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

T.B.C. : B–GTD–O–FDA **Test Booklet Series**

Serial No.

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. **Please note that it is the candidate's responsibility to encode and fill in the Roll Number and Test Booklet Series Code A, B, C or D carefully and without any omission or discrepancy at the appropriate places in the OMR Answer Sheet. Any omission/discrepancy will render the Answer Sheet liable for rejection.**
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.
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 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.
    (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 **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 maximum space rate of change of the function which is in increasing direction of the function is known as
   (a) curl of the vector function
   (b) gradient of the scalar function
   (c) divergence of the vector function
   (d) Stokes theorem

2. The field strength at a point of finite distance from an infinitely long straight uniformly charged conductor is obtained by considering the radial (R) component and the longitudinal (L) component of the forces acting on a unit charge at the point, by the charges on the elemental length of the conductor. The resultant field strength is
   (a) the sum of R-components, when the sum of L-components is zero
   (b) the sum of L-components, when the sum of R-components is zero
   (c) the sum of both R- and L-components
   (d) average of the sums of R- and L-components

3. Consider the following standard symbols for two-port parameters :
   1. h_{12} and h_{21} are dimensionless.
   2. h_{11} and B have dimensions of ohms.
   3. BC is dimensionless.
   4. C is dimensionless.

   Which of the above are correct?
   (a) 1, 2 and 3 only
   (b) 1, 2 and 4 only
   (c) 3 and 4 only
   (d) 1, 2, 3 and 4

4. A conductor having a cross-sectional area a sq m carrying current $I\vec{j}$ A, lies in a magnetic field
   $$\vec{B} = B_0(\vec{i} + \vec{j}) \text{ Wb/m}^2$$
   The force density on the conductor is
   (a) $\frac{B_0}{a} I\vec{k}$ (b) $-\frac{B_0}{a} I\vec{i}$
   (c) $-\frac{B_0}{a} I\vec{k}$ (d) $\frac{B_0}{a} I\vec{j}$

   where $\vec{i}$, $\vec{j}$ and $\vec{k}$ are orthogonal unit vectors.

5. For electromechanical energy conversion, a magnetic field is employed as the medium rather than electric field because
   (a) the stored energy density for practicable field strength is low in the electric field
   (b) the electric field presents insulation problem
   (c) the specific magnetic loss is more than the specific dielectric loss
   (d) None of the above

6. The reliability of an instrument refers to
   (a) the measurement of changes due to temperature variation
   (b) the degree to which repeatability continues to remain within specified limits
   (c) the life of an instrument
   (d) the extent to which the characteristics remain linear

7. If the current density inside a straight conductor is uniform over its cross-section, the flux density variation inside the conductor at different distances from its centre is

(a) linear

(b) square of the distance

(c) inverse of the distance

(d) exponential

8. The law which states that the line integral of the magnetic field around a closed curve is equal to the free current through a surface, is

(a) Gauss' law

(b) Tellegen's theorem

(c) Coulomb's law

(d) Ampere's law

9. In an electrodynamometer wattmeter

(a) the fixed coils providing magnetic flux are connected across the power line

(b) the compensated wattmeter improves its accuracy by using windings with opposite currents with respect to series windings

(c) if the full-scale power measured is 100 W, then the half-scale power will be 10 W

(d) It can measure a.c. power but is unsuitable for d.c. power

10. $(\vec{\nabla} \times H) = J$ is differential form of

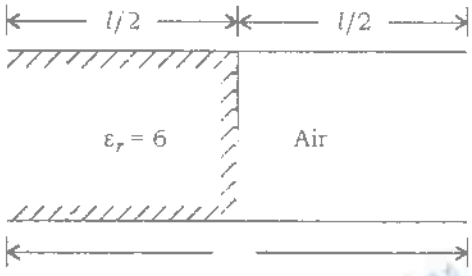
(a) Gauss' law

(b) Ampere's circuital law

(c) Poisson's equation

(d) Laplace's equation

11. A parallel-plate air capacitor as shown below has a total charge Q and a breakdown voltage V. A slab of dielectric constant 6 is inserted as shown. The maximum breakdown voltage and the charge at this voltage respectively would be



(a) V and $3{\cdot}5Q$

(b) $3{\cdot}5V$ and Q

(c) $V/5$ and $3Q$

(d) $6V$ and $3Q$

12. In a 4-bit R-$2R$ ladder type digital-to-analog converter with $R_F = R$ and $V_R = 5$ V, where R_F and R are the feedback and input resistances respectively to realize the gain of the inverting amplifier using an op-amp, the resolution and full-scale output respectively are

(a) $-0{\cdot}31$ V and $-4{\cdot}7$ V

(b) $+0{\cdot}31$ V and $-4{\cdot}7$ V

(c) $-0{\cdot}31$ V and $+4{\cdot}7$ V

(d) $+0{\cdot}31$ V and $+4{\cdot}7$ V

13. Two conductors of a transmission line carry equal current I in opposite directions. The force on each conductor is proportional to

(a) I

(b) I^2

(c) the distance between the conductors

(d) I^3

14. Enameled wires are preferred to cotton-covered wires to

(a) withstand higher temperature

(b) improve heat dissipation

(c) reduce the resistivity

(d) increase the mechanical strength

15. A conductor of length 100 cm moves at right angle to a uniform field flux density of 1·5 Wb/m^2 with a velocity of 50 m/s. The e.m.f. induced in the conductor will be

(a) 150 V *(b)* 75 V

(c) 50 V *(d)* 37·5 V

16. Maxwell equations

1. are extension of the works of Gauss, Faraday and Ampere
2. help studying the application of electrostatic fields only
3. can be written in integral form and point form
4. need not be modified depending upon the media involved in the problem

Which of the above statements are correct?

(a) 1 and 3

(b) 1 and 4

(c) 2 and 3

(d) 3 and 4

17. A phasor

1. may be a scalar or a vector
2. is a time-dependent quantity
3. is a complex quantity

Which of the above statements are correct?

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 1 and 3 only

(d) 2 and 3 only

18. Fermion particles obey

(a) Maxwell-Boltzmann statistics

(b) Bose-Einstein statistics

(c) Pauli's exclusion principle

(d) Heisenberg's uncertainty principle

19. The complex permeability and resulting wave losses are due to

(a) free electrons or ion oscillation and dipole relaxation

(b) free electrons oscillation and relaxation of free space charge

(c) bound electrons oscillation and relaxation of free space charge

(d) bound electrons or ion oscillation and dipole relaxation

20. Consider the time response of a second-order system with damping coefficient less than 1 to a unit step input :

1. It is overdamped.
2. It is a periodic function.
3. Time duration between any two consecutive values of 1 is the same

Which of the above statements is/are correct?

(a) 1, 2 and 3

(b) 1 only

(c) 2 only

(d) 3 only

21. A 10 GHz plane wave travelling in free space has amplitude of 15 V/m. The propagation coefficient β is

(a) 209·4 rad/m

(b) 173·6 rad/m

(c) 543·5 rad/m

(d) $3 \cdot 97 \times 10^{-2}$ rad/m

22. Brewster angle is the angle when a wave is incident on the surface of a perfect dielectric at which there is no reflected wave and the incident wave is

(a) parallely polarized

(b) perpendicularly polarized

(c) normally polarized

(d) None of the above

23. In time domain specification, decay ratio is the ratio of the

(a) amplitude of the first peak and the steady-state value

(b) amplitudes of the first two successive peaks

(c) peak value to the steady-state value

(d) None of the above

24. A lossless transmission line has a characteristic impedance of Z_0 and capacitance per unit length of C. The velocity of propagation of the travelling wave on the line is

(a) $Z_0 C$ (b) $\frac{1}{Z_0 C}$

(c) $\frac{Z_0}{C}$ (d) $\frac{C}{Z_0}$

25. A pair of high-frequency parallel transmission lines has distributed capacitance and inductance of 0·8 μF and 9·8 mH respectively. What is the characteristic impedance of the line?

(a) 98·26 Ω

(b) 110·68 Ω

(c) 125 Ω

(d) 128·2 Ω

26. The propagation constant of a transmission line is

$$0 \cdot 15 \times 10^{-3} + j 1 \cdot 5 \times 10^{-3}$$

The wavelength of the travelling wave is

(a) $\frac{1 \cdot 5 \times 10^{-3}}{2\pi}$ m

(b) $\frac{2\pi}{1 \cdot 5 \times 10^{-3}}$ m

(c) $\frac{1 \cdot 5 \times 10^{-3}}{\pi}$ m

(d) $\frac{\pi}{1 \cdot 5 \times 10^{-3}}$ m

27. The skin effect in a transmission line is affected by

(a) the resistivity of the transmission line

(b) the current magnitude in the transmission line

(c) the cross-sectional area of the transmission line

(d) the voltage applied across the transmission line

28. Heat conduction in a semiconductor takes place

(a) by the mobility of the carriers

(b) due to energy gap between conduction band and valency band

(c) by the holes and thermal vibrations of atoms

(d) by the electrons and thermal vibrations of atoms

29. The problems of the binary-weighted resistor digital-to-analog converter (DAC) can be overcome by using

(a) an 8-bit binary-weighted resistor DAC

(b) a flash DAC

(c) an *R*/2*R* ladder DAC

(d) a staircase DAC

30. The resistivity of intrinsic germanium at 30 °C is 0·46 Ω-m. What is the intrinsic carrier density at 30 °C if the electron mobility is 0·38 m^2/V-s and the hole mobility is 0·18 m^2/V-s?

(a) $9.2 \times 10^5/m^3$

(b) $2.77 \times 10^3/m^3$

(c) $2.43 \times 10^{19}/m^3$

(d) $8.9 \times 10^{12}/m^3$

31. For the intrinsic gallium-arsenide, the conductivity at room temperature 25 °C is 10^{-6} (ohm-m)$^{-1}$, the electron and hole mobilities are 0·85 m^2/V-s and 0·04 m^2/V-s respectively. What is the intrinsic carrier concentration at the room temperature?

(a) $7.0 \times 10^{12}\ m^{-3}$

(b) $7.0 \times 10^{-12}\ m^{-3}$

(c) $7.0 \times 10^{-12}\ m^3$

(d) $7.0 \times 10^{-2}\ m^3$

32. If μ_I and μ_P represent the impurity scattering and phonon scattering limited values of mobility of a semiconductor, the overall mobility would be

(a) $\mu_I + \mu_P$

(b) $\dfrac{\mu_I + \mu_P}{2}$

(c) $\sqrt{\mu_I \mu_P}$

(d) $\dfrac{\mu_I \mu_P}{\mu_I + \mu_P}$

33. An electrical breakdown of a *p-n* junction occurs if

(a) forward voltage increases up to the rating

(b) reverse voltage increases beyond the rating

(c) forward voltage decreases below the rating

(d) reverse voltage decreases below the rating

34. The chief deterrent to the widespread application of superconducting materials is

(a) very difficult to form, machine or cast

(b) the difficulty in attaining and maintaining extremely low temperature

(c) the poor strength-to-weight ratio

(d) the lower oxidation rate at elevated temperatures

35. Which one of the following properties is ***not*** observed in the carbon nanotubes?

(a) High stiffness and strengths

(b) Low densities

(c) Unusual electrical property

(d) Non-ductile

36. The evidence for the importance of electron-phonon interaction in superconductors comes from

(a) Meissner effect

(b) Josephson effect

(c) isotope effect

(d) flux quantization experiments

37. Which one of the following materials is used for cable insulation?

(a) Phenol formaldehyde

(b) Polytetrafluoroethylene

(c) Polyvinyl chloride

(d) Acrylonitrile butadiene styrene

38. For high-speed reading and storing of information in a computer, the material used is

(a) ferrite

(b) piezoelectric

(c) pyroelectric

(d) ferromagnetic above 763 °C

39. The temperature above which an anti-ferromagnetic material becomes paramagnetic is called

(a) peak temperature

(b) Néel temperature

(c) critical temperature

(d) Weiss temperature

40. Which effect is the converse of Peltier effect?

(a) Seebeck effect

(b) Thomson effect

(c) Hall effect

(d) Joule effect

41. Magnetic materials which may be readily magnetized in either direction are

(a) soft magnetic materials

(b) hard magnetic materials

(c) high eddy current loss materials

(d) high hysteresis loss materials

42. Consider the following statements regarding a ferromagnetic material :

1. Below the ferromagnetic Curie temperature, the ferromagnetic materials exhibit hysteresis effect.
2. The coercive force is the field required to reduce the flux density to zero.

Which of the above statements is/are correct?

(a) Both 1 and 2

(b) Neither 1 nor 2

(c) 1 only

(d) 2 only

43. The impact ionization phenomenon in semiconductor may be viewed as the reverse process of

(a) radiative recombination

(b) Auger recombination

(c) surface recombination

(d) Shockley-Read-Hall recombination

44. Refractive index of a slice glass can be reduced by doping it with tiny amount of

(a) GeO_2 *(b)* B_2O_3

(c) P_2O_5 *(d)* Al_2O_3

45. An iron-cored choke coil has an equivalent resistance of 5 Ω. It draws 10 A when the applied voltage is 240 V, 50 Hz. Its inductance and power factor respectively are

(a) 7·5 mH and 0·1 (lag)

(b) 74·7 mH and 0·1 (lag)

(c) 74·7 mH and 0·208 (lag)

(d) 7·5 mH and 0·208 (lag)

46. A voltage of 100 V is applied to an impedance of $Z = (3 + j4)$ Ω. What are the values of active power, reactive power and volt-amperes respectively?

(a) 1200 W, 1200 VAR and 2400 VA

(b) 1600 W, 1600 VAR and 2200 VA

(c) 1200 W, 1600 VAR and 2000 VA

(d) 1600 W, 1200 VAR and 2200 VA

47. The voltage across an impedance Z is $100\angle 15°$ V and the current through Z is $20\angle -45°$ A. The active and the reactive powers in Z respectively are

(a) 1000 W and 1732 VAR

(b) 500 W and 1732 VAR

(c) 1000 W and 5000 VAR

(d) 500 W and 6000 VAR

48. An a.c. source of 200 V r.m.s. supplies an active power of 1200 W and a reactive power of 1600 VAR to a load. The r.m.s. current and the power factor of the load respectively are

(a) 10 A and 0·6

(b) 8 A and 0·8

(c) 10 A and 0·8

(d) 8 A and 0·6

49. A shunt capacitor used for reactive power compensation is operated at 98% of its rated frequency and 95% of its rated voltage. The reactive power supplied by this capacitor (as compared to its rated capacity) is

(a) 7·9% lower

(b) 11·5% lower

(c) 11·5% higher

(d) 7·9% higher

50. Consider two nodes A and B connected by an impedance of $j5\ \Omega$. If the voltages at nodes A and B are $100\angle 30°$ V and $100\angle 0°$ V respectively, the real power that can be transferred from node A to B is

(a) 1120 W *(b)* 2000 W

(c) 2769 W *(d)* 276·9 W

51. None of the poles of a linear control system lies in the right-half of s-plane. For a bounded input, the output of this system

(a) is always bounded

(b) could be unbounded

(c) always tends to zero

(d) None of the above

52. If the diameter of a copper wire is increased by two times keeping its terminal voltage same, then the drift velocity will

(a) become twice

(b) become half

(c) become four times

(d) remain unchanged

53. Phase lead compensation

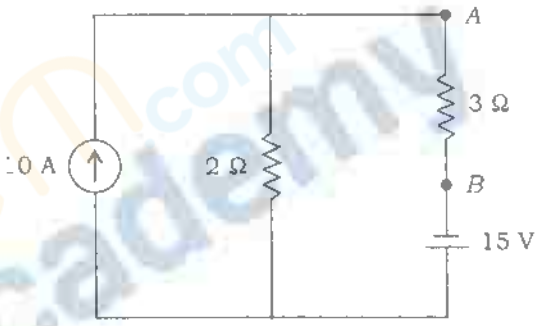
(a) increases bandwidth and increases steady-state error

(b) decreases bandwidth and decreases steady-state error

(c) will not affect bandwidth but decreases steady-state error

(d) increases bandwidth but will not affect steady-state error

54. The Thevenin equivalent voltage and resistance across AB shown in the figure respectively are



(a) 5 V and 5 Ω

(b) 25 V and 3 Ω

(c) 35 V and 2 Ω

(d) 25 V and 5 Ω

55. The theorem which states that in any linear, non-linear, passive, active, time-variant and time-invariant network, the summation of instantaneous powers is zero will be called as

(a) Tellegen's theorem

(b) compensation theorem

(c) reciprocity theorem

(d) superposition theorem

56. Transients are caused because

1. the load is suddenly connected to or disconnected from the supply
2. of the sudden change in applied voltage from one finite value to the other
3. of the change in stored energy in inductors and capacitors

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

57. A unit impulse function is defined as

1. a pulse of area 1
2. a pulse compressed along horizontal axis and stretched along vertical axis keeping the area unity
3. $\frac{du}{dt}$
4. $\delta(t) = 0,\ t \neq 0$

Which of the above statements are correct?

(a) 1, 2 and 3 only

(b) 1, 3 and 4 only

(c) 2, 3 and 4 only

(d) 1, 2, 3 and 4

58. The derivative of a parabolic function becomes

(a) a unit-impulse function

(b) a ramp function

(c) a gate function

(d) a triangular function

59. Which of the following can produce maximum induced voltage?

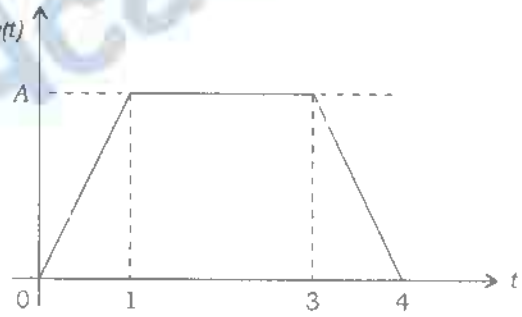
(a) 1 A d.c. current

(b) 50 A d.c. current

(c) 1 A, 60 Hz a.c. current

(d) 1 A, 490 Hz a.c. current

60. The Laplace transform of the waveform of the following figure is



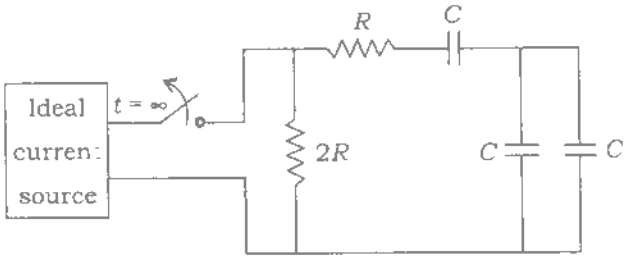
(a) $\frac{A}{s^2}(1+e^{-s}-e^{-3s}+e^{-4s})$

(b) $\frac{A}{s^2}(1-e^{-s}-e^{-3s}-e^{-4s})$

(c) $\frac{A}{s^2}(-1-e^{-s}-e^{-3s}-e^{-4s})$

(d) None of the above

61. An ideal current source is connected to the disconnected circuit shown in the figure at $t = 0$. The time constant of the circuit is



(a) $\frac{RC}{2}$

(b) RC

(c) $2RC$

(d) $\frac{9RC}{2}$

62. If the Q-factor of a coil at resonant frequency of 1·5 MHz is 150 for a series resonant circuit, then the corresponding bandwidth is

(a) 225 MHz

(b) 1·06 MHz

(c) 50 kHz

(d) 10 kHz

63. A one-port network consists of a capacitor of 2 F in parallel with a resistor of $\frac{1}{3}\ \Omega$. Then the input admittance is

(a) $2s + 3$

(b) $3s + 2$

(c) $\frac{2}{s} + \frac{1}{3}$

(d) $\frac{s}{2} + 3$

64. In a two-wattmeter method of measuring power in a balanced 3-phase circuit, the ratio of the two wattmeter readings is 1 : 2. The circuit power factor is

(a) 0·707

(b) 0·5

(c) 0·856

(d) indeterminate

65. A balanced delta-connected load $(16 + j12)\ \Omega$/phase is connected to a 3-phase 230 V balanced supply. The line current and the real power drawn respectively are

(a) 19·9 A and 3·17 kW

(b) 11·5 A and 6·34 kW

(c) 19·9 A and 6·34 kW

(d) 11·5 A and 3·17 kW

66. The servomotor differs from the standard motors principally in that, it has

(a) entirely different construction

(b) high inertia and hence high torque

(c) low inertia and low torque

(d) low inertia and higher starting torque

67. A balanced load of $5 + j4$ is connected in delta. What is the impedance per phase of the equivalent star connection?

(a) $5 + j4$

(b) $1·66 + j1·33$

(c) $15 + j12$

(d) $2·5 + j2$

68. The vector $\begin{bmatrix} 1 \\ 2 \\ -1 \end{bmatrix}$ is an eigenvalue of

$$A = \begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$$

One of the eigenvalues of A is

(a) 1

(b) 2

(c) 5

(d) 7

69. In an electric circuit, the number of independent meshes M is

(a) $2B - N + 1$

(b) $B - N + 1$

(c) $2B - N - 1$

(d) $B - N - 1$

where B is number of branches and N is number of nodes.

70. Frequency counter can be used to measure

1. fundamental frequency of input signal
2. fundamental and harmonic frequencies of input signal
3. time interval between two pulses
4. pulse width

Which of the above statements are correct?

(a) 1, 2, 3 and 4

(b) 1, 2 and 3 only

(c) 2, 3 and 4 only

(d) 1, 3 and 4 only

71. In vector impedance meter, the coverage of the instrument can be obtained with

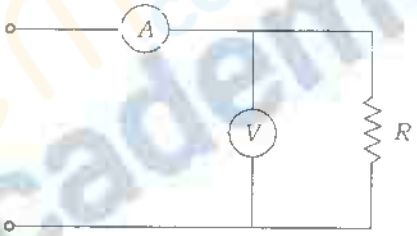
(a) *V-I* characteristics of the test system

(b) power-frequency plot

(c) sweep frequency plots of impedance and phase angle versus frequency

(d) voltage-angle plot

72. In the circuit shown below, the ammeter reads 0·1 A and the voltmeter reads 10 V. The internal resistance of the ammeter is 1 Ω and that of the voltmeter is 500 Ω. What is the value of R?



(a) 100 Ω (b) 125 Ω

(c) 90 Ω (d) 120 Ω

73. The open-loop transfer function of a feedback control system is given by

$$G(s)H(s) = \frac{K(s+8)}{s(s+4)(s^2+4s+8)}$$

In the root locus diagram of the system, the asymptotes of the root loci for large values of K meet at a point in the s-plane. Which one of the following is the set of coordinates of that point?

(a) (−1, 0) (b) (−2, 0)

(c) (1, 0) (d) (2, 0)

74. A 1 mA galvanometer with internal resistance of 50 Ω is to be converted to measure 5 A (full-scale). What is the value of the shunt resistance required for this conversion?

(a) 1 Ω

(b) 0·01 Ω

(c) 1 kΩ

(d) 10 Ω

75. A 50 μA basic d'Arsonval movement with an internal resistance of 500 Ω is to be used as a voltmeter. The value of the multiplier resistance required to measure a full-scale voltage range of 0–5 volts is

(a) 999·5 kΩ

(b) 99·5 kΩ

(c) 9·99 kΩ

(d) 0·99 kΩ

76. The power factor of a circuit in which voltage and current waves are non-sinusoidal is defined as

(a) it is the cosine of the angle of phase difference between the voltage and current waves

(b) it is the cosine of the angle of phase difference between the two complex waves

(c) it is the cosine of the angle of phase difference between two equivalent sine waves having respectively r.m.s. values equal to those of the voltage and current in the circuit

(d) it is the sine of the angle of phase difference between the two complex waves

77. The maximum power demand of a consumer is 2 kW and the corresponding daily energy consumption is 30 units. What is the corresponding load factor?

(a) 0·25

(b) 0·5

(c) 0·625

(d) 0·75

78. Time response of an indicating instrument is decided by which of the following systems?

(a) Mechanical system provided by pivot and jewel bearing

(b) Controlling system

(c) Deflecting system

(d) Damping system

79. What happens to the resistance of a conductor if its length is increased three times and diameter is halved?

(a) Resistance remains the same

(b) Resistance is increased 3 times

(c) Resistance is increased 6 times

(d) Resistance is increased 12 times

80. An integrator type DVM (digital voltmeter) contains a 100 kΩ and 1 μF capacitor. If the voltage applied to the integrator input is 1 volt, what voltage will be present at the output of the integrator after 1 second?

(a) 0·1 V

(b) 1 V

(c) 10 V

(d) 100 V

81. In measuring resistance by voltmeter-ammeter method, the voltmeter can be connected either across supply or across the resistance. If the resistance is low, the voltmeter should be connected

(a) across the supply

(b) across the resistance

(c) either across the supply or across the resistance

(d) neither across the supply nor across the resistance

82. A bridge circuit works at a frequency of 2 kHz. Which of the following can be used as detectors for detection of null conditions in the bridge?

(a) Vibration galvanometers and headphones

(b) Headphones and tunable amplifiers

(c) Vibration galvanometers and tunable amplifiers

(d) Vibration galvanometers, headphones and tunable amplifiers

83. A dual-beam CRO

(a) has one set of vertical deflection plates

(b) has two sets of horizontal deflection plates

(c) has two separate electron beams

(d) None of the above

84. If the bandwidth of an oscilloscope is 10 MHz, what is the fastest rise time a square wave can have to be accurately reproduced by the instrument?

(a) 10 ns

(b) 35 ns

(c) 28 ns

(d) 100 ns

85. A Wheatstone bridge has got three resistances taken in clockwise direction as 120 Ω, 150 Ω and 150 Ω. The value of the fourth resistance for null balance would be

(a) 150 Ω *(b)* 120 Ω

(c) 300 Ω *(d)* 750 Ω

86. A capacitive transducer consists of two parallel plates of diameter 2 cm each and separated by an air gap of 0·25 mm. What is the displacement sensitivity?

(a) +200 pF / cm

(b) −300 pF / cm

(c) −444 pF / cm

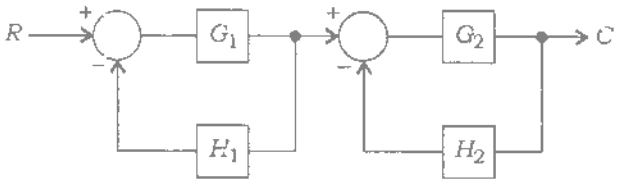
(d) +44·4 pF / cm

87. An analog transducer with a 0–10 V input is able to distinguish a charge of 10 mV in its input signal. What is the number of bits of an A/D converter in binary code so that the digital output has almost the same resolution as the transducer?

(a) 8 *(b)* 10

(c) 12 *(d)* 4

88. The transfer function C/R of the system shown in the figure is



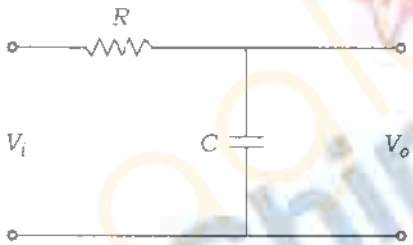
(a) $\dfrac{G_1G_2}{1+G_1H_1+G_2H_2}$

(b) $\dfrac{G_1H_1G_2H_2}{(1-G_1H_1)(1+G_2H_2)}$

(c) $\dfrac{G_1G_2}{1-G_1-G_2+G_1G_2H_1H_2}$

(d) $\dfrac{G_1G_2}{1+G_1H_1-G_2H_2+G_1G_2H_1H_2}$

89. The transfer function of the circuit as shown in the figure is expressed as



R-C network

(a) $\dfrac{R}{1+sRC}$

(b) $\dfrac{s}{1+sCR}$

(c) $\dfrac{1}{1+sRC}$

(d) $1+sCR$

90. A 3-turn 100 kΩ potentiometer with 1% linearity uses 30 V supply. What is the potentiometer constant?

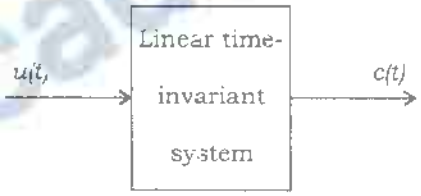
(a) 0·1 V/turn

(b) 10 V/turn

(c) 33·33 V/turn

(d) 0·3 V/turn

91. A quiescent linear time-invariant system subjected to a unit step input $u(t)$ has the response $c(t) = te^{-t}$, $t \geq 0$. Then $\frac{C(s)}{R(s)}$ would be



(a) $\dfrac{1}{s(s+1)}$

(b) $\dfrac{1}{s+1}$

(c) $\dfrac{1}{(s+1)^2}$

(d) None of the above

92. The characteristic equation of a closed-loop system is $s^2 + 4s + 16 = 0$. The natural frequency of oscillation and damping constant respectively are

(a) 2 rad/s and $\frac{1}{2}$

(b) $2\sqrt{3}$ rad/s and $\frac{1}{\sqrt{3}}$

(c) 4 rad/s and $\frac{1}{2}$

(d) 4 rad/s and $\frac{1}{\sqrt{2}}$

93. Consider the following input and system types :

Input type	*System type*
Unit step	Type '0'
Unit ramp	Type '1'
Unit parabolic	Type '2'

Which of the following statements are correct?

1. Unit step input is acceptable to all the three types of system.
2. Type '0' system cannot accept unit parabolic input.
3. Unit ramp input is acceptable to Type '2' system only.

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

94. A sensor requires 30 s to indicate 90% of the response to a step input. If the sensor is a first-order system, the time constant is [given, $\log_e(0.1) = -2.3$]

(a) 15 s

(b) 13 s

(c) 21 s

(d) 28 s

95. A unity feedback system has open-loop transfer function

$$G(s) = \frac{K(s+4)}{(s+1)(s+2)}$$

The portions of the real axis that lie on the root loci are between

(a) $s = -2$ and $s = -4$; $s = -1$ and $+\infty$

(b) $s = -1$ and $s = -2$; $s = -4$ and $-\infty$

(c) $s = 0$ and $s = -2$, beyond $s = -4$

(d) $s = 0$ and $s = -1$

96. If V_1 is the fundamental voltage, V_3 and V_5 are the amplitudes of the 3rd and 5th harmonic and

$$\frac{V_3}{V_1} = x\%, \quad \frac{V_5}{V_1} = y\%$$

then the total harmonic distortion of the system will be

(a) $\sqrt{x^2 + y^2}$ (b) $\frac{y}{x}$

(c) $x + y$ (d) $\frac{1}{\sqrt{x^2 + y^2}}$

97. The characteristic equation of a feedback system is $s^3 + Ks^2 + 5s + 10 = 0$. For a stable system, the value of K should be less than

(a) 1

(b) 2

(c) 3

(d) 4·5

98. Consider the following statements with respect to Routh-Hurwitz criterion :

1. It can be used to determine relative stability.
2. It is valid only for real coefficients of the characteristic equation.
3. It is applicable only for non-linear systems.
4. It does not provide the exact location of closed-loop poles in left- or right-half of s-plane.

Which of the above statements are correct?

(a) 1, 2 and 3 only

(b) 3 and 4 only

(c) 1, 2 and 4 only

(d) 1, 2, 3 and 4

99. The first element of each of the rows of a Routh-Hurwitz stability test showed the signs as follows :

Row	I	II	III	IV	V
Sign	+	−	−	+	−

Consider the following statements :

1. The system has three roots in the right-half of s-plane.
2. The system has three roots in the left-half of s-plane.
3. The system is stable.
4. The system is unstable.

Which of the above statements about the system are correct?

(a) 1 and 3

(b) 1 and 4

(c) 2 and 3

(d) 2 and 4

100. Consider the following statements about root locus :

1. The root locus is symmetrical about real axis.
2. If a root locus branch moves along the real axis from an open-loop pole to zero or to infinity, this root locus branch is called real root branch.
3. The breakaway points of the root locus are the solutions of $\frac{dK}{ds} = 0$.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

101. The low-frequency circuit impedance and the high-frequency circuit impedance for a series resonant circuit respectively are

(a) capacitive and inductive

(b) inductive and capacitive

(c) resistive and inductive

(d) capacitive and resistive

102. The state-variable formulation of a system is

$$\dot{x} = Ax + Bu; \quad y = [1 \;\; 0]\, x$$

where

$$A = \begin{bmatrix} -3 & 1 \\ 0 & -2 \end{bmatrix}, \quad B = \begin{bmatrix} 2 \\ 1 \end{bmatrix}$$

The system transformation would be

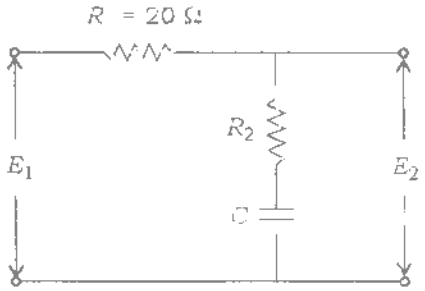
(a) $\dfrac{s+2}{s^2+5s-6}$

(b) $\dfrac{2s+5}{s^2+5s+6}$

(c) $\dfrac{2s-5}{s^2+5s-6}$

(d) $\dfrac{s+1}{s^2+5s+6}$

103. For the following network to work as lag compensator, the value of R_2 should be



(a) $R_2 \geq 20\ \Omega$

(b) $R_2 \leq 10\ \Omega$

(c) $R_2 C \leq \dfrac{R_1^2 C}{2}$

(d) Any value of R_2

104. The z-transform $X(z)$ of the signal

$$x[n] = \alpha^n u(n)$$

where $u(n)$ is sequence of unit pulses, is

(a) $\dfrac{\alpha}{z-1}$

(b) $\dfrac{z}{z-1}$

(c) $\dfrac{z}{z-\alpha}$

(d) $\dfrac{1}{z-\alpha}$

105. How many roots of the following equation lie in the right-half of s-plane?

$$2s^4 - s^3 + 2s^2 + 5s + 10 = 0$$

(a) 1

(b) 2

(c) 3

(d) 4

Directions : Each of the next **fifteen (15)** items consists of two statements, one labelled as 'Statement (I)' and the other as 'Statement (II)'. Examine these two statements carefully and select the answers to these items using the codes given below :

Codes :

(a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I)

(b) Both Statement (I) and Statement (II) are individually true but Statement (II) is ***not*** the correct explanation of Statement (I)

(c) Statement (I) is true but Statement (II) is false

(d) Statement (I) is false but Statement (II) is true

106. Statement (I)

Cold-working of a conductor material results in a decrease in the electrical conductivity of the metal because the localized strains interfere with the electron movement.

Statement (II) :

Subsequent annealing of the conductor material restores the electrical conductivity by establishing greater regularity in the crystal lattice.

107. Statement (I) :

A large number of metals become 'superconducting' below a temperature which is characteristic of the particular metal.

Statement (II) :

Superconducting compounds and alloys should necessarily have components which are themselves superconducting.

108. Statement (I) :

In an *R-L-C* series circuit, excited from a variable frequency voltage source, the circuit behaves like a 'resistive' one at a particular frequency.

Statement (II)

The frequency at which an *R-L-C* series circuit becomes 'resistive' in character, a part of the input energy oscillates between the inductive and the capacitive elements of the circuit.

109. Statement (I) :

If a ramp input is applied to a second-order system, the steady-state error of the response can be reduced by reducing damping and increasing natural frequency of oscillation.

Statement (II)

In the frequency response of a second-order system, the change in slope at one of the corner frequencies is of ±40 dB/decade.

110. Statement (I) :

The ammeter loading effect is due to the high resistance of the ammeter.

Statement (II)

Increasing the resistance of voltmeter will reduce the voltmeter loading effect.

111. Statement (I) :

In instruments where spring control is used for providing controlling torque, the scale is uniform, and where gravity control is used, the scale is non-uniform.

Statement (II)

In instruments where controlling torque is provided by spring control, the current is proportional to the deflection, and where the controlling torque is provided by gravity control, the current is proportional to sine of the deflection.

112. Statement (I) :

Ammeter and voltmeter method is used for measurement of low as well as medium resistances.

Statement (II) :

Carey-Foster slide wire bridge is a modification of the Wheatstone bridge.

113. Statement (I) :

In the Kelvin double-bridge method, provision has been made to eliminate the errors due to contact and lead resistances.

Statement (II) :

The Schering bridge is used for measuring small capacitance at low voltages with very high precision.

114. Statement (I) :

A 'strain gauge' is an example of a 'Transducer' or an electromechanical transformer.

Statement (II) :

In the 'strain gauge', displacement is used to vary the resistance of a circuit component and the 'strain' is measured in terms of the change in the resistance.

115. Statement (I) :

The principle of the resistance strain gauge is that if gauge factor is known, the measurement of $\frac{dR}{R}$ allows the measurement of strain $\frac{dL}{L} = \varepsilon$.

Statement (II) :

The output of an LVDT is of the order of millivolt.

116. Statement (I) :

Inverse root locus is the image of the direct root locus

Statement (II) :

Root locus is symmetrical about the imaginary axis

117. Statement (I) :

Centroid is the point where the root loci break from the real axis

Statement (II) :

Centroid is the point on the real axis where all the asymptotes intersect.

118. Statement (I) :

At breakaway point the system is critically damped.

Statement (II) :

At the point where root loci intersect with the imaginary axis, the system is marginally stable

119. Statement (I) :

A root locus is obtained using the closed-loop poles.

Statement (II) :

A root locus is plotted using the open-loop poles.

120. Statement (I) :

Inductor is not used to realize a lag network.

Statement (II) :

Inductor produces time delay and hysteresis loss.

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(17)

	Exam:Engg Services-2015														
	Series-A Sub: Electrical Engg Paper-I														
	Max Marks:200		Items Dropped: Nil												
	Items for Scoring:120														
1	B	16	A	31	A	46	C	61	C	76	C	91	D	106	A
2	A	17	D	32	D	47	A	62	D	77	C	92	C	107	C
3	A	18	C	33	B	48	A	63	A	78	D	93	A	108	A
4	C	19	D	34	B	49	B	64	C	79	D	94	B	109	B
5	A	20	D	35	D	50	A	65	C	80	C	95	B	110	D
6	B	21	A	36	C	51	B	66	D	81	B	96	A	111	A
7	A	22	A	37	C	52	D	67	B	82	B	97	B	112	B
8	D	23	B	38	A	53	D	68	C	83	C	98	C	113	B
9	B	24	B	39	B	54	C	69	B	84	B	99	B	114	A
10	B	25	B	40	A	55	A	70	D	85	B	100	D	115	C
11	A	26	B	41	A	56	D	71	C	86	C	101	A	116	C
12	A	27	C	42	A	57	D	72	B	87	B	102	B	117	D
13	B	28	D	43	B	58	B	73	B	88	D	103	D	118	B
14	A	29	C	44	B	59	D	74	B	89	C	104	C	119	D
15	B	30	C	45	C	60	D	75	B	90	B	105	B	120	A

	Exam:Engg Services-2015														
	Series-A Sub: Electrical Engg Paper-II														
	Max Marks:200		Items Dropped: Nil												
	Items for Scoring:120														
1	D	16	C	31	C	46	C	61	C	76	A	91	B	106	A
2	C	17	A	32	B	47	D	62	C	77	A	92	A	107	C
3	C	18	B	33	D	48	B	63	C	78	C	93	B	108	B
4	A	19	B	34	C	49	C	64	A	79	A	94	D	109	C
5	C	20	B	35	C	50	A	65	A	80	C	95	C	110	C
6	D	21	B	36	B	51	C	66	C	81	A	96	B	111	A
7	C	22	C	37	C	52	B	67	D	82	C	97	C	112	A
8	A	23	B	38	D	53	C	68	A	83	D	98	C	113	A
9	D	24	B	39	D	54	D	69	C	84	C	99	A	114	C
10	B	25	D	40	D	55	D	70	B	85	A	100	C	115	B
11	D	26	B	41	A	56	A	71	D	86	A	101	D	116	A
12	C	27	A	42	D	57	D	72	B	87	A	102	A	117	C
13	A	28	B	43	B	58	C	73	A	88	C	103	D	118	B
14	C	29	A	44	C	59	C	74	A	89	A	104	A	119	B
15	B	30	B	45	D	60	A	75	B	90	A	105	B	120	A