the driving point impedance function of a circuit, $Z(s) = \frac{s+\alpha}{s+\beta}$, α and β real. Then voltage will lead the current if α and β are

(a) positive and $\alpha > \beta$

(b) positive and $\alpha < \beta$

(c) positive and real negative, respectively

(d) negative and real positive, respectively

55. A 100 Ω resistor has an effective inductance of 0·1 μH and a distributed capacitance of 10 pF. Its time constant at medium frequency is

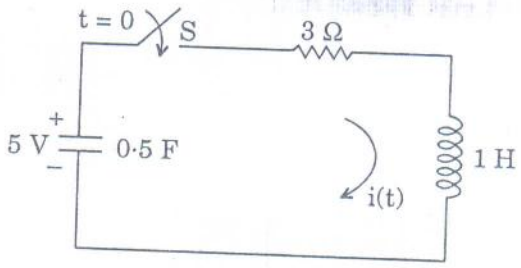
(a) 0 ns

(b) 1 ns

(c) 2 ns

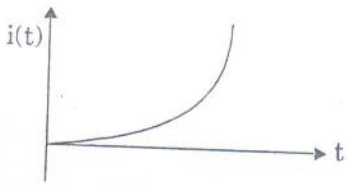
(d) 3 ns

56.



The nature of current response i(t) for $t \geq 0$ for the network shown is

(a)



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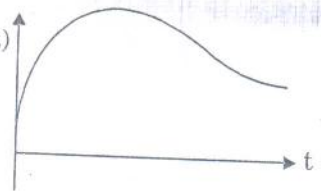
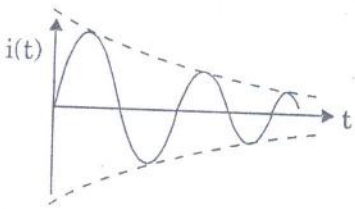
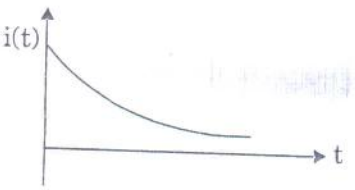


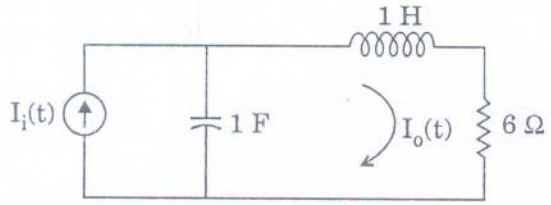
(c)



(d)



57.



For the above circuit, the current gain function $\frac{I_o(s)}{I_i(s)}$ has poles and zeros as

(a) No zeros,

$P_1 = -3 + 2\sqrt{2}$,

$P_2 = -3 - 2\sqrt{2}$

(b) $Z_1 = 0$; $Z_2 = 2$,

$P_1 = -3 + 2\sqrt{2}$,

$P_2 = +3 - 2\sqrt{2}$

(c) No zeros,

$P_1 = 1$, $P_2 = 1$

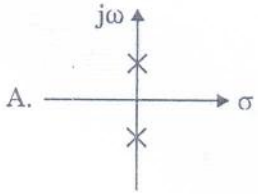
(d) $Z_1 = 1$; $Z_2 = 1$,

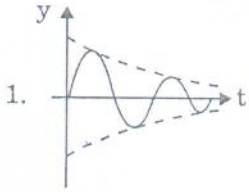
$P_1 = 3 + j2\sqrt{2}$,

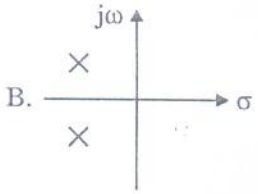
$P_2 = 3 - j2\sqrt{2}$

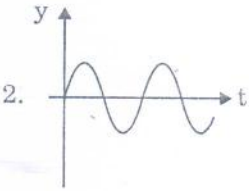
58. Match List I with List II and select the correct answer using the code given below the lists :

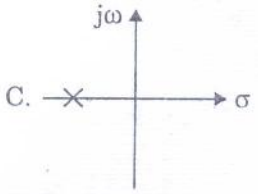
List I *List II*

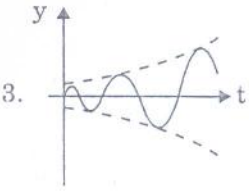
A. 

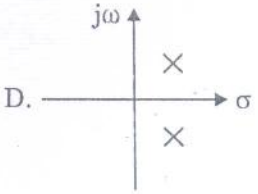
1. 

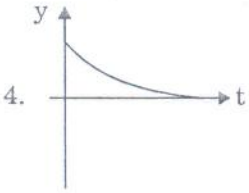
B. 

2. 

C. 

3. 

D. 

4. 

Code :

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

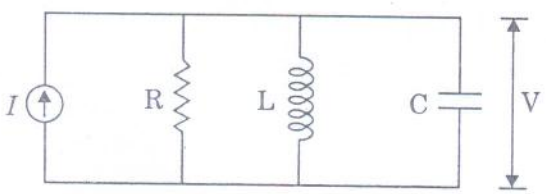
59. For the network function $\frac{V(s)}{I(s)} = \frac{s+3}{2s+3}$, the v(t) at t = 0 for the relaxed circuit with unit step i(t), is

(a) 0·5 V

(b) 1·0 V

(c) 1·5 V

(d) 2·0 V

60. 

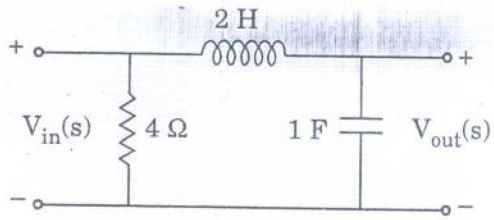
For the parallel RLC circuit shown, if R = 10 Ω, L = 0·1 H and C = 0·1 F, the current I is sinusoidal of frequency equal to the resonant frequency of the circuit, then the current through R is

(a) 0

(b) 0·1 I

(c) I

(d) 10 I

61. 

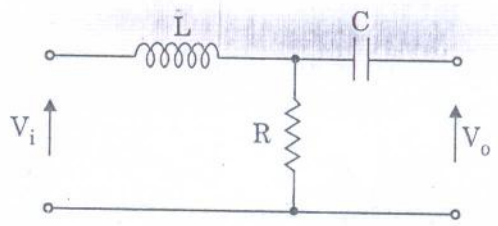
The voltage transfer function of the network is

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

(b) $1 + 4s$

(c) $6 - s$

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

62. 

The transfer function $\frac{V_o(s)}{V_i(s)}$ of the 2-port network is

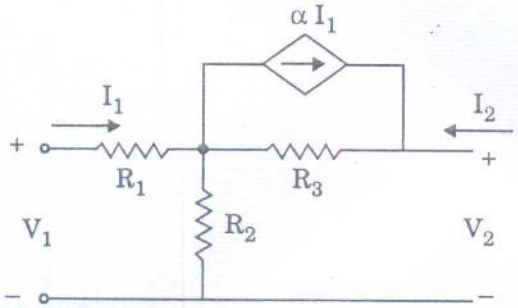
(a) $\frac{1}{1 + s\frac{L}{R}}$

(b) $\frac{1 + sCR}{sc(R+sL)}$

(c) $\frac{\frac{1}{sC}}{R + sL}$

(d) $\frac{s}{s + \frac{R}{L}}$

63.



Consider the two-port network as shown. The hybrid parameter h_{12} is

(a) $-\dfrac{(\alpha R_3 + R_2)}{R_2 + R_3}$

(b) $\dfrac{(1 - \alpha)R_3}{R_2 + R_3}$

(c) $\dfrac{(1 - \alpha)R_2}{R_2 + R_3}$

(d) $\dfrac{R_2}{R_2 + R_3}$

64. A 2-port network is defined by the relation :

$V_1 = \frac{3}{4}I_1 - \frac{1}{4}I_2$, $V_2 = -\frac{1}{2}I_1 + \frac{1}{2}I_2$.

Then y_{12} is

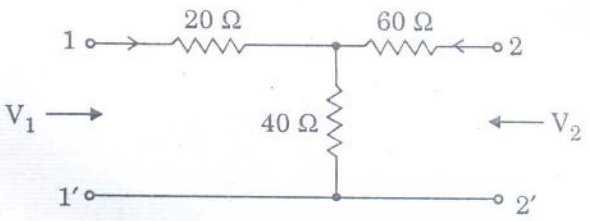
(a) $\frac{1}{2}$ ℧

(b) $-\frac{1}{2}$ ℧

(c) 1 ℧

(d) −1 ℧

65.



For the two-port network, the impedance parameter matrix $[Z] = \begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix}$ is

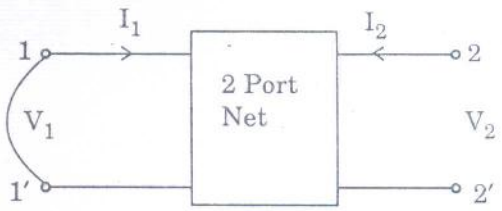
(a) $\begin{bmatrix} 60\,\Omega & 100\,\Omega \\ 40\,\Omega & 60\,\Omega \end{bmatrix}$

(b) $\begin{bmatrix} 40\,\Omega & 100\,\Omega \\ 60\,\Omega & 40\,\Omega \end{bmatrix}$

(c) $\begin{bmatrix} 60\,\Omega & 40\,\Omega \\ 40\,\Omega & 100\,\Omega \end{bmatrix}$

(d) $\begin{bmatrix} 40\,\Omega & 100\,\Omega \\ 100\,\Omega & 60\,\Omega \end{bmatrix}$

66.



When port-1 of a two-port network is short circuited, $I_1 = 4\,I_2$ and $V_2 = 0{\cdot}5\,I_2$, then which of the following is true ?

(a) $Y_{11} = 4$ mho

(b) $Y_{12} = 8$ mho

(c) $Y_{21} = 16$ mho

(d) $Y_{22} = 0{\cdot}25$ mho

67. The driving point impedance function,

$$Z(s) = \frac{s^2 + 2s + 2}{s^2 + s + 1}$$, may be realized by

(a) R-C network

(b) R-L network

(c) L-C network

(d) None of the above networks

68. If an RC driving point impedance function, Z(s) has equal number of poles and zeros at finite locations, then

(a) $Z(0) \leq Z(\infty)$

(b) $Z(0) \geq Z(\infty)$

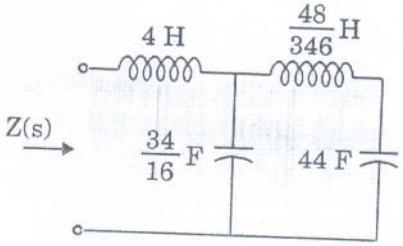
(c) $Z(0) < Z(\infty)$

(d) $Z(0) > Z(\infty)$

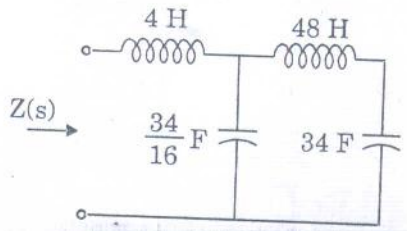
69. Which one of the following networks represents the Cauer's IInd form for the given driving point impedance function

$$Z(s) = \frac{12s^4 + 10s^2 + 1}{6s^3 + 4s}$$?

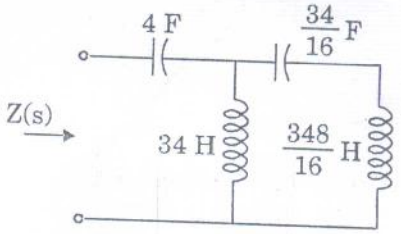
(a)



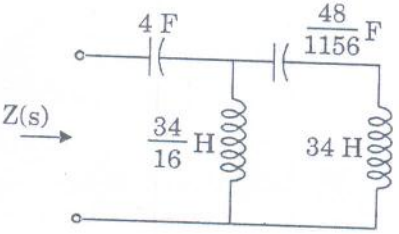
(b)



(c)



(d)



70. Match List I with List II and select the correct answer using the code given below the lists :

List I	*List II*
A. Work	1. Ampere per meter
B. Electric field strength	2. Weber
C. Magnetic flux	3. Volt per meter
D. Magnetic field strength	4. Joule

Code :

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

71. A 0 – 100 V voltmeter has an accuracy of 1 percent at full-scale reading. What will be the error if it reads 50 V ?

(a) 1 percent

(b) 2 percent

(c) 0·5 percent

(d) 4 percent

72. A resistance of 108 Ω is specified using significant figures as indicated below :

1. 108 Ω
2. 108·0 Ω
3. 0·000108 MΩ

Among these

(a) 1 represents greater precision than 2 and 3

(b) 2 represents greater precision but 1 and 3 represent same precision

(c) 2 and 3 represent greater precision than 1

(d) 1, 2 and 3 represent the same precision

73. What are the causes of gross error in the instruments ?

1. Misreading of instruments
2. Incorrect adjustment of instruments
3. Errors due to defective instrument
4. Errors due to effect of environment on the instrument

(a) 1 and 2

(b) 2 and 3

(c) 3 and 1

(d) 4 and 1

74. The measured value of a capacitor is 205·5 μF; whereas its true value is 202·4 μF. The relative error is

(a) 1·87%

(b) 1·94%

(c) 1·53%

(d) 1·73%

75. Which of the following types of errors come under systematic errors ?

1. Irregular spring tension.
2. Improper readings of an instrument.
3. Loading effects.
4. Error due to the presence of electric field or magnetic field.

(a) 1 and 2

(b) 2 and 3

(c) 3 and 1

(d) 4 and 1

76. The value of a quantity and its uncertainty are given as 26455 ± 3754 without rounding off. Only two significant digits are relevant for error. Value of error rounded off to two significant figures is

(a) 26500 ± 3800

(b) 26400 ± 3800

(c) 26460 ± 3750

(d) 26400 ± 3700

77. The value of a shunt resistance required to convert an ammeter of 1 mA with 100 Ω internal resistances into 0 – 100 mA ammeter is

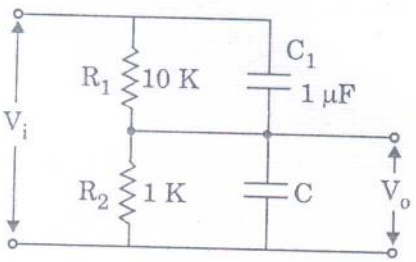
(a) 2·2 Ω

(b) 1·01 Ω

(c) 1·2 Ω

(d) 1·1 Ω

78.



A RC potentiometer to measure ac voltage, it is desired that $\frac{V_o}{V_i}$ should be independent of frequency. The value of C should be

(a) 10 μF

(b) 11 μF

(c) 0·1 μF

(d) 0·09 μF

79. The current and potential coils of a dynamometer type wattmeter were accidentally interchanged while connecting. After energizing the circuit, it was observed that the wattmeter did not show the reading. This could be due to the

(a) Damage to potential coil

(b) Damage to current coil

(c) Damage to both the potential and current coil

(d) Loose contacts

80. Consider the following statements associated with an energy meter :

1. It is an integrating type instrument.
2. It is an induction type instrument.
3. It uses a permanent magnet for rotation of aluminium disc.
4. It employs a high control torque.

Which of these statements are correct ?

(a) 1, 2, 3 and 4

(b) 1 and 2 only

(c) 2 and 3 only

(d) 3 and 4 only

81. A capacitor is connected across a portion of resistance of the multiplier in order to make the pressure coil circuit of the wattmeter non-inductive. The value of this resistance is r while the total resistance and inductance of the pressure circuit are respectively R_p and L. The value of the capacitance C is

(a) $\frac{L}{R_p^2}$

(b) $\frac{0{\cdot}41\,L}{r^2}$

(c) $\frac{L}{r^2}$

(d) $\frac{0{\cdot}41\,L}{R_p^2}$

82. The magnetic field responsible for the production of the deflecting torque in an accurate dynamometer type wattmeter, being very weak, the accuracy of the measurement can be increased by providing a

(a) Magnetic shield around the instrument

(b) Compensating winding along with the pressure coil

(c) Astatic arrangement to the moving system of the instrument

(d) Capacitance shunt across a portion of the pressure coil

83. Consider the following statements regarding the controlling torque :

1. It is not present in power factor meter.
2. It opposes the deflecting torque.
3. It is provided by air friction or by fluid friction.

Which of these statements are correct ?

(a) 1, 2 and 3

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1 and 2 only

84. Consider the following statements in connection with deflection and null type instruments :

1. Null type instrument is more accurate than the deflection type one.
2. Null type of instrument can be highly sensitive as compared with deflection type instrument.
3. Under dynamic conditions, null type instrument is not preferred to deflection type instrument.
4. Response is faster in null type instrument as compared to deflection type instrument.

Which of these statements are correct ?

(a) 1, 2 and 3 only

(b) 1, 2 and 4 only

(c) 2, 3 and 4 only

(d) 1, 2, 3 and 4

85. Match List I with List II and select the correct answer using the code given below the lists :

List I	*List II*
A. Moving iron and hot wire type	1. Air friction
B. Galvanometer	2. Electromagnetic
C. PMMC type	3. Fluid friction
D. Electrostatic type	4. Eddy current

Code :

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

86. Match List I with List II and select the correct answer using the code given below the lists :

List I	*List II*
A. Average value of current	1. Self-balancing bridge
B. Frequency of a wave form	2. Wein's bridge
C. Strain-gauge resistance	3. PMMC ammeter

Code :

	A	B	C
(a)	2	1	3
(b)	3	1	2
(c)	1	2	3
(d)	3	2	1

87. In a vibrating reed type frequency meter, all the reeds

(a) Are of identical dimensions and weight

(b) Have different natural frequencies

(c) Have the same natural frequencies

(d) Are not placed closed to an electromagnet

88. Match List I with List II and select the correct answer using the code given below the lists :

List I	*List II*
A. Hay bridge	1. Medium resistance
B. Wheatstone bridge	2. Frequency
C. Wein bridge	3. Capacitance
D. Schering bridge	4. High Q-inductance

Code :

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

89. Due to the effect of inductance in the pressure coil, a dynamometer type wattmeter

(a) Reads low on lagging power factor and high on leading power factor

(b) Reads high on lagging power factor and low on leading power factor

(c) Reading is independent of the power factor

(d) Always reads lower than the actual value

90. The full scale input voltage to an ADC is 10 V. If the resolution required is 5 mV, the minimum number of bits required for ADC is

(a) 8

(b) 10

(c) 11

(d) 12

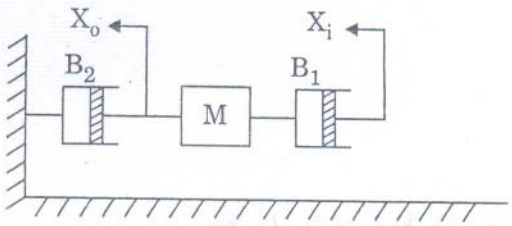
91. Which one of the following is ***not*** a self-generating type transducer ?

(a) Thermocouple and thermopile

(b) Piezoelectric pick-up

(c) Photovoltaic cell

(d) Magnetostriction gauge

92. 

For the mechanical system with mass and viscous friction components, shown in figure, $\frac{X_o(s)}{X_i(s)}$ is

(a) $\frac{B_2}{Ms + B_1 + B_2}$

(b) $\frac{B_2}{Ms^2 + (B_1 + B_2)s}$

(c) $\frac{B_1}{Ms + B_1 + B_2}$

(d) $\frac{B_1}{Ms^2 + (B_1 + B_2)s}$

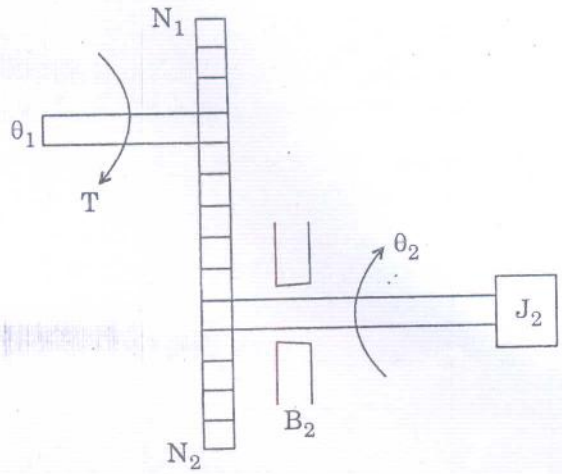
93. Match List I with List II and select the correct answer using the code given below the lists :

List I	List II
A. Mass	1. Capacitor
B. Damper	2. Voltage
C. Spring	3. Resistor
D. Force	4. Inductor

Code :

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

94.



Consider the following relations with regard to the above shown gear trains :

1. $\frac{\theta_1}{\theta_2} = \frac{N_2}{N_1}$

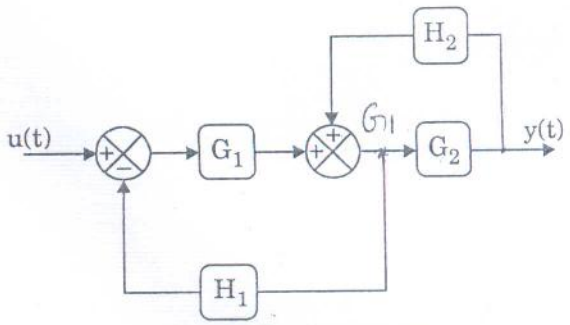
2. $T_2 = J_2 \frac{d^2\theta_2}{dt^2} + B_2 \frac{d\theta_2}{dt}$

3. $T_1 = J_2 \left(\frac{N_1}{N_2}\right)^2 \frac{d^2\theta_1}{dt^2} + B_2 \left(\frac{N_1}{N_2}\right)^2 \frac{d\theta_1}{dt}$

Which of these relations are correct ?

(a) 1, 2 and 3
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1 and 3 only

95.



The system transfer function for the block diagram shown is

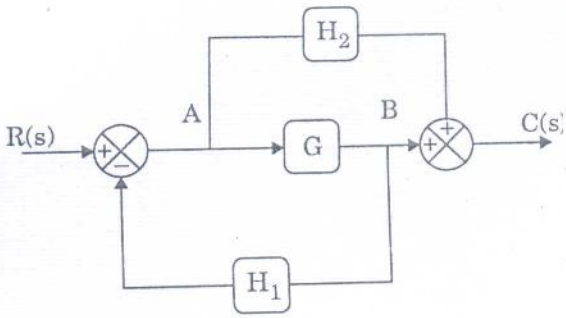
(a) $\frac{G_1G_2}{1 - G_2H_2 + G_1H_1}$

(b) $\frac{G_1G_2}{1 - H_1G_1 + G_2H_1}$

(c) $\frac{G_1G_2H_1}{1 + G_2H_1 + G_1H_1}$

(d) $\frac{G_1G_2H_1}{1 + G_2H_2 + G_1H_1}$

96.



The transfer function $\frac{C(s)}{R(s)}$ for the system shown above is

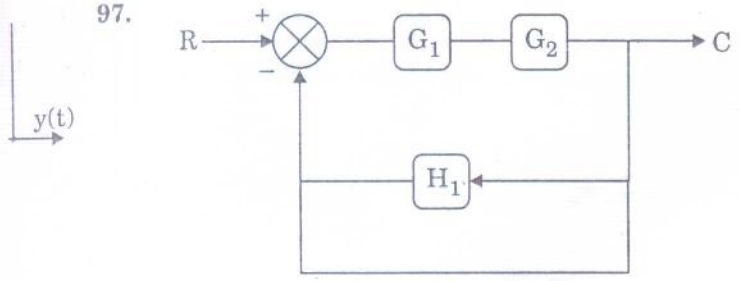
(a) $\frac{G + H_1}{1 + GH_2}$

(b) $\frac{G + H_2}{1 + GH_1}$

(c) $\frac{H_2}{1 + GH_1}$

(d) $\frac{GH_2}{1 + GH_1}$

97.



The resulting equivalent transfer function of the system shown above is

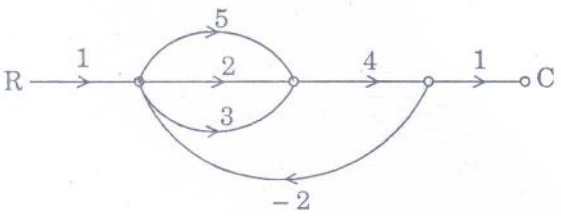
(a) $\dfrac{G_1G_2}{1+G_1G_2+G_1G_2H_1}$

(b) $\dfrac{G_1G_2}{1+G_1G_2+G_1H_1}$

(c) $\dfrac{G_1G_2}{1+H_1G_1G_2}$

(d) $\dfrac{G_1G_2}{1+G_1G_2+H_1}$

98.



Consider the following statements with regards to signal flow graph :

1. The number of loops are 3.
2. The number of loops are 2.
3. The number of forward paths are 3.
4. $\dfrac{C}{R}$ ratio is $\dfrac{40}{81}$.
5. $\dfrac{C}{R}$ ratio is $\dfrac{28}{81}$.

Which of these statements are correct ?

(a) 1, 3, 4 and 5

(b) 1, 3 and 4

(c) 2, 3 and 4

(d) 3, 4 and 5

99. The transfer function of a linear control system is given by

$$G(s) = \frac{100(s+15)}{s(s+4)(s+10)}$$

In its Bode diagram, the value of gain for $\omega = 0{\cdot}1$ rad/sec is

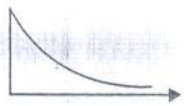
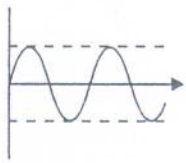
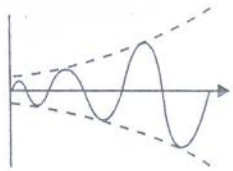
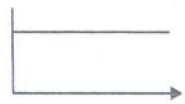
(a) 20 db

(b) 40 db

(c) 60 db

(d) 80 db

100. Match List I with List II and select the correct answer using the code given below the lists :

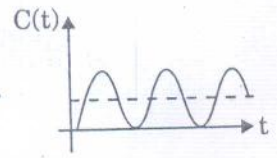
List I	*List II*
A. Two imaginary roots	1. 
B. Two complex roots in RH of s-plane	2. 
C. A single root on negative real axis	3. 
D. A single root at the origin	4. 

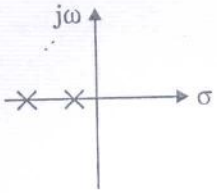
Code :

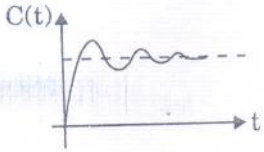
	A	B	C	D
(a)	4	1	3	2
(b)	2	1	3	4
(c)	4	3	1	2
(d)	2	3	1	4

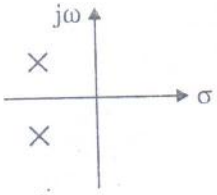
101. Match List I with List II and select the correct answer using the code given below the lists :

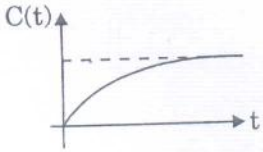
List I *List II*

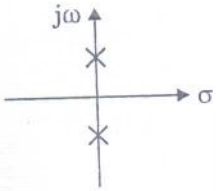
A. 

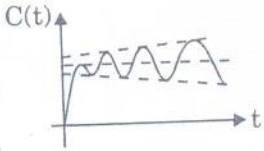
1. 

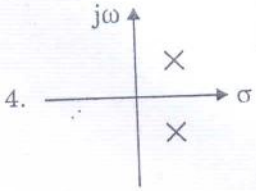
B. 

2. 

C. 

3. 

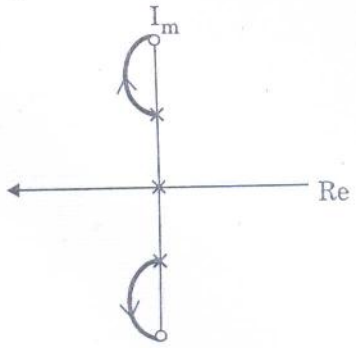
D. 

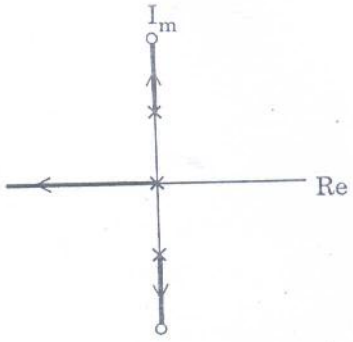
4. 

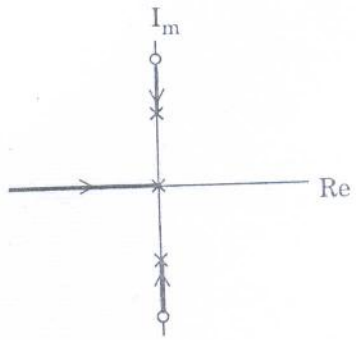
Code :

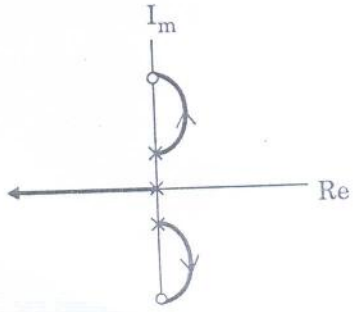
	A	B	C	D
(a)	4	1	2	3
(b)	3	1	2	4
(c)	4	2	1	3
(d)	3	2	1	4

102. Loop transfer function of unity feedback system is $G(s) = \frac{K(s^2+64)}{s(s^2+16)}$. The correct root locus diagram for the system is **10**

(a) 

(b) 

(c) 

(d) 

edback ect root

103. The breakaway point in the root loci plot for the loop transfer function

$$G(s)H(s) = \frac{K}{s(s+3)^2}$$ is

(a) $-2{\cdot}5$

(b) $-2{\cdot}0$

(c) $-1{\cdot}0$

(d) $-0{\cdot}5$

104. Consider the following statements regarding root loci plot :

1. When gain K is zero, the roots coincide with the poles.
2. When K is increased, the roots move away from the poles.
3. A root locus diagram is always symmetric about the imaginary axis.
4. The number of branches terminates on infinity is open loop poles plus zeros.

Which of these statements are correct ?

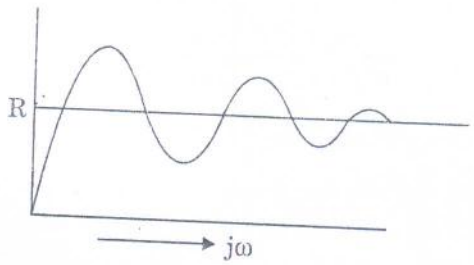
(a) 1 and 2

(b) 2 and 3

(c) 3 and 4

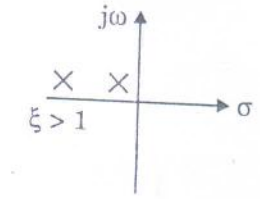
(d) 1, 2, 3 and 4

105.

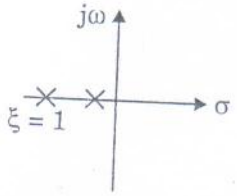


For the response shown above, the correct root locations in the s-plane is

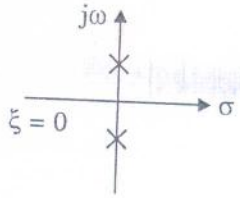
(a)



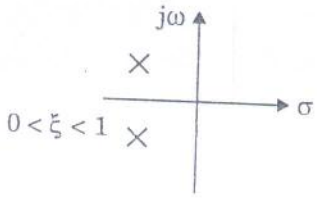
(b)

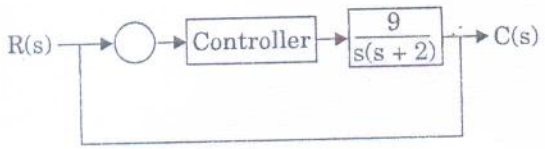


(c)



(d)



106. 

In the control system shown above the controller which can give zero steady-state error to a ramp input is of

(a) Proportional type

(b) Integral type

(c) Derivative type

(d) Proportional plus derivative type

107. Let $\dot{x} = \begin{bmatrix} 1 & 2 \\ 0 & b \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$

where b is an unknown constant. This system is

(a) Uncontrollable for b = 1

(b) Uncontrollable for b = 0

(c) Uncontrollable for all values of b

(d) Controllable for all values of b

108. The state variable description of a linear autonomous system is $\dot{x} = Ax$, where x is the two-dimensional state vector and A is given by

$$A = \begin{bmatrix} 0 & -2 \\ -2 & 0 \end{bmatrix}$$

The poles of the system are located at

(a) – 2 and + 2

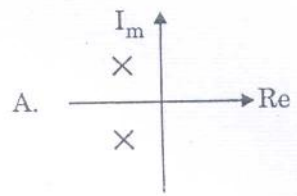
(b) – 2j and + 2j

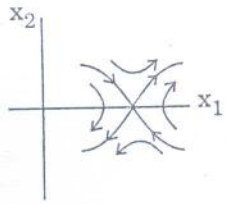
(c) – 2 and – 2

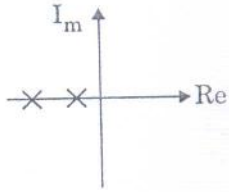
(d) + 2 and + 2

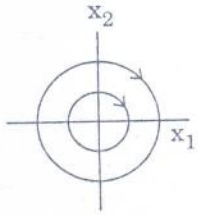
109. Match List I with List II and select the correct answer using the code given below the lists :

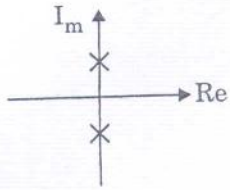
List I *List II*

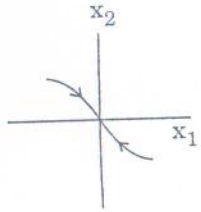
A. 

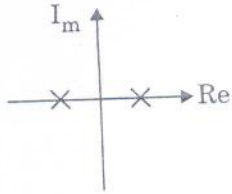
1. 

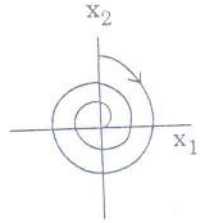
B. 

2. 

C. 

3. 

D. 

4. 

Code :

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

110. For a tachometer, if $\theta(t)$ is the rotor displacement, e(t) is the output voltage and K is the tachometer constant, then the transfer function is defined as

(a) Ks^2

(b) $\frac{K}{s}$

(c) Ks

(d) K

111. Match List I with List II and select the correct answer using the code given below the lists :

List I

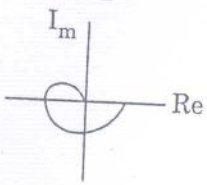
A. $G(s) = \frac{1 + sT}{1 + 2\,sT}$

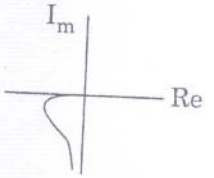
B. $G(s) = \frac{1}{(1 + sT_1)(1 + sT_2)(1 + sT_3)}$

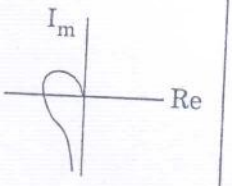
C. $G(s) = \frac{1 + sT_1}{s(1 + sT_2)(1 + sT_3)}$

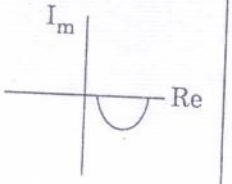
D. $G(s) = \frac{\omega_n^2}{s(s^2 + 2\xi\omega_n s + \omega_n^2)}$

List II

1. 

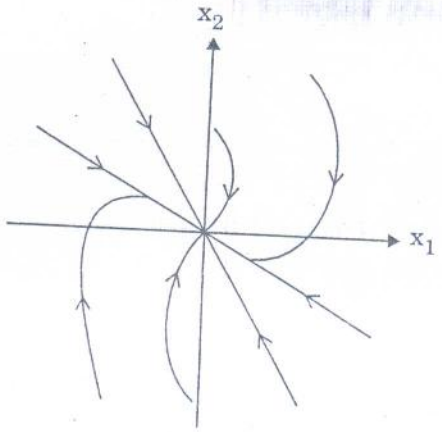
2. 

3. 

4. 

Code :

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

112. 

The figure shown is a phase-plane representation of trajectories. The singular point shown is a

(a) Unstable node

(b) Saddle point

(c) Stable focus

(d) Stable node

***Directions** : Each of the next eight (08) items consists of two statements, one labelled as the 'Assertion (A)' and the other as 'Reason (R)'. You are to examine these two statements carefully and select the answers to these items using the codes given below :*

Codes :

(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) :* The electric field around a positive charge is outward.

Reason (R) : Gauss law states that the differential of the normal component of the outward electric flux density over a closed surface yields the positive charge enclosed.

114. *Assertion (A) :* Electromagnetic waves propagate being guided by parallel plate perfect conductor surface.

Reason (R) : Tangential component of electric field intensity and normal component of magnetic field intensity are zero on a perfect conductor surface.

115. *Assertion (A) :* A thin sheet of conducting material can act as a low-pass filter for electromagnetic waves.

Reason (R) : The penetration depth is inversely proportional to the square root of the frequency.

116. *Assertion (A) :* Superconductors cannot be used as coils for production of strong magnetic fields.

Reason (R) : Superconductivity in a wire may be destroyed if the current in the wire exceeds a critical value.

117. *Assertion (A) :* A network is said to be in resonance when the voltage and current at the network input terminals are in phase.

Reason (R) : In a two-terminal network containing at least one inductor and one capacitor, the resonance is defined as the condition which exists when the input impedance of the network is purely resistive.

118. *Assertion (A) :* It is always desirable to take measurements as close to the full-scale as possible.

Reason (R) : The magnitude of the limiting error is a fixed quantity based on the full-scale reading of the meter and error increases as reading decreases.

119. *Assertion (A) :* Electrodynamometer wattmeter is not suitable for low power factor power measurement.

Reason (R) : Many watt-meters are compensated for errors caused by inductance of voltage coil by means of a capacitor connected in parallel with a portion of multiplier series resistance.

120. *Assertion (A) :* AC bridge methods are the best and most usual methods for the precise measurement of self and mutual inductances and capacitances.

Reason (R) : Wagner earthing device is used in AC bridge for eliminating the effect of the earth capacitance.