CCE (P) - 2015

ELECTRICAL ENGINEERING

KTM–13–XV

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Subject Code : | 1 | 3 |

Test Booklet No. : 00590

TEST BOOKLET

ELECTRICAL ENGINEERING

Time Allowed : 2 (Two) Hours **Full Marks : 200**

INSTRUCTIONS

1. The name of the Subject, Roll Number as mentioned in the Admission Certificate, Test Booklet No. and Subject Code shall be written legibly and correctly in the space provided on the Answer Sheet with black ball pen.
2. **Space provided for Series in the Answer Sheet is not applicable for Optional Subject. So the space shall be left blank.**
3. All questions carry equal marks. Your total marks will depend only on the number of correct responses marked by you in the Answer Sheet.
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SEAL

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[No. of Questions : 100]

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ELECTRICAL ENGINEERING

1. Inside a hollow conducting sphere

(A) electric field is zero

(B) electric field is non-zero constant

(C) electric field changes with the distance from centre of the sphere

(D) electric field changes with the magnitude of charge on the sphere

2. The magnetic flux density B and the vector magnetic potential A are related as

(A) $B = \nabla \times A$

(B) $A = \nabla \times B$

(C) $B = \nabla \cdot A$

(D) $A = \nabla \cdot B$

3. The velocity of EM waves in free space is

(A) 3×10^{11} m/sec

(B) 2×10^{8} m/sec

(C) 3×10^{8} m/sec

(D) 2×10^{10} m/sec

4. Three concentric conducting spherical surfaces of radii R_1, R_2 and R_3 ($R_1 < R_2 < R_3$) carry charges of -1 coulomb, -2 coulombs and 4 coulombs respectively. The charges on the inner and outer surfaces of the outermost sphere will be respectively [in coulomb(s)]

(A) 0, 4

(B) 3, 1

(C) -3, -1

(D) -3, 1

5. The Laplace transform of t is

(A) s

(B) $\frac{1}{s}$

(C) $\frac{1}{s^2}$

(D) $\frac{1}{(s-a)}$

6. Which of the following equations represents Gauss's law in homogeneous isotropic medium?

(A) $\int D \cdot ds = \iiint \rho \, dv$

(B) $\nabla \times H = D$

(C) $\nabla \cdot J + \rho = 0$

(D) $\nabla \cdot H = \frac{\rho}{\varepsilon}$

7. The energy density in a static magnetic field is

(A) $W_m = \frac{1}{2} LI^2$

(B) $W_m = \mu H^2$

(C) $W_m = \frac{1}{2} \mu H^2$

(D) $W_m = \frac{1}{2} H\mu^2$

8. What causes electromagnetic wave polarization?

(A) Longitudinal nature of electromagnetic wave

(B) Transverse nature of electromagnetic wave

(C) Reflection

(D) All of the above

9. An electromagnetic field is radiated from

(A) conductor carrying a d.c. current

(B) a capacitor with d.c. voltage

(C) an oscillating dipole

(D) All of the above

10. Two incandescent light bulbs of 40 W and 60 W rating are connected in series across the mains. Then

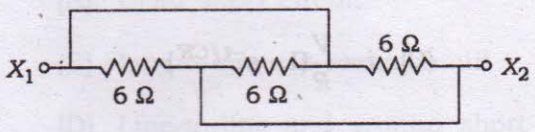
(A) the bulbs together consume 100 W

(B) the bulbs together consume 50 W

(C) the 60 W bulb glows brighter

(D) the 40 W bulb glows brighter

11. Three resistors of 6 Ω each are connected as shown in the figure below :



The equivalent resistance between X_1 and X_2 is

(A) 2 Ω

(B) 4 Ω

(C) 8 Ω

(D) 12 Ω

12. An *R-L-C* series circuit has f_1 and f_2 as the half-power frequencies and f_0 as the resonant frequency. The *Q*-factor of the circuit is given by

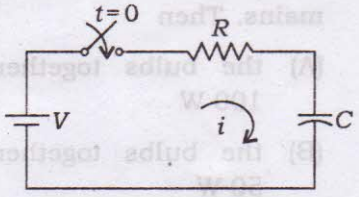
(A) $\frac{f_1 + f_2}{2f_0}$

(B) $\frac{f_1 - f_0}{f_2 - f_0}$

(C) $\frac{f_0}{f_1 - f_2}$

(D) $\frac{f_1 - f_2}{f_0}$

13. The transient response of the initially relaxed network shown in the figure below



is

(A) $i = \frac{V}{R} e^{-t/CR}$

(B) $i = \frac{V}{R} e^{1/CR}$

(C) $i = \frac{V}{R}(1 - e^{-t/CR})$

(D) $i = \frac{V}{R}(1 + e^{-t/CR})$

14. The difference between the indicated value and the true value of a quantity is

(A) gross error

(B) absolute error

(C) dynamic error

(D) relative error

15. What capacitance must be placed in series with a 15 μF capacitor to give a total capacitance of 5 μF?

(A) 5 μF

(B) 7·5 μF

(C) 10 μF

(D) 15 μF

16. An indicating instrument is more sensitive if its torque to weight ratio is

(A) much larger than unity

(B) of the order of unity

(C) much less than unity

(D) almost zero

17. The sine wave output of a function generator is fed to both the horizontal (X) and vertical (Y) inputs of a CRO. The pattern on the CRO screen is

(A) a circle

(B) an ellipse

(C) a straight line with 45° slope

(D) a semicircle

18. Which one of the following bridges is used for measurement of dielectric loss and power factor of a capacitor?

(A) Maxwell's bridge

(B) Anderson bridge

(C) De Sauty's bridge

(D) Schering bridge

19. A system can be completely described by a transfer function if it is

(A) non-linear and continuous

(B) linear and time-varying

(C) non-linear and time-invariant

(D) linear and time-invariant

20. A high frequency a.c. signal is applied to a PMMC instrument. If the r.m.s. value of the a.c. signal is 2 V, the reading of the instrument will be

(A) zero

(B) 2 V

(C) $2\sqrt{2}$ V

(D) $4\sqrt{2}$ V

21. Which of the following is usually not the generating voltage?

(A) 6·6 kV

(B) 9·9 kV

(C) 11 kV

(D) 13·2 kV

22. Transposition of a transmission line is done to

(A) reduce skin effect

(B) reduce line loss

(C) reduce corona

(D) balance the voltage drop

23. Transient disturbances are due to

(A) switching operations

(B) load variations

(C) faults

(D) Any of the above

24. Which of the following is the most dangerous short circuit?

(A) Line-to-line short circuit

(B) Dead short circuit

(C) Line-to-ground short circuit

(D) Line-to-line and ground short circuit

25. Isolators are used to disconnect a circuit when

(A) line is on full-load

(B) line is energized

(C) circuit breaker is not open

(D) there is no current in the line

26. Insulation coordination for UHV lines (above 500 kV) is done based on

(A) lightning surges

(B) lightning surges and switching surges

(C) switching surges

(D) all types of travelling waves

27. The stability of a system is not affected by

(A) reactance of line

(B) losses

(C) reactance of generator

(D) output torque

28. The function of steel wire in an ACSR conductor is to

(A) compensate for skin effect

(B) take care of surges

(C) provide additional mechanical strength

(D) reduce inductance

29. A generating station has a maximum demand of 30 MW, a load factor of 60% and a plant capacity factor of 50%. The reserve capacity of the plant is

(A) 5 MW

(B) 4 MW

(C) 6 MW

(D) 10 MW

30. In a load duration curve for an integrated power system, the uppermost crest represents the energy contributed by which one of the following?

(A) Base power stations

(B) Major thermal stations

(C) Peaking hydro or gas turbine stations

(D) Non-conventional power stations

31. The rating of a 3-phase power system is given as

(A) r.m.s. phase voltage

(B) peak phase voltage

(C) r.m.s. line-to-line voltage

(D) peak line-to-line voltage

32. The number of discs in a string of insulators for a 400 kV a.c. overhead transmission line is in the range of

(A) 32 to 33

(B) 22 to 23

(C) 15 to 16

(D) 9 to 10

33. Corona loss increases with

(A) decrease in conductor size and increase in supply frequency

(B) increase in both conductor size and supply frequency

(C) decrease in both conductor size and supply frequency

(D) increase in conductor size and decrease in supply frequency

34. Galloping in transmission line conductors arises due to

(A) asymmetrical layers of ice formation

(B) vortex phenomenon in light winds

(C) heavy weight of line conductors

(D) adaptation of horizontal conductor configuration

35. Transient state stability is generally improved by

(A) using high speed governors on machines

(B) using low inertia machines

(C) dispensing with natural grounding

(D) Any of the above

36. In a controlled rectifier, a free wheeling diode is necessary if the load is

(A) inductive

(B) capacitive

(C) resistive

(D) Any of the above

37. In a single-phase semi-converter, the number of thyristors is

(A) 16

(B) 8

(C) 4

(D) 2

38. In a single-phase full-converter (B2 connection), the number of thyristors is

(A) 32

(B) 16

(C) 8

(D) 4

39. Static voltage equalization in series connected SCRs is obtained by the use of

(A) one resistor across the string

(B) resistors of different values across each SCR

(C) resistors of same value across each SCR

(D) one resistor in series with the string

40. To turn off an SCR, it is necessary to reduce its current to less than

(A) trigger current

(B) holding current

(C) break-over current

(D) latching current

41. Which one of the following is called 'd.c. transformer'?

(A) Inverter

(B) Chopper

(C) Dual converter

(D) Cyclo-converter

42. Turn-off time of a thyristor

(A) depends upon stored charge in the junction

(B) is a constant

(C) depends on load

(D) Any of the above

43. UJT is normally used for

(A) firing of thyristor

(B) commutation of thyristor

(C) both firing and commutation of thyristor

(D) loading of thyristor

44. Heat sinks are normally used for

(A) series connected SCRs

(B) parallel connected SCRs

(C) both series and parallel connected SCRs

(D) Any of the above

45. Pole changing method of speed control is used in

(A) slip ring induction motor

(B) d.c. shunt motor

(C) d.c. series motor

(D) squirrel-cage induction motor

46. A shunt generator produces 450 A at 230 V. The resistances of shunt field and armature are 50 Ω and 0·025 Ω respectively. The armature voltage drop will be

(A) 11·39 V

(B) 22·7 V

(C) 31·6 V

(D) 38·4 V

47. Which of the following windings on d.c. generators is preferred for generating large currents?

(A) Lap winding

(B) Progressive wave winding

(C) Reprogressive wave winding

(D) Simple wave winding

48. The armature voltage control is considered as suitable in case the d.c. machine is driven at

(A) constant torque

(B) constant speed

(C) constant load

(D) constant current

49. Hysteresis loss in d.c. machine depends upon

(A) volume and grade of iron

(B) maximum value of flux density

(C) frequency of magnetic reversals

(D) All of the above

50. The direction of rotation of shunt generator can be reversed by interchanging

(A) supply terminals

(B) polarity of field winding

(C) polarity of armature and field winding

(D) All of the above

51. Neglecting all losses, how is the developed torque (T) of a d.c. separately excited motor, operating under constant terminal voltage, related to its output power (P)?

(A) $T \propto \sqrt{P}$

(B) $T \propto P$

(C) $T^2 \propto P^3$

(D) T is independent of P

52. If the applied voltage to a transformer primary is increased by keeping the V/f ratio fixed, then the magnetizing current and the core loss will, respectively

(A) decrease and remain the same

(B) increase and decrease

(C) both remain the same

(D) remain the same and increase

53. Can a 50 Hz transformer be used for 25 Hz if the input voltage is maintained constant at the rated value corresponding to 50 Hz?

(A) Yes, since the voltage is constant, current level will not change

(B) No, flux will be doubled which will drive the core to excessive saturation

(C) No, owing to decreased resistance of transformer, input current will be doubled at the load

(D) Yes, at constant voltage, insulation will not be overstressed

54. A 10 kVA, 400 V/200 V single-phase transformer with a resistance of 3% and reactance of 6% is supplying a current of 50 A to a resistive load. The voltage across the load is

(A) 194 V

(B) 196 V

(C) 198 V

(D) 390 V

55. Which 3-phase connection can be used in a transformer to introduce a phase difference of 30° between its output and corresponding input line voltages?

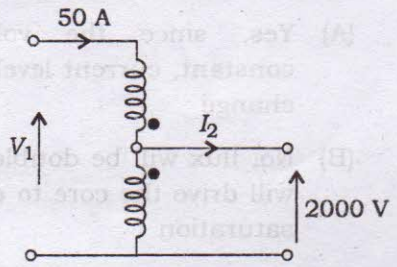
(A) Y-Y

(B) Y-Δ

(C) Δ-Δ

(D) Δ-Zigzag

56. A 1-phase, 10 kVA, 2000 V/200 V, 50 Hz transformer is connected to form an auto-transformer as shown in the figure below :



What are the values of V_1 and I_2?

(A) 2200 V, 55 A

(B) 2200 V, 45 A

(C) 2000 V, 45 A

(D) 1800 V, 45 A

57. Short-circuit test is to be performed on a 1-phase, 2 kVA, 230 V/230 V transformer. What should be the range of the ammeter to be connected on the secondary side of the transformer?

(A) 0–1 A

(B) 0–5 A

(C) 0–2 A

(D) 0–10 A

58. In case of alternators, the dark and bright lamp method is used for

(A) load balancing

(B) load transfer

(C) phase correction

(D) synchronizing

59. The speed of synchronous motor can be varied by varying its

(A) excitation

(B) supply voltage

(C) load

(D) supply frequency

60. Hunting of a synchronous motor may be due to

(A) pulsating torque of driven equipment

(B) reciprocating type of load

(C) pulsation in power supply

(D) Any of the above

61. The resistance of a diode is equal to

(A) ohmic resistance of *P* and *N* semiconductors

(B) junction resistance

(C) reverse resistance

(D) algebraic sum of (A) and (B)

62. A tunnel diode is

(A) a high resistivity *P-N* junction diode

(B) a very heavily doped *P-N* junction diode

(C) a slow switching device

(D) used with reverse bias

63. The leakage current I_{CBO} flows in

(A) the emitter, base and collector leads

(B) the emitter and base leads

(C) the emitter and collector leads

(D) the base and collector leads

64. The type of multivibrator used for generation of clock pulse is

(A) astable multivibrator

(B) bistable multivibrator

(C) monostable multivibrator

(D) Both (A) and (B)

65. An oscillator whose frequency is changed by a variable d.c. voltage is known as

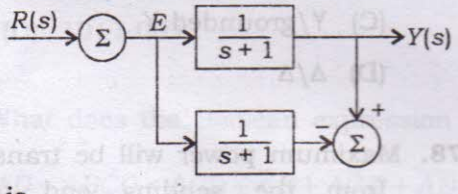
(A) a VCO

(B) a crystal oscillator

(C) an Armstrong oscillator

(D) a piezoelectric device

66. The transfer function $Y(s)/R(s)$ of the system shown in the figure below



is

(A) zero

(B) $\frac{1}{(s+1)}$

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

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

67. The transfer function of a system is given as

$$\frac{100}{s^2+20s+100}$$

The system is

(A) an overdamped system

(B) an underdamped system

(C) a critically damped system

(D) an unstable system

68. Two coupled coils with

$$L_1 = L_2 = 0{\cdot}6\,\text{H}$$

have a coupling coefficient of $K = 0{\cdot}8$. The turn ratio $\frac{N_1}{N_2}$ is

(A) 4

(B) 2

(C) 1

(D) 0·5

69. The power in a 3-phase 4-wire circuit can be measured by using

(A) one wattmeter

(B) two wattmeters

(C) three wattmeters

(D) four wattmeters

70. The frequency band from 30 MHz to 300 MHz is of

(A) audio-frequency oscillator

(B) radio-frequency oscillator

(C) video-frequency oscillator

(D) very high frequency oscillator

71. In high frequency region, an amplifier behaves like a

(A) band-pass filter

(B) low-pass filter

(C) high-pass filter

(D) Any of the above

72. Feedback oscillators have a closed-loop gain of

(A) $\frac{G}{1-GH}$

(B) $\frac{G}{1+GH}$

(C) $\frac{G}{1\pm GH}$

(D) $\frac{H}{1+GH}$

73. A 30 km long transmission line carrying power at 33 kV is known as

(A) short transmission line

(B) long transmission line

(C) high power line

(D) ultrahigh voltage line

74. Which of the following voltage regulations is considered to be the best?

(A) 2%

(B) 30%

(C) 70%

(D) 98%

75. A 3-phase Δ-connected symmetrical load consumes P watt of power from a balanced supply. If the same load is connected in Y to the same supply, then the power consumed is

(A) $\frac{P}{3}$

(B) P

(C) $\sqrt{3}P$

(D) $3P$

76. The horsepower obtained from the motor shaft is called

(A) IHP

(B) BHP

(C) useful output

(D) overall output

77. Zero sequence currents can flow from a line into a transformer bank if the windings are

(A) grounded Y/Δ

(B) Δ/Y

(C) Y/grounded Y

(D) Δ/Δ

78. Maximum power will be transferred from the sending end to the receiving end by a transmission line when

(A) line reactance is $\sqrt{3}$ times its resistance, i.e., $X = \sqrt{3}R$

(B) the torque angle $\delta = 90°$

(C) Both (A) and (B)

(D) Neither (A) nor (B)

79. If the positive, negative and zero sequence reactances of an element of a power system are 0·3 pu, 0·3 pu and 0·8 pu respectively, then the element would be a

(A) synchronous generator

(B) synchronous motor

(C) static load

(D) transmission line

80. What is the preferred type of circuit breaker (CB) to be installed in extra-high voltage a.c. system?

(A) Bulk oil CB

(B) Airblast CB

(C) Vacuum CB

(D) SF_6 CB

81. The binary equivalent of $(11{\cdot}6275)_{10}$ is

(A) 101·11011

(B) 1011·1011

(C) 101·0011

(D) 1011·0011

82. What does the Boolean expression

$AD + ABCD + ACD + \overline{A}B + A\overline{C}D + \overline{A}\overline{B}$

on minimization, result into?

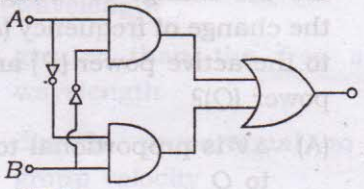
(A) $A + D$

(B) $AD + \overline{A}$

(C) AD

(D) $\overline{A} + D$

83. Which one of the following logic operations is performed by the digital circuit shown in the figure below?



(A) NOR

(B) NAND

(C) EX-OR

(D) OR

84. Feedback control systems are

(A) insensitive to both forward- and feedback-path parameter changes

(B) less sensitive to feedback-path parameter changes than to forward-path parameter changes

(C) less sensitive to forward-path parameter changes than to feedback-path parameter changes

(D) equally sensitive to forward- and feedback-path parameter changes

85. Two generators rated at 200 MW and 400 MW are operating in parallel. Both governors have a droop of 4% when the total load is 300 MW. They share the load as (suffix 1 is used for 200 MW generator and suffix 2 is used for 400 MW generator)

(A) $P_1 = 100$ MW and $P_2 = 200$ MW

(B) $P_1 = 150$ MW and $P_2 = 150$ MW

(C) $P_1 = 200$ MW and $P_2 = 100$ MW

(D) $P_1 = 200$ MW and $P_2 = 400$ MW

86. For a synchronous generator connected to an infinite bus through a transmission line, how are the change of voltage (ΔV) and the change of frequency (Δf) related to the active power (P) and reactive power (Q)?

(A) ΔV is proportional to P and Δf to Q

(B) ΔV is proportional to Q and Δf to P

(C) Both ΔV and Δf are proportional to P

(D) Both ΔV and Δf are proportional to Q

87. When there is a change in load in a power station having a number of generator units operating in parallel, the system frequency is controlled by

(A) adjusting the steam input to the units

(B) adjusting the field excitation to the generators

(C) changing the load divisions between the units

(D) injecting reactive power at the station busbar

88. In order to have a lower cost of electrical energy generation

(A) load factor and diversity factor should be low

(B) load factor should be low and diversity factor be high

(C) load factor should be high and diversity factor be low

(D) both load factor and diversity factor be high

89. A balanced 3-phase induction motor runs at slip s. If w_s is its synchronous speed, what is the relative speed between the stator m.m.f. and rotor m.m.f.?

(A) sw_s

(B) $(1-s)w_s$

(C) w_s

(D) Zero

90. What is the frequency of rotor current of a 50 Hz induction motor operating at 2% slip?

(A) 1 Hz

(B) 100 Hz

(C) 2 Hz

(D) 50 Hz

91. Which motor is most suitable for electric traction?

(A) d.c. shunt motor

(B) d.c. series motor

(C) d.c. compound motor

(D) Universal motor

92. What is the z-transform of the signal $x[n] = \alpha^n u[n]$?

(A) $X(z) = \dfrac{1}{z-1}$

(B) $X(z) = \dfrac{1}{1-z}$

(C) $X(z) = \dfrac{z}{z-\alpha}$

(D) $X(z) = \dfrac{1}{z-\alpha}$

93. Microprogramming is used in

(A) microcontroller

(B) 8085

(C) 8086

(D) All of the above

94. Accumulator is

(A) counter

(B) register

(C) keyboard

(D) both counter and register

95. In a lead-acid battery, during charging

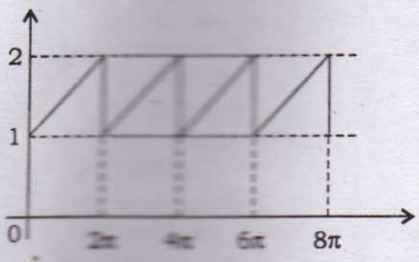
(A) anode becomes whitish in colour

(B) voltage drops

(C) specific gravity of acid increases

(D) the cell gives out energy

96. For the wave shown in the figure below



the average value is

(A) 1 A

(B) 1·1 A

(C) 1·5 A

(D) 2 A

97. The wavelength of a wave propagating in a waveguide is

(A) smaller than the free space wavelength

(B) greater than the free space wavelength

(C) directly proportional to the group velocity

(D) inversely proportional to the phase velocity

98. A practical current source is represented by

(A) a resistance in series with an ideal current source

(B) a resistance in parallel with an ideal current source

(C) a resistance in parallel with an ideal voltage source

(D) a resistance in series with an ideal voltage source

99. When reading is taken at half scale in the instrument, the error is

(A) exactly equal to half of full-scale error

(B) equal to full-scale error

(C) less than full-scale error

(D) more than full-scale error

100. The power of a solar cell is supplied at a voltage of

(A) 5–6 V

(B) 0·5–0·6 V

(C) 50–60 V

(D) 220–240 V