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

Test Booklet No. : **Series**

02761

TEST BOOKLET

ELECTRICAL ENGINEERING

Paper—I

A

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. The resistance of an aluminium wire is R. Four such wires with the same cross-sectional area, but twice the length are connected in parallel. The total resistance is

(A) R

(B) $\frac{R}{2}$

(C) $\frac{R}{4}$

(D) $\frac{R}{8}$

2. Ampere-second can be the unit of

(A) charge

(B) voltage

(C) power

(D) reluctance

3. The material with lowest resistivity is

(A) manganin

(B) iron

(C) copper

(D) silver

4. A practical voltage source having an open-circuit voltage of 24 V and internal resistance of 100 mΩ is equivalent to a practical current source of

(A) 24 A in parallel of 100 mΩ

(B) 24 A in series of 100 mΩ

(C) 240 A in parallel of 100 mΩ

(D) 240 A in series of 100 mΩ

5. The node voltage V in Fig. 1 is

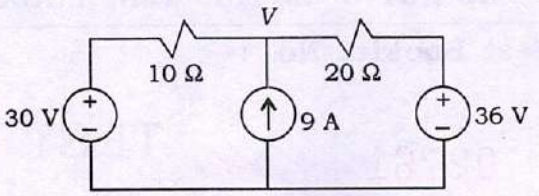


Fig. 1

(A) 92 V

(B) 36 V

(C) 30 V

(D) 6 V

6. Thevenin's equivalent circuit to the left of the terminals a and b in the circuit shown in Fig. 2 has equivalent voltage source V_{th} and equivalent resistance R_{th} respectively as

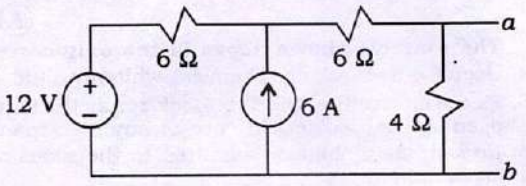


Fig. 2

(A) 12 V and 16 Ω

(B) 20 V and 3 Ω

(C) 12 V and 12 Ω

(D) 12 V and 3 Ω

7. The V-I relation for the network shown in Fig. 3 is $V = 4I - 9$. If now a resistance $R = 2\ \Omega$ is connected across it, then the value of I will be

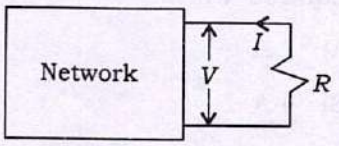


Fig. 3

(A) $-4 \cdot 5$ A

(B) $-1 \cdot 5$ A

(C) $4 \cdot 5$ A

(D) $1 \cdot 5$ A

8. Two bulbs rated 100 W, 230 V each are connected in series across 230 V, 50 Hz supply. The total power consumed by the load would be

(A) 200 W

(B) 100 W

(C) 50 W

(D) 75 W

9. Three parallel resistive branches are connected across a DC supply. What will be the ratio of branch currents $I_1 : I_2 : I_3$, if the branch resistances are in the ratio $R_1 : R_2 : R_3 = 2 : 4 : 6$?

(A) 3 : 2 : 6

(B) 6 : 3 : 2

(C) 2 : 4 : 6

(D) 6 : 2 : 4

10. A voltage source connected to a load has an EMF of 10 V and an internal impedance of $(500 + j100)\ \Omega$. The maximum power that can be transferred to the load is

(A) $0 \cdot 05$ W

(B) $0 \cdot 10$ W

(C) $0 \cdot 50$ W

(D) $0 \cdot 01$ W

11. An ideal inductor is connected across a practical DC voltage source. The inductor

(A) is an open circuit

(B) is a short circuit

(C) It depends on polarity

(D) It depends on voltage magnitude

12. A 3-phase, delta-connected symmetrical load consumes P watt of power from the 3-phase balanced supply at 50 Hz. If the same load is connected in star to the same supply, then what will be the power consumption?

(A) $\sqrt{3}P$ watt

(B) $\frac{P}{\sqrt{3}}$ watt

(C) $\frac{P}{3}$ watt

(D) $3P$ watt

13. A circuit with a resistor, an inductor and a capacitor in series is resonant at f_0 Hz. If all the component values are now doubled, then the new resonant frequency is

(A) f_0 Hz

(B) $2f_0$ Hz

(C) $4f_0$ Hz

(D) $\frac{f_0}{2}$ Hz

14. Two coils with self-inductances 1 H and 2 H having a mutual inductance of 1 H between them carry currents of 2 A and $\sqrt{2}$ A respectively. The total energy stored in the field, in joules, is

(A) $4+2\sqrt{2}$

(B) $2+\sqrt{2}$

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

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

15. In an *R-L* series circuit connected across 230 V, 50 Hz supply, the power factor of the circuit is increased if

(A) the inductive reactance is increased

(B) the inductive reactance is decreased

(C) the resistance is decreased

(D) the supply frequency is increased

16. A voltmeter must have very high resistance so that

(A) its accuracy is high

(B) its resolution is high

(C) it draws a very small amount of current

(D) it creates a very high loading effect on the circuit

17. In a moving-iron instrument, 8 A current causes a deflection of the needles over the scale by 60°. For a deflection of 15°, the current required will be

(A) 2 A

(B) 4 A

(C) 16 A

(D) 0·5 A

18. In permanent magnet moving-coil type meter, the expression for deflecting torque (T_d) will be

(A) $T_d \propto I$

(B) $T_d \propto I^2$

(C) $T_d \propto \frac{1}{I^2}$

(D) $T_d \propto \frac{1}{I}$

19. A multimeter uses different multipliers to increase the range of

(A) current

(B) voltage

(C) resistance

(D) impedance

20. The current required for FSD of a voltmeter is 10 mA. The sensitivity of the voltmeter (in Ω/V) is

(A) 100

(B) 10

(C) 0·01

(D) 0·001

21. Wien's bridge is used to measure

(A) power

(B) energy

(C) phase angle

(D) frequency

22. A potentiometer is used to measure the voltage between two points of a DC circuit, which is found to be 1·2 V. This is also measured by a voltmeter, which is found to be 0·9 V. The resistance of the voltmeter is 60 kΩ. The input resistance between the two points is

(A) 60 kΩ

(B) 45 kΩ

(C) 20 kΩ

(D) 80 kΩ

23. The current and potential coils of a wattmeter are accidentally interchanged while connecting. After energizing the circuit, it is observed that the wattmeter is not showing reading. This may be due to

(A) damage done to the potential coil

(B) damage done to the current coil

(C) damage done to both potential and current coils

(D) None of the above

24. For an unbalanced load, the method used to measure 3-phase power is

(A) three voltmeters

(B) two voltmeters and one ammeter

(C) two wattmeters

(D) one wattmeter

25. A 230 V, 1-phase, domestic energy meter has a constant load of 4 A passing through it for 6 h at unity power factor. The meter disc makes 2208 revolutions during this period. What will be the energy consumed by the load if the meter disc completes 1240 revolutions?

(A) 2·5 kWh

(B) 2·8 kWh

(C) 3·5 kWh

(D) 3·1 kWh

26. The incorrect statement is

(A) $e = -N\frac{d\phi}{dt}$

(B) $L = \frac{\mu NA}{l}$

(C) $L = \frac{\mu N^2 A}{l}$

(D) $L = N\frac{d\phi}{di}$

27. The electrical power of a DC motor, i.e., $E_b I_b$, converted to mechanical power, is equal to (T = torque, N = speed)

(A) $T \times 2\pi N$

(B) $T \times \frac{\pi N}{60}$

(C) $\frac{2\pi N}{60T}$

(D) $T \times \frac{2\pi N}{60}$

28. Generally which type of DC motor is used for high starting torque?

(A) DC series motor

(B) DC shunt motor

(C) DC compound motor

(D) All types of DC motor

29. The active and reactive powers of an inductive circuit are 60 W and 80 VAR respectively. The power factor of the circuit is

(A) 0·8 lagging

(B) 0·75 lagging

(C) 0·6 lagging

(D) 0·5 lagging

30. The voltage and current waveforms in an AC circuit are represented by

$v(t) = V_m \sin(\omega t + 15°)$

$i(t) = I_m \sin(\omega t - 45°)$

The power factor of the circuit is

(A) 0·5

(B) 0·87

(C) 0·7

(D) 0·2

31. A magnetic circuit carries a flux ϕ_i in the iron path and a flux ϕ_g in the air gap. Then the leakage coefficient is

(A) $\frac{\phi_i}{\phi_g}$

(B) $\phi_i - \phi_g$

(C) $\phi_i \times \phi_g$

(D) $\frac{\phi_g}{\phi_i}$

32. Residual magnetism of the field pole is necessary for the voltage built up in

(A) DC shunt motor

(B) DC shunt generator

(C) DC series motor

(D) DC compound motor

33. The number of parallel paths of the armature winding of 8-pole, 250 V, wave-wound DC machine, having 1500 armature conductors, is

(A) 4

(B) 6

(C) 2

(D) 8

34. The flux in a transformer core

(A) increases with load

(B) decreases with load

(C) remains constant irrespective of load

(D) first increases and then decreases gradually

35. In a slip-ring induction motor, high starting torque is achieved by

(A) increasing supply voltage

(B) increasing supply frequency

(C) connecting a capacitor across the motor terminals

(D) connecting a star-connected resistance across the slip-ring terminals of the motor

36. For speed control of DC motors using controlled rectifiers, armature voltage control gives

(A) speed above the rated speed

(B) speed below the rated speed

(C) speed above as well as below the rated speed

(D) any speed

37. If the field circuit resistance of a DC shunt generator exceeds its critical value, the generator

(A) fails to build up voltage

(B) builds up very high voltage

(C) exceeds its current capacity

(D) None of the above

38. The efficiency of a DC machine will be maximum if

(A) the speed is very high

(B) the variable loss is equal to constant loss

(C) the winding is lap winding

(D) there is no friction loss

39. The purpose of using interpoles in DC machines is to nullify

(A) the demagnetizing effect of armature m.m.f.

(B) the cross-magnetizing effect of armature m.m.f.

(C) the reactance voltage

(D) Both (B) and (C)

40. A 250 V DC generator is run at rated speed with no excitation. The open-circuit voltage will be

(A) zero

(B) very small, say 2 V or 3 V

(C) about 100 V

(D) 250 V

41. A DC shunt motor runs at 500 r.p.m. at 220 V. A resistance of 4·5 Ω is added in series with the armature for speed control. The armature resistance is 0·5 Ω. The current to stall the motor is

(A) 50 A

(B) 44·4 A

(C) 44 A

(D) 60 A

42. A conducting SCR can be turned off by

(A) reducing the anode current below the holding current

(B) decreasing the voltage applied across the SCR

(C) removing the gate terminal connection

(D) applying negative gate voltage

43. The *V-I* characteristics of an element are shown in Fig. 4. The element is

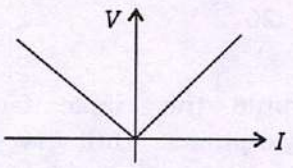


Fig. 4

(A) non-linear, active and non-bilateral

(B) linear, active and non-bilateral

(C) non-linear, passive and non-bilateral

(D) non-linear, active and bilateral

44. If the length of a bar of magnetic material is increased by 20% and the cross-sectional area is decreased by 20%, then the reluctance

(A) is increased by 50%

(B) remains the same

(C) is decreased by 33%

(D) is increased by 67%

45. With the positive half-cycle of the sinusoidal input, the maximum V_o (Fig. 5) will be

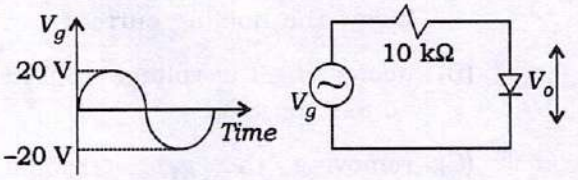


Fig. 5

(A) 20 V

(B) zero

(C) -20 V

(D) $20\sqrt{2}$ V

46. Compute the ripple factor of a single-phase, full-wave rectifier with load resistance 10 kΩ. The forward bias dynamic resistance of the diodes used is 100 Ω. The RMS voltage across the secondary winding is 330 V.

(A) 4·82

(B) 1·21

(C) 0·812

(D) 0·482

47. The average value over a half-cycle of the sinusoidal current

$$i(t) = I_m \cos(\omega t + 45°)$$

is

(A) $\frac{I_m}{\pi}$

(B) $\frac{I_m}{2\pi}$

(C) $\frac{2I_m}{\pi}$

(D) $\frac{2I_m}{3\pi}$

48. The magnetic field around a current-carrying conductor is given by

(A) Lenz's law

(B) Fleming's left-hand rule

(C) Fleming's right-hand rule

(D) corkscrew rule

49. The magnetic field energy in an inductor changes from maximum value to minimum value in 5 ms when connected to an AC source. The frequency of the source is

(A) 500 Hz

(B) 50 Hz

(C) 200 Hz

(D) 20 Hz

50. If the magnetic susceptibility of any material is less than zero, then the material is

(A) paramagnetic

(B) ferromagnetic

(C) diamagnetic

(D) ferrimagnetic

51. The maximum demand of a power plant is 400 MW. The capacity factor is 0·5 and the utilization factor is 0·8. The load factor will be

(A) 0·8

(B) 0·5

(C) 0·625

(D) 40

52. A single-phase transformer installed in a control room has a name plate indicating 200 kVA, 11 kV/415 V, 50 Hz. During a routine inspection, an engineer needs to verify the rated secondary voltage. At what condition should the engineer measure this secondary voltage to confirm it matches the name plate rating?

(A) At full load with rated current on the secondary side

(B) At no load with secondary winding open and primary voltage half the rated value

(C) At no load with rated voltage applied to the primary winding

(D) At short circuit with primary voltage set to zero

53. If a 500 kVA, 200 Hz transformer is operated at 50 Hz, its kVA rating will be

(A) 1000 kVA

(B) 125 kVA

(C) 2000 kVA

(D) 250 kVA

54. A 3-phase transformer has its primary connected in delta and secondary in star. The secondary to primary turns ratio per phase is 6. For the primary voltage of 200 V, the secondary voltage would be

(A) 2078 V

(B) 1200 V

(C) 693 V

(D) 58 V

55. In synchronous motor, the minimum armature current occurs at

(A) zero power factor

(B) leading power factor

(C) lagging power factor

(D) unity power factor

56. If a 10-pole, 25 Hz alternator is directly coupled to and is driven by 60 Hz synchronous motor, then the number of poles in the synchronous motor is

(A) 24

(B) 48

(C) 12

(D) 6

57. An alternator is supplying a load of 300 kW at a power factor of 0·6 lagging. If the power factor is raised to unity, how many more kW can it supply?

(A) 300 kW

(B) 100 kW

(C) 200 kW

(D) 150 kW

58. A distribution transformer usually is a

(A) star-delta transformer

(B) delta-star transformer

(C) star-star transformer

(D) delta-delta transformer

59. A single-phase induction motor with only the main winding excited would exhibit which of the following responses at synchronous speed?

(A) Rotor current is zero

(B) Rotor current is non-zero and is at slip frequency

(C) Forward and backward rotating fields are equal

(D) Forward rotating field is more than the backward rotating field

60. In a split-phase motor

(A) the starting winding is connected through a centrifugal switch

(B) the running winding is connected through a centrifugal switch

(C) both starting and running windings are connected through a centrifugal switch

(D) centrifugal switch is used to control the supply voltage

61. Increase in rotor circuit resistance of an induction motor will

(A) increase the starting torque

(B) decrease the starting torque

(C) increase the maximum torque developed

(D) decrease the maximum torque developed

62. In alternator, damper windings are used to

(A) prevent hunting

(B) reduce eddy current loss

(C) reduce armature reaction

(D) reduce both eddy current and hysteresis losses

63. Which of the following motors is suitable for elevators, small cranes and hoists, large cranes and hoists?

(A) 3-phase, squirrel-cage induction motor

(B) 3-phase, slip-ring induction motor

(C) DC series motor

(D) All of the above

64. In a capacitor-start, single-phase induction motor, the capacitor is connected

(A) in series with the main winding

(B) in series with the auxiliary winding

(C) across the supply terminals

(D) in parallel with the auxiliary winding

65. Which of the following faults is coming under symmetrical fault?

(A) LG fault

(B) LLG fault

(C) LL fault

(D) LLLG fault

66. For short transmission line, the transfer matrix is given in terms of impedance Z as

(A) $\begin{bmatrix} 1 & Z \\ 0 & 1 \end{bmatrix}$

(B) $\begin{bmatrix} 1 & 0 \\ 1 & Z \end{bmatrix}$

(C) $\begin{bmatrix} 1 & Z \\ 0 & 0 \end{bmatrix}$

(D) $\begin{bmatrix} 1 & 1 \\ Z & 1 \end{bmatrix}$

67. For a short transmission line with R/X ratio 1·0, the voltage regulation will be zero when the load power factor is

(A) unity

(B) 0·707 (leading)

(C) 0·707 (lagging)

(D) None of the above

68. Low power factor has the drawback of

(A) increased transmission and distribution losses

(B) poor voltage regulation

(C) high cost of equipment for a given load

(D) All of the above

69. Admittance relay is a/an

(A) directional relay

(B) non-directional relay

(C) impedance relay

(D) None of the above

70. The corona of a transmission line is ***not*** affected by the

(A) conductor size

(B) spacing between the conductors

(C) line voltage

(D) location of the transmission line

71. Synchronous condenser is a/an

(A) static capacitor

(B) over-excited, no-load synchronous motor

(C) under-excited synchronous motor

(D) induction motor running at no load

72. A string insulator has 5 units. The voltage across the bottommost unit is 25% of the total voltage. The string efficiency is

(A) 25%

(B) 50%

(C) 80%

(D) 75%

73. In substations, instrument transformers are for

(A) protection

(B) measurement

(C) stability

(D) Both (A) and (B)

74. Which type of hydroturbine is used for medium-head applications?

(A) Francis turbine

(B) Pelton turbine

(C) Kaplan turbine

(D) Propeller turbine

75. The minimum clearance distance the equipments should be kept away from 11 kV power lines is

(A) 20 feet

(B) 10 feet

(C) 15 feet

(D) 5 feet

76. Which distribution system is more reliable?

(A) Ring main system

(B) Tree system

(C) Radial system

(D) All are equally reliable

77. The maximum demand on a power station is 600 MW, the annual load factor is 60% and the capacity factor is 45%. The plant capacity is

(A) 600 MW

(B) 1000 MW

(C) 1200 MW

(D) 800 MW

78. When V-V system is converted into Δ-Δ system, the capacity of the system is increased by

(A) 86·6%

(B) 66·7%

(C) 73·2%

(D) 50%

79. An iron-cored choke coil when connected to a 15 V DC supply draws a current of 1·5 A. When connected to 230 V, 50 Hz supply, it takes 2 A current and consumes 60 W. The iron loss in the core is

(A) 20 W

(B) 40 W

(C) 7·5 W

(D) 10 W

80. The power plant generally used for peak load is

(A) nuclear power plant

(B) thermal power plant

(C) gas-based power plant

(D) pumped storage hydropower plant

81. In induction heating

(A) heat is produced due to currents induced in the charge by electromagnetic action

(B) the resistance of the charge must be low and voltage applied must be high in order to provide sufficient heat

(C) magnetic materials can be easily treated in comparison to non-magnetic materials

(D) All of the above

82. The internal fault of transformers is protected by

(A) thermal overload relay

(B) Buchholz relay

(C) over-current relay

(D) directional relay

83. A balanced 3-phase system consists of

(A) zero sequence current only

(B) positive sequence current only

(C) negative and zero sequence currents only

(D) zero, negative and positive sequence currents

84. The single-phasing relays are used for the protection of

(A) single-phase motors only

(B) two-phase motors only

(C) two single-phase motors running in parallel

(D) three-phase motors

85. If iron core of an iron-cored coil is removed so as to get an air-cored coil, the new inductance of the coil

(A) increases

(B) decreases

(C) remains the same

(D) becomes zero

86. In synchronous motor, V-curves represent the variation of

(A) armature current with excitation current

(B) excitation current with stalling torque

(C) armature current with maximum power developed

(D) excitation current with minimum power developed

87. Where voltages are high and current to be interrupted is low, the circuit breaker preferred is

(A) air break

(B) vacuum

(C) oil

(D) air blast

88. The relay with inverse time characteristics will operate within

(A) 2 s

(B) 5 s to 10 s

(C) 5 s to 20 s

(D) 20 s to 30 s

89. The snubber circuit is used in thyristor circuits for

(A) triggering

(B) $\frac{dv}{dt}$ protection

(C) $\frac{di}{dt}$ protection

(D) phase shifting

90. In motor operations, if at any time _____, the motor will accelerate.

(A) $T_e > T_L$

(B) $T_e = T_L$

(C) $T_e < T_L$

(D) $T_e = -T_L$

91. In the fourth quadrant of operation of electrical drives, what is the nature of operation of DC motor?

(A) Forward regeneration

(B) Forward motoring

(C) Reverse motoring

(D) Reverse regeneration

92. Which of the following is ***not*** an advantage of DC transmission?

(A) No charging current

(B) No skin effect

(C) No stability problem

(D) Cheap converters

93. Which of the following is the fastest switching device?

(A) JFET

(B) BJT

(C) MOSFET

(D) Triode

94. When the firing angle α of a single-phase, fully controlled rectifier feeding constant DC current into the load is 30°, what is the displacement factor of the rectifier?

(A) 1

(B) 0·5

(C) $\sqrt{3}$

(D) $\frac{\sqrt{3}}{2}$

95. Thyristor is a semiconductor switch which is

(A) unilateral and stable

(B) bilateral and astable

(C) unilateral and bistable

(D) bilateral and bistable

96. In a single-phase, half-wave controlled rectifier, if the input voltage is $400 \sin (314t)$ V, the average output voltage for a firing angle of 60° is

(A) $\frac{100}{\pi}$ V

(B) $\frac{200}{\pi}$ V

(C) $\frac{300}{\pi}$ V

(D) $\frac{400}{\pi}$ V

97. Which among the following is a current-controlled device?

(A) MOSFET

(B) BJT

(C) IGBT

(D) JFET

98. Which of the following is a trivalent doping element?

(A) Arsenic

(B) Antimony

(C) Boron

(D) Phosphorus

99. The difference between the two binary numbers 10010000 and 1111001 is

(A) 11101

(B) 11011

(C) 10111

(D) 10011

100. Which of the following expressions is in the sum-of-products (SOP) form?

(A) $AB + CD$

(B) $AB(CD)$

(C) $(A + B)(C + D)$

(D) $(A)B(CD)$

SPACE FOR ROUGH WORK