A
SET

Booklet No. :

EE - 16

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

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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. The value of k for which the matrix $\begin{bmatrix} 1 & 1 & k \\ 1 & 2 & 3 \\ 0 & 1 & 1 \end{bmatrix}$ is of rank 2 is

(A) 0 (B) 1 (C) 2 (D) 3

2. If λ is an eigen value of A, then the eigen value of adjoint of A is

(A) λ (B) $\frac{1}{\lambda}$ (C) $\frac{|A|}{\lambda}$ (D) 0

3. The function $f = x^2 + y^2 + 2(\frac{1}{x} + \frac{1}{y})$ has minimum at the point

(A) (1,-1) (B) (1,0) (C) (0,0) (D) (1,1)

4. If $u = x(1-y)$, $v = xy$, then $\frac{\partial(u,v)}{\partial(x,y)} =$

(A) x (B) y (C) $1-x$ (D) $1-y$

5. The real and imaginary parts of a complex analytic function are

(A) both non-zero (B) periodic

(C) orthogonal (D) either of them is zero

6. If the probability density of a random variable is $\frac{1}{\alpha}e^{-\frac{x}{\alpha}}$, then the variance of it is

(A) $\frac{1}{\alpha}$ (B) $\frac{1}{\alpha^2}$ (C) $\frac{2}{\alpha^2}$ (D) $\frac{2}{\alpha}$

7. If r_{xy} and r_{yx} are the regression coefficients of y on x and x on y then the coefficient of correlation is

(A) $r_{xy}r_{yx}$ (B) $(r_{xy}r_{yx})^{1/2}$ (C) $\frac{r_{xy}}{r_{yx}}$ (D) $r_{xy}+r_{yx}$

8. $\frac{xdy - ydx}{x^2 - y^2} =$

(A) $\frac{1}{2}\log\frac{x+y}{x-y}$ (B) $\log(x^2 - y^2)$

(C) $\tan^{-1}(x^2 - y^2)$ (D) $x^2 - y^2$

9. The differential equation whose auxiliary equation has roots 0, -2, -1 is

(A) $\frac{d^3y}{dx^3} + 3y = f(x)$ (B) $\frac{d^2y}{dx^2} + 3\frac{dy}{dx} + 2y = f(x)$

(C) $\frac{d^3y}{dx^3} + 3\frac{d^2y}{dx^2} + 2\frac{dy}{dx} = f(x)$ (D) $\frac{dy}{dx} + 3y = 0$

10. The condition for convergence of the Newton-Raphson method to find a root of $f(x)=0$ is

(A) $|ff''|<|f'|^2$ (B) $|ff''|<1$

(C) $|ff''|>0$ (D) Always converges

11. At very high temperatures, extrinsic semiconductor becomes intrinsic semiconductor because

(A) Of drive in diffusion of dopants & carriers.

(B) Band to band transition dominates impurity ionization.

(C) Impurity ionization dominates band to band transition.

(D) Band to band transition is balanced by impurity ionisation.

12. If a bias voltage of V_t (in Volts) is applied to a forward biased silicon P-N junction diode with a non ideality coefficient of 2, the diode current (in Amps) shall be

(A) I_o (B) $(\sqrt{e}-1)I_o$ (C) $\sqrt{e}I_o$ (D) $(e-1)I$

13. The threshold voltage of an n- channel enhancement mode MOSFET is 0.5V when the device is biased at a gate voltage of 3V. Pinch off would be occurs at a drain voltage of

(A) 1.5V (B) 2.5V (C) 3.5V (D) 4.5V

14. The drain current of a MOSFET is constant, given $I_D = K(V_{GS} - V_T)^2$, where K is a constant. The magnitude of the trans conductance g_m is

(A) $\frac{2(V_{GS}-V_T)^2}{V_{DS}}$ (B) $2K(V_{GS} - V_T)$

(C) $\frac{I_D}{V_{GS}-V_{DS}}$ (D) $\frac{2(V_{GS}-V_T)}{V_{GS}}$

15. Find the values of x and y in the following equation

$\sqrt{4425_x + 1750_y} = (40)_x + (25)_y$

(A) 5,8 (B) 6,9 (C) 6,8 (D) 7,8

16. If CS $= A_{15}A_{14}A_{13}A_{12}$ (and its value is 0111) is used as the chip select logic of A 4K RAM in an 8085 system then its memory range will be

(A) 3000H - 3FFFH (B) 7000H - 7FFFFH

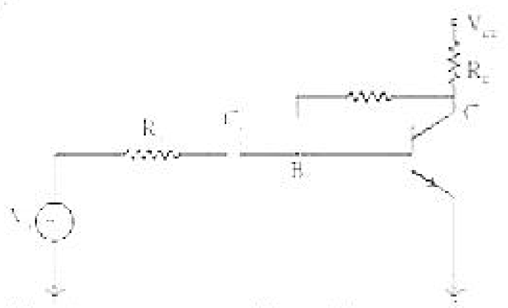
(C) 5000H - 5FFFH& 6000H - 6FFFH (D) 6000H - 6FFFH & 7000H -7FFFH

17. Which of the following instructions is not available in 8085 microprocessor?

(A) LDA 3850 (B) XTHL

(C) push PSW (D) LDAXH

18. Identify the feedback in the below circuit as shown with unknown feedback resistor from collector to base of BJT.



(A) Current series feed back (B) Current shunt feed back

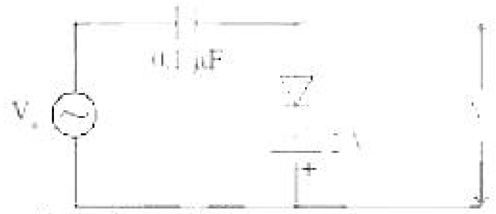
(C) Voltage series feedback (D) Voltage shunt feed back

19. Assertion (A) : Wein bridge oscillator is generally used as a variable audio frequency oscillator

Reason (R) : by using either capacitor (or) resistor in one of the arms of the bridge, the frequency of a wein bridge oscillator can be varied

(A) Both (A) & (R) are true & (R) is correct explanation of (A)
(B) Both (A) & (R) are true but (R) is not the correct explanation of (R).
(C) (A) is true but (R) is false
(D) (A) is false but (R) is true

20. For an input of V_s = 5sinωt,(assuming ideal diode), circuit shown in the figure will becomes as a



(A) Clipper, sine wave clipped at –2V
(B) Clamper, sine wave clamped at –2V
(C) Clamper, sine wave clamped at zero volt
(D) Clipper, sine wave clipped at 2V.

21. The internal resistances of an ideal current source, and an ideal voltage source are, respectively.

(A) $0, \infty$ (B) ∞, ∞ (C) $\infty, 0$ (D) $0, 0$

22. The equation $i(0+) = i(0-) = some\ finite\ value$, where the notations and symbols have usual meanings (as adopted in transient response analysis of circuits) holds good in the case of

(A) a previously unenergized series RL circuit to which a DC voltage source is suddenly applied at $t = 0$.
(B) a previously energized series RL circuit to which a DC voltage source is suddenly applied at $t = 0$.
(C) a previously unenergized series RC circuit to which a DC voltage source is suddenly applied at $t = 0$.
(D) a previously energized series RC circuit to which a DC voltage source is suddenly applied at $t = 0$.

23. The Thevenin equivalent circuit of a network consists of an ideal Thevenin voltage source of DC voltage V_{Th} and Thevenin resistance R_{Th}. A load resistance R_L is connected to the terminals of the Thevenin equivalent circuit. Maximum power that can be transferred to the load is

(A) $V_{Th}^2 / (R_{Th} + R_L)^2$ (B) $V_{Th}^2 / 2R_L$

(C) $V_{Th}^2 / 4R_{Th}$ (D) $V_{Th}^2 / 4(R_{Th} + R_L)$

24. A series R-C circuit has constant value of R and varying value of C. The current locus with constant applied voltage V at constant frequency, as C is varied, is a semi circle with centre at
(A) $\left(\frac{V}{R}, 0\right)$ (B) $\left(\frac{V}{2R}, 0\right)$ (C) $\left(\frac{V}{1R}, 0\right)$ (D) $\left(\frac{V}{2X_C}, 0\right)$

25. The current through a linear time-invariant inductor with inductance $L = 10^{-3}$ is given by $i_L = 0.1 \sin 10^6 t$. The voltage across the inductor is
(A) $100 \cos(10^6 t)$ (B) $100 \sin(10^6 t)$
(C) $10^{-4} \cos(10^6 t)$ (D) $10^{-4} \sin(10^6 t)$

26. Which of the following are known as the short circuit parameters of a 2- port network?
(A) Z- parameters. (B) H- parameters.
(C) Y- parameters. (D) A.B.C.D. parameters.

27. The line current in a balanced delta system is 30 A. The load current is
(A) $30\sqrt{3}$ A (B) $30/\sqrt{3}$ A (C) 10 A (D) $30/\sqrt{2}$ A

28. Possible maximum value of mutual inductance between two coils of self inductances L_1 and L_2 is
(A) $2L_1 + 2L_2$ (B) $L_1 + L_2$ (C) $(L_1 L_2)^2$ (D) $(L_1 L_2)^{\frac{1}{2}}$

29. The resistance required for critical damping in a series RLC circuit is
(A) $R = 2\sqrt{\frac{L}{C}}$ (B) $R = \sqrt{\frac{L}{C}}$ (C) $R = \frac{1}{2}\sqrt{\frac{L}{C}}$ (D) $R = 2\sqrt{LC}$

30. The impedance of a series resonant circuit, at half power frequencies, is
(A) R (B) $2R$ (C) $R/\sqrt{2}$ (D) $\sqrt{2}R$

31. Two +ve charges, Q coulomb each, are placed at points (0,0,0), and (4,4,0), while two –ve charges, Q coulomb each in magnitude, are placed at points (0,4,0), and (4,0,0). The electric field intensity at the point (2,2,0) is
(A) $\frac{Q}{\pi\epsilon_0\epsilon_r}$ (B) $\frac{Q}{4\pi\epsilon_0\epsilon_r}$ (C) $\frac{4Q}{\pi\epsilon_0\epsilon_r}$ (D) zero

32. The magnetic field intensity at the centre of a current carrying coil of diameter d m is H. The current flowing in the coil is
(A) dH (B) $\frac{1}{2}dH$ (C) $2dH$ (D) πdH

33. Two infinite plane sheets of charge with densities of $-\sigma$ and $-\sigma$ C/m^2 are placed parallel to each other with a separating distance of d metres. The value of electric field intensity at a point exactly midway between the plane sheets is
(A) σ/ε_0 (B) $\sigma/2\varepsilon_0$ (C) $2\sigma/\varepsilon_0$ (D) zero

34. Which of the following statements is not characteristic of a static magnetic field?
(A) It is solenoidal. (B) It is conservative.
(C) It has no sinks or sources. (D) Flux lines are always closed.

35. The polarization of a dielectric material is given by
(A) $P = \epsilon_0 \epsilon_r E$ (B) $(\epsilon_0 \epsilon_r - 1)E$
(C) $\epsilon_0 E(\epsilon_r - 1)$ (D) $(\epsilon_r - 1)\epsilon_0$

36. Integration of step signal gives
(A) Impulse signal. (B) Ramp function.
(C) Parabola. (D) Square pulse.

37. The period of the function $Cos\ \frac{\pi}{10}(t-3)$ is
(A) 20 (B) 10 (C) 30 (D) 3.3

38. If $f(t) = -f(-t)$, and $f(t)$ satisfies Dirichlet's conditions, then $f(t)$ can be expanded in a Fourier series containing
(A) Only Sine terms (B) Only Cosine terms.
(C) Cosine terms, and a constant term. (D) Sine terms, and a constant term.

39. Minimum sampling rate required to avoid aliasing when the signal $10\ Cos\ 400\ \pi t$ is sampled is
(A) 4000 (B) 40 (C) 200 (D) 400

40. The Fourier transform of $f(t)$ is $F(\omega)$. Then, the Fourier transform of $f(at)$, where a is a constant, is given by
(A) $\frac{1}{a}F\left(\frac{\omega}{a}\right)$ (B) $aF(\omega)$ (C) $\frac{F(\omega)}{a}$ (D) $\frac{1}{a}F(a\omega)$

41. Laplace transform of $Cos\ t$ is
(A) $\frac{s}{(s^2-1)}$ (B) $\frac{s}{(s-1)}$ (C) $\frac{s}{(s+1)}$ (D) $\frac{s}{(s^2+1)}$

42. The z-transform of $\sum_{k=0}^{\infty} \delta(n-k)$ is
(A) $\frac{z}{z-1}$ (B) $\frac{z^2}{z-1}$ (C) $\frac{z}{(z-1)^2}$ (D) $\frac{z-1}{z}$

43. The continuous time signal $\sin 25\ \pi t + \sin 80\ \pi t$ requires a Nyquist rate of
(A) 50 (B) 25 (C) 105 (D) 80

44. The Fourier transform of a function $f(t)$ is defined as
(A) $\int_0^{\infty} f(t)e^{-j\omega t}dt$ (B) $\int_{-\infty}^{\infty} f(t)e^{-j\omega t}dt$
(C) $\int_0^{\infty} f(t)e^{j\omega t}dt$ (D) $\int_{-\infty}^{\infty} f(t)e^{j\omega t}dt$

45. GATE function is defined by $G_T(t) = 1\ for\ -\frac{T}{2} \le t \le \frac{T}{2};\ and\ 0\ elsewhere.$ Its Fourier Transform is given by
(A) $\frac{2}{\omega}sin(\omega T)$ (B) $\frac{2}{\omega}sin\left(\frac{T}{2}\right)$ (C) $\frac{2}{\omega}sin\left(\frac{\omega T}{2}\right)$ (D) $\frac{\omega}{2}sin\left(\frac{\omega T}{2}\right)$

46. Consider the following systems :
(i) a normal human being walking on the road, and
(ii) servomechanism.
Systems (i) and (ii) are, respectively,
(A) Open loop control system, Open loop control system.
(B) Closed loop control system, Closed loop control system.
(C) Open loop control system, Closed loop control system.
(D) Closed loop control system, Open loop control system.

47. The transfer function of a system is $\frac{10}{s(s+1)(s^2+3s+2)}$. The steady state errors exhibited by the system, to (i) step, (ii) ramp, and (iii) parabolic input are, respectively,
(A) Zero, finite, infinite. (B) Zero, Zero, finite.
(C) Zero, Zero, Zero. (D) Finite, infinite, infinite.

48. System 1 : The first column of the RH array consists of the terms 6,3,9,-2, and 4.
System 2 : The first column of the RH array consists of the terms 3,6,9,2, and -4.
The number of unstable poles for system1, and system 2, are respectively.
(A) 1,1 (B) none, none (C) 2,2 (D) 2,1

49. A second order system shows 100% overshoot in its unit step response. It can be categorized as
(A) underdamped system. (B) overdamped system.
(C) Critically damped system. (D) undamped system.

50. A unity negative feedback control system is found to have a gain margin of 20 dB. The Nyquist plot of the system
(A) crosses the real axis at +0.1 (B) crosses the real axis at -0.1
(C) crosses the imaginary axis at -0.1 (D) crosses the imaginary axis at −0.1

51. A certain control system has the open loop transfer function given by $\frac{K(s+3)(s+5)}{s(s+7)(s+9)}$. Which portions of the real axis, among the ones given below, are parts of the root locus?
(A) the portions between -9 and $-\infty$, -5 and -7; 0 and -3.
(B) the portions between -3 and -5; -7 and -9; 0 and $-\infty$.
(C) the portions between -3 and -5; -7 and -9.
(D) the portions between +9 and ∞; +5 and +7; 0 and +3.

52. The open loop transfer function of a unity negative feedback control system is $\frac{10}{s^2(7s+1)}$
The TYPE number and order of the closed loop system are, respectively
(A) 2,1 (B) 1,2 (C) 3,0 (D) 0,3

53. The transfer function of a system is given by $\frac{1}{(1+T_1s)(1+T_2s)}$. A controller of the form $\frac{K(1+T_3s)}{(1+T_4s)}$ is used to improve the performance of the system when operated in closed loop with unity feedback. The rise time in the unit step response can be reduced by choosing
(A) $T_3 = T_1$ (B) $T_3 = T_4$ (C) $T_3 < T_4$ (D) $T_3 > T_4$

54. In the state variable representation of systems, let A denote the system characteristic matrix, and let $\emptyset(t)$ denote the state transition matrix. Then, which of the following is not a property of the state transition matrix?
(A) $\emptyset(t_2 - t_1)\emptyset(t_1 - t_0) = \emptyset(t_2 - t_0)$ (B) $\emptyset(t_1 + t_2) = \emptyset(t_2)\emptyset(t_1)$
(C) $\emptyset^{-1}(t) = \emptyset(-t)$ (D) $\emptyset(0) = A$

55. The state equation of a system is given by $\dot{X} = AX + bu$, where $A = \begin{bmatrix} -2 & 4 \\ 2 & -1 \end{bmatrix}$ and $b = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$. The system is
(A) Controllable, stable. (B) Uncontrollable, unstable.
(C) Uncontrollable, stable. (D) Controllable, unstable.

56. Observability of a system is essential for
(A) finding a solution to the state equation.
(B) finding a suitable model in state space.
(C) transferring the state of the system from any initial value to any specified final value.
(D) state estimation.

57. Time constant of a first order system is defined as the time taken to reach $x\%$ of the final steady state value in the step response. The value of x is

(A) 100 (B) 36.2 (C) 63.2 (D) 90

58. In Torque-Voltage analogy, the Moment of Inertia of a mechanical rotational system is analogous to

(A) Capacitance C. (B) Inductance L.
(C) Resistance R. (D) Inductive reactance X_L

59. The bridge most suited for accurate measurement of relative permittivity of dielectric materials is

(A) Carey Foster Bridge
(B) Anderson's bridge
(C) Heaviside Bridge modified by Campbell
(D) Schering Bridge.

60. The operation of a ramp type Digital Voltmeter is based on the principle of

(A) Voltage-to-current conversion.
(B) Voltage-to-time conversion.
(C) Current-to-time conversion.
(D) Current-to-frequency conversion.

61. The vertical deflection of an electron beam on the screen of a CRO is measured to be 8 mm. Now, the potential difference between the Y-plates is doubled, and simultaneously the pre-accelerating anode voltage is reduced to half of its previous value. Then, the vertical deflection of the beam on the screen would become

(A) 64 mm (B) 32 mm (C) 8 mm (D) 4 mm

62. Gross errors occur in measurements because of

(A) disturbances about which we are unaware.
(B) human mistakes.
(C) inherent shortcomings in the instrument.
(D) loading effects on the meters.

63. An induction type energy meter is found to run fast. Correction for this error can be made by

(A) Over-load compensation
(B) Voltage compensation.
(C) Moving the brake magnet away from the centre of the disc.
(D) Moving the brake magnet towards the centre of the disc.

64. Standardization of potentiometers is done so that

(A) They become accurate and direct-reading.
(B) They become accurate and precise.
(C) They become accurate and take zero current when null condition is reached.
(D) Power consumption is reduced during operation.

65. The meter which does not have any component in it to provide control torque is

(A) Electrodynamometer for current measurement
(B) Electrodynamometer for voltage measurement
(C) Electrodynamometer for power measurement.
(D) Electrodynamometer for power factor measurement.

66. In a single-phase transformer, the magnetizing current is
(A) in phase with the no-load current
(B) in quadrature with the no-load current
(C) the product of no-load current and power factor
(D) in phase with the flux in the core

67. A 230 V/460 V single-phase transformer operating at 20 A and unity power factor has primary referred resistance of 0.2 Ω and reactance of 0.5 Ω. The approximate primary induced emf is
(A) 216 V (B) 226 V (C) 234 V (D) 236 V

68. A transformer at 25 Hz develops 20 W hysteresis loss and 50 W eddy current loss. If the applied voltage and frequency are doubled, the new core losses are
(A) 140 W (B) 180 W (C) 240 W (D) 480 W

69. A 3-phase transformer possible 3-phase connection by a combination of star (Y or y) and delta (D or d) with 30° lead phase displacement corresponding to watch clock-face hour is
(A) Dy0 (B) Dy1 (C) Yd1 (D) Dy11

70. Two transformers of voltage ratio 1 kV/500 V, with impedances z_1 = j0.04 Ω and z_2 = j0.06 Ω, respectively, connected in parallel share a total load of 200 kVA. The kVA carried by each transformer is
(A) $S_1 = 40$, $S_2 = 160$ (B) $S_1 = 80$, $S_2 = 120$
(C) $S_1 = 120$, $S_2 = 80$ (D) $S_1 = 160$, $S_2 = 40$

71. A two winding transformer is connected as an auto-transformer with the same voltage ratio of 2:1. If primary and secondary winding resistances of auto-transformer are 0.03 Ω and 0.02 Ω, respectively, the primary equivalent resistance of auto-transformer is
(A) 0.035 Ω (B) 0.05 Ω (C) 0.11 Ω (D) 0.14 Ω

72. In a duplex lap winding, if y_b and y_f are back-pitch and front-pitch, respectively, then
(A) $y_b = y_f \pm 2$ (B) $y_b = 2y_f$ (C) $y_f = 2y_b$ (D) $y_b = y_f \pm 4$

73. In a 4-pole wave winding connected dc motor, the cross-magnetizing AT/pole for a brush shift of θ radians
(A) Armature amp-conductors × (θ/360°)
(B) Armature amp-turns × (θ/360°)
(C) Armature amp-conductors × (1/4 - θ/360°)
(D) Armature amp-conductors × (1/8 - θ/360°)

74. The magnetic neutral plane shifts in a dc machine
(A) in the direction of motion of motor
(B) in the direction of motion of generator
(C) due to increase in the field flux
(D) cause reduction of flash over between commutator segments

75. The terminal characteristics of a dc generator suitable for electric welders is
(A) separately excited generator (B) shunt generator
(C) series generator (D) differentially compounded generator

76. A 220 V separately excited motor with $R_a = 0.5\ \Omega$ running at 500 rpm draws a current of 20 A. The value of additional resistance in armature circuit to reduce the speed to 300 rpm at constant flux is

(A) 4.0 Ω (B) 4.2 Ω (C) 4.4 Ω (D) 7.67 Ω

77. The layout pattern of 3-phase double-layer stator winding in an induction motor in the anticlockwise direction of rotating magnetic field

(A) $c - a' - b - c' - a - b'$ (B) $c - a' - b - c' - a - b$

(C) $c' - b - a' - c - b' - a$ (D) $c - b' - a' - c' - b - a$

78. The mechanical power developed by a 3-phase induction motor if the total rotor I^2R losses are 200 W and the slip is 4 %

(A) 576 W (B) 625 W (C) 4800 W (D) 5000 W

79. Slot harmonics are reduced in induction motors by using

(A) fractional-pitch windings (B) fractional-slot windings

(C) integral-slot windings (D) distributed windings

80. The armature reaction in a synchronous generator supplying leading power factor load is

(A) magnetizing

(B) demagnetizing

(C) demagnetizing and cross-magnetizing

(D) magnetizing and cross-magnetizing

81. Torque angle for the synchronous machine is the angle between

(A) stator magnetic field and rotor magnetic field

(B) stator magnetic field and net magnetic field in the air gap

(C) rotor magnetic field and net magnetic field in the air gap

(D) excitation voltage and impedance voltage drop

82. The power factor angle and torque angle of a salient pole synchronous generator drawing a current of 1.0 pu from a lagging load are 45° and 15°, respectively. The direct axis and quadrature axis currents, respectively, are

(A) 0.5 pu, 0.866 pu (B) 0.866 pu, 0.5 pu

(C) 0.707 pu, 0.707 pu (D) 0.5 pu, 0.5 pu

83. The maximum reluctance power of a salient-pole synchronous motor having direct-axis reactance, 1.0 pu and quadrature-axis reactance, 0.5 pu, and input voltage, 1.0 pu is

(A) 0.25 pu (B) 0.5 pu (C) 1.0 pu (D) 1.5 pu

84. In a single-phase induction motor when the rotor is stationary and voltage is applied to the stator, then

(A) the flux is constant

(B) the flux first decreases and then increases in the same direction

(C) the flux increases and decreases in the opposite direction with the same magnitude

(D) current flows through the rotor

85. In a split-phase induction motor, the resistance/reactance ratios of windings are such that

(A) current in the auxiliary winding leads the current in the main winding

(B) current in the auxiliary winding lags the current in the main winding

(C) both windings develop the same starting torque

(D) both windings develop high starting current

86. Two synchronous generators operating in parallel supply a common load of 2.5 MW. The frequency-power characteristics have a common slope of 1 MW/Hz and the no-load frequencies of the generators are 51.5 Hz and 51.0 Hz, respectively. Then the system frequency is

(A) 50 Hz (B) 51 Hz (C) 51.25 Hz (D) 51.5 Hz

87. The speed of a 2-pole, 3-phase stepper motor operated by 1200 pulses/min

(A) 100 rpm (B) 200 rpm (C) 400 rpm (D) 800 rpm

88. If the constants, A = D = 1 + YZ/2 of a transmission line by nominal π model, then the constants B and C, respectively, are

(A) Y and $Z\left(1+\frac{YZ}{4}\right)$ (B) Z and $Y\left(1+\frac{YZ}{4}\right)$

(C) YZ and $\left(1+\frac{YZ}{4}\right)$ (D) $Y\left(1+\frac{YZ}{4}\right)$ and Z

89. In a per unit system of a transmission line

(A) the P_{base} is different from S_{base}

(B) $Z_{base} = R_{base} + j X_{base}$

(C) $Y_{base} = G_{base} - j B_{base}$

(D) angle of per unit quantity = angle of the actual quantity

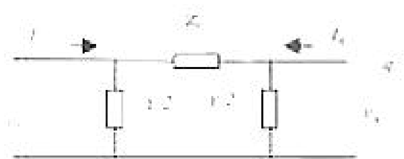
90. The insulation resistance per metre length of a single core cable of conductor radius, r, sheath inside radius, R and resistivity, ρ is

(A) $\rho \frac{1}{\pi} \ln \frac{r}{R}$ (B) $\rho \frac{1}{2\pi} \ln \frac{r}{R}$ (C) $\rho \frac{1}{\pi} \ln \frac{R}{r}$ (D) $\rho \frac{1}{2\pi} \ln \frac{R}{r}$

91. A single core lead sheathed cable with two dielectrics of permittivity 4 and 3, respectively, are subjected to same maximum stress. If the conductor diameter is 1.5 cm, the outer diameter of the first dielectric is

(A) 1.125 cm (B) 1.5 cm (C) 2 cm (D) 8 cm

92. The Y_{bus} representation of the line between the nodes p and q shown in figure is



(A) $\begin{bmatrix} \frac{Y}{2} & -\frac{1}{Z_s} \\ \frac{1}{Z_s} & \frac{Y}{2} \end{bmatrix}$ (B) $\begin{bmatrix} \frac{1}{Z_s} & \frac{Y}{2} \\ \frac{Y}{2} & \frac{1}{Z} \end{bmatrix}$

(C) $\begin{bmatrix} \frac{1}{Z_s}+\frac{Y}{2} & \frac{1}{Z_s} \\ \frac{1}{Z} & \frac{1}{Z_s}+\frac{Y}{2} \end{bmatrix}$ (D) $\begin{bmatrix} \frac{1}{Z_s}+\frac{Y}{2} & -\frac{1}{Z_s} \\ -\frac{1}{Z} & \frac{1}{Z_s}+\frac{Y}{2} \end{bmatrix}$

93. In a large power system for n x n matrix, the sparsity is defined as

(A) $\frac{\text{Total number of zero elements}}{n} \times 100$

(B) $\frac{\text{Total number of elements}}{n^2} \times 100$

(C) $\frac{\text{Total number of nonzero elements}}{n^2} \times 100$

(D) $\frac{\text{Total number of zero elements}}{n^2} \times 100$

94. The Jacobian for the following set of power flow equations, where $X = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$

$$f_1(X) = 1.0 - 100x_2 + 200x_1^2 - 100x_2x_1$$
$$f_2(X) = 0.5 - 100x_1 - 100x_1x_2 + 200x_2^2$$

(A) $100\begin{bmatrix} -1+4x_2-x_1 & -x_1 \\ -x_2 & -1-x_1+4x_2 \end{bmatrix}$

(B) $\begin{bmatrix} 400 & 0 \\ -100 & 400 \end{bmatrix}$

(C) $\begin{bmatrix} 1.0 & 100x_2 \\ 0.5 & -100x_1 \end{bmatrix}$

(D) $100\begin{bmatrix} -1+4x_1-x_2 & -x_2 \\ -x_1 & -1-x_2+4x_1 \end{bmatrix}$

95. If non-linear loads are connected to the power system, then

(A) displacement power factor is same as the total power factor

(B) displacement power factor is not equal to the total power factor

(C) displacement power factor is due to harmonic currents

(D) total power factor is due to fundamental component of current

96. The benefit of power factor correction in a power system is

(A) lower power consumption

(B) increased demand charge

(C) reduced load carrying capabilities in existing lines

(D) reduced voltage profile

97. The power flow problem mathematical model for a linear transmission network

(A) is non-linear

(B) is linear

(C) considers time variation of generation

(D) does not consider tap-changing transformers

98. The sequence components of current of a single-phase load connected to a 3-phase system are
(A) equal positive and negative sequence components
(B) equal positive, negative and zero sequence components
(C) vector sum of sequence currents is zero
(D) algebraic sum of sequence currents is zero

99. The phase voltages of an unbalanced system are expressed as zero, positive and negative sequence voltages, V_0, V_1, V_2, respectively, as

$$\begin{bmatrix} V_a \\ V_b \\ V_c \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & [\text{- -}] & \\ 1 & [\text{- -}] & \end{bmatrix} \begin{bmatrix} V_0 \\ V_1 \\ V_2 \end{bmatrix}$$

If $a = 1\angle 120^\circ$, then the missing sub-matrix is

(A) $\begin{bmatrix} a & a^2 \\ a^2 & a \end{bmatrix}$ (B) $\begin{bmatrix} a & -a^2 \\ -a^2 & a \end{bmatrix}$ (C) $\begin{bmatrix} a^2 & a \\ a & a^2 \end{bmatrix}$ (D) $\begin{bmatrix} a^2 & -a \\ -a & a^2 \end{bmatrix}$

100. In a 3-phase balanced neutral grounded star-connected load, phase b is open. If $I_a = 10\angle 0$ and $I_c = 10\angle 120^\circ$ then
(A) Zero sequence current = neutral current
(B) Zero sequence current = 1/3 neutral current
(C) Zero sequence current = 3 × neutral current
(D) Positive sequence current = negative sequence current

101. The value of capacitor used for power factor improvement in a feeder with V volts at 50 Hz and capacitor current I_c is

(A) $100\pi I_c V$ (B) $\dfrac{100\pi V}{I_c}$ (C) $\dfrac{100\pi V}{I}$ (D) $\dfrac{I_c}{100\pi V}$

102. A double-line-to-ground fault from phase b to phase c occurs through the fault impedance, Z_F to ground. The fault conditions are

(A) $I_b = I_c = 0,\ V_a = Z_F I_a$
(B) $I_a = 0,\ I_b = -I_c,\ V_b + V_c = Z_F I_b$
(C) $I_a = 0, V_b = V_c = Z_F (I_b + I_c)$
(D) $I_a = 0,\ I_b = -I_c,\ V_b - V_c = Z_F I_b$

103. A solid state relay
(A) withstands voltage transients
(B) does not require auxiliary dc supply
(C) provide low burden on CT and P
(D) does not provide earth fault protection

104. In the induction type directional over current relay, when a short-circuit occurs in the circuit
(A) power flows in reverse direction
(B) power flows in normal direction
(C) directional power element does not operate
(D) over current element is not energized

105. In a differential protection scheme of a generator winding with a fault, the secondary currents of CTs are I_{s1} = 2.2 + j 0 A and I_{s2} = 1.8 + j 0 A. The % bias setting, K of the relay is

(A) 5 % (B) 10 % (C) 20 % (D) 40 %

106. In voltage source converter based HVDC transmission system the active power is controlled by changing

(A) phase angle of the converter ac input voltage
(B) supply frequency of the converter ac input voltage
(C) magnitude of the converter ac input voltage
(D) DC voltage at the inverter terminals

107. A Unified Power Flow Controller (FACTS controller) is a voltage source converter based

(A) Inter-phase power controller
(B) Static Compensator
(C) Combination of series and shunt compensators
(D) Solid-state series compensator

108. An SCR without any external connections is considered as

(A) two diodes in series (B) three diodes in series
(C) two n-p-n transistors in series (D) two p-n-p transistors in series

109. The device which allows reverse power flow and withstands highest switch frequency is

(A) GTO (B) MOSFET
(C) IGBT (D) Inverter grade SCR

110. In a 230 V, 50 Hz single-phase SCR bridge converter operating at a firing delay angle, α and with large R-L load, the input source current is

(A) sinusoidal current (B) constant dc current
(C) continuous rectangular pulses (D) alternating rectangular pulses

111. In a bi-phase half-wave SCR converter at a firing delay angle, α and considering the voltage drop, V_d across each SCR, the average load voltage is

(A) $\frac{2\sqrt{2}V_s}{\pi}\cos\alpha - v_d$ (B) $2(\frac{\sqrt{2}V_s}{\pi}\cos\alpha - v_d)$

(C) $\frac{2V_s}{\pi}\cos\alpha - v_d$ (D) $(\frac{2\sqrt{2}V_s}{\pi} - v_d)\cos\alpha$

112. In a half-controlled 3-phase SCR bridge converter, the average voltage across R-L load at a firing delay angle, α is

(A) $\frac{3\sqrt{3}V_{line-max}}{2\pi}\cos\alpha$ (B) $\frac{3V_{line-max}}{2\pi}\cos\alpha$

(C) $\frac{3\sqrt{3}V_{line-max}}{\pi}(1+\cos\alpha)$ (D) $\frac{3V_{line-max}}{2\pi}(1-\cos\alpha)$

113. In a dc-dc step-down converter, the minimum inductance required for continuous current operation, if D, f, and R are duty ratio, switching frequency and load resistance, respectively, then

(A) $\frac{(1-D)R}{2f}$ (B) $\frac{(1-D)R}{f}$ (C) $\frac{DR}{2f}$ (D) $\frac{1}{R} - \frac{(1-D)}{2f}$

114. If D is the duty ratio of a dc-dc step-up converter, the relation between the input and out currents is

(A) $I_{in} = D I_{out}$ (B) $I_{in} = \frac{1}{D} I_{out}$

(C) $I_{in} = \frac{1}{(1-D)} I_{out}$ (D) $I_{in} = (1-D) I_{out}$

115. A 230 V, 50 Hz phase controlled single-phase full-controlled SCR bridge converter draws 15 A constant dc current. If the source inductance is 3 mH, the drop in dc output voltage is

(A) 4.5 V (B) 6.75 V (C) 9 V (D) 13.5 V

116. The direction of rotation of an inverter fed 3-phase ac motor is reversed by

(A) a mechanical reversing switch (B) reversing the input dc link voltage
(C) operating the inverter as a rectifier (D) changing the sequence of switching

117. The no-load speed of a single-phase SCR bridge converter fed separately excited dc motor operating at a firing delay angle, α and flux, Φ

(A) directly proportional to α and Φ
(B) inversely proportional to α and Φ
(C) directly proportional to α and inversely proportional to Φ
(D) directly proportional to Φ and inversely proportional to α

118. The PWM pulses for the gate control circuit of an IGBT inverter fed 3-phase induction motor drive are generated by using a triangular wave of frequency, f_c and

(A) a modulating wave of frequency, f_m
(B) a constant dc signal
(C) an alternating rectangular wave of frequency, f_t
(D) an alternating trapezoidal wave of frequency, f_t

119. In electric traction for a trapezoidal speed-time curve, the time period is

(A) free running speed period = constant speed period
(B) free running period = coasting period
(C) free running period + coasting period = constant speed period
(D) average speed period = scheduled speed period

120. Specific energy consumption of an electric train is the ratio between

(A) Specific energy output at driving wheels and efficiency of the traction motor
(B) Specific energy output at driving wheels and efficiency of the transmission gear
(C) Specific energy output of driving motor and efficiency of the driving wheels
(D) Specific energy output at driving wheels and efficiency of the (motor + transmission gear)

SPACE FOR ROUGH WORK

A
SET

Booklet No. :

EE - 16

Electrical Engineering

Duration of Test : 2 Hours

Max. Marks : 120

Hall Ticket No.

Name of the Candidate : ____________________

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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.
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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.
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9. No part of the Booklet should be detached under any circumstances.
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ELECTRICAL ENGINEERING (EE)

1. The value of k for which the matrix $\begin{bmatrix} 1 & 1 & k \\ 1 & 2 & 3 \\ 0 & 1 & 1 \end{bmatrix}$ is of rank 2 is

(A) 0 (B) 1 (C) 2 (D) 3

2. If λ is an eigen value of A, then the eigen value of adjoint of A is

(A) λ (B) $\frac{1}{\lambda}$ (C) $\frac{|A|}{\lambda}$ (D) 0

3. The function $f = x^2 + y^2 + 2(\frac{1}{x} + \frac{1}{y})$ has minimum at the point

(A) (1,–1) (B) (1,0) (C) (0,0) (D) (1,1)

4. If $u = x(1-y)$, $v = xy$, then $\frac{\partial(u,v)}{\partial(x,y)} =$

(A) x (B) y (C) $1-x$ (D) $1-y$

5. The real and imaginary parts of a complex analytic function are

(A) both non-zero (B) periodic

(C) orthogonal (D) either of them is zero

6. If the probability density of a random variable is $\frac{1}{\alpha}e^{-\frac{x}{\alpha}}$, then the variance of it is

(A) $\frac{1}{\alpha}$ (B) $\frac{1}{\alpha^2}$ (C) $\frac{2}{\alpha^2}$ (D) $\frac{2}{\alpha}$

7. If r_{xy} and r_{yx} are the regression coefficients of y on x and x on y then the coefficient of correlation is

(A) $r_{xy} r_{yx}$ (B) $(r_{xy} r_{yx})^{1/2}$ (C) $\frac{r_{xy}}{r_{yx}}$ (D) $r_{xy} + r_{yx}$

8. $\frac{x\,dy - y\,dx}{x^2 - y^2} =$

(A) $\frac{1}{2}\log\frac{x+y}{x-y}$ (B) $\log(x^2 - y^2)$

(C) $\tan^{-1}(x^2 - y^2)$ (D) $x^2 - y^2$

9. The differential equation whose auxiliary equation has roots 0, –2, –1 is

(A) $\frac{d^3y}{dx^3} + 3y = f(x)$ (B) $\frac{d^2y}{dx^2} + 3\frac{dy}{dx} + 2y = f(x)$

(C) $\frac{d^3y}{dx^3} + 3\frac{d^2y}{dx^2} + 2\frac{dy}{dx} = f(x)$ (D) $\frac{dy}{dx} + 3y = 0$

10. The condition for convergence of the Newton-Raphson method to find a root of $f(x) = 0$ is

(A) $|ff''| < |f'|^2$ (B) $|ff''| < 1$

(C) $|ff''| > 0$ (D) Always converges

11. At very high temperatures, extrinsic semiconductor becomes intrinsic semiconductor because

(A) Of drive in diffusion of dopants & carriers.

(B) Band to band transition dominates impurity ionization.

(C) Impurity ionization dominates band to band transition.

(D) Band to band transition is balanced by impurity ionisation.

12. If a bias voltage of V_t (in Volts) is applied to a forward biased silicon P-N junction diode with a non ideality coefficient of 2, the diode current (in Amps) shall be

(A) I_0 (B) $(\sqrt{e}-1)I_0$ (C) $\sqrt{e}I_0$ (D) $(e-1)I$

13. The threshold voltage of an n- channel enhancement mode MOSFET is 0.5V when the device is biased at a gate voltage of 3V. Pinch off would be occurs at a drain voltage of

(A) 1.5V (B) 2.5V (C) 3.5V (D) 4.5V

14. The drain current of a MOSFET is constant, given $I_D = K(V_{GS} - V_T)^2$, where K is a constant. The magnitude of the trans conductance g_m is

(A) $\frac{2(V_{GS}-V_T)^2}{V_{DS}}$ (B) $2K(V_{GS} - V_T)$

(C) $\frac{I_D}{V_{GS}-V_{DS}}$ (D) $\frac{2(V_{GS}-V_T)^2}{V_{GS}}$

15. Find the values of x and y in the following equation

$\sqrt{4425_x + 1750_y} = (40)_x - (25)_y$

(A) 5,8 (B) 6,9 (C) 6,8 (D) 7,8

16. If CS = $A_{15}A_{14}A_{13}A_{12}$ (and its value is 0111) is used as the chip select logic of A 4K RAM in an 8085 system then its memory range will be

(A) 3000H - 3FFFH (B) 7000H -7FFFFH

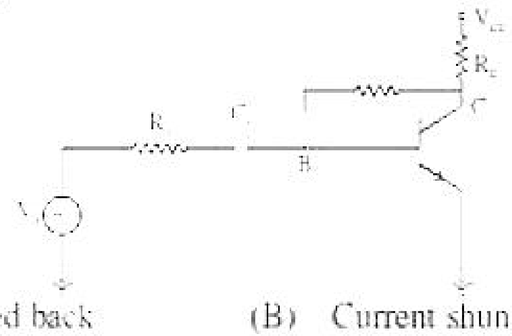
(C) 5000H - 5FFFH& 6000H -6FFFH (D) 6000H - 6FFFH & 7000H -7FFFH

17. Which of the following instructions is not available in 8085 microprocessor?

(A) LDA 3850 (B) XTHL

(C) push PSW (D) LDAXH

18. Identify the feedback in the below circuit as shown with unknown feedback resistor from collector to base of BJT.



(A) Current series feed back (B) Current shunt feed back

(C) Voltage series feedback (D) Voltage shunt feed back

19. Assertion (A) : Wein bridge oscillator is generally used as a variable audio frequency oscillator

Reason (R) : by using either capacitor (or) resistor in one of the arms of the bridge, the frequency of a wein bridge oscillator can be varied

(A) Both (A) & (R) are true & (R) is correct explanation of (A)
(B) Both (A) & (R) are true but (R) is not the correct explanation of (R).
(C) (A) is true but (R) is false
(D) (A) is false but (R) is true

20. For an input of V_s = 5sinωt,(assuming ideal diode), circuit shown in the figure will becomes as a

(A) Clipper, sine wave clipped at –2V
(B) Clamper, sine wave clamped at –2V
(C) Clamper, sine wave clamped at zero volt
(D) Clipper, sine wave clipped at 2V.

21. The internal resistances of an ideal current source, and an ideal voltage source are, respectively,

(A) 0, ∞ (B) ∞, ∞ (C) ∞, 0 (D) 0, 0

22. The equation $i(0+) = i(0-) = some\ finite\ value$, where the notations and symbols have usual meanings (as adopted in transient response analysis of circuits) holds good in the case of

(A) a previously unenergized series RL circuit to which a DC voltage source is suddenly applied at $t = 0$.
(B) a previously energized series RL circuit to which a DC voltage source is suddenly applied at $t = 0$.
(C) a previously unenergized series RC circuit to which a DC voltage source is suddenly applied at $t = 0$.
(D) a previously energized series RC circuit to which a DC voltage source is suddenly applied at $t = 0$.

23. The Thevenin equivalent circuit of a network consists of an ideal Thevenin voltage source of DC voltage V_{Th} and Thevenin resistance R_{Th}. A load resistance R_L is connected to the terminals of the Thevenin equivalent circuit. Maximum power that can be transferred to the load is

(A) $V_{Th}^2 / (R_{Th} + R_L)^2$ (B) $V_{Th}^2 / 2R_L$

(C) $V_{Th}^2 / 4R_{Th}$ (D) $V_{Th}^2 / 4(R_{Th} + R_L)$

24. A series R-C circuit has constant value of R and varying value of C. The current locus with constant applied voltage V at constant frequency, as C is varied, is a semi circle with centre at

(A) $\left(\frac{V}{R}, 0\right)$ (B) $\left(\frac{V}{2R}, 0\right)$ (C) $\left(\frac{V}{1R}, 0\right)$ (D) $\left(\frac{V}{2X_C}, 0\right)$

25. The current through a linear time-invariant inductor with inductance $L = 10^{-3}$ is given by $i_L = 0.1 \sin 10^6 t$. The voltage across the inductor is

(A) $100 \cos(10^6 t)$ (B) $100 \sin(10^6 t)$
(C) $10^{-4} \cos(10^6 t)$ (D) $10^{-4} \sin(10^6 t)$

26. Which of the following are known as the short circuit parameters of a 2- port network?

(A) Z- parameters. (B) H- parameters.
(C) Y- parameters. (D) A.B.C.D. parameters.

27. The line current in a balanced delta system is 30 A. The load current is

(A) $30\sqrt{3}$ A (B) $30/\sqrt{3}$ A (C) 10 A (D) $30/\sqrt{2}$ A

28. Possible maximum value of mutual inductance between two coils of self inductances. L_1 and L_2 is

(A) $2L_1 + 2L_2$ (B) $L_1 + L_2$ (C) $(L_1L_2)^2$ (D) $(L_1L_2)^{\frac{1}{2}}$

29. The resistance required for critical damping in a series RLC circuit is

(A) $R = 2\sqrt{\frac{L}{C}}$ (B) $R = \sqrt{\frac{L}{C}}$ (C) $R = \frac{1}{2}\sqrt{\frac{L}{C}}$ (D) $R = 2\sqrt{LC}$

30. The impedance of a series resonant circuit, at half power frequencies, is

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

31. Two +ve charges, Q coulomb each, are placed at points (0,0,0), and (4,4,0), while two –ve charges, Q coulomb each in magnitude, are placed at points (0,4,0), and (4,0,0). The electric field intensity at the point (2,2,0) is

(A) $\frac{Q}{\pi\epsilon_0\epsilon_r}$ (B) $\frac{Q}{4\pi\epsilon_0\epsilon_r}$ (C) $\frac{4Q}{\pi\epsilon_0\epsilon_r}$ (D) zero

32. The magnetic field intensity at the centre of a current carrying coil of diameter d m is H. The current flowing in the coil is

(A) dH (B) $\frac{1}{2}dH$ (C) $2dH$ (D) πdH

33. Two infinite plane sheets of charge with densities of $-\sigma$ and $-\sigma$ C/m^2 are placed parallel to each other with a separating distance of d metres. The value of electric field intensity at a point exactly midway between the plane sheets is

(A) σ/ε_0 (B) $\sigma/2\varepsilon_0$ (C) $2\sigma/\varepsilon_0$ (D) zero

34. Which of the following statements is not characteristic of a static magnetic field?

(A) It is solenoidal. (B) It is conservative.
(C) It has no sinks or sources. (D) Flux lines are always closed.

35. The polarization of a dielectric material is given by

(A) $P = \epsilon_0\epsilon_r E$ (B) $(\epsilon_0\epsilon_r - 1)E$
(C) $\epsilon_0 E(\epsilon_r - 1)$ (D) $(\epsilon_r - 1)\epsilon_0$

36. Integration of step signal gives
(A) Impulse signal. (B) Ramp function.
(C) Parabola. (D) Square pulse.

37. The period of the function $Cos\ \frac{\pi}{10}\ (t-3)$ is
(A) 20 (B) 10 (C) 30 (D) 3.3

38. If $f(t) = -f(-t)$, and $f(t)$ satisfies Dirichlet's conditions, then $f(t)$can be expanded in a Fourier series containing
(A) Only Sine terms. (B) Only Cosine terms.
(C) Cosine terms, and a constant term. (D) Sine terms, and a constant term.

39. Minimum sampling rate required to avoid aliasing when the signal $10\ Cos\ 400\ \pi t$ is sampled is
(A) 4000 (B) 40 (C) 200 (D) 400

40. The Fourier transform of $f(t)$ is $F(\omega)$. Then, the Fourier transform of $f(at)$, where a is a constant, is given by
(A) $\frac{1}{a}F\left(\frac{\omega}{a}\right)$ (B) $aF(\omega)$ (C) $\frac{F(\omega)}{a}$ (D) $\frac{1}{a}F(a\omega)$

41. Laplace transform of $Cos\ t$ is
(A) $\frac{s}{(s^2-1)}$ (B) $\frac{s}{(s-1)}$ (C) $\frac{s}{(s+1)}$ (D) $\frac{s}{(s^2+1)}$

42. The z-transform of $\sum_{k=0}^{\infty} \delta(n-k)$is
(A) $\frac{z}{z-1}$ (B) $\frac{z^2}{z-1}$ (C) $\frac{z}{(z-1)^2}$ (D) $\frac{z-1}{z}$

43. The continuous time signal $\sin 25\ \pi t + \sin 80\ \pi t$ requires a Nyquist rate of
(A) 50 (B) 25 (C) 105 (D) 80

44. The Fourier transform of a function $f(t)$ is defined as
(A) $\int_0^{\infty} f(t)e^{-j\omega t}dt$ (B) $\int_{-\infty}^{\infty} f(t)e^{j\omega t}dt$
(C) $\int_0^{\infty} f(t)e^{j\omega t}dt$ (D) $\int_{-\infty}^{\infty} f(t)e^{-j\omega t}dt$

45. GATE function is defined by $G_T(t) = 1\ for\ -\frac{T}{2} \le t \le \frac{T}{2};\ and\ 0\ elsewhere.$ Its Fourier Transform is given by
(A) $\frac{2}{\omega}sin(\omega T)$ (B) $\frac{2}{\omega}sin\left(\frac{T}{2}\right)$ (C) $\frac{2}{\omega}sin\left(\frac{\omega T}{2}\right)$ (D) $\frac{\omega}{2}sin\left(\frac{\omega T}{2}\right)$

46. Consider the following systems :
(i) a normal human being walking on the road, and
(ii) servomechanism.
Systems (i) and (ii) are, respectively,
(A) Open loop control system, Open loop control system.
(B) Closed loop control system, Closed loop control system.
(C) Open loop control system, Closed loop control system.
(D) Closed loop control system, Open loop control system.

47. The transfer function of a system is $\frac{10}{s(s+1)(s^2+3s+2)}$. The steady state errors exhibited by the system, to (i) step, (ii) ramp, and (iii) parabolic input are, respectively,
(A) Zero, finite, infinite. (B) Zero, Zero, finite.
(C) Zero, Zero, Zero. (D) Finite, infinite, infinite.

48. System 1 : The first column of the RH array consists of the terms 6,3,9,-2, and 4.
System 2 : The first column of the RH array consists of the terms 3,6,9,2, and -4.
The number of unstable poles for system1, and system 2, are respectively.
(A) 1,1 (B) none, none (C) 2,2 (D) 2,1

49. A second order system shows 100% overshoot in its unit step response. It can be categorized as
(A) underdamped system. (B) overdamped system.
(C) Critically damped system. (D) undamped system.

50. A unity negative feedback control system is found to have a gain margin of 20 dB. The Nyquist plot of the system
(A) crosses the real axis at +0.1 (B) crosses the real axis at -0.1
(C) crosses the imaginary axis at -0.1 (D) crosses the imaginary axis at −0.1

51. A certain control system has the open loop transfer function given by $\frac{K(s+3)(s+5)}{s(s+7)(s+9)}$. Which portions of the real axis, among the ones given below, are parts of the root locus?
(A) the portions between -9 and $-\infty$, -5 and -7; 0 and -3.
(B) the portions between -3 and -5; -7 and -9; 0 and $-\infty$.
(C) the portions between -3 and -5; -7 and -9.
(D) the portions between +9 and ∞; +5 and +7; 0 and −3.

52. The open loop transfer function of a unity negative feedback control system is $\frac{10}{s^2(7s+1)}$
The TYPE number and order of the closed loop system are, respectively
(A) 2,1 (B) 1,2 (C) 3,0 (D) 0,3

53. The transfer function of a system is given by $\frac{1}{(1+T_1 s)(1+T_2 s)}$. A controller of the form $\frac{K(1+T_3 s)}{(1+T_4 s)}$ is used to improve the performance of the system when operated in closed loop with unity feedback. The rise time in the unit step response can be reduced by choosing
(A) $T_3 = T_1$ (B) $T_3 = T_4$ (C) $T_3 < T_4$ (D) $T_3 > T_4$

54. In the state variable representation of systems, let A denote the system characteristic matrix, and let $\emptyset(t)$ denote the state transition matrix. Then, which of the following is not a property of the state transition matrix?
(A) $\emptyset(t_2 - t_1)\emptyset(t_1 - t_0) = \emptyset(t_2 - t_0)$ (B) $\emptyset(t_1 + t_2) = \emptyset(t_2)\emptyset(t_1)$
(C) $\emptyset^{-1}(t) = \emptyset(-t)$ (D) $\emptyset(0) = A$

55. The state equation of a system is given by $\dot{X} = AX + bu$, where $A = \begin{bmatrix} -2 & 4 \\ 2 & -1 \end{bmatrix}$ and $b = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$. The system is
(A) Controllable, stable. (B) Uncontrollable, unstable.
(C) Uncontrollable, stable. (D) Controllable, unstable.

56. Observability of a system is essential for
(A) finding a solution to the state equation.
(B) finding a suitable model in state space.
(C) transferring the state of the system from any initial value to any specified final value.
(D) state estimation.

57. Time constant of a first order system is defined as the time taken to reach $x\%$ of the final steady state value in the step response. The value of x is

(A) 100 (B) 36.2 (C) 63.2 (D) 90

58. In Torque-Voltage analogy, the Moment of Inertia of a mechanical rotational system is analogous to

(A) Capacitance C. (B) Inductance L.
(C) Resistance R. (D) Inductive reactance X_L

59. The bridge most suited for accurate measurement of relative permittivity of dielectric materials is

(A) Carey Foster Bridge
(B) Anderson's bridge
(C) Heaviside Bridge modified by Campbell
(D) Schering Bridge.

60. The operation of a ramp type Digital Voltmeter is based on the principle of

(A) Voltage-to-current conversion.
(B) Voltage-to-time conversion.
(C) Current-to-time conversion.
(D) Current-to-frequency conversion.

61. The vertical deflection of an electron beam on the screen of a CRO is measured to be 8 mm. Now, the potential difference between the Y-plates is doubled, and simultaneously the pre-accelerating anode voltage is reduced to half of its previous value. Then, the vertical deflection of the beam on the screen would become

(A) 64 mm (B) 32 mm (C) 8 mm (D) 4 mm

62. Gross errors occur in measurements because of

(A) disturbances about which we are unaware.
(B) human mistakes.
(C) inherent shortcomings in the instrument.
(D) loading effects on the meters.

63. An induction type energy meter is found to run fast. Correction for this error can be made by

(A) Over-load compensation
(B) Voltage compensation.
(C) Moving the brake magnet away from the centre of the disc.
(D) Moving the brake magnet towards the centre of the disc.

64. Standardization of potentiometers is done so that

(A) They become accurate and direct-reading.
(B) They become accurate and precise.
(C) They become accurate and take zero current when null condition is reached.
(D) Power consumption is reduced during operation.

65. The meter which does not have any component in it to provide control torque is

(A) Electrodynamometer for current measurement
(B) Electrodynamometer for voltage measurement
(C) Electrodynamometer for power measurement.
(D) Electrodynamometer for power factor measurement.

66. In a single-phase transformer, the magnetizing current is
(A) in phase with the no-load current
(B) in quadrature with the no-load current
(C) the product of no-load current and power factor
(D) in phase with the flux in the core

67. A 230 V/460 V single-phase transformer operating at 20 A and unity power factor has primary referred resistance of 0.2 Ω and reactance of 0.5 Ω. The approximate primary induced emf is
(A) 216 V (B) 226 V (C) 234 V (D) 236 V

68. A transformer at 25 Hz develops 20 W hysteresis loss and 50 W eddy current loss. If the applied voltage and frequency are doubled, the new core losses are
(A) 140 W (B) 180 W (C) 240 W (D) 480 W

69. A 3-phase transformer possible 3-phase connection by a combination of star (Y or y) and delta (D or d) with 30° lead phase displacement corresponding to watch clock-face hour is
(A) Dy0 (B) Dy1 (C) Yd1 (D) Dy11

70. Two transformers of voltage ratio 1 kV/500 V, with impedances z_1 = j0.04 Ω and z_2 = j0.06 Ω, respectively, connected in parallel share a total load of 200 kVA. The kVA carried by each transformer is
(A) $S_1 = 40$, $S_2 = 160$ (B) $S_1 = 80$, $S_2 = 120$
(C) $S_1 = 120$, $S_2 = 80$ (D) $S_1 = 160$, $S_2 = 40$

71. A two winding transformer is connected as an auto-transformer with the same voltage ratio of 2:1. If primary and secondary winding resistances of auto-transformer are 0.03 Ω and 0.02 Ω, respectively, the primary equivalent resistance of auto-transformer is
(A) 0.035 Ω (B) 0.05 Ω (C) 0.11 Ω (D) 0.14 Ω

72. In a duplex lap winding, if y_b and y_f are back-pitch and front-pitch, respectively, then
(A) $y_b = y_f \pm 2$ (B) $y_b = 2y_f$ (C) $y_f = 2y_b$ (D) $y_b = y_f \pm 4$

73. In a 4-pole wave winding connected dc motor, the cross-magnetizing AT/pole for a brush shift of θ radians
(A) Armature amp-conductors × (θ/360°)
(B) Armature amp-turns × (θ/360°)
(C) Armature amp-conductors × (1/4 - θ/360°)
(D) Armature amp-conductors × (1/8 - θ/360°)

74. The magnetic neutral plane shifts in a dc machine
(A) in the direction of motion of motor
(B) in the direction of motion of generator
(C) due to increase in the field flux
(D) cause reduction of flash over between commutator segments

75. The terminal characteristics of a dc generator suitable for electric welders is
(A) separately excited generator (B) shunt generator
(C) series generator (D) differentially compounded generator

76. A 220 V separately excited motor with $R_a = 0.5\ \Omega$ running at 500 rpm draws a current of 20 A. The value of additional resistance in armature circuit to reduce the speed to 300 rpm at constant flux is

(A) 4.0 Ω (B) 4.2 Ω (C) 4.4 Ω (D) 7.67 Ω

77. The layout pattern of 3-phase double-layer stator winding in an induction motor in the anticlockwise direction of rotating magnetic field

(A) $c - a' - b - c' - a - b'$ (B) $c - a' - b - c' - a - b$

(C) $c' - b - a' - c - b' - a$ (D) $c - b - a' - c' - b - a$

78. The mechanical power developed by a 3-phase induction motor if the total rotor I^2R losses are 200 W and the slip is 4 %

(A) 576 W (B) 625 W (C) 4800 W (D) 5000 W

79. Slot harmonics are reduced in induction motors by using

(A) fractional-pitch windings (B) fractional-slot windings

(C) integral-slot windings (D) distributed windings

80. The armature reaction in a synchronous generator supplying leading power factor load is

(A) magnetizing

(B) demagnetizing

(C) demagnetizing and cross-magnetizing

(D) magnetizing and cross-magnetizing

81. Torque angle for the synchronous machine is the angle between

(A) stator magnetic field and rotor magnetic field

(B) stator magnetic field and net magnetic field in the air gap

(C) rotor magnetic field and net magnetic field in the air gap

(D) excitation voltage and impedance voltage drop

82. The power factor angle and torque angle of a salient pole synchronous generator drawing a current of 1.0 pu from a lagging load are 45° and 15°, respectively. The direct axis and quadrature axis currents, respectively, are

(A) 0.5 pu, 0.866 pu (B) 0.866 pu, 0.5 pu

(C) 0.707 pu, 0.707 pu (D) 0.5 pu, 0.5 pu

83. The maximum reluctance power of a salient-pole synchronous motor having direct-axis reactance, 1.0 pu and quadrature-axis reactance, 0.5 pu, and input voltage, 1.0 pu is

(A) 0.25 pu (B) 0.5 pu (C) 1.0 pu (D) 1.5 pu

84. In a single-phase induction motor when the rotor is stationary and voltage is applied to the stator, then

(A) the flux is constant

(B) the flux first decreases and then increases in the same direction

(C) the flux increases and decreases in the opposite direction with the same magnitude

(D) current flows through the rotor

85. In a split-phase induction motor, the resistance/reactance ratios of windings are such that

(A) current in the auxiliary winding leads the current in the main winding

(B) current in the auxiliary winding lags the current in the main winding

(C) both windings develop the same starting torque

(D) both windings develop high starting current

86. Two synchronous generators operating in parallel supply a common load of 2.5 MW. The frequency-power characteristics have a common slope of 1 MW/Hz and the no-load frequencies of the generators are 51.5 Hz and 51.0 Hz, respectively. Then the system frequency is

(A) 50 Hz (B) 51 Hz (C) 51.25 Hz (D) 51.5 Hz

87. The speed of a 2-pole, 3-phase stepper motor operated by 1200 pulses/min

(A) 100 rpm (B) 200 rpm (C) 400 rpm (D) 800 rpm

88. If the constants, A = D = 1 + YZ/2 of a transmission line by nominal π model, then the constants B and C, respectively, are

(A) Y and $Z\left(1+\frac{YZ}{4}\right)$ (B) Z and $Y\left(1+\frac{YZ}{4}\right)$

(C) YZ and $\left(1+\frac{YZ}{4}\right)$ (D) $Y\left(1+\frac{YZ}{4}\right)$ and Z

89. In a per unit system of a transmission line

(A) the P_{base} is different from S_{base}

(B) $Z_{base} = R_{base} + j\,X_{base}$

(C) $Y_{base} = G_{base} - j\,B_{base}$

(D) angle of per unit quantity = angle of the actual quantity

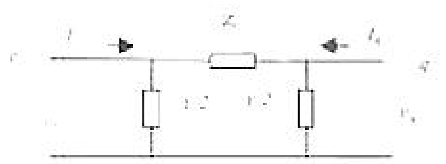
90. The insulation resistance per metre length of a single core cable of conductor radius, r, sheath inside radius, R and resistivity, ρ is

(A) $\rho\frac{1}{\pi}\ln\frac{r}{R}$ (B) $\rho\frac{1}{2\pi}\ln\frac{r}{R}$ (C) $\rho\frac{1}{\pi}\ln\frac{R}{r}$ (D) $\rho\frac{1}{2\pi}\ln\frac{R}{r}$

91. A single core lead sheathed cable with two dielectrics of permittivity 4 and 3, respectively, are subjected to same maximum stress. If the conductor diameter is 1.5 cm, the outer diameter of the first dielectric is

(A) 1.125 cm (B) 1.5 cm (C) 2 cm (D) 8 cm

92. The Y_{bus} representation of the line between the nodes p and q shown in figure is



(A) $\begin{bmatrix} \frac{Y}{2} & -\frac{1}{Z_s} \\ -\frac{1}{Z_s} & \frac{Y}{2} \end{bmatrix}$ (B) $\begin{bmatrix} \frac{1}{Z_s} & \frac{Y}{2} \\ \frac{Y}{2} & \frac{1}{Z} \end{bmatrix}$

(C) $\begin{bmatrix} \frac{1}{Z_s}+\frac{Y}{2} & \frac{1}{Z_s} \\ \frac{1}{Z_s} & \frac{1}{Z_s}+\frac{Y}{2} \end{bmatrix}$ (D) $\begin{bmatrix} \frac{1}{Z_s}+\frac{Y}{2} & -\frac{1}{Z_s} \\ -\frac{1}{Z_s} & \frac{1}{Z_s}+\frac{Y}{2} \end{bmatrix}$

93. In a large power system for n x n matrix, the sparsity is defined as

(A) $\frac{\text{Total number of zero elements}}{n} \times 100$

(B) $\frac{\text{Total number of elements}}{n^2} \times 100$

(C) $\frac{\text{Total number of nonzero elements}}{n^2} \times 100$

(D) $\frac{\text{Total number of zero elements}}{n^2} \times 100$

94. The Jacobian for the following set of power flow equations, where $X = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$

$$f_1(X) = 1.0 - 100x_1 + 200x_1^2 - 100x_2x_1$$
$$f_2(X) = 0.5 - 100x_2 - 100x_1x_2 + 200x_2^2$$

(A) $100\begin{bmatrix} -1+4x_1-x_2 & -x_1 \\ -x_2 & -1-x_1+4x_2 \end{bmatrix}$

(B) $\begin{bmatrix} 400 & 0 \\ -100 & 400 \end{bmatrix}$

(C) $\begin{bmatrix} 1.0 & 100x_2 \\ 0.5 & -100x_1 \end{bmatrix}$

(D) $100\begin{bmatrix} -1+4x_1-x_1 & -x_2 \\ -x_1 & -1-x_2+4x_1 \end{bmatrix}$

95. If non-linear loads are connected to the power system, then
(A) displacement power factor is same as the total power factor
(B) displacement power factor is not equal to the total power factor
(C) displacement power factor is due to harmonic currents
(D) total power factor is due to fundamental component of current

96. The benefit of power factor correction in a power system is
(A) lower power consumption
(B) increased demand charge
(C) reduced load carrying capabilities in existing lines
(D) reduced voltage profile

97. The power flow problem mathematical model for a linear transmission network
(A) is non-linear
(B) is linear
(C) considers time variation of generation
(D) does not consider tap-changing transformers

98. The sequence components of current of a single-phase load connected to a 3-phase system are
(A) equal positive and negative sequence components
(B) equal positive, negative and zero sequence components
(C) vector sum of sequence currents is zero
(D) algebraic sum of sequence currents is zero

99. The phase voltages of an unbalanced system are expressed as zero, positive and negative sequence voltages, V_0, V_1, V_2, respectively, as

$$\begin{bmatrix} V_a \\ V_b \\ V_c \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & [-\,-] \\ 1 & [-\,-] \end{bmatrix} \begin{bmatrix} V_0 \\ V_1 \\ V_2 \end{bmatrix}$$

If $a = 1\angle 120°$, then the missing sub-matrix is

(A) $\begin{bmatrix} a & a^2 \\ a^2 & a \end{bmatrix}$ (B) $\begin{bmatrix} a & -a^2 \\ -a^2 & a \end{bmatrix}$ (C) $\begin{bmatrix} a & a^2 \\ a & a^2 \end{bmatrix}$ (D) $\begin{bmatrix} a^2 & -a \\ -a & a^2 \end{bmatrix}$

100. In a 3-phase balanced neutral grounded star-connected load, phase b is open. If $I_a = 10\angle 0$ and $I_c = 10\angle 120°$ then
(A) Zero sequence current = neutral current
(B) Zero sequence current = 1/3 neutral current
(C) Zero sequence current = 3 × neutral current
(D) Positive sequence current = negative sequence current

101. The value of capacitor used for power factor improvement in a feeder with V volts at 50 Hz and capacitor current I_c is

(A) $100\pi I_c V$ (B) $\frac{100\pi V}{I_c}$ (C) $\frac{100\pi V}{I}$ (D) $\frac{I_c}{100\pi V}$

102. A double-line-to-ground fault from phase b to phase c occurs through the fault impedance, Z_F to ground. The fault conditions are

(A) $I_b = I_c = 0,\ V_a = Z_F I_a$
(B) $I_a = 0,\ I_b = -I_c,\ V_b + V_c = Z_F I_b$
(C) $I_a = 0, V_b = V_c = Z_F (I_b + I_c)$
(D) $I_a = 0,\ I_b = -I_c,\ V_b - V_c = Z_F I_b$

103. A solid state relay
(A) withstands voltage transients
(B) does not require auxiliary dc supply
(C) provide low burden on CT and P
(D) does not provide earth fault protection

104. In the induction type directional over current relay, when a short-circuit occurs in the circuit
(A) power flows in reverse direction
(B) power flows in normal direction
(C) directional power element does not operate
(D) over current element is not energized

105. In a differential protection scheme of a generator winding with a fault, the secondary currents of CTs are $I_{s1} = 2.2 + j\,0$ A and $I_{s2} = 1.8 + j\,0$ A. The % bias setting, K of the relay is

(A) 5 % (B) 10 % (C) 20 % (D) 40 %

106. In voltage source converter based HVDC transmission system the active power is controlled by changing

(A) phase angle of the converter ac input voltage
(B) supply frequency of the converter ac input voltage
(C) magnitude of the converter ac input voltage
(D) DC voltage at the inverter terminals

107. A Unified Power Flow Controller (FACTS controller) is a voltage source converter based

(A) Inter-phase power controller
(B) Static Compensator
(C) Combination of series and shunt compensators
(D) Solid-state series compensator

108. An SCR without any external connections is considered as

(A) two diodes in series (B) three diodes in series
(C) two n-p-n transistors in series (D) two p-n-p transistors in series

109. The device which allows reverse power flow and withstands highest switch frequency is

(A) GTO (B) MOSFET
(C) IGBT (D) Inverter grade SCR

110. In a 230 V, 50 Hz single-phase SCR bridge converter operating at a firing delay angle, α and with large R-L load, the input source current is

(A) sinusoidal current (B) constant dc current
(C) continuous rectangular pulses (D) alternating rectangular pulses

111. In a bi-phase half-wave SCR converter at a firing delay angle, α and considering the voltage drop, V_d across each SCR, the average load voltage is

(A) $\frac{2\sqrt{2}\,V_s}{\pi}\cos\alpha - v_d$ (B) $2(\frac{\sqrt{2}\,V_s}{\pi}\cos\alpha - v_d)$

(C) $\frac{2V_s}{\pi}\cos\alpha - v_d$ (D) $(\frac{2\sqrt{2}\,V_s}{\pi} - v_d)\cos\alpha$

112. In a half-controlled 3-phase SCR bridge converter, the average voltage across R-L load at a firing delay angle, α is

(A) $\frac{3\sqrt{3}\,V_{line-max}}{2\pi}\cos\alpha$ (B) $\frac{3V_{line-max}}{2\pi}\cos\alpha$

(C) $\frac{3\sqrt{3}\,V_{line-max}}{\pi}(1+\cos\alpha)$ (D) $\frac{3V_{line-max}}{2\pi}(1-\cos\alpha)$

113. In a dc-dc step-down converter, the minimum inductance required for continuous current operation, if D, f, and R are duty ratio, switching frequency and load resistance, respectively, then

(A) $\frac{(1-D)R}{2f}$ (B) $\frac{(1-D)R}{f}$ (C) $\frac{DR}{2f}$ (D) $\frac{1}{R}-\frac{(1-D)}{2f}$

114. If D is the duty ratio of a dc-dc step-up converter, the relation between the input and out currents is

(A) $I_{in} = D\,I_{out}$ (B) $I_{in} = \frac{1}{D} I_{out}$

(C) $I_{in} = \frac{1}{(1-D)} I_{out}$ (D) $I_{in} = (1-D)\,I_{out}$

115. A 230 V, 50 Hz phase controlled single-phase full-controlled SCR bridge converter draws 15 A constant dc current. If the source inductance is 3 mH, the drop in dc output voltage is

(A) 4.5 V (B) 6.75 V (C) 9 V (D) 13.5 V

116. The direction of rotation of an inverter fed 3-phase ac motor is reversed by

(A) a mechanical reversing switch (B) reversing the input dc link voltage

(C) operating the inverter as a rectifier (D) changing the sequence of switching

117. The no-load speed of a single-phase SCR bridge converter fed separately excited dc motor operating at a firing delay angle, α and flux, Φ

(A) directly proportional to α and Φ

(B) inversely proportional to α and Φ

(C) directly proportional to α and inversely proportional to Φ

(D) directly proportional to Φ and inversely proportional to α

118. The PWM pulses for the gate control circuit of an IGBT inverter fed 3-phase induction motor drive are generated by using a triangular wave of frequency, f_c and

(A) a modulating wave of frequency, f_m

(B) a constant dc signal

(C) an alternating rectangular wave of frequency, f_r

(D) an alternating trapezoidal wave of frequency, f_t

119. In electric traction for a trapezoidal speed-time curve, the time period is

(A) free running speed period = constant speed period

(B) free running period = coasting period

(C) free running period + coasting period = constant speed period

(D) average speed period = scheduled speed period

120. Specific energy consumption of an electric train is the ratio between

(A) Specific energy output at driving wheels and efficiency of the traction motor

(B) Specific energy output at driving wheels and efficiency of the transmission gear

(C) Specific energy output of driving motor and efficiency of the driving wheels

(D) Specific energy output at driving wheels and efficiency of the (motor + transmission gear)

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