EJ/EPH/EE/II/25/12

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

Test Booklet No. : 01381

Series A

TEST BOOKLET

ELECTRICAL ENGINEERING

Time Allowed : 2 Hours **Full Marks : 100**

Read the following instructions carefully before you begin to answer the questions :

1. The name of the Subject, Roll Number as mentioned in the Admission Certificate, Test Booklet No. and Series are to be written legibly and correctly in the space provided on the Answer-Sheet with Black/Blue ballpoint pen.
2. **Answer-Sheet without marking Series as mentioned above in the space provided for in the Answer-Sheet shall not be evaluated.**
3. All questions carry equal marks.
   The Answer-Sheet should be submitted to the Invigilator.
   Directions for giving the answers : Directions for answering questions have already been issued to the respective candidates in the 'Instructions for marking in the OMR Answer-Sheet' along with the Admit Card and Specimen Copy of the OMR Answer-Sheet.
   Example :
   Suppose the following question is asked :
   The capital of Bangladesh is
   (A) Chennai
   (B) London
   (C) Dhaka
   (D) Dhubri
   You will have four alternatives in the Answer-Sheet for your response corresponding to each question of the Test Booklet as below :

   Ⓐ Ⓑ Ⓒ Ⓓ

   In the above illustration, if your chosen response is alternative (C), i.e., Dhaka, then the same should be marked on the Answer-Sheet by blackening the relevant circle with a Black/Blue ballpoint pen only as below :

   Ⓐ Ⓑ ● Ⓓ

   The example shown above is the only correct method of answering.
4. Use of eraser, blade, chemical whitener fluid to rectify any response is prohibited.
5. Please ensure that the Test Booklet has the required number of pages (16) and 100 questions immediately after opening the Booklet. In case of any discrepancy, please report the same to the Invigilator.
6. No candidate shall be admitted to the Examination Hall/Room 20 minutes after the commencement of the examination.
7. No candidate shall leave the Examination Hall/Room without prior permission of the Supervisor/Invigilator. No candidate shall be permitted to hand over his/her Answer-Sheet and leave the Examination Hall/Room before expiry of the full time allotted for each paper.
8. No Mobile Phone, Electronic Communication Device, etc., are allowed to be carried inside the Examination Hall/Room by the candidates. Any Mobile Phone, Electronic Communication Device, etc., found in possession of the candidate inside the Examination Hall/Room, even if on off mode, shall be liable for confiscation.
9. No candidate shall have in his/her possession inside the Examination Hall/Room any book, notebook or loose paper, except his/her Admission Certificate and other connected papers permitted by the Commission.
10. Complete silence must be observed in the Examination Hall/Room. No candidate shall copy from the paper of any other candidate, or permit his/her own paper to be copied, or give, or attempt to give, or obtain, or attempt to obtain irregular assistance of any kind.
11. This Test Booklet can be carried with you after answering the questions in the prescribed Answer-Sheet.
12. Noncompliance with any of the above instructions will render a candidate liable to penalty as may be deemed fit.
13. No rough work is to be done on the OMR Answer-Sheet. You can do the rough work on the space provided in the Test Booklet.

N.B. : There will be negative marking @ 0·25 per 1 (one) mark against each wrong answer.

SEAL

[No. of Questions : 100]

1. A conducting wire of length L, cross-sectional area A and resistivity ρ is connected across 12 V battery. If the length of the wire of the same material is doubled and cross-sectional area is halved, the current flow through the conducting wire will be

(A) $\frac{2A}{\rho L}$ (B) $\frac{3A}{\rho L}$

(C) $\frac{4A}{\rho L}$ (D) $\frac{6A}{\rho L}$

2. Two identical dimensions of metallic wires connected in series. If the conductivities of both the conductors are σ_1 and σ_2, what is the effective conductivity of the combination?

(A) $\sigma_1 + \sigma_2$ (B) $\frac{1}{\sigma_1} + \frac{1}{\sigma_2}$

(C) $\frac{\sigma_1\sigma_2}{\sigma_1 + \sigma_2}$ (D) $\frac{2\sigma_1\sigma_2}{\sigma_1 + \sigma_2}$

3. Two 230 V, 60 W bulbs are connected in series and parallel combination respectively. The total powers consumed of each combination are

(A) 30 W, 30 W

(B) 30 W, 120 W

(C) 120 W, 30 W

(D) 60 W, 120 W

4. Twenty-four 230 V, 230 W bulbs are connected in parallel across 230 V supply. If one of the bulbs is fused due to overheating, the equivalent current will be

(A) 1 A (B) 1·5 A

(C) 2 A (D) 4 A

5. The ratings of an electric fan and a heater are 100 W, 230 V, and 1 kW, 230 V respectively. The resistance of the heater will be

(A) zero

(B) greater than that of fan

(C) less than that of fan

(D) equal to that of fan

6. Three capacitors of capacitances 3 μF, 9 μF and 18 μF are connected once in series and another time in parallel. The ratio of equivalent capacitances in the two cases will be

(A) 1 : 3 (B) 1 : 15

(C) 1 : 9 (D) 1 : 12

7. A capacitor is charged through a potential difference of 20 V and possesses a charge of 0·1 C. When discharged, it would release an energy of

(A) 20 J (B) 12 J

(C) 10 J (D) 1 J

8. Three parallel plates each of area A with separation d_1 between first and second and d_2 between second and third are arranged to form a capacitor. If dielectric constants are K_1 and K_2, the capacitance of the capacitor is

(A) $\dfrac{\varepsilon_0 K_1 K_2}{A(d_1 + d_2)}$

(B) $\dfrac{\varepsilon_0}{A\left(\dfrac{d_1}{K_1} + \dfrac{d_2}{K_2}\right)}$

(C) $\dfrac{\varepsilon_0 A K_1 K_2}{(d_1 + d_2)}$

(D) $\dfrac{\varepsilon_0 A}{\left(\dfrac{d_1}{K_1} + \dfrac{d_2}{K_2}\right)}$

9. Which of the following is a bilateral element?

(A) Resistor

(B) Capacitor

(C) Inductor

(D) All of the above

10. A magnetic needle is kept in a uniform magnetic field. It experiences

(A) a force and a torque

(B) a force but not a torque

(C) a torque but not a force

(D) neither a torque nor a force

11. The resistance of a human body is about

(A) 10 Ω (B) 50 Ω

(C) 200 Ω (D) 1000 Ω

12. In the circuit shown in the Fig. 1, the diode used is ideal. The input power factor is

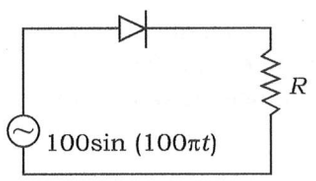

Fig. 1

(A) 0·707 (B) 0·89

(C) 1·0 (D) zero

13. The scale of voltmeter is uniform. Its type is

(A) moving iron

(B) induction-type instrument

(C) moving-coil permanent magnet

(D) moving-coil dynamometer

14. The range of an ammeter is extended by connecting a

(A) high resistance in parallel

(B) low resistance in parallel

(C) high resistance in series

(D) low resistance in series

15. Insulator has _____ temperature co-efficient of resistance.

(A) zero

(B) negative

(C) positive

(D) None of the above

16. Three identical resistors are connected to form a triangle. The resistance between any two corners is

(A) $R/3\ \Omega$ (B) $2R/3\ \Omega$

(C) $1/3R\ \Omega$ (D) $2/3R\ \Omega$

17. The superposition theorem is used when the circuit contains

(A) a single voltage source

(B) multiple voltage and current sources

(C) only passive elements

(D) None of the above

18. What percentage of the maximum power is delivered to a load if the load resistance is 10 times greater than the Thevenin resistance of the source to which it is connected?

(A) 25% (B) 40%

(C) 35% (D) 33%

19. An iron-core coil has an inductance of 2 H. If the reluctance of the magnetic path is 200 AT/Wb, the number of turns on the coil is

(A) 20 (B) 50

(C) 100 (D) 400

20. Three 50-Ω resistors are connected in star (Y) across 400 V, 3-phase supply. If one of the resistors is disconnected, then the line current will be

(A) 8 A (B) 4 A

(C) $8\sqrt{3}$ A (D) $8/\sqrt{3}$ A

21. Three identical resistances are connected in star (Y) consumed 4 kW power. If the resistances are in delta (Δ) across the same supply, the power consumed will be

(A) 4 kW (B) 6 kW

(C) 8 kW (D) 12 kW

22. A small swamping resistance is put in series with operating coil of a moving-coil ammeter in order to compensate for the effect of

(A) temperature variation

(B) external magnetic fields

(C) hysteresis loss

(D) None of the above

23. If the current through the operating coil of a moving-iron instrument is doubled, the operating force becomes

(A) two times

(B) four times

(C) one-half time

(D) three times

24. Two perfectly coupled coils each of 1 H self-inductance are connected in parallel so as to aid each other. What is the value of overall inductance?

(A) 0 H (B) 0·5 H

(C) 1 H (D) 2 H

25. The effective inductance across the terminal *A* and *B* of the network shown in Fig. 2 is

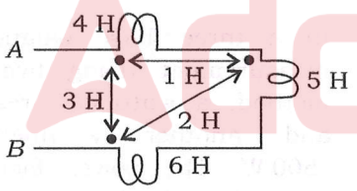

Fig. 2

(A) 9 H (B) 21 H

(C) 11 H (D) 6 H

26. A moving-coil instrument gives a full-scale deflection of 10 mA, when the potential difference across its terminals is 100 mV. What is the value of the shunt resistance for full-scale deflection corresponding to 100 A?

(A) $0 \cdot 0001\ \Omega$

(B) $0 \cdot 001\ \Omega$

(C) $0 \cdot 01\ \Omega$

(D) $0 \cdot 1\ \Omega$

27. Two ammeters are connected in parallel with the current scale of 10 A and 15 A, respectively and their corresponding resistances are $0 \cdot 01\ \Omega$ and $0 \cdot 005\ \Omega$. The maximum current of this combination will be

(A) 22·5 A (B) 15 A

(C) 12·5 A (D) 10 A

28. A 230 V single-phase energy meter has a constant load current of 20 A at unit power factor. If the meter disc makes 2300 revolutions during 2 hours, the meter constant will be

(A) 200 rev/kWh

(B) 230 rev/kWh

(C) 240 rev/kWh

(D) 250 rev/kWh

29. A moving-iron instrument and a moving-coil instrument are connected in series with a resistive load. The load current is

$$i(t) = 8 + 6\sqrt{2}\cos(2\pi ft + 30^\circ)\ \text{A}$$

The ammeter readings are respectively

(A) $10\sqrt{2}$ A and 8 A

(B) $15\sqrt{2}$ A and 8 A

(C) 10 A and 8 A

(D) 8 A and 10 A

30. Creeping is the phenomenon that occurs in

(A) ammeter

(B) voltmeter

(C) energy meter

(D) wattmeter

31. A (0–10) ampere permanent magnet moving-coil instrument reads 5 A when it is connected in series with the load resistance of 50 Ω. What will be the meter reading if its bottom control spring snaps suddenly?

(A) 10 A (B) 5 A

(C) 2·5 A (D) 0 A

32. A water boiler at home is switched ON to the a.c. mains supplying power at 230 V, 50 Hz. The frequency of instantaneous power consumed by the boiler is

(A) 50 Hz (B) 100 Hz

(C) 150 Hz (D) 200 Hz

33. The instrument which has a linear scale is

(A) MI instrument

(B) electrostatic instrument

(C) PMMC instrument

(D) dynamometer instrument

34. If a wattmeter connected in circuit gives down scale reading, then we normally change the connection of

(A) current coil

(B) potential coil

(C) both current and potential coils

(D) None of the above

35. In a three-phase balanced power measurement using two-wattmeter method, a wattmeter reads 500 W and another wattmeter reads –500 W. The power factor of the three-phase load is

(A) zero

(B) 0·9 lagging

(C) 0·9 leading

(D) None of the above

36. The resolutions of a $3\frac{1}{2}$ digital voltmeter display on 1 V and 50 ranges are

(A) 0·01 V and 0·05 V

(B) 0·001 V and 0·05 V

(C) 0·001 V and 0·005 V

(D) 0·01 V and 0·005 V

37. An analog voltmeter uses external multiplier settings. With a multiplier setting of 20 kΩ, it reads 440 V and with a multiplier setting of 80 kΩ, it reads 352 V. For multiplier setting of 40 kΩ, the voltmeter reads

(A) 371 V (B) 383 V

(C) 394 V (D) 406 V

38. A DC voltmeter has a sensitivity of 1000 Ω/V. When it measures half of the scale in 100-V range, the current through the voltmeter is

(A) 100 mA (B) 1 mA

(C) 0·5 mA (D) 50 mA

39. Load factor is defined as

(A) $\frac{\text{peak load}}{\text{average load}}$

(B) $\frac{\text{maximum load}}{\text{minimum load}}$

(C) $\frac{\text{average load}}{\text{peak load}}$

(D) $\frac{\text{peak load}}{\text{rated load}}$

40. Which of the following is/are correct?

1. Bundle conductors reduce the corona loss.
2. Bundle conductors increase the inductance and reduce the capacitance.
3. Corona loss causes radio interference in adjoining telephone lines.

(A) 1 only

(B) 1 and 2 only

(C) 2 only

(D) 1 and 3 only

41. Which of the following power plants is suitable for supplying peak load?

(A) Nuclear power plant

(B) Steam power plant

(C) Hydropower plant

(D) Gas turbine power plant

42. The corona loss on a particular system at 50 Hz is 1 kW/phase/km. The corona loss on the same system with supply frequency 25 Hz will be

(A) 1 kW/phase/km

(B) 0·5 kW/phase/km

(C) 0·667 kW/phase/km

(D) None of the above

43. An *R-L-C* series circuit remains predominantly inductive

(A) at resonant frequency

(B) below resonant frequency

(C) above resonant frequency

(D) at the lower half power frequency

44. The power factor of a series *R-L-C* circuit at the time of resonance is

(A) unity

(B) zero

(C) 0·5 lagging

(D) 0·5 leading

45. In a circuit, the instantaneous voltage and current are given by $v(t) = 10\sin(\omega t + 30°)$ V and $i(t) = 10\sin(\omega t - 30°)$ A. The power consumed in the circuit is

(A) 100 W (B) 50 W

(C) 25 W (D) 12·5 W

46. KCL is a consequence of the law of conservation of

(A) energy

(B) charge

(C) flux

(D) All of the above

47. An a.c. source of 200 V r.m.s. supplies active power of 600 W and reactive power of 800 VAR. The RMS current drawn from the source is

(A) 10 A (B) 5 A

(C) 3·75 A (D) 2·5 A

48. A transformer has full-load copper loss of 800 W and core loss of 600 W. Total loss at no-load will be approximately

(A) 1400 W (B) 1100 W

(C) 1000 W (D) 600 W

49. The internal resistance of an ideal current source is

(A) zero

(B) infinite

(C) very small value

(D) variable with respect to time

50. Which parameter does not change in a single-phase transformer operation from high voltage to low voltage or vice versa?

(A) Frequency

(B) Voltage

(C) Current

(D) None of the above

51. If an induction motor is started with DOL starter, the starting torque is 300 N-m. If it is started with star/delta starter, the starting torque is

(A) 300 N-m

(B) 600 N-m

(C) 900 N-m

(D) 100 N-m

52. In a d.c. series motor for large armature current, the torque is proportional to

(A) I_a (B) I_a^2

(C) $\sqrt{I_a}$ (D) $I_a^{2/3}$

53. The torque-speed characteristic of a DC shunt motor is

(A) a rectangular hyperbola

(B) a drooping straight line

(C) a parabola

(D) None of the above

54. Practical d.c. machines have air gaps ranging from

(A) 0 mm to 0·5 mm

(B) 0·5 mm to 1·5 mm

(C) 1·5 mm to 2·5 mm

(D) 2·5 mm to 3·5 mm

55. The purpose of laminating the armature core is to reduce

(A) eddy current loss

(B) copper loss

(C) hysteresis loss

(D) mechanical loss

56. In a simplex wave winding, the number of parallel paths is equal to

(A) the number of poles

(B) the number of series windings

(C) 2

(D) 4

57. A 6-pole lap wound generator has 300 conductors, the e.m.f. induced per conductor being 5 V. The generated voltage of the generator is

(A) 60 V (B) 1500 V

(C) 360 V (D) 250 V

58. A d.c. shunt motor should not be started on

(A) heavy load

(B) no load

(C) half full load

(D) None of the above

59. DC series motors are used in those applications where it is required to have

(A) high starting torque

(B) constant speed

(C) low no-load speed

(D) None of the above

60. If the field of a d.c. shunt motor is open

(A) it will continue to run at its rated speed

(B) the speed of the motor will decrease

(C) the motor will stop

(D) the speed of the motor will become very high

61. The direction of rotation of a d.c. shunt motor is reversed by

(A) reversing the armature connection

(B) interchanging the armature and field connection

(C) adding resistance to the field circuit

(D) reversing the supply terminals

62. A synchronous motor can run at

(A) leading p.f.

(B) unity p.f.

(C) lagging, leading or unity p.f.

(D) zero p.f.

63. When a synchronous motor is started, the field winding is initially

(A) short-circuited

(B) excited by a d.c. source

(C) open-circuited

(D) None of the above

64. A 50 Hz, 10-pole, 3-phase IM is used to drive a 60 Hz, 3-phase alternator. The number of poles of the alternator is

(A) 10 (B) 6

(C) 16 (D) 12

65. A ceiling fan uses

(A) split-phase motor

(B) capacitor start capacitor run motor

(C) capacitor start motor

(D) universal motor

66. If X is the system reactance and R its resistance, the power transferred is maximum when

(A) $X = R$ (B) $X = \sqrt{2}R$

(C) $X = \sqrt{3}R$ (D) $X = 2R$

67. Induction generator works between the slip

(A) $1 < S < 2$

(B) $0 \cdot 1 < S < 1$

(C) $S < 0$

(D) None of the above

68. The unit of resistivity is

(A) mho-m^2

(B) ohm-m^2

(C) ohm/m

(D) ohm-m

69. If transformer frequency is changed from 50 Hz to 60 Hz, the ratio of eddy current loss 50 Hz to 60 Hz at constant voltage is

(A) 5/6 (B) 25/36

(C) 6/5 (D) 1

70. When two transformers of different kVA ratings are connected in parallel, they share the load in proportion to their respective kVA rating only when their

(A) kVA ratings are identical

(B) efficiencies are equal

(C) p.u. impedances are equal

(D) equivalent impedances are equal

71. A 400 V/100 V, 10 kVA two-winding transformer is reconnected as an autotransformer across a suitable voltage source. The maximum rating of such an arrangement could be

(A) 50 kVA (B) 15 kVA

(C) 12·5 kVA (D) 8·75 kVA

72. A 4-point starter is used to start and control the speed of a

(A) d.c. shunt motor with armature resistance control

(B) d.c. series motor

(C) d.c. compound motor

(D) d.c. shunt motor with field weakening control

73. If the normal system frequency is 50 Hz and if it is operating at 53 Hz, the equipment on the system most adversely affected is

(A) power transformer

(B) turbine

(C) alternator

(D) All of the above

74. A fuse wire is a wire of

(A) high resistance and low melting point

(B) high resistance and high melting point

(C) low resistance and low melting point

(D) low resistance and high melting point

75. The insulation resistance of a cable of length 10 km is 1 MΩ. For a length of 100 km of the same cable, the insulation resistance will be

(A) 1 MΩ (B) 10 MΩ

(C) 0·1 MΩ (D) 0·01 MΩ

76. The undesirable property of an electrical insulating material is

(A) high dielectric strength

(B) high relative permittivity

(C) high thermal conductivity

(D) high insulation resistivity

77. The normal practice to specify the making current of a circuit breaker is in terms of

(A) RMS value

(B) peak value

(C) average value

(D) both RMS and peak values

78. An isolator is designed to open a circuit under

(A) half load condition

(B) normal condition

(C) no-load condition

(D) full load condition

79. Buchholz relay in oil-immersed transformer provides protection against

(A) insulation failure of windings

(B) core heating

(C) fall of oil level

(D) All of the above

80. Differential relays are used to protect the equipment against

(A) overcurrent

(B) reverse current

(C) internal faults

(D) None of the above

81. What will be the wind power generation if the wind speed is double of its initial wind speed?

(A) $P = 4P_0$ (B) $P = 6P_0$

(C) $P = 8P_0$ (D) $P = 10P_0$

82. Which of the following instruments is used to measure the wind speed?

(A) Anemometer

(B) Wind vane

(C) Hydrometer

(D) Manometer

83. Which of the following is not non-conventional energy source?

(A) Coal

(B) Solar

(C) Tidal

(D) Geothermal

84. Which of the following is non-dispatchable energy source?

(A) Geothermal

(B) Solar

(C) Hydroelectric

(D) Biomass

85. Which renewable energy source uses the Earth's internal heat?

(A) Solar

(B) Tidal

(C) Biomass

(D) Geothermal

86. The material best suited for manufacturing of fuse wire is

(A) silver

(B) copper

(C) aluminium

(D) zinc

87. The cheap and temporary system of internal wiring is

(A) conduit wiring

(B) cleat wiring

(C) CTS or TRS wiring

(D) casing capping

88. The BCD code for the decimal number $(874)_{10}$ is

(A) $(100001110100)_{BCD}$

(B) $(010001111000)_{BCD}$

(C) $(100001000111)_{BCD}$

(D) $(011110000100)_{BCD}$

89. The decimal equivalent of the hexadecimal number 2A0F is

(A) 17670 (B) 17607

(C) 17067 (D) 10767

90. The output of a logic gate is "1" when all its inputs are at "0". The gate is either

(A) a NAND or an EX-OR gate

(B) a NOR or an EX-OR gate

(C) an AND or an EX-NOR gate

(D) a NOR or an EX-NOR gate

91. The Boolean expression of the output of the logic circuit shown in Fig. 3 is

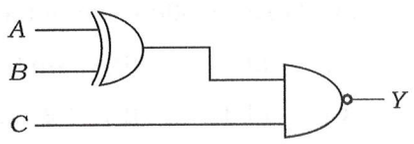

Fig. 3

(A) $Y = \bar{A}\bar{B} + AB + \bar{C}$

(B) $Y = \bar{A}\bar{B} + AB + C$

(C) $Y = \bar{A}B + \bar{A}B + C$

(D) $Y = \bar{A}B + \bar{A}\bar{B} + \bar{C}$

92. Which one of the following is the dual form of the Boolean identity?

$$AB + \bar{A}C = (A + C)(\bar{A} + B)$$

(A) $AB + \bar{A}C = AC + \bar{A}B$

(B) $(A + B) + (\bar{A} + C) = (A + C)(\bar{A} + B)$

(C) $(A + B)(\bar{A} + C) = AC + \bar{A}B$

(D) $AB + \bar{A}C = AB + \bar{A}C + BC$

93. The two's complement of $(1101100.1011)_2$ is

(A) 1101100.0101

(B) 0010011.1011

(C) 0010010.0100

(D) 0010011.0101

94. The binary number $(1101.101)_2$ is equivalent to the decimal number

(A) $(13.622)_{10}$

(B) $(13.256)_{10}$

(C) $(13.625)_{10}$

(D) $(13.652)_{10}$

95. How many bit program counters are available in 8085 microprocessor?

(A) 4-bit (B) 8-bit

(C) 16-bit (D) 32-bit

96. The maximum number of input or output devices that can be connected to 8085 microprocessor is

(A) 8 (B) 16

(C) 40 (D) 256

97. Which one of the following functions is performed by the 8085 instruction MOV H,C?

(A) Moves the contents of H register to C register

(B) Moves the contents of C register to H register

(C) Moves the contents of C register to HL pair

(D) Moves the contents of HL pair to C register

98. Which of the following will be done in an 8085 microprocessor when instruction LXI 2070 H is executed?

(A) 2070 H is loaded in H register

(B) 70 H is loaded in H register and 20 H is loaded in L register

(C) Content of memory 2070 H is loaded in H register

(D) 20 H is loaded in H register and 70 H is loaded in L register

99. The register which holds the information about the nature of results of arithmetic or logic operations is called as

(A) accumulator

(B) condition code register

(C) flag register

(D) process status register

100. In a microprocessor, the address of the next instruction to be executed is stored in

(A) stack pointer

(B) address latch

(C) program counter

(D) general-purpose register

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SEAL

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