A
SET

Booklet No. :

EE - 15
Electrical Engineering

Duration of Test : 2 Hours **Max. Marks : 120**

Hall Ticket No. | | | | | | | | |

Name of the Candidate :____

Date of Examination :__________________ **OMR Answer Sheet No. :** _________________

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Signature of the Candidate **Signature of the Invigilator**

INSTRUCTIONS

1. This Question Booklet consists of **120** multiple choice objective type questions to be answered in **120** minutes.
2. Every question in this booklet has 4 choices marked (A), (B), (C) and (D) for its answer.
3. Each question carries **one** mark. There are no negative marks for wrong answers.
4. This Booklet consists of **16** pages. Any discrepancy or any defect is found, the same may be informed the Invigilator for replacement of Booklet.
5. Answer all the questions on the OMR Answer Sheet using **Blue/Black ball point pen only.**
6. Before answering the questions on the OMR Answer Sheet, please read the instructions printed on the OMR sheet carefully.
7. OMR Answer Sheet should be handed over to the Invigilator before leaving the Examination Hall.
8. Calculators, Pagers, Mobile Phones, etc., are not allowed into the Examination Hall.
9. No part of the Booklet should be detached under any circumstances.
10. The seal of the Booklet should be opened only after signal/bell is given.

ELECTRICAL ENGINEERING (EE)

1. If $A = \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$, then which one of the following is true ?

(A) $A^3 - 5A^2 + 7A + 3I = 0$ (B) $A^3 + 5A^2 + 7A - 3I = 0$

(C) $A^3 - 5A^2 + 7A - 3I = 0$ (D) $A^3 + 5A^2 + 7A + 3I = 0$

2. The directional derivative of $xy + yz + zx$ at the point (1, 2, 0) in the direction of $i + 2j + 2k$ is

(A) $\frac{10}{\sqrt{14}}$ (B) $\frac{10}{\sqrt{3}}$ (C) $\frac{10}{3}$ (D) $\frac{10}{14}$

3. If $u = xy$, $v = x + y$, then $\frac{\partial(u, v)}{\partial(x, y)} =$

(A) $(x - y)(y - z)(z - x)$ (B) $x + y + z$

(C) xyz (D) $(x - y)(z - y)(z - x)$

4. The P.I. of $(D^2 + 16)y = \cos 4x$ is

(A) $-\frac{x}{8}\cos 4x$ (B) $\frac{x}{8}\sin 4x$ (C) $x \cos 4x$ (D) $x \sin 4x$

5. The half range Fourier sine series of $f(x) = 1$, $0 < x < \pi$ is

(A) $f(x) = \sum_{n=1}^{\infty} \frac{(-1)^n - 1}{n\pi} \sin nx$ (B) $f(x) = \sum_{n=1}^{\infty} \frac{(-1)^n + 1}{n\pi} \sin nx$

(C) $f(x) = \sum_{n=1}^{\infty} \frac{(-1)^n}{n\pi} \sin nx$ (D) $f(x) = \sum_{n=1}^{\infty} \frac{1 - (-1)^n}{n\pi} \sin nx$

6. The solution of $3\frac{\partial u}{\partial x} + 2\frac{\partial u}{\partial y} = 0$, $u(x, 0) = 4e^{-x}$ is

(A) $u(x, y) = 4e^{x - \frac{3}{2}y}$ (B) $u(x, y) = 4e^{-x - \frac{3}{2}y}$

(C) $u(x, y) = 4e^{-x + \frac{3}{2}y}$ (D) $u(x, y) = 4e^{-x} + y$

7. $\int_c \frac{(z^2 + 1)}{(z^2 - 1)} dz$, where $c : |z - 1| = 1$ is

(A) πi (B) $\pi i/2$ (C) $2\pi i$ (D) $-\pi i$

8. If $f(x) = \begin{cases} k(1 - x^2) & \text{for } 0 < x < 1 \\ 0 & \text{elsewhere} \end{cases}$ represents the probability density of a random variable X, then k =

(A) 2/3 (B) 3/2 (C) 1/2 (D) 1

9. The correlation coefficient of twelve pairs of data having $\Sigma x = 730$, $\Sigma y = 1017$, $\Sigma x^2 = 44932$, $\Sigma y^2 = 86801$ and $\Sigma xy = 62352$ is

(A) 0.5674 (B) 0.68 (C) 0.83 (D) 0.857

10. The solution of y' = x + y, y(0) = 1 at x = 0.2, using Euler's method, is

(A) 1.24 (B) 0.2 (C) 1.02 (D) 1.1

11. A tree of a network graph consists of

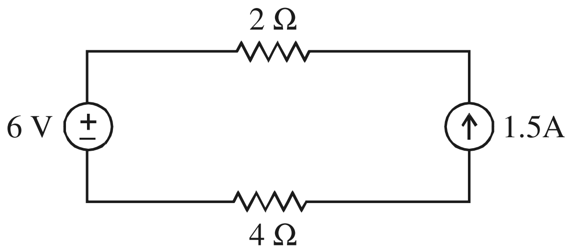
(A) (n-1) nodes

(B) n branches

(C) one or two nodes left in isolated position

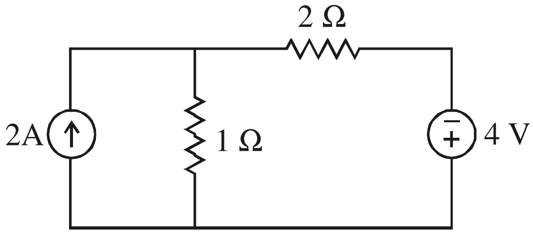
(D) no closed paths

12. The power delivered by the current source in the circuit shown in Figure.



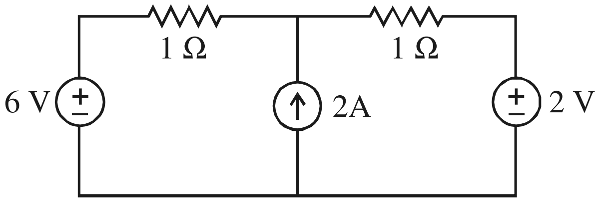
(A) 9 W (B) 12 W (C) 18.5 W (D) 22.5 W

13. The voltage across the 2 Ω resistor in the circuit shown in Figure.



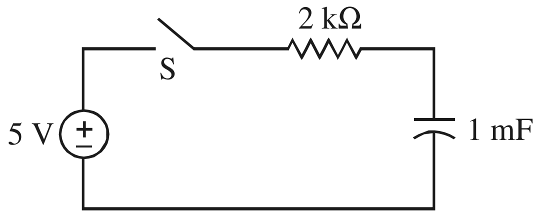
(A) 2 V (B) 4 V (C) 8 V (D) 12 V

14. The current through 6 V source in the circuit shown in Figure.



(A) 0.5 A (B) 1.0 A (C) 1.5 A (D) 2 A

15. The current through the circuit shown in Figure, if switch, S is closed at time, t = 0



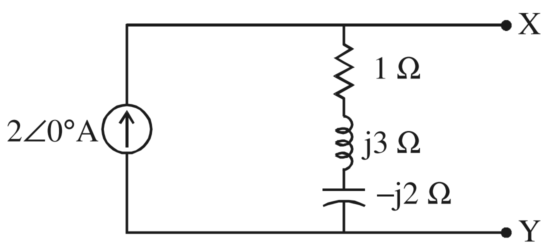
(A) $10 \times 10^{-3}\, e^{-0.5\,t}$ (B) $10 \times 10^{-3}\, e^{-2\,t}$

(C) $7.5 \times 10^{-3}\, e^{-2\,t}$ (D) $2.5 \times 10^{-3}\, e^{-0.5\,t}$

16. The damping ratio of an under damped R-L-C circuit with step response is

(A) $\dfrac{R}{\sqrt{L/C}}$ (B) $\dfrac{R}{2\sqrt{L/C}}$ (C) $2R\sqrt{L/C}$ (D) $\dfrac{R}{2\sqrt{C/L}}$

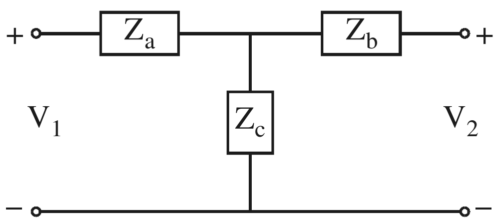
17. The Thevenin equivalent across X-Y for the circuit shown below :



(A) $\sqrt{2}\,\angle 45^\circ$ V, $(1 + j1)\,\Omega$ (B) $2\,\angle 45^\circ$ V, $(1 + j1)\,\Omega$

(C) $2\sqrt{2}\,\angle 45^\circ$ V, $(1 + j1)\,\Omega$ (D) $\sqrt{2}\,\angle 45^\circ$ V, $(1 - j1)\,\Omega$

18. The Z parameters of Tee network shown in Figure.



(A) $\begin{bmatrix} Z_a + Z_c & Z_c \\ Z_c & Z_b + Z_c \end{bmatrix}$ (B) $\begin{bmatrix} Z_a - Z_c & Z_c \\ Z_c & Z_b - Z_c \end{bmatrix}$

(C) $\begin{bmatrix} Z_a + Z_c & -Z_c \\ -Z_c & Z_b + Z_c \end{bmatrix}$ (D) $\begin{bmatrix} Z_c - Z_a & Z_c \\ Z_c & Z_c - Z_a \end{bmatrix}$

19. In a 3-phase balanced system the phase voltages with a-b-c phase sequence are $V_{an} = V_p\angle 0^\circ$ and $V_{bn} = V_p\angle -120^\circ$. The line voltages are

(A) $V_{ab} = V_L\angle 30^\circ,\ V_{bc} = V_L\angle -90^\circ$ (B) $V_{ab} = V_L\angle 30^\circ,\ V_{bc} = V_L\angle 150^\circ$

(C) $V_{ab} = V_L\angle 30^\circ,\ V_{bc} = V_L\angle 90^\circ$ (D) $V_{ab} = V_L\angle -30^\circ,\ V_{bc} = V_L\angle -150^\circ$

20. Two parallel conductors are separated by a distance, d carrying a current, I in the same direction. The magnetic field along a line running parallel to the conductors and midway between them is

(A) zero
(B) proportional to I
(C) proportional to d
(D) proportional to the permeability of the medium.

21. A coil of N turns is placed in a medium of reluctance, S. The inductance is

(A) $\frac{N}{S}$ (B) $\frac{N^2}{S}$ (C) $\frac{N}{S^2}$ (D) $N \times S$

22. A dielectric material is said to be linear if the electric flux density varies

(A) non-linearly with electric field (B) linearly with electric field
(C) linearly with the permittivity (D) non-linearly with electric potential

23. The capacitance of a coaxial conductor of length L, having inner radius, a, outer radius, b and permittivity, €

(A) $\frac{2\pi€\,L}{ln\frac{a+b}{2}}$ (B) $\frac{2\pi€\,L}{ln\frac{a}{b}}$ (C) $\frac{2\pi€\,L}{ln\frac{b}{a}}$ (D) $\frac{2\pi€\,L}{(a+b)/2}$

24. If $x_1(t)$ is an odd signal and $x_2(t)$ is an even signal then the condition to prove that the product of the signals, y(t) is

(A) odd and y(t) = − y(t) (B) even and y(− t) = y(t)
(C) odd and y(− t) = − y(t) (D) even and − y(t) = y(t)

25. A continuous time signal $x(t)$ is sampled and the periodic impulse train of period τ is given by $s(t) = \sum_{n=-\infty}^{\infty}\delta(t - n\tau)$. If ω_s is the sampling frequency, then the Fourier Transform

(A) $S(j\omega) = \frac{2\pi}{\tau}\sum_{n=-\infty}^{\infty}\delta(k\omega_s)$ (B) $S(j\omega) = 2\pi\sum_{n=-\infty}^{\infty}\delta(k\omega_s)$

(C) $S(j\omega) = \frac{2\pi}{\tau}\sum_{n=-\infty}^{\infty}\delta(\omega - k\omega_s)$ (D) $S(j\omega) = \frac{2\pi}{\tau}\sum_{n=-\infty}^{\infty}\delta(\omega_s)$

26. The current through a circuit is expressed as, $i(t) = 3e^{-2t} - 2e^{-t}$. The corresponding transfer function of the circuit is

(A) $\frac{s+1}{s^2+3s+2}$ (B) $\frac{s-1}{s^2+3s+2}$ (C) $\frac{5s-1}{s^2+3s+2}$ (D) $\frac{5s+1}{s^2+3s+2}$

27. The Z-Transform of a discrete time signal x(n) is

(A) $\sum_{n=0}^{\infty} x(n)z^{-n}$ (B) $\sum_{n=-\infty}^{\infty} x(n)z^{-1}$ (C) $\sum_{n=-\infty}^{\infty} x(n)z^{-n}$ (D) $\sum_{n=1}^{\infty} x(n)z^{-n}$

28. The magnetizing reactance of a 4 kV/ 400 V, 50 Hz single-phase transformer on low voltage side is 35 Ω. The magnetizing reactance on the high voltage side is

(A) 0.35 Ω (B) 3.5 Ω (C) 350 Ω (D) 3500 Ω

29. At maximum efficiency of a single-phase transformer, the load power factor is

(A) unity (B) lagging (C) leading (D) zero

30. The per unit I^2R losses and per unit reactance of a transformer at 0.8 leading power factor is 0.1 and 0.03, respectively. The per unit regulation of the transformer is

(A) −0.02 (B) −0.01 (C) 0.04 (D) 0.026

31. In star-star connection of 3-phase transformer, the triplen harmonics are suppressed by using

(A) star connected tertiary windings (B) delta connected tertiary windings
(C) neutral conductor (D) additional insulation for the phases

32. If two 3-phase transformers with unequal voltage ratios are connected in parallel, the result is

(A) circulating current on no-load (B) no circulating current on no-load
(C) dead short-circuit (D) equal no-load secondary emfs

33. In a 6-pole wave wound dc machine the number of conductors is 70. The back pitch and commutator segments, respectively, are

(A) 11and 35 (B) 12 and 34 (C) 13 and 35 (D) 14 and 34

34. The number of brushes in a 6-pole double-layer lap wound dc machine is

(A) 8 (B) 6 (C) 4 (D) 2

35. Equalizer rings are used in a dc machine to

(A) provide mechanical balance
(B) balance the flux produced by the poles
(C) provide path for the circulating currents
(D) overcome armature reaction

36. The demagnetizing AT/pole of a 4-pole dc generator is 480. The number of conductors is 480 and the current in each conductor is 40 A. Then the required brush shift in mechanical degrees

(A) 9° (B) 7° (C) 5° (D) 3°

37. In a dc shunt generator critical field circuit resistance line is the line drawn

(A) above the OCC (B) below the OCC
(C) tangent to the saturation curve (D) tangent to the linear portion of OCC

38. A 200 V dc motor takes a field current of 2 A to generate a back emf of 180 V. If the field winding resistance is 80 Ω, the resistance of the shunt field regulator is

(A) 10 Ω (B) 20 Ω (C) 100 Ω (D) 180 Ω

39. The stator mmf and rotor mmf of a 3-phase induction motor
(A) are equal
(B) rotate with slip speed
(C) are opposite but rotate with synchronous speed
(D) rotate with the same rotor speed

40. The mechanical power developed and the rotor copper losses of a 3-phase induction motor in terms of slip, s are in the ratio of
(A) 1 − s : s (B) s : 1 − s (C) 1 + s : s (D) (1 − s)/s : s

41. In a single-phase induction motor the slip with respect to forward and backward rotating magnetic fields, respectively, are
(A) s and (1 − s) (B) s and (1 + s) (C) s and (2 − s) (D) (1 − s) and (2 − s)

42. The number of slip-rings in a turbo-alternator are
(A) zero (B) 2 (C) 3 (D) 4

43. To eliminate n^{th} harmonic voltage in the generated voltage of a 3-phase synchronous generator, the coil span of the stator winding is
(A) π/n (B) π (1 − 1/n) (C) π (1 + 1/n) (D) n π (1 − 1/n)

44. The ratio of air-gap line voltage from open-circuit characteristic and armature current from short-circuit characteristic for a particular value of the field current in a synchronous generator is
(A) synchronous reactance
(B) synchronous impedance
(C) unsaturated synchronous reactance
(D) unsaturated synchronous impedance

45. When two synchronous machines are connected in parallel the synchronizing power tends to
(A) accelerate the faster machine
(B) retard the faster machine
(C) retards the slower machine
(D) pull the faster machine out of step

46. The maximum power transferred by a 3-phase, 400 V synchronous generator with synchronous reactance of 5 Ω and at an excitation voltage of 650 V is
(A) 52 kW (B) 78 kW (C) 104 kW (D) $52\sqrt{3}$ kW

47. The power factor of a synchronous machine is controlled by
(A) connected load (B) generated voltage
(C) field current (D) load angle

48. In a non-salient pole synchronous generator $\frac{VE}{X_d}\cos\delta - \frac{V^2}{X_d}$, where V = generated voltage, E = back emf, X_d = direct axis synchronous reactance, and δ = load angle, represents
(A) active power (B) reactive power
(C) reluctance power (D) total power

49. As the speed increases, the torque developed by a dc servo motor

(A) decrease with a negative slope (B) increases with a positive slope
(C) remain constant (D) becomes unstable

50. A plant with 10 MW installed capacity produces an annual output of 6×10^6 kWh and remains in operation for 2000 hours in a year. The Plant Use Factor is

(A) 0.33 % (B) 3.33 % (C) 15 % (D) 30 %

51. In a medium transmission line, the complex A, B, C, D constants are related as

(A) A = B, C = D (B) A = D, C = 0
(C) AB − CD = 0 (D) A = C, B = D

52. The sending end current and receiving end current of a medium transmission line are (120 − j 15) A and (180 − j 90) A, respectively. The charging current is

(A) (300 − j 105) A (B) (−60 + j 75) A
(C) (60 − j 75) A (D) 135 A

53. The minimum potential gradient of a single-core cable with core diameter, d, internal sheath diameter, D and the potential difference between the conductor and sheath, V is

(A) $\dfrac{2V}{D\log_e \frac{D}{d}}$ (B) $\dfrac{2V}{d\log_e \frac{D}{d}}$ (C) $\dfrac{V}{d\log_e \frac{D}{d}}$ (D) $\dfrac{V}{D\log_e \frac{D}{d}}$

54. The overhead radial distribution is preferred to

(A) reduce voltage fluctuations
(B) increase service reliability
(C) distribute power at low voltage
(D) distribute power to long distances

55. The base kV and base MVA are halved and the per unit impedance new value is 0.5. The per unit impedance of the original circuit element is

(A) 0.25 (B) 0.5 (C) 0.625 (D) 1.0

56. The necessary condition for an n × n Z_{bus} and Y_{bus} matrices is, if

(A) Z_{bus} is symmetric, Y_{bus} is diagonal
(B) Z_{bus} is diagonal, Y_{bus} is symmetric
(C) Z_{bus} is symmetric, Y_{bus} is symmetric
(D) Z_{bus} is symmetric, then Y_{bus} is transpose of Z_{bus}

57. In the load flow analysis, a Jacobian is a matrix of size n × n with

(A) constant elements
(B) upper triangular constant elements
(C) first partial derivative elements
(D) second partial derivative elements

58. In a power flow program the input and output data, respectively, at the k^{th} load bus are

(A) P_k, V_k and Q_k, δ_k (B) P_k, Q_k and V_k, δ_k

(C) V_k, δ_k and P_k, Q_k (D) P_k, δ_k and V_k, Q_k

59. The effect of corona is less by using

(A) overhead lines of large conductor size

(B) under ground cable of small conductor size

(C) overhead lines having less spacing between conductors

(D) overhead lines of higher voltages

60. A synchronous condenser is used at the receiving end of a transmission line for

(A) supplying lagging kVA

(B) voltage control

(C) frequency control

(D) maintaining a higher voltage than at the sending end

61. Real power flow in transmission lines is controlled by

(A) tap changing transformer

(B) voltage regulating transformer

(C) phase-angle regulating transformer

(D) booster transformer

62. The injected complex power for a given bus system, given Ybus, Zbus, bus voltage for i = 1, 2, ….n

(A) $\sum_{m=1}^{n} Y_{im} V_m V_i$ (B) $\sum_{m=1}^{n} Y_{im} V_m V_i^*$ (C) $\sum_{m=1}^{n} Z_{im} V_m V_i^*$ (D) $\sum_{m=1}^{n} Y_{im} V_m^* V_i$

63. The voltage profile of a n-bus power system can be improved by controlling the

(A) load angles (B) active power flows

(C) reactive power flows (D) complex power flows

64. Given 3-phase voltages a, b, c, and the transformation matrix ($a = 1\angle 120^\circ$),
$T = \begin{bmatrix} 1 & 1 & 1 \\ 1 & a & a^2 \\ 1 & a^2 & a \end{bmatrix}$, the matrix equation for positive, negative and zero sequence currents is

(A) $V_{1,2,0} = TV_{a,b,c}$ (B) $V_{1,2,0} = \frac{1}{3} TV_{a,b,c}$

(C) $V_{0,1,2} = TV_{a,b,c}$ (D) $V_{1,2,0} = \frac{1}{2} TV_{a,b,c}$

65. Two 3-phase synchronous generators with reactance 60% and 40% feed a fault current of 1200 A up to short-circuit fault point. The short-circuit current is

(A) 1200 A (B) 2400 A (C) 4000 A (D) 5000 A

66. A single-line-to-ground fault on a overhead transmission line creates
(A) voltage sag (B) voltage swell (C) over voltage (D) voltage flicker

67. Ratio relay by using line-to-neutral voltage protect
(A) 3-phase faults (B) double line faults
(C) double-line-to-ground faults (D) generator bus earth faults

68. Protection of transformer from all types of faults is by using
(A) over current relay (B) differential relay
(C) distance relay (D) Buchholz relay

69. The voltage that appears across the contacts of the circuit breaker after the arc extinction is called as
(A) arc voltage (B) recovery voltage
(C) re-striking voltage (D) extinction voltage

70. Differential relays detect internal faults in 3-phase transformers by
(A) zero sequence currents
(B) positive sequence currents
(C) negative sequence currents
(D) both positive and negative sequence currents

71. For a synchronous machine swing curve, the load angle swings between δ_{min} and δ_{max}, if the damping constant is
(A) equal to zero (B) greater than zero
(C) less than zero (D) equal to normalized inertia constant

72. The breakeven distance for HVDC transmission is
(A) 100 kM (B) 250 kM
(C) 500 kM – 800 kM (D) Above 1000 kM

73. A homo-polar HVDC link consists of
(A) single-conductor with positive polarity
(B) two conductors with one positive and another negative polarity
(C) two conductors having the same polarity with a ground return
(D) single conductor with negative polarity and ground as positive polarity

74. A static VAR compensator is a
(A) series connected thyristor based controller
(B) shunt connected thyristor based controller
(C) energy storage device
(D) combined series–shunt connected controller

75. The Interline Power Flow Controller in a transmission system
(A) injects voltage by static series converters
(B) injects current by static shunt converters
(C) injects voltage and current by the static series and shunt converters
(D) provides real and reactive power compensation by static shunt compensator

76. The system given by the transfer function, $G(s)=\dfrac{1+sT}{1+sT_1}$

(A) non-minimum phase system (B) minimum phase system
(C) system with transport lag (D) unstable system

77. The closed-loop transfer function of unity feedback system with $G_1(s)=\dfrac{K}{s}$ and $G_2(s)=\dfrac{R}{RCs+1}$ in the forward path is

(A) $\dfrac{KR}{KRs^2+s+RC}$ (B) $\dfrac{RCs^2+s}{RCs^2+s+KR}$

(C) $\dfrac{RC}{RCs^2+s+KR}$ (D) $\dfrac{KR}{RCs^2+s+KR}$

78. The open-loop transfer function of a unity feedback system is $\dfrac{K_pK}{Ts+1}$. The steady state error in the unit-step response is

(A) Zero (B) $\dfrac{1}{1+K_pK}$ (C) $\dfrac{1}{1-K_pK}$ (D) K_pK

79. For a unity feedback system with a transfer function G(s) and input R(s), the steady state error is

(A) $\lim_{s\to 0}\dfrac{sR(s)}{1+G(s)}$ (B) $\lim_{s\to 0}\dfrac{R(s)}{1+G(s)}$ (C) $\lim_{s\to 0}\dfrac{1}{1+G(s)}$ (D) $\lim_{s\to 0}\dfrac{R(s)}{s(1+G(s))}$

80. A system represented by the characteristic equation $s^4+2s^3+3s^2+2s+K$ is said to be stable if

(A) K > 0 (B) 1 > K > 0 (C) 2 > K > 0 (D) K > − 1

81. The Nyquist plot of a unity feedback minimum phase system is drawn for different values of gain, K. The system is stable if the plot

(A) does not enclose the (− 1 + j 0) point
(B) passes through the (− 1 + j 0) point
(C) encloses the (− 1 + j 0) point
(D) passes through the (− 2 + j 0) point

82. For unity feedback control system, the magnitude of $G(j\omega_1)$ at the phase cross-over frequency, ω_1 is measured as 2/3 from the Bode plot. The gain margin is

(A) 2/3 (B) 3/2 (C) 4/9 (D) 9/4

83. A lag-lead compensator for a second order system

(A) improves steady state errors, reduces relative stability
(B) marginally improves steady state errors, increases relative stability
(C) reduces steady state errors, increases relative stability
(D) improves both transient response and steady state response

84. The point of intersection of two asymptotes in a plot is called
(A) corner frequency in uniform scale
(B) corner frequency in logarithmic scale
(C) phase cross-over frequency in uniform scale
(D) phase cross-over frequency in logarithmic scale

85. In the Bode plots, the magnitude and phase angle of the factor (1 + j ω T) are
(A) $20\log|1+j\omega T|,\ \tan^{-1}\dfrac{1}{\omega T}$ (B) $-20\log\left|\dfrac{1}{1+j\omega T}\right|,\ \tan^{-1}\omega T$
(C) $|1+j\omega T|,\ \cos^{-1}\omega T$ (D) $-20\log\left|\dfrac{1}{1+j\omega T}\right|,\ 0$

86. For the state equation $\dot{X} = AX$ where X = n-vector and A = n × n constant matrix. Given the initial state X(0), the solution of the state equation
(A) $X(t) = e^{-At}X(0)$ (B) $X(t) = A^{-1}X(0)$
(C) $X(t) = e^{At}X(0)$ (D) $X(t) = A^{T}X(0)$

87. The mathematical model of a system is $\ddot{y} + 3\dot{y} + 2y = u$, where u = input, and y = output. The matrix state equation for y = x_1, is
(A) $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}0 & 1\\ 2 & 3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$ (B) $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$
(C) $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}1\\ 0\end{bmatrix}[u]$ (D) $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}0\\ 1\end{bmatrix}[u]$

88. The state transition matrix of a state equation, $\dot{X} = AX + Bu$
(A) $L^{-1}\left[(sI-A)^{-1}\right]$ (B) $\left[(sI-A)^{-1}\right]$
(C) $L^{-1}\left[(sI-A)\right]$ (D) $L^{-1}\left[(A-sI)^{-1}\right]$

89. Given $\dot{X} = AX + Bu$ where A is a 2 × 2 matrix and B is a 2 × 1 matrix. The condition for controllability is
(A) $[A : AB]$ (B) $[B : AB]$ (C) $[AB : A]$ (D) $[AB : B]$

90. Given $\dot{X} = AX + Bu$, $y = CX$ where A = 2 × 2 matrix, B = 2 × 1 matrix and C = 1 × 2 matrix. The condition for observability is
(A) $[CB : CAB]$ (B) $[B : AB]$ (C) $\left[B^{*} : A^{*}B^{*}\right]$ (D) $\left[C^{*} : A^{*}C^{*}\right]$

91. A Wien bridge is used to measure
(A) quality factor of a coil (B) audio frequency of a signal
(C) capacitance of a capacitor (D) inductance of a coil

92. The full scale range of PMMC voltmeter is 100 V and its sensitivity is 1000 Ω/V. If the meter reads 50 V, the current through the voltmeter is
(A) 0.05 mA (B) 0.5 mA (C) 5 mA (D) 50 mA

93. The power in a 3-phase load is measured by two watt meters. If one watt meter reads zero, then the load power factor is
(A) Zero (B) 0.5 (C) 0.866 (D) unity

94. The burden of the instrument transformers is
(A) VA rating
(B) secondary winding current
(C) secondary winding voltage
(D) $(\text{secondary winding current})^2 \times$ resistance of secondary winding

95. Digital meters are superior over analogue meters because
(A) less expensive
(B) output reading is binary in nature
(C) output impedance is less
(D) installation is easy as panel meters

96. The most accurate instrument for measuring phase difference between two signals is
(A) X – Y plotter (B) oscilloscope
(C) phase sensitive detector (D) electronic counter/timer

97. Measurement of power by voltmeter and ammeter method in a circuit resulted in calculated maximum errors of ±1 % and ± 2 %, respectively. The likely error in calculated power is
(A) ± 3 % (B) ± 0.022 % (C) ± 1.5 % (D) ± 0.22 %

98. Major cause for creeping in induction type energy meter is due to
(A) only current coil is energized (B) under compensation for friction
(C) over compensation for friction (D) over loading of meter

99. The semiconductor device that operates in the reverse breakdown region
(A) light emitting diode (B) zener diode
(C) field effect transistor (D) bipolar junction transistor

100. The region consisting of holes and electrons near the p-n junction of a diode is
(A) diffusion region (B) neutral zone
(C) recombination region (D) depletion region

101. A BJT's voltage stand-off capability when the base current is zero
(A) collector-emitter breakdown voltage
(B) minimum collector-emitter voltage
(C) collector-base breakdown voltage
(D) emitter-base voltage

102. The output voltage change in 2 μs of a certain operation amplifier is ± 8 V in the linear region. The slew rate is
(A) 4 V/μs (B) – 4 V/μs (C) 8 V/μs (D) 16 V/μs

103. The critical frequency of a single-pole active low-pass filter with RC network is

(A) $\frac{2\pi}{RC}$ (B) $\frac{1}{2\pi RC}$ (C) $\frac{RC}{2\pi}$ (D) $\frac{1}{2\pi\sqrt{RC}}$

104. An 8-bit analogue-to-digital converter returns for an analogue input signal

(A) a continuous set of discrete values
(B) 2^{16} discrete values
(C) 2^{10} discrete values
(D) 2^{8} discrete values

105. The IC used for 2:1 multiplexer is

(A) IC 74150 (B) IC 74151 (C) IC 74153 (D) IC 74157

106. In a sample-and-hold circuit, the aperture time is

(A) time required following a sample
(B) time required for the switch to open
(C) transition time interval between sample and hold
(D) time from the hold command to the opening of the switch

107. A bi-stable multi-vibrator can be built by using

(A) NAND gates (B) AND gates
(C) AND or OR gates (D) Excusive-NOR gates

108. Semiconductor devices are protected by a fuse and the material used is

(A) silver (B) gold (C) copper (D) tin

109. The power loss in a transistor is a function of the product of

(A) base current and collector-emitter voltage
(B) collector current and base current
(C) collector current and saturation voltage
(D) collector current and collector-emitter voltage

110. A TRIAC can be switched into on-state by

(A) positive gate current only
(B) negative gate current only
(C) positive or negative gate current
(D) sinusoidal gate current

111. The conducting SCR turns-off when the on-state current is

(A) below the latching current
(B) below the holding current
(C) equal to the reverse leakage current
(D) zero

112. The power factor of input source current of a single-phase semi-converter operating at a firing delay angle, α and feeding a dc load, is

(A) $\cos\frac{\alpha}{2}$ (B) $\cos\alpha$ (C) unity (D) $\cos 2\alpha$

113. A fully controlled single-phase bridge converter is supplied at 120 V, 50 Hz and the firing delay angle of the SCRs is 45°. The average output load voltage for continuous current is

(A) $\frac{120}{\pi}$ (B) $\frac{120\sqrt{2}}{\pi}$ (C) $\frac{240}{\pi}$ (D) $\frac{120}{\pi\sqrt{2}}$

114. The duty ratio of a step-up chopper with an output voltage of 200 V from a 80 V dc source, is

(A) 0.4 (B) 0.5 (C) 0.6 (D) 1.5

115. The fundamental component of rms output voltage of a full-bridge single-phase square-wave inverter with V_{dc} as input voltage, is

(A) $\frac{4}{\pi}V_{dc}$ (B) $\frac{2}{\pi}V_{dc}$ (C) $\frac{4V_{dc}}{\sqrt{2}\pi}$ (D) $\frac{4V_{dc}}{\sqrt{3}\pi}$

116. The starting torque of a V/f controlled inverter-fed 3-phase induction motor operating at 25 Hz as compared with the same motor operating at 50 Hz is

(A) more (B) double (C) equal (D) less

117. Regenerative breaking of ac-dc converter fed dc motor is possible when firing delay angle of SCRs is

(A) 30° (B) 60° (C) 90° (D) 120°

118. In slip-energy recovery scheme of converter-fed 3-phase induction motor, super synchronous speeds are possible by

(A) injecting voltage into the stator
(B) injecting voltage into the rotor
(C) extracting voltage from the stator
(D) extracting voltage from the rotor.

119. The voltage collected by the pantograph of electric locomotive is

(A) DC voltage (B) single-phase AC, 50 Hz
(C) 3-phase AC, 50 Hz (D) single-phase AC, 25 Hz

120. Fast acceleration and high-speed cruising electric traction drive motor is

(A) separately excited dc motor
(B) DC series motor
(C) AC series motor
(D) 3-phase squirrel cage induction motor

SPACE FOR ROUGH WORK