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UKPSC AE Electrical

Previous Year Paper
### 27 April 2022 Paper I

1. In Gauss Seidel method of Load flow analysis, the number of iterations may be reduced, if the correction in voltage at each bus is multiplied by
   (a) Gauss constant
   (b) Acceleration constant
   (c) Deceleration constant
   (d) Blocking factor

2. Rihand-Dadri HVDC transmission line is a
   (a) Monopolar line
   (b) Bipolar line
   (c) Homopolar line
   (d) None of the above

3. NR method with polar co-ordinates is used to solve a load flow problem having a Jacobian matrix of size 80×80. Let there be 40 PV buses, some PQ buses and a slack bus. Find the total number of buses in the system.
   (a) 41
   (b) 61
   (c) 80
   (d) 101

4. If the LV side of a single phase 450/230 V, 50 Hz transformer is connected to a supply of 25 Hz, then the voltage of supply should be made equal to
   (a) 115 V
   (b) 230 V
   (c) $230\sqrt{2}$ V
   (d) 460 V

5. A 400 V, 15 kW, 4 Pole, 50 Hz, Y connected induction machine has full load slip of 4%. The output torque of the motor at full load will be
   (a) 1.66 N m
   (b) 95.50 N m
   (c) 99.47 N m
   (d) 624.73 N m

6. At low values of slip 's', the torque 'T' of an Induction motor is
   (a) $T \propto \dfrac{1}{s}$
   (b) $T \propto \sqrt{s}$
   (c) $T \propto s^2$
   (d) $T \propto s$

7. The flux is maximum in the following part of a DC motor.
   (a) Pole core
   (b) Under the inter pole
   (c) Under the leading pole trip
   (d) Under the trailing pole trip

8. Potier reactance of an alternator is almost the same as
   (a) Field winding reactance
   (b) Total armature reactance
   (c) Leakage reactance of field winding
   (d) Armature leakage reactance

9. A 240 V DC series motor takes 40 A when giving its rated output at 1500 rpm. Its resistance is 0.3 Ω. The value of resistance, which must be added to obtain the rated torque at 1000 rpm, will be
   (a) 6 Ω
   (b) 5.7 Ω
   (c) 2.2 Ω
   (d) 1.9 Ω

10. In an Induction motor, if the air gap is increased, then its
    (a) speed will be reduced
    (b) efficiency will improve
    (c) power factor will be reduced
    (d) breakdown torque will be reduced

11. For the purpose of starting an Induction motor, Star/Delta starter is equivalent to an autotransformer of ratio
    (a) 33.3%
    (b) 66.6%
    (c) 50%
    (d) 57.7%

12. A dc shunt motor runs at 500 rpm at 220 V. A resistance of 4.5 ohm is added in series with the armature having resistance of 0.5 Ω. The starting current of the motor will be
    (a) 44 A
    (b) 50 A
    (c) 44.4 A
    (d) 60 A

13. In a 3 phase, 4 pole, 50 Hz synchronous motor, the frequency, number of poles and load torque are all halved. The motor speed in this situation will be
    (a) 375 rpm
    (b) 750 rpm
    (c) 1500 rpm
    (d) 3000 rpm

14. The number of slip rings in a 3 phase synchronous machine will be
    (a) 0
    (b) 1
    (c) 2
    (d) 3 or 4

15. A 500 kVA, 3 phase transformer has iron loss of 300 W and full load copper loss of 600 W. Percentage load at which the transformer is expected to have maximum efficiency is
    (a) 50.0%
    (b) 70.7%
    (c) 141.4%
    (d) 200%

16. A 50 kVA, 3300/230 V, single phase transformer is connected as an auto-transformer shown below. The nominal rating of the transformer will be
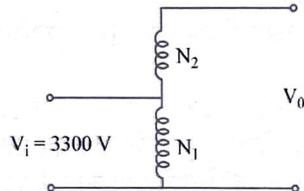
(a) 50 kVA   (b) 53.5 kVA   (c) 617.4 kVA   (d) 767.4 kVA

17. A 300 kVA transformer has 95% efficiency at full load, 0.8 pf lagging. It has 96% efficiency at half load unity power factor. The Iron loss and the copper loss of transformer at full load will respectively be
   (a) 4.12 kW, 8.51 kW   (b) 6.59 kW, 9.21 kW
   (c) 3.51 kW, 4.12 kW   (d) 12.72 kW, 3.07 kW

18. The advantage of having double cage rotor over single cage rotor in a squirrel cage Induction motor is that its
   (a) slip is larger   (b) efficiency is higher
   (c) starting current is lower   (d) power factor is higher

19. In the star-delta transformer shown below, the supply is on star side with a balanced 3-phase, 4 wire sinusoidal voltage. The transformer is at No load condition. With S_2 closed and S_1 open the current waveform in delta winding will be

   (a) A sinusoidal at fundamental frequency (b) Flat top with 3rd harmonic
   (c) Only third harmonic   (d) None of the above

20. A 2300 V, 3 Phase, 60 Hz, Y connected cylindrical rotor synchronous motor has synchronous reactance of 11 Ω per phase. When it delivers 200 hp, the efficiency is 90% and the load angle is 15°. The induced emf voltage per phase will be
   (a) 1500 V   (b) 1676 V   (c) 1768 V   (d) 1968 V

21. Speed-torque characteristic of a repulsion motor resembles with which of the following dc motor's characteristic ?
   (a) Separately excited   (b) Shunt
   (c) Series   (d) Compound

22. A synchronous generator is feeding a zero power factor (lagging) load at rated current. The armature reaction will be
   (a) Magnetizing   (b) De-Magnetizing
   (c) Cross-Magnetizing   (d) Ineffective

23. Skewing is used in Induction motors to reduce torque produced due to
   (a) Time harmonics   (b) Space harmonics
   (c) Slot harmonics   (d) Reverse rotating field

24. The constant speed of synchronous motor can be changed to a new value of fixed speed by which of the following ?
   (a) By changing supply frequency   (b) By changing any two phases
   (c) By changing supply voltage   (d) None of the above

25. A dc generator has an efficiency of 90% for an output voltage and current of 250 V and 18 A respectively. If this machine is made to operate at the same speed as a dc motor, with an input voltage of 250 V and the current of 18 A, the efficiency of the motor will be
   (a) 90%   (b) 91.12%   (c) 88.88%   (d) 87.12%

26. In an Induction motor, the number of stator slots should never be equal to the number of rotor slots in order to prevent
    (a) Crawling   (b) Cogging   (c) Over heating   (d) Humming Sound

27. An Induction motor has a rotor resistance of 0.002 ohm/phase. If this resistance is increased to 0.004 ohm/phase, then the maximum torque will be
    (a) reduced to half   (b) increased by 100%
    (c) increased by 200%   (d) unaltered

28. Which of the following connections of a three phase transformer give the highest secondary voltage ?
    (a) Delta-Delta   (b) Delta-Star   (c) Star-Star   (d) Star-Delta

29. The Faraday's law and the Lenz's law relating to electromagnetic induction can be summarized as follows :

    (a) $e = \dfrac{d\psi}{dt}$ (b) $e = iR$ (c) $e = L\dfrac{di}{dt}$ (d) $e = -\dfrac{d\psi}{dt}$

30. In order to eliminate the fifth harmonic voltage from the phase voltage of an alternator, the coil should be short pitched by
    (a) 72° electrical   (b) 36° electrical   (c) 15° electrical   (d) 18° electrical

31. The power input to a 3 phase Induction motor is 50 kW. If stator losses are 800 W at a slip of 0.015, then the copper loss of rotor per phase will be
    (a) 100 W   (b) 200 W   (c) 246 W   (d) 123 W

32. For successful parallel operation of two single phase transformers, the most essential condition is that their
    (a) percentage impedances are equal   (b) polarities are properly connected
    (c) shape and size are equal   (d) None of the above

33. The residual magnetism of a self-excited dc shunt generator is lost. To build up its emf again
    (a) The field winding should be replaced
    (b) The armature winding connections should be reversed
    (c) The field winding connections should be reversed
    (d) The field winding should be excited separately and used

34. A 3 phase diode bridge rectifier is fed from a 400 V rms, 50 Hz source. If the load is purely resistive then the peak of instantaneous output voltage is equal to
    (a) 400 V   (b) $400\sqrt{2}$ V   (c) $400/\sqrt{2}$ V   (d) $400/\sqrt{3}$ V

35. Which type of motor is suitable for computer printer drive ?
    (a) Reluctance motor   (b) Hysteresis motor
    (c) Shaded pole motor   (d) Stepper motor

36. A chopper fed separately excited dc motor drive in regenerative braking mode operate in the following quadrant :

    (a)

   (b)

    (c)
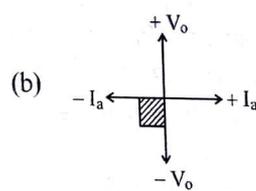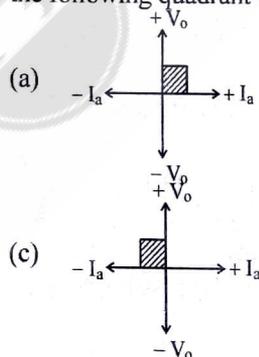
    (d) Regenerative braking is not possible

37. A single phase half controlled bridge rectifier with input as 330 sin 314 t volt is feeding a separately excited dc motor. If the back emf of the motor is 80 V and the armature reaction is 4 Ω and SCRs are fired symmetrically at 30°, then the armature current will be
(a) 21 A   (b) 29 A   (c) 35 A   (d) 39 A

38. Which of the following statements are true in the field flux method of controlling a separately excited dc motor ?
(1) Torque is constant
(2) Power is constant
(3) Speed increases when field flux decreases
(4) Speed increases when field flux increases
(a) (1) and (3)   (b) (1), (2) and (3)   (c) (2) and (3)   (d) (2) and (4)

39. An SCR chopper circuit supplies power to a dc motor. What will be the nature of motor armature current ?
(a) Sinusoidal
(b) Exponential rise and decay
(c) Constant
(d) None of the above

40. A 12 pole, 3 phase alternator is coupled to an engine running at 500 rpm. It supplies an Induction motor which has a full load speed of 1440 rpm. The slip and the number of poles of the induction motor will be
(a) 67% and 12   (b) 67% and 4   (c) 4% and 12   (d) 4% and 4

41. A 3 phase semiconverter feeds the armature of a separately excited dc motor supplying a non-zero torque. For steady state operation, the motor armature current is found to drop to zero value at certain instant of time. The voltage at that instant assumes a value
(a) equal to the instantaneous value of the ac phase voltage
(b) equal to the instantaneous value of the motor back emf
(c) Arbitrary
(d) Zero

42. When a line commutated converter operates in the inverter mode;
(a) It draws both real and reactive power from the ac source
(b) It delivers both real and reactive power to ac source
(c) It delivers real power to ac source
(d) It draws reactive power from ac source.

43. The output voltage waveform of a three phase square wave inverter contains
(a) only even harmonics
(b) both even and odd harmonics
(c) only odd harmonics
(d) only triplex harmonics

44. An ac Induction motor, used for speed control application, is fed from an inverter with a constant v/f control. The motor name plate reads; V : 415 V, Ph : 3, f : 50 Hz, N : 2850 rpm. The motor is run with inverter output frequency set at 40 Hz and with half rated slip. The running speed of the motor will be
(a) 2400 rpm   (b) 2280 rpm   (c) 2340 rpm   (d) 2790 rpm

45. Which inverter circuit uses coupled inductors ?
(a) Modified McMurray full wave bridge inverter
(b) McMurray Bedford half wave bridge inverter
(c) Modified McMurray Bedford half wave bridge inverter
(d) Both (b) and (c)

46. Which of the following heating methods has maximum power factor ?
(a) Arc heating
(b) Dielectric heating
(c) Induction heating
(d) Resistance heating

47. A thermometer is calibrated from 100 °C to 150 °C. The accuracy is specified within ± 0.2 °C. The maximum static error will be
(a) 0.125 °C   (b) 0.1 °C   (c) 0.145 °C   (d) –0.125 °C

48. In case of voltage injection method of speed control, the injected emf should be of
   (a) Supply frequency (f)
   (b) Slip frequency
   (c) $(1-s)f$
   (d) $(2-s)f$

49. For regenerative braking, the generated power should have
   (a) the same frequency as that of the main supply
   (b) frequency of $1/3^{rd}$ of the main supply
   (c) frequency of half of the main supply
   (d) Any frequency

50. A 3 phase, 3 stack, variable reluctance step motor has 20 poles on each rotor and stator stack. The step angle of this motor will be
   (a) $3°$
   (b) $6°$
   (c) $9°$
   (d) $18°$

51. The power required by a pump from the motor is proportional to
   (a) $(speed)^2$
   (b) $(speed)^3$
   (c) speed
   (d) $(speed)^{1/2}$

52. Which of the following combination for a drive system is incorrect ?
   (a) Plugging-II quadrant
   (b) Regenerative braking-II quadrant
   (c) Reverse motoring-III quadrant
   (d) Forward motoring-I quadrant

53. In the following circuit, a separately excited dc motor is having following converter between the dc source and itself.
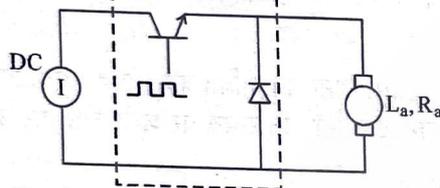

   (a) Buck converter
   (b) Boost converter
   (c) Buck-Boost converter
   (d) None of the above

54. A moving coil galvanometer of $10\ \Omega$ resistance has a 50 division scale and indicates $1\ \mu A$ per division. The series resistance required to be used to make it work as a voltmeter of 5 V range will be
   (a) $19999.8\ \Omega$
   (b) $0.01001\ \Omega$
   (c) $99990\ \Omega$
   (d) $100010\ \Omega$

55. Two Wattmeters method is used to measure active power of a 3 phase, 3 wire system. If the phase voltage is unbalanced, then the power reading will get
   (a) affected by both negative sequence and zero sequence voltages
   (b) affected only by negative sequence voltage
   (c) affected only by zero sequence voltage
   (d) affected neither by negative sequence nor by zero sequence voltages

56. A certain oscilloscope with 4 cm screen has its own sweep output fed into it as input. If the x and y scale sensitivities are the same, then the oscilloscope will display a
   (a) Triangular wave
   (b) Diagonal line
   (c) Sinusoidal wave
   (d) Circle

57. Which of the following bridges is used for measurement of inductance ?
   (a) Maxwell bridge
   (b) Schering bridge
   (c) Wein's bridge
   (d) None of the above

58. Two milliammeters having full scale current of 1 mA each are connected in parallel. If they are reading 0.5 mA and 2.5 mA respectively, then the ratio of their internal resistances will be
   (a) $10:1$
   (b) $1:10$
   (c) $5:1$
   (d) $1:5$

59. A Q-meter works on the principle of
   (a) Self-inductance
   (b) Mutual inductance
   (c) Series resonant circuit
   (d) Parallel resonant circuit

60. Which of the following represents SI unit of luminous intensity ?
   (a) Lumen   (b) Candela   (c) Dioptre   (d) Decibel

61. LVDT windings are wound on
   (a) Copper
   (b) Ferrite
   (c) Aluminium
   (d) Laminated steel sheet

62. The range of resistance measured by a Kelvin's bridge is
   (a) $10 \text{ m}\Omega$ to $10 \text{ }\Omega$
   (b) $0.1 \text{ }\mu\Omega$ to $1 \text{ }\Omega$
   (c) $0.01 \text{ }\Omega$ to $10 \text{ M}\Omega$
   (d) $1 \text{ k}\Omega$ to $100 \text{ M}\Omega$

63. Which of the following devices can measure the pressure directly ?
   (a) Bourdon tube   (b) Rotameter   (c) Both (a) and (b)·   (d) None of the above

64. Observational errors are called
   (a) Gross error   (b) Systematic error   (c) Random error   (d) Residual error

65. What is the name of the bridge that measures the value of an unknown inductance in terms of resistance and capacitance ?
   (a) Wein Bridge   (b) Schering bridge   (c) Hay's bridge   (d) Anderson bridge

66. Pole faces and iron core in a PMMC instrument are made cylindrical because
   (a) It is easy to manufacture
   (b) The coil can easily move in the gap
   (c) Damping torque is produced
   (d) Magnetic field is radial

67. A resistance thermometer shows resistances of $400 \text{ }\Omega$ and $440 \text{ }\Omega$ at ice point and at steam point respectively. When the resistance is $428 \text{ }\Omega$, the temperature will be
   (a) $60 \text{ }°C$ (b) $70 \text{ }°C$ (c) $80 \text{ }°C$ (d) $90 \text{ }°C$

68. Accuracy of a 0-100 V voltmeter is specified as 2% of the full scale. The accuracy of the reading when the voltmeter measures 50 V on full scale will be
   (a) 1%   (b) 2%   (c) 3%   (d) 4%

69. Phantom loading for testing an energy meter is used
   (a) for meters having low current ratings
   (b) to isolate current and potential circuits
   (c) for meters having high current ratings for which loads may not be available in laboratory
   (d) None of the above

70. A thermometer at room temperature of $30 \text{ }°C$ is dipped suddenly into a bath of boiling water at $100 \text{ }°C$. It takes 30 seconds to reach $96.5 \text{ }°C$. The total time required to reach the temperature of $98 \text{ }°C$ will be
   (a) 32.5 second   (b) 34.6 second   (c) 35.6 second   (d) 38.6 second

71. In two wattmeter method for measurement of power in a star connected 3 phase load, the readings of both the wattmeters be equal at
   (a) zero power factor
   (b) unity power factor
   (c) 0.5 power factor
   (d) Never

72. The bridge commonly used for measuring mutual inductance is
   (a) Heaviside Campbell bridge
   (b) Schering bridge
   (c) De Sauty bridge
   (d) Wein bridge

73. A tangent galvanometer is
   (a) an absolute instrument
   (b) a secondary instrument
   (c) a recording instrument
   (d) an integrating instrument

74. A series RLC circuit is excited by a voltage $e = E \sin wt$, where $LC < \dfrac{1}{w^2}$. The current, with respect to voltage, will be
   (a) Lagging   (b) Leading   (c) In same phase   (d) None of above

75. If $f(s) = L[f(t)]$, then $f(\infty)$ is given by
   (a) $\lim\limits_{s \to 0} s\, f(s)$ (b) $\lim\limits_{s \to \infty} s\, f(s)$ (c) $\lim\limits_{s \to 0} f(s)/s$ (d) $\lim\limits_{s \to \infty} f(s)/s$

76. The quality factors of series and parallel resonant circuits are expressed respectively as
   (a) $\omega_0 LR,\ \omega_0 CG$ (b) $\omega_0 L/R,\ \omega_0 C/G$
   (c) $\omega_0 CR,\ \omega_0 LG$ (d) $\omega_0 L/G,\ \omega_0 CR$

77. A series R-L circuit, having a resistance of 20 Ω and an inductance of 8 H, is connected to a dc voltage source of 120 V at time $t = 0$. The current in the circuit at $t = 0.6$ sec. will be
   (a) 0 A   (b) 2.33 A   (c) 4.66 A   (d) 1 A

78. If f_1 and f_2 are half power frequencies and f_0 is the resonant frequency, then the selectivity of RLC series circuit is given by
   (a) $(f_2 - f_1)/f_0$ (b) $(f_2 - f_1)/2f_0$ (c) $(f_2 - f_0)/f_1$ (d) $(f_1 - f_0)/f_2$

79. The Laplace transform of $f(t) = e^{-2t} \cos t$ is
   (a) $\dfrac{2}{s^2 + 4s + 5}$ (b) $\dfrac{s}{s^2 + 4s + 5}$ (c) $\dfrac{s-2}{s^2 + 4s + 5}$ (d) $\dfrac{s+2}{s^2 + 4s + 5}$

80. A system represented by $h(n) = (0.99)^n u(n + 2)$ is
   (a) Unstable, because it is an FIR system
   (b) Stable, because it is a IIR system
   (c) Unstable, because it does not obey BIBO stability criterion
   (d) Stable, because it obeys BIBO stability criterion

81. Find the Z parameter Z_{11} in the circuit shown below :

   (a) 1 Ω (b) 1.5 Ω (c) 2 Ω (d) 2.5 Ω
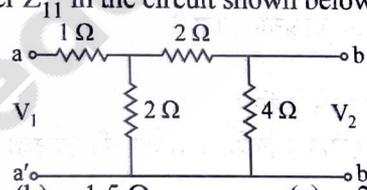
82. The relation among Z_{11}, Z_{12}, B and C parameters in a symmetrical network is
   (a) $Z_{11} = Z_{12} = B/C$ (b) $Z_{11} = Z_{12} = C/B$
   (c) $Z_{11} = Z_{12} = \sqrt{(B/C)}$ (d) $Z_{11} = Z_{12} = \sqrt{(C/B)}$

83. A system with open Loop transfer function $G(s) = \dfrac{k}{s(s + 2)(s^2 + 2s + 2)}$ is connected in unity −ve feedback configuration. The value of k for marginal stability is
   (a) 10   (b) 15   (c) 20   (d) 05

84. The transfer function of a ZOH (Zero Order Hold) device, in a discrete time system with sampling period as 'T', is
   (a) $\dfrac{1 - e^{Ts}}{s}$ (b) $\dfrac{1 - e^{-Ts}}{s}$ (c) $\dfrac{e^{Ts}}{s}$ (d) $\dfrac{e^{-Ts}}{s}$

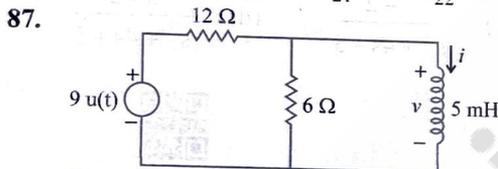**85.** Laplace transform of the signal given below is :
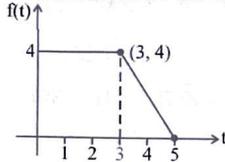
(a) $\dfrac{4}{s} + \dfrac{2}{s^2} e^{-3s} + \dfrac{2}{s^2} e^{-5s}$

(b) $\dfrac{4}{s} - \dfrac{2}{s^2} e^{-2s} - \dfrac{2}{s^2} e^{-5s}$

(c) $\dfrac{4}{s} - \dfrac{2}{s^2} e^{-3s} + \dfrac{2}{s^2} e^{-5s}$

(d) $\dfrac{4}{s} + \dfrac{2e^{-3s}}{s} + \dfrac{2}{s} e^{-5s}$

86.
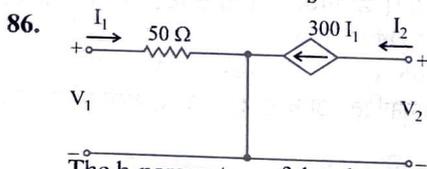
The h-parameters of the above network are

(a) $h_{11} = 50, h_{12} = 0, h_{21} = 300, h_{22} = 0$

(b) $h_{11} = 50, h_{12} = 0, h_{21} = 0, h_{22} = 300$

(c) $h_{11} = 0, h_{12} = 0, h_{21} = 50, h_{22} = 300$

(d) $h_{11} = 50, h_{12} = 300, h_{21} = 0, h_{22} = 0$

87.

The voltage across and the current through the inductor in the above circuit are respectively.

(a) $9 e^{-300\,t} u(t), 0.75 (1 - e^{-1200\,t})$

(b) $3 e^{800t} u(t), 0.75 (1 - e^{800\,t}) u(t)$

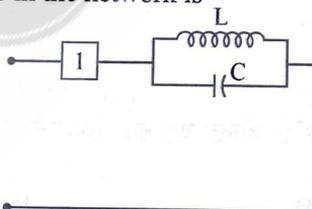(c) $3 e^{-800\,t} u(t), 0.75 (1 - e^{-800\,t})$

(d) None of the above

88. If u(t) is the unit step and $\delta(t)$ is the unit impulse function, then the inverse Z transform of $F(Z) = \dfrac{1}{Z+1}$, for k > 0, is

(a) $(-1)^k \delta(k)$

(b) $\delta(k) - (-1)^k u(k)$

(c) $(-1)^k u(k)$

(d) $u(k) - (-1)^k \delta(k)$

89. Choose the false statement :
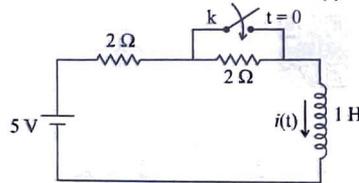
(a) $t\delta(t) = 0$

(b) $\cos(t) \cdot \delta(t - \pi) = -\delta(t - \pi)$

(c) $\delta(t) = \int u(t)\, dt$

(d) $t \cdot \delta'(t) = -\delta(t)$

90. The first Foster form has poles at $\omega = 0$ and $\omega = \infty$ in the following network, the element in box 1 in the network is


(a) an inductor

(b) a capacitor

(c) a parallel L-C circuit

(d) a series L-C circuit

91. After keeping the switch 'k' open for a long time in the circuit given below, it is suddenly closed at time t = 0. The current i(t) through inductor for t > 0 will be


(a) zero (b) $2.5 + 1.25\,e^{-2t}$ (c) $1.25 - 2.5\,e^{-4t}$ (d) $2.5 - 1.25\,e^{-2t}$

92. The peak value of signal cos (wt + 60) – sin (wt – 30) is

(a) 1 (b) $\sqrt{2}$ (c) 2 (d) $\sqrt{3}$

93. The Laplace transform of the function (cos h bt) is

(a) $\dfrac{b}{s^2 - b^2}$ (b) $\dfrac{s}{s^2 + b^2}$ (c) $\dfrac{s}{s^2 - b^2}$ (d) None of the above

94. What will be the reading of ammeter A_1, when the ammeters A_2 and A_3 read 12 A and 9 A respectively ?
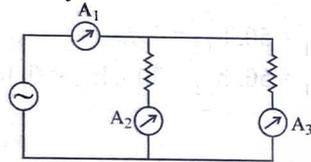
(a) 21 A (b) 12 A (c) 15 A (d) 9 A

95. The time constant of the circuit shown below is :
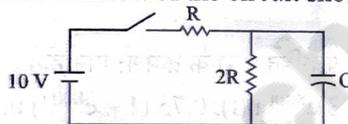
(a) $\dfrac{2\,RC}{3}$ (b) RC (c) 3 RC (d) 2 RC

96. Final value theorem states that

(a) $x(\infty) = \lim_{Z \to \infty} X(Z)$ (b) $x(\infty) = \lim_{Z \to 1} (1 - Z^{-1})\, X(Z)$

(c) $x(\infty) = \lim_{Z \to 1} X(Z)$ (d) None of the above

97. Two continuous signals $x(t) = e^{-t}$ and $y(t) = e^{-2t}$ exist for t > 0. The convolution $Z(t) = x(t) * y(t)$ will be

(a) $e^{-t} - e^{-2t}$ (b) e^{-3t} (c) e^{t} (d) $e^{-t} + e^{-2t}$

98. Find the rms value of the following wave shape :
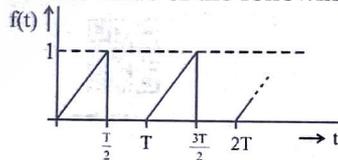
(a) $\sqrt{\dfrac{1}{3}}$ (b) $\sqrt{\dfrac{1}{6}}$ (c) $\sqrt{\dfrac{2}{3}}$ (d) $\dfrac{1}{6}$
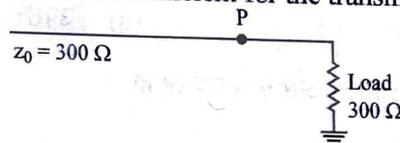
99. Considering pure electrostatics, $\nabla \times \vec{E}$ is given by one of the following :

   (a) Zero   (b) $-\dfrac{\partial \vec{B}}{\partial t}$ (c) $\dfrac{\partial \vec{B}}{\partial t}$ (d) None of the above
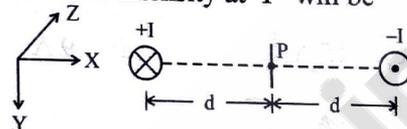
100. The Divergence theorem states that

   (a) $\displaystyle\oint_s \vec{D} \cdot \vec{ds} = \int_{vol} \nabla \times \vec{D}\, dv$ (b) $\displaystyle\oint_s \vec{D} \cdot \vec{ds} = \int_{vol} \nabla \cdot \vec{D}\, dv$

   (c) $\displaystyle\int_{vol} \vec{D} \cdot dv = \oint_s \nabla \times \vec{D}\, ds$ (d) $\displaystyle\oint_s \vec{D} \times \vec{ds} = \int_{vol} \nabla \times \vec{D}\, dv$

101. The reflection coefficient for the transmission line at 'P' is

   (a) $+1$ (b) -1 (c) 0 (d) 0.5

102. Two conductors are carrying forward and return currents $+I$ and $-I$ as shown below. The magnetic field intensity at 'P' will be

   (a) $\dfrac{I}{\pi d}\hat{x}$ (b) $\dfrac{I}{\pi d}\hat{y}$ (c) $\dfrac{I}{2\pi d}\hat{y}$ (d) $\dfrac{I}{2\pi d}\hat{x}$

103. Which of the following law is used to express line charge ?
   (a) Faraday's law (b) Maxwell's law (c) Gauss's law (d) Ampere's law

104. Laplacian of scalar function V is
   (a) Gradient of V
   (b) Divergence of V
   (c) Gradient of Divergence of V
   (d) Divergence of Gradient of V

105. Maxwell's Curl equation for stable magnetic field is given by

   (a) $\nabla \times \vec{B} = \mu_0 \vec{J}$ (b) $\nabla \times \vec{B} = 0$

   (c) $\nabla \cdot \vec{B} = \mu_0 J$ (d) $\nabla \times B = \mu_0 / \vec{J}$

106. The continuity equation is a combination of which of the following ?
   (a) Ohm's law and Gauss's law
   (b) Ampere's law and Gauss's law
   (c) Ohm's law and Ampere's law
   (d) Maxwell's law and Ampere's law

107. In free space, the Poisson's equation becomes
   (a) Maxwell's equation
   (b) Ampere's equation
   (c) Laplace equation
   (d) Steady state equation

108. Two coaxial cables 1 and 2 are filled with different dielectric materials having dielectric constants ε_{r_1} and ε_{r_2} respectively. The ratio of wavelengths in the two cables λ_1/λ_2 will be

   (a) $\sqrt{\varepsilon_{r_1}/\varepsilon_{r_2}}$ (b) $\sqrt{\varepsilon_{r_2}/\varepsilon_{r_1}}$ (c) $\varepsilon_{r_1}/\varepsilon_{r_2}$ (d) $\varepsilon_{r_2}/\varepsilon_{r_1}$

109. An electric field in free space is given by E = 50 cos (10^8t + βx) $\hat{a}_y$ V/m. The time taken by the wave to travel through a distance of λ/2 in $-\hat{a}_x$ direction will be

(a) 0.3142 ns   (b) 3.142 ns   (c) 31.42 ns   (d) 314.2 ns

110. Divergence of a vector field V(x, y, z) = $-$(x cos xy + y)i + (y cos xy)j + (sin z^2 + x^2 + y^2) k is given by

(a) 2z cos z^2 (b) sin xy + 2z cos z^2 (c) x sin xy − cos z (d) None of the above

111. The depth of penetration of electromagnetic wave in a medium having conductivity 6 at a frequency of 1 MHz is 25 cm. The depth of penetration at a frequency of 4 MHz will be

(a) 6.25 cm   (b) 12.50 cm   (c) 50.00 cm   (d) 100.00 cm

112. A quarter wave transmission line section is used to reject an interfering frequency of 100 MHz. Its approximate length is

(a) 3 m   (b) 75 m   (c) 1.5 m   (d) 6 m

113. Infinite uniform line charge of 5 nC/m lie along the (positive and negative) x and y axes in free space. The magnitude of electric field intensity at P(0, 0, 4) will be

(a) 11.25 V/m   (b) ∞ V/m   (c) 0 V/m   (d) 45 V/m

114. A control system is defined by $\dfrac{dx^2}{dt^2}$ + 6$\dfrac{dx}{dt}$ + 5x = 12(1 − e^{-2t}). The response of the system at t → ∞ will be

(a) x = 6   (b) x = 2   (c) x = 2.4   (d) x = −2

115. A system is described by the state space equation $\dot{X}$ = Ax + Bu, Y = CX, where

$$A = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}, B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}, C = [1, 1]$$

The transfer function of this system will be

(a) 1/(s + 1) (s + 2)   (b) 1/(s)(s + 1)
(c) 1/(s) (s + 2)   (d) 1/(s + 1)^2

116. The range of K, for the system with the following characteristic equation being stable, will be

F(s) = s(s^2 + s + 1) (s + 4) + k = 0

(a) 0 < k < 3.36   (b) 1 < k < 3.36   (c) 2 < k < 3.36   (d) 3 < k < 3.36

117. For a system having G(s) = $\dfrac{25}{s(s+10)}$ and having unity feedback, the peak time T_p will be

(a) 0.5 sec   (b) 5.0 sec   (c) 50 sec   (d) ∞ (Infinity)

118. The characteristic equation of a system having transfer function G(s) = $\dfrac{4(s+2)}{(s+3)(s+4)}$ will be

(a) s^2 + 5s + 1 = 0 (b) s^2 + 6s + 1 = 0   (c) s^2 + 7s + 12 = 0   (d) s^2 + 7s + 10 = 0

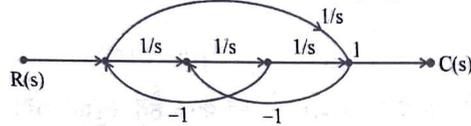119. The transfer function of the circuit shown below is :
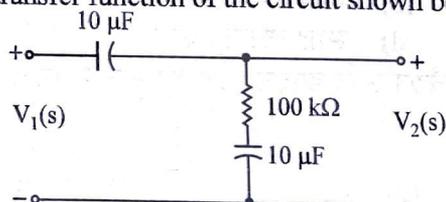
(a) (s + 2)/(s + 1) (b) (s)/(s + 1)   (c) (s + 1)/(s + 2)   (d) (s)/(s + 2)

120. For the following block diagram, the total number of nodes will be
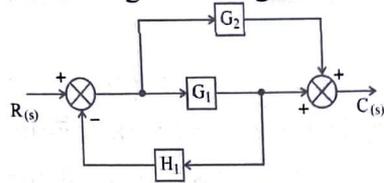
(a) 5   (b) 4   (c) 3   (d) 6

121. For the following signal flow graph of a control system,

the value of $C_{(s)}/R_{(s)}$ will be

(a) $\dfrac{1}{s}$ (b) $(s^2+1)/s(s^2+2)$ (c) $s(s^2+1)/(s^2+2)$ (d) $1-\dfrac{1}{s}$

**122.** Which of the statements is correct for the following system ?

$$\dot{X} = \begin{bmatrix} 2 & 3 \\ 0 & 5 \end{bmatrix}\begin{bmatrix} X_1 \\ X_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u$$

(a) The system is controllable but unstable.
(b) The system is uncontrollable and unstable.
(c) The system is controllable and stable.
(d) The system is uncontrollable but stable.

123. Which one of the following is not the property of a state transition matrix, $\phi(t)$?

(a) $\phi(0) = I$ (b) $\phi(t) = [\phi(-t)]^{-1}$ (c) $\phi(t)^{-1} = \phi(-t)$ (d) $\phi(t)^{-1} = \phi(t)$

124. For which range of k will the following system be stable ?
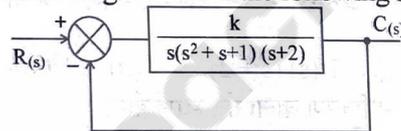
(a) $2 < k < \dfrac{14}{9}$ (b) $k > 0$ (c) $0 < k < \dfrac{14}{9}$ (d) $0 < k < 2$

125. Gain of the following signal flow graph will be
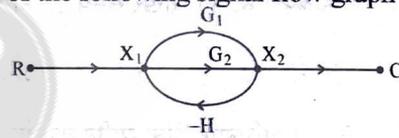
(a) $G_1 + G_2$ (b) $\dfrac{G_1 + G_2}{1 + G_1H + G_2H}$ (c) $\dfrac{G_1 + G_2}{1 - G_1H + G_2H}$ (d) $\dfrac{G_1 + G_2}{1 - G_1H - G_2H}$

126. Zero input state response, of the system given by below state space equation,

$$\begin{bmatrix} \dot{X_1} \\ \dot{X_2} \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}\begin{bmatrix} X_1 \\ X_2 \end{bmatrix} \text{ and } \begin{bmatrix} X_{1(0)} \\ X_{2(0)} \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \end{bmatrix} \text{ will be}$$

(a) $\begin{bmatrix} te^t \\ t \end{bmatrix}$ (b) $\begin{bmatrix} e^t \\ t \end{bmatrix}$ (c) $\begin{bmatrix} e^t \\ te^t \end{bmatrix}$ (d) $\begin{bmatrix} t \\ te^t \end{bmatrix}$

127. In the unity feedback system shown below :

$R_{(s)}$ + → $E_{(s)}$ → $G_{(s)} = \dfrac{5000}{s(s+75)}$ → $C_{(s)}$
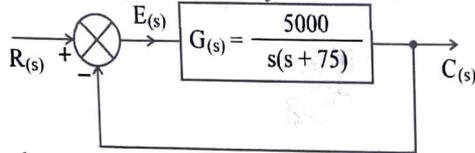
the steady state error for a ramp input r(t) = 5t will be
(a) 0.015   (b) 0.075   (c) 0.15   (d) 0.75

128. Closed loop transfer function of a unity feedback system is given by

$$\frac{Y_{(s)}}{R_{(s)}} = \frac{\omega_n^2}{s^2 + 2\xi\omega_n s + \omega_n^2}$$

The steady state error to unit ramp input will be
(a) ∞ (b) $2\xi/\omega_n$ (c) 1   (d) $4/\xi\omega_n$

129. The analysis of Multi Input Multi Output system is conveniently done by
(a) Root Locus approach   (b) Characteristic Equation approach
(c) State Space approach   (d) Nichol's Chart approach

130. The transfer function of a phase lead compensator is $\dfrac{1+3T_s}{1+T_s}$. The maximum value of phase provided by this is
(a) 90°   (b) 60°   (c) 45°   (d) 30°

131. In a second order system, if the damping ratio is greater than one, the roots will be
(a) imaginary   (b) real and equal
(c) real but not equal   (d) complex conjugate

132. A linear second order system with transfer function $G_s = \dfrac{49}{s^2 + 16s + 49}$ is initially at rest and is subjected to a step input signal. The overshoot in response is
(a) 0%   (b) 2%   (c) 4%   (d) 8%

133. A lead compensator used for a closed loop controller has following transfer function $\dfrac{k\left(1+\frac{s}{a}\right)}{\left(1+\frac{s}{b}\right)}$; then
(a) a < b   (b) b < a   (c) a < kb   (d) a > kb

134. In a reverse biased p-n junction circuit, the current is of the order of
(a) kA   (b) A   (c) mA   (d) μA

135. The peak inverse voltage of a full wave rectifier is
(a) $V_m/2$ (b) $2 V_m$ (c) $2 V_m/3$ (d) V_m

**136.** In common emitter configuration of an N.P.N. transistor
(a) $\beta = \Delta I_C/\Delta I_B$ (b) $\beta = \alpha/(1-\alpha)$ (c) Both (a) and (b)   (d) None of the above

**137.** Potential divider biasing is used in the amplifiers to
(a) reduce dc base current
(b) make the operating point independent of β.
(c) limit the input ac signal going to the base
(d) None of the above

138. In a Zener diode voltage regulator, if the load current increases by the increase in the load, then
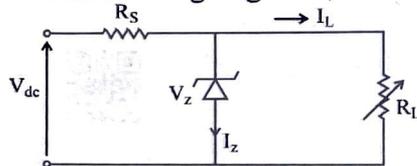

(a) Zener current decreases   (b) Zener current increases
(c) Zener current is not affected   (d) None of the above

139. Cross-over distortion occurs in
(a) Class A amplifier   (b) Class B amplifier
(c) Class C amplifier   (d) Push-Pull amplifier

140. If $\alpha = 0.98$, $I_{C_0} = 6\ \mu A$ and $I_B = 100\ \mu A$ for a transistor, then the value of I_C will be
(a) 2.3 mA   (b) 3.1 mA   (c) 4.6 mA   (d) 5.2 mA

141. The relation between α and β of a BJT is given by

(a) $\beta = \dfrac{\alpha}{1+\alpha}$ (b) $\alpha = \dfrac{1-\beta}{\beta}$ (c) $\beta = \dfrac{\alpha}{1-\alpha}$ (d) $\alpha = \dfrac{\beta}{1-\beta}$

142. The forward resistance of the diode shown in figure is 5 Ω.
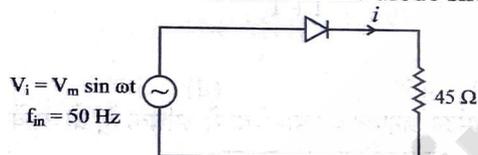
The dc component of the source current is

(a) $\dfrac{V_m}{50\pi}$ (b) $\dfrac{V_m}{50\sqrt{2}\pi}$ (c) $\dfrac{V_m}{100\sqrt{2}\pi}$ (d) $\dfrac{2\,V_m}{50\pi\sqrt{2}}$

143. In a single phase bridge rectifier shown below, what is the power dissipated in R_L ?
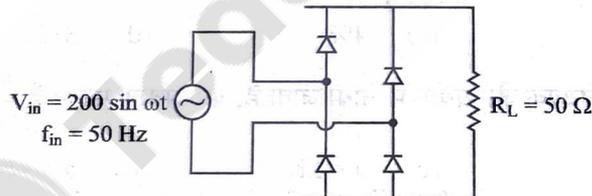
(a) $3200/\pi$ Watt   (b) 800 Watt   (c) $400/\pi$ Watt   (d) 400 Watt

144. If a differential amplifier has differential gain of 20000, CMRR = 8 dB, then the common mode gain is

(a) 2   (b) 1   (c) $\dfrac{1}{2}$ (d) 0

145. What is the percentage reduction in gain of an amplifier due to introduction of 20 dB of negative feedback ?
(a) 100%   (b) 90%   (c) 75%   (d) 50%

146. An n-channel JFET has $I_{DSS} = 2$ mA and $V_P = -4$ V. Its transconductance g_m for an applied gate to source voltage V_{GS} of -2 V is
(a) 0.25   (b) 0.50   (c) 0.75   (d) 1.0

147. Match items in Group-1 with Group-2 :

Group-1	Group-2
(P) LED	(1) Heavy doping
(Q) Avalanche Photodiode	(2) Coherent radiation
(R) Tunnel diode	(3) Spontaneous emission
(S) LASER	(4) Current gain

  (a) P-1, Q-2, R-4, S-3   (b) P-2, Q-3, R-1, S-4
  (c) P-3, Q-4, R-1, S-2   (d) P-2, Q-1, R-4, S-3

148. Match the following :

Configuration	Input resistance
CB – Common Base	L – Low
CC – Common Collector	M – Medium
CE – Common Emitter	H – High

  (a) CB-L, CC-M, CE-H   (b) CB-L, CC-H, CE-M
  (c) CB-M, CC-H, CE-L   (d) CB-H, CC-L, CE-M

149. Find V_{CE} in the following figure :

$V_{CC} = 12\ V$, $R_B = 390\ k\Omega$, $R_C = 1.5\ k\Omega$, $\beta_{dc} = 150$

  (a) 0.7 V   (b) 5.48 V   (c) 6.5 V   (d) 12 V

150. Enhancement type n-channel MOSFET is represented by

151. The Boolean expression of the output of the logic circuit shown in figure is

  (a) $Y = \overline{A}\,\overline{B} + AB + \overline{C}$ (b) $Y = \overline{A}\,\overline{B} + AB + C$
  (c) $Y = \overline{A}B + \overline{A}B + C$ (d) $Y = \overline{A}B + \overline{A}\,\overline{B} + \overline{C}$

152. The desired logical function of a 8 to 1 Mux with three variables A, B and C is

$$Z = AC + \overline{B}\,\overline{C}$$

The logic levels of input lines $I_7I_6I_5I_4I_3I_2I_1I_0$ will be

  (a) 10001101   (b) 11100010   (c) 11001110   (d) 10110001

153. The digital circuit shown in figure will generate a modified clock pulse. Choose the correct option, where clock signal is given as CLK.
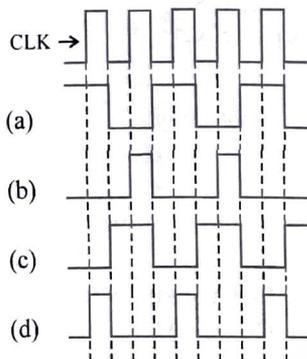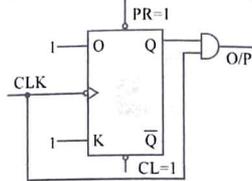
154. The zero sequence equivalent circuit for Y-Δ transformer will be
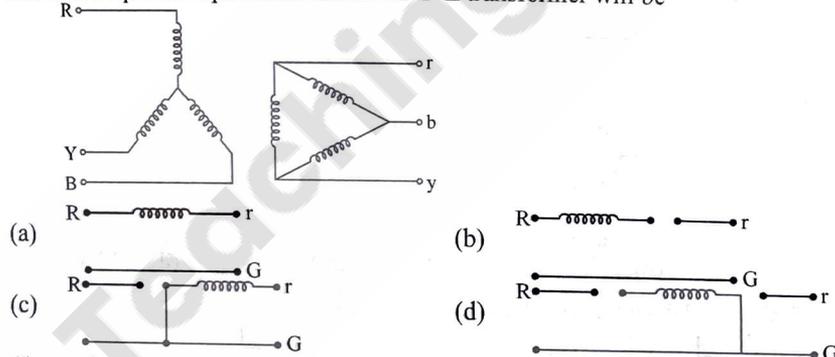
155. Choose the appropriate auxiliary components for HVDC transmission system, from the following :
(1) DC Line inductor   (2) AC Line inductor
(3) Reactive Power Sources   (4) Series Capacitance of AC line
(a) (1) and (2)   (b) (1) and (3)   (c) (2) and (4)   (d) (3) and (4)

156. According to Peek's empirical relation, the Corona loss is directly proportional to (where V_{CDV} is the critical disruptive voltage)
(a) $(V_{operating} - V_{CDV})^2$
(b) $(V_{operating} - V_{CDV})$
(c) δ (Air density corrective factor)
(d) None of the above

157. The steady state stability of two machine system depends on
(a) Per unit reactance of power system   (b) Power input
(c) Power factor of the system   (d) None of the above

158. Generally, in load flow solutions, the load is modelled as a
(a) Constant impedance load   (b) Constant power load
(c) Constant Current load   (d) None of the above

159. The real power transfer over a line, mainly depends on
    (a) Power angle   (b) $|V_S| - |V_R|$ (c) V_S (d) V_R

160. The loop inductance of a single phase overhead line consisting of two conductors, each having 1.213 cm diameter and spaced 1.25 m apart at frequency of 50 Hz will be
    (a) 44.62×10^{-4} H/km   (b) 11.15×10^{-4} H/km
    (c) 22.31×10^{-4} H/km   (d) 55.77×10^{-4} H/km

161. Which of the following matrix reveals the topology of the Power System Network ?
    (a) Bus Incidence Matrix   (b) Primitive Impedance Matrix
    (c) Primitive Admittance Matrix   (d) Bus Impedance Matrix

162. The maximum demand of a consumer is 2 kW and his daily energy consumption is 20 units. His load factor will be
    (a) 10%   (b) 41.6%   (c) 50%   (d) None of the above

163. If 'δ' is the loss angle of a cable, its power factor will be
    (a) $\sin \delta$ (b) $\cos \delta$
    (c) Power factor is independent of 'δ'   (d) None of the above

164. If a line is 100% series compensated, it may result into series resonance at
    (a) Power frequency (50 Hz)   (b) 100 Hz
    (c) 150 Hz   (d) None of the above

165. Transient stability of a power system can be effectively improved by
    (a) Excitation control   (b) Phase shifting transformer
    (c) Single pole switching circuit breaker   (d) Increasing the turbine valve opening

166. Transmission lines are transposed to reduce
    (a) Farranti effect   (b) Skin effect
    (c) Proximity effect   (d) Interference with communication lines

167. Which chart is used for calculations of transmission lines ?
    (a) Andre chart   (b) Smith chart   (c) Wilson chart   (d) Maxwell chart

168. By using which component, the transient stability limit of a power system can be improved ?
    (a) Series resistance   (b) Series capacitor
    (c) Series inductor   (d) Shunt resistance

169. In ACSR conductors, the insulation used between the aluminium and steel conductors is
    (a) Mica   (b) Bitumen   (c) Varnish   (d) No insulation

170. Negative sequence relays are used for protection of
    (a) Transmission lines   (b) Generators and motors
    (c) Transformers   (d) Busbars

171. A 50 Hz, 4 pole, 20 MVA, 13.2 kV generator has inertia constant of 9 kW-sec/kVA. If input power loss, rotational loss, is 20 MW and the output power is 15 MW, then the acceleration in rpm/sec will be
    (a) 20.83   (b) 41.66   (c) 250   (d) 125

172. In the series of suspension insulators shown below, if the maximum voltage per insulator unit is 20 kV, then maximum voltage that this string can withstand would be

$C' = \dfrac{C}{6}$
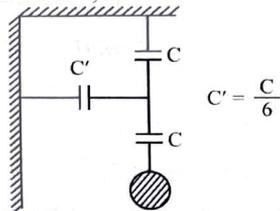
    (a)   17.14 kV   (b)   20 kV   (c)   25.7 kV   (d)   37.14 kV

173. A three phase transmission line is supplying a Δ connected load as shown below. The conductor 'C' develops an open circuit fault. The positive sequence component of current in line 'a' will be

$I_a = 10\underline{|0}$
$I_b = 10\underline{|180}$
$I_c = 0$
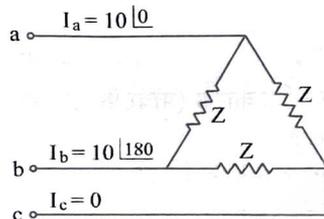
    (a) $5.78\underline{|-30}$ (b) $5.78\underline{|90}$ (c) $6.33\underline{|90}$ (d) $10.00\underline{|-30}$

174. At an industrial substation with a 4 MW load, a capacitor of 2 MVAR is installed to maintain the load power factor at 0.97 lagging. If the capacitor goes out of order, the load power factor would become

    (a)   0.9 lag   (b)   1   (c)   0.8 lag   (d)   0.8 lead

175. The receiving end voltage of a long transmission line under no load condition is

    (a)   Less than sending end voltage   (b)   More than sending end voltage

    (c)   Equal to sending end voltage   (d)   None of the above

176. The velocity of a travelling wave through a cable of relative permittivity 9 is

    (a) 9×10^8 m/sec   (b) 3×10^8 m/sec   (c) 10^8 m/sec   (d) 2×10^8 m/sec

177. The capacitance and inductance per unit length of a line operating at 110 kV are 0.01 μF and 2 mH respectively. The surge Impedance Loading of the line would be

    (a)   40 MVA   (b)   30 MVA   (c)   27 MVA   (d)   None of the above

178. If 'r' is the radius of conductor and 'R' is the radius of sheath of a cable, then the cable can operate stably from the view point of dielectric strength, if

    (a) $\dfrac{r}{R} > 1.0$ (b) $\dfrac{r}{R} < 1.0$ (c) $\dfrac{r}{R} > 0.632$ (d) $\dfrac{r}{R} < 0.368$

179. If a bus admittance matrix of size 800×800 in a power system has 6000 non-zero elements, then the minimum branches (transformers and transmission lines) in the system are

    (a)   2600   (b)   5200   (c)   6000   (d)   6400

180. A power system has 100 buses including 10 generator buses. For the load flow analysis using NR method in polar co-ordinates, the size of Jacobian matrix would be

    (a) 90×90 (b) 100×100 (c) 180×180 (d) 189×189