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Engineering Service (P) Exam, 2019

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T.B.C. : VBY-S-ETE

Test Booklet Series

A

1052997

Serial

TEST BOOKLET

ELECTRICAL ENGINEERING

Time Allowed : Three Hours *Maximum Marks : 300*

INSTRUCTIONS

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2. **Please note that it is the candidate's responsibility to encode and fill in the Roll Number and Test Booklet Series Code A, B, C or D carefully and without any omission or discrepancy at the appropriate places in the OMR Answer Sheet. Any omission/discrepancy will render the Answer Sheet liable for rejection.**
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THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE.

(i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third (0·33)** of the marks assigned to that question will be deducted as penalty.

(ii) If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that question.

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1. What are the values of k for which the system of equations

$$(3k-8)x + 3y + 3z = 0$$
$$3x + (3k-8)y + 3z = 0$$
$$3x + 3y + (3k-8)z = 0$$

has a non-trivial solution ?

(a) $k = \frac{2}{3}, \frac{11}{3}, \frac{10}{3}$

(b) $k = \frac{2}{3}, \frac{10}{3}, \frac{11}{3}$

(c) $k = \frac{11}{3}, \frac{11}{3}, \frac{11}{3}$

(d) $k = \frac{2}{3}, \frac{11}{3}, \frac{11}{3}$

2. If

$$A = \begin{bmatrix} 2+i & 3 & -1+3i \\ -5 & i & 4-2i \end{bmatrix},$$

then AA* will be

(where, A* is the conjugate transpose of A)

(a) Unitary matrix

(b) Orthogonal matrix

(c) Hermitian matrix

(d) Skew Hermitian matrix

3. If $y = 2x^3 - 3x^2 + 3x - 10$, the value of $\Delta^3 y$ will be

(where, Δ is forward differences operator)

(a) 10

(b) 11

(c) 12

(d) 13

4. The solution of the differential equation

$$x^2 \frac{d^2y}{dx^2} - x\frac{dy}{dx} + y = \log x \text{ is}$$

(a) $y = (c_1 + c_2 x)\log x + 2\log x + 3$

(b) $y = (c_1 + c_2 x^2)\log x + \log x + 2$

(c) $y = (c_1 + c_2 x)\log x + \log x + 2$

(d) $y = (c_1 + c_2 \log x)x + \log x + 2$

5. The area between the parabolas

$y^2 = 4ax$ and $x^2 = 4ay$ is

(a) $\frac{2}{3}a^2$

(b) $\frac{14}{3}a^2$

(c) $\frac{16}{3}a^2$

(d) $\frac{17}{3}a^2$

6. The volume of the solid surrounded by the surface

$$\left(\frac{x}{a}\right)^{2/3} + \left(\frac{y}{b}\right)^{2/3} + \left(\frac{z}{c}\right)^{2/3} = 1$$

is

(a) $\frac{4\pi abc}{35}$

(b) $\frac{abc}{35}$

(c) $\frac{2\pi abc}{35}$

(d) $\frac{\pi abc}{35}$

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7. The solution of the partial differential equation

$$x^2 \frac{\partial z}{\partial x} + y^2 \frac{\partial z}{\partial y} = (x + y)\, z \quad \text{is}$$

(a) $f\left(\frac{1}{x} - \frac{1}{y}, \frac{xy}{z}\right) = 0$

(b) $f\left(\frac{1}{xy}, \frac{xy}{z}\right) = 0$

(c) $f\left(\frac{1}{x} - \frac{1}{y}, xyz\right) = 0$

(d) $f\left(\frac{1}{x} + \frac{1}{y} + \frac{1}{z}, \frac{xy}{z}\right) = 0$

8. The complex number $\left(\frac{2+i}{3-i}\right)^2$ is

(a) $\frac{1}{2}\left(\cos\frac{\pi}{4} + i \sin\frac{\pi}{4}\right)$

(b) $\frac{1}{2}\left(\cos\frac{\pi}{2} + i \sin\frac{\pi}{2}\right)$

(c) $\frac{1}{2}(\cos\pi + i \sin\pi)$

(d) $\frac{1}{2}\left(\cos\frac{\pi}{6} + i \sin\frac{\pi}{6}\right)$

9. If n is a positive integer then,

$$(\sqrt{3} + i)^n + (\sqrt{3} - i)^n \quad \text{is}$$

(a) $2^n \sin\frac{n\pi}{6}$

(b) $2^n \cos\frac{n\pi}{6}$

(c) $2^{n+1} \cos\frac{n\pi}{6}$

(d) $2^{n+1} \sin\frac{n\pi}{6}$

10. The nature of singularity of function

$$f(z) = \frac{1}{\cos z - \sin z} \text{ at } z = \frac{\pi}{4} \text{ is}$$

(a) Removable singularity
(b) Isolated singularity
(c) Simple pole
(d) Essential singularity

11. If X is a discrete random variable that follows Binomial distribution, then which one of the following response relations is correct ?

(a) $P(r+1) = \frac{n-r}{r+1} P(r)$

(b) $P(r+1) = \frac{p}{q} P(r)$

(c) $P(r+1) = \frac{n+r}{r+1}\frac{p}{q} P(r)$

(d) $P(r+1) = \frac{n-r}{r+1}\frac{p}{q} P(r)$

12. If the probability that an individual suffers a bad reaction from a certain infection is 0·001, what is the probability that out of 2000 individuals, more than 2 individuals will suffer a bad reaction ?

(a) $\frac{1}{2} - \frac{5}{e^2}$

(b) $1{\cdot}2 - \frac{5}{e^2}$

(c) $1 - \frac{5}{e^2}$

(d) $\frac{5}{e^2}$

13. Materials in which the atomic order extends uninterrupted over the entirety of the specimen; under some circumstances, they may have flat faces and regular geometric shapes, are called

(a) Anisotropy
(b) Crystallography
(c) Single crystals
(d) Crystal system

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14. Which material possesses the following properties ?

- Shining white colour with lustre
- Soft, malleable and can be drawn into wires
- Poor in conductivity and tensile strength
- Used in making alloys with lead and copper
- Used for fuses and cable sheathing

(a) Silver
(b) Tin
(c) Nickel
(d) Aluminium

15. The saturation magnetization for Fe_3O_4, given that each cubic unit cell contains 8 Fe^{2+} and 16 Fe^{3+} ions, where Bohr magneton is $9{\cdot}274 \times 10^{-24}$ A.m^2 and that the unit cell edge length is 0·839 nm, will be

(a) $1{\cdot}25 \times 10^5$ A/m
(b) 5×10^5 A/m
(c) 10×10^5 A/m
(d) 20×10^5 A/m

16. Consider the following applications of the materials :

- Bismuth strontium calcium copper oxide used as a high temperature superconductor
- Boron carbide used in helicopter and tank armour
- Uranium oxide used as fuel in nuclear reactors
- Bricks used for construction

The materials used in these applications can be classified as

(a) Ceramic
(b) Constantan
(c) Manganin
(d) Tantalum

17. The saturation flux density for Nickel having density of 8·90 g/cm^3, atomic number 58·71 and net magnetic moment per atom of 0·6 Bohr magnetons is nearly

(a) 0·82 tesla
(b) 0·76 tesla
(c) 0·64 tesla
(d) 0·52 tesla

18. The temperature at which iron ceases to be ferromagnetic and becomes paramagnetic is

(a) Curie-Weiss point
(b) Thermo-magnetic point
(c) Ferro-paramagnetic point
(d) Curie point

19. Fick's laws refer to

(a) Finding whether a semiconductor is *n* or *p* type
(b) Diffusion
(c) Crystal imperfections
(d) Electric breakdown

20. A magnetic field applied perpendicular to the direction of motion of a charged particle exerts a force on the particle perpendicular to both the magnetic field and the direction of motion of the particle. This phenomenon results in

(a) Flux effect
(b) Hall Effect
(c) Magnetic field effect
(d) Field effect

21. An electric kettle is marked 500 W, 230 V and is found to take 15 minutes to bring 1 kg of water at 15°C to 100°C. If the specific heat of water is 4200 J/kg/°C, the heat efficiency of the kettle will be

(a) 87·3%
(b) 83·6%
(c) 79·3%
(d) 75·6%

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22. With reference to nano materials, the prefix nano stands for

(a) Nano centimetre

(b) Nanometre

(c) Nano micrometre

(d) Nano millimetre

23. Consider the following applications :

- High temperature heat engines
- Nuclear fusion reactors
- Chemical processing industry
- Aeronautical and space industry

Which one of the following materials will be used for these applications ?

(a) Zirconia

(b) Alumina

(c) Ceramic

(d) Silicon carbide

24. The machine used for the preparation of nano particles of alumina is

(a) Attrition mill

(b) Grinding machine

(c) Vending machine

(d) Welding machine

25. If the voltage across an element in a circuit is linearly proportional to the current through it, then it is a

(a) Capacitor

(b) Transformer

(c) Resistor

(d) Inductor

26. Thevenin's equivalent circuit consists of

(a) Current source and series impedance

(b) Voltage source and series impedance

(c) Voltage source and shunt impedance

(d) Current source and shunt impedance

27. When the voltage sources are replaced with short circuits and current sources are replaced with open circuits, leaving dependent sources in the circuit, the theorem applied is

(a) Superposition

(b) Thevenin

(c) Norton

(d) Millman

28. The maximum power is delivered from a source to a load when the source resistance is

(a) Greater than the load resistance

(b) Equal to zero

(c) Less than the load resistance

(d) Equal to the load resistance

29. A network delivers maximum power to the load resistance when it is

(a) Greater than Norton's equivalent resistance of the network

(b) Equal to Thevenin's equivalent resistance of the network

(c) Less than source resistance

(d) Less than Norton's equivalent resistance of the network

30. The impedance of a parallel circuit is $(10 - j\ 30)\ \Omega$ at 1 MHz. The values of circuit elements will be

(a) $10\ \Omega$ and 6·4 mH

(b) $100\ \Omega$ and 4·7 nF

(c) $10\ \Omega$ and 4·7 mH

(d) $100\ \Omega$ and 6·4 nF

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31. The defining equations for V_1 and V_2 analyzing a two-port network in terms of its impedance parameters are respectively

(a) $Z_{12}I_1 + Z_{12}I_2$ and $Z_{21}I_1 + Z_{21}I_2$

(b) $Z_{11}I_1 + Z_{12}I_2$ and $Z_{21}I_1 + Z_{22}I_2$

(c) $Z_{21}I_1 + Z_{21}I_2$ and $Z_{12}I_1 + Z_{12}I_2$

(d) $Z_{12}I_1 + Z_{12}I_2$ and $Z_{22}I_1 + Z_{22}I_2$

32. A filter that allows high and low frequencies to pass but attenuates any signal with a frequency between two corner frequencies is a

(a) Notch filter

(b) Band pass filter

(c) Band stop filter

(d) Multiband filter

33. When a number of two-port networks are cascaded then

(a) z-parameters are added up

(b) y-parameters are added up

(c) h-parameters are multiplied

(d) ABCD-parameters are multiplied

34. A 3-phase star-connected 1000 volt alternator supplies power to a 500 kW delta-connected induction motor. If the motor power factor is 0·8 lagging and its efficiency 0·9, then the current in each alternator and motor phase respectively are nearly

(a) 321 A and 231·5 A

(b) 401 A and 231·5 A

(c) 321 A and 185·4 A

(d) 401 A and 185·4 A

35. Consider the following statements :

1. Mutual inductance describes the voltage induced at the ends of a coil due to the magnetic field generated by a second coil.
2. The dot convention allows a sign to be assigned to the voltage induced due to mutual inductance term.
3. The coupling coefficient is given by $k = \frac{M}{\sqrt{L_1 + L_2}}$.

Which of the above statements are correct ?

(a) 1, 2 and 3

(b) 1 and 3 only

(c) 1 and 2 only

(d) 2 and 3 only

36. Consider the following statements :

1. The rules for series and parallel combinations of capacitors are opposite to those for resistors.
2. The rules for series and parallel combinations of inductors are same as those for resistors.
3. An inductor is a short circuit to dc currents.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

37. The standard resistor is a coil of wire of some alloy having the properties of

(a) Low electrical resistivity and high temperature coefficient of resistance

(b) High electrical resistivity and high temperature coefficient of resistance

(c) Low electrical resistivity and low temperature coefficient of resistance

(d) High electrical resistivity and low temperature coefficient of resistance

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38. Which one of the following materials is used for the swamping resistance of moving coil instruments ?

(a) Carbon

(b) Manganin

(c) Silver

(d) Brass

39. In a PMMC instrument, the swamping resistor is used to

(a) Increase the damping of the instrument

(b) Reduce the current within safe limits

(c) Compensate for temperature variations

(d) Increase the full-scale sensitivity

40. A moving coil ammeter has a fixed shunt of 0·02 Ω. With a coil resistance of R = 1000 Ω and a potential difference of 500 mV across it, full scale deflection is obtained. The current through the moving coil to give full scale deflection will be

(a) 25 A

(b) $0{\cdot}5 \times 10^{-2}$ A

(c) $0{\cdot}25 \times 10^{-3}$ A

(d) $0{\cdot}5 \times 10^{-3}$ A

41. A moving iron instrument has full scale current of 100 mA. It is converted into a 250 V voltmeter by using a series resistance made of a material having negligible resistance temperature coefficient. The meter has a resistance of 320 Ω at 20°C. After carrying a steady current of 100 mA for a long time, the resistance of the coil increases to 369 Ω due to self heating. When a voltage of 250 V is applied continuously, the error due to self-heating will be nearly

(a) – 1·1%

(b) – 1·9%

(c) – 2·5%

(d) – 3·3%

42. There will be serious errors if power factor of non-sinusoidal waveform is measured by electrodynamometer power factor meter. This is true for

(a) Single-phase meters alone

(b) 3-phase meters only

(c) Both Single-phase meters and 3-phase meters

(d) 3-phase meters with balanced loads

43. The ramp type digital voltmeter can measure accurately with

(a) A positive going ramp voltage only

(b) A negative or positive going linear ramp voltage

(c) A negative going ramp voltage only

(d) An asymptotic ramp voltage only

44. The self-capacitance of a coil is measured by the resonating capacitor. The measurement gives the value of tuning capacitor as $C_1 = 460$ pF at a frequency, $f_1 = 2$ MHz. The second measurement at $f_2 = 4$ MHz yields a new value of tuning capacitor, $C_2 = 100$ pF. The distributed capacitance C_d will be

(a) 10 pF

(b) 20 pF

(c) 30 pF

(d) 40 pF

45. Vertical delay line in CRO

(a) Gives proper time for thermionic emission of electrons

(b) Delays the signal voltage by 200 ns

(c) Allows the horizontal sweep to start prior to vertical deflection

(d) Delays the generation of sweep voltage

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46. A 0 – 150 V voltmeter has a guaranteed accuracy of 1% full scale reading. The voltage measured by this instrument is 83 V. The limiting error will be nearly

(a) 1·2%

(b) 1·8%

(c) 2·4%

(d) 3·2%

47. The variations in the measured quantity due to sensitivity of transducer to any plane other than the required plane is

(a) Cross sensitivity

(b) Sensitivity

(c) Interference

(d) Distributed sensitivity

48. A resistance strain gauge with a gauge factor of 2 is fastened to a steel member subjected to a stress of 1050 kg/cm^2. The modulus of elasticity of steel is $2{\cdot}1 \times 10^6$ kg/cm^2. The change in resistance ΔR of the strain gauge element due to the applied stress will be

(a) 0·1%

(b) 0·2%

(c) 0·3%

(d) 0·4%

49. In which one of the following classes of computers, is the relationship between architecture and organization very close ?

(a) Microcomputers

(b) Mini computers

(c) Mainframe computers

(d) Super computers

50. The decimal equivalent of binary number 1001·101 is

(a) 9·750

(b) 9·625

(c) 10·750

(d) 10·625

51. Convert decimal 41·6875 into equivalent binary :

(a) 100101·1011

(b) 100101·1101

(c) 101001·1011

(d) 101001·1101

52. The Central Processing Unit (CPU) consists of

(a) ALU and Control unit only

(b) ALU, Control unit and Registers only

(c) ALU, Control unit and System bus only

(d) ALU, Control unit, Registers and Internal bus

53. When enough total memory space exists to satisfy a request, but it is not contiguous, then this problem is known as

(a) Internal Fragmentation

(b) External Fragmentation

(c) Overlays

(d) Partitioning

54. The total average read or write time T_{total} is

(a) $T_s + \frac{1}{2r} + \frac{b}{N}$

(b) $T_s + \frac{1}{2r} + \frac{b}{rN}$

(c) $\frac{T_s}{rN} + \frac{b}{N}$

(d) $T_s + 2r + \frac{b}{rN}$

where,

T_s = average seek time

b = number of bytes to be transferred

N = number of bytes on a track

r = rotation speed, in revolutions per second

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55. If a cache has 64-byte cache lines, how long does it take to fetch a cache line if the main memory takes 20 cycles to respond to each memory request and returns 2 bytes of data in response to each request ?

(a) 980 cycles

(b) 640 cycles

(c) 320 cycles

(d) 160 cycles

56. Which of the following statements are correct about SRAM ?

1. It provides faster access as compared to DRAM.
2. It is cheaper than DRAM.
3. It is more expensive than DRAM.
4. It has higher bit density than DRAM.

(a) 1 and 4 only

(b) 1 and 3 only

(c) 1, 3 and 4 only

(d) 2 and 4 only

57. Features of solid state drives (SSDs) are

1. High-performance in input/output operations per second
2. More power consumption than comparable size HDDs
3. Lower access times and latency rates
4. More susceptible to physical shock and vibration

(a) 2 and 3 only

(b) 2 and 4 only

(c) 1 and 3 only

(d) 1 and 4 only

58. The decimal value of signed binary number 11101000 expressed in 1's complement is

(a) – 223

(b) – 184

(c) – 104

(d) – 23

59. The memory management function of virtual memory includes

1. Space allocation
2. Program relocation
3. Program execution
4. Code sharing

(a) 1, 2 and 3 only

(b) 1, 2 and 4 only

(c) 1, 3 and 4 only

(d) 2, 3 and 4 only

60. Which of the following instructions of 8085 are the examples of implied addressing ?

1. CMA
2. IN byte
3. RET

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1 and 3 only

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61. The important fact about the collector current is

(a) It is greater than emitter current

(b) It equals the base current divided by the current gain

(c) It is small

(d) It approximately equals the emitter current

62. What is Shockley's equation of a semiconductor diode in the forward bias regions ?

(a) $I_D = I_S (e^{V_D^2 / nV_T} - 1)$

(b) $I_D = I_S (e^{V_D / nV_T} - 1)$

(c) $I_D = I_S (e^{nV_D / V_T} - 1)$

(d) $I_D = I_S (e^{V_T / nV_D} - 1)$

where

I_S is reverse saturation current

V_D is applied forward-bias voltage across the diode

V_T is thermal voltage

n is an ideality factor

63. The thermal voltage V_T of a semiconductor diode at 27°C temperature is nearly

(a) 17 mV

(b) 20 mV

(c) 23 mV

(d) 26 mV

64. The disadvantage of a typical MOSFET as compared to BJT is

(a) Increased power-handling levels

(b) Reduced power-handling levels

(c) Increased voltage-handling levels

(d) Reduced voltage-handling levels

65. Which one of the following conditions will be satisfied for an impedance matched system ?

(a) The decibel power gain is equal to twice the decibel voltage gain

(b) The decibel power gain is equal to the decibel voltage gain

(c) The decibel power gain is half the decibel voltage gain

(d) The decibel power gain is equal to thrice the decibel voltage gain

66. For most FET configurations and for common-gate configurations, the input impedances are respectively

(a) High and high

(b) High and low

(c) Low and low

(d) Low and high

67. The dB gain of cascaded systems is simply

(a) The square of the dB gains of each stage

(b) The sum of the dB gains of each stage

(c) The multiplication of the dB gains of each stage

(d) The division of the dB gains of each stage

68. The Miller effect input capacitance C_{M_i} is

(a) $(1 - A_V^2)\, C_f$

(b) $(1 - A_V)\, C_f$

(c) $(1 - C_f)\, A_V$

(d) $(1 - C_f^2)\, A_V$

where

C_f = feedback capacitance

$A_V = \frac{V_o}{V_i}$

69. For an op-amp having a slew rate of 2 V/μs, if the input signal varies by 0·5 V in 10 μs, the maximum closed-loop voltage gain will be

(a) 50

(b) 40

(c) 22

(d) 20

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70. A negative feedback amplifier where an input current controls an output voltage is called

(a) Current amplifier
(b) Transconductance amplifier
(c) Transresistance amplifier
(d) Voltage amplifier

71. In emergency lighting system, the component used for maintaining the charge on the battery is

(a) LED
(b) Shockley diode
(c) Thermistor
(d) SCR

72. For RC phase shift oscillator using FET, the gain of the amplifier stage must be practically somewhat greater than

(a) 27
(b) 28
(c) 29
(d) 30

73. The time delay in a look-ahead carry adder is independent of

(a) Number of operands only
(b) Propagation delay only
(c) Number of bits in the operand only
(d) Bits in the operand, number of operands and propagation delay

74. The time delay Δt introduced by a SISO shift register in digital signals is given by

(a) $N^2 \times \frac{1}{f_c}$

(b) $N^2 \times f_c$

(c) $\frac{f_c}{N}$

(d) $N \times \frac{1}{f_c}$

where

N is the number of stages

f_c is the clock frequency

75. An analog output voltage for the input 1001 to a 4 bit D/A converter for all possible inputs assuming the proportionality factor K = 1 will be

(a) 9
(b) 6
(c) 3
(d) 1

76. In microprocessor interface, the concept of detecting some error condition such as 'no match found' is called

(a) Syntax error
(b) Semantic error
(c) Logical error
(d) Error trapping

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

(a) 8
(b) 16
(c) 40
(d) 256

78. The contents of the accumulator and register C are 2EH and 6CH respectively. The instruction ADD C is used. The values of AC and P flags are

(a) 0 and 0
(b) 1 and 1
(c) 0 and 1
(d) 1 and 0

79. When an information signal is multiplied by an auxiliary sinusoidal signal to translate its frequency, the modulation is called

(a) Phase modulation
(b) Frequency modulation
(c) Amplitude modulation
(d) Quadrature amplitude modulation

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80. The transmission power efficiency for a tone modulated signal with modulated index of 0·5 will be nearly

(a) 6·7%

(b) 11·1%

(c) 16·7%

(d) 21·1%

81. For practical purposes, the signal to noise ratio for acceptable quality transmission of analog signals and digital signals respectively are

(a) 10 – 30 dB and 05 – 08 dB

(b) 40 – 60 dB and 10 – 12 dB

(c) 60 – 80 dB and 20 – 24 dB

(d) 70 – 90 dB and 30 – 36 dB

82. The discrete samples of an analog signal are to be uniformly quantized for PCM system. If the maximum value of the analog sample is to be represented within 0·1% accuracy, then minimum number of binary digits required will be nearly

(a) 7

(b) 9

(c) 11

(d) 13

83. A signal :

$m(t) = 2 \cos 6000 \pi t + 4 \cos 8000 \pi t + 6 \cos 10000 \pi t$

is to be truthfully represented by its samples. The minimum sampling rate using band pass consideration will be

(a) 5,000 Hz

(b) 10,000 Hz

(c) 15,000 Hz

(d) 20,000 Hz

84. If 'N' signals are multiplexed using PAM band limited to f_M, the channel bandwidth need ***not*** be larger than

(a) $N \cdot \frac{f_M}{2}$

(b) $N \cdot f_M$

(c) $2N \cdot f_M$

(d) $N^2 \cdot f_M$

85. A linear discrete-time system is characterized by its response $h_k(n) = (n - k)u(n - k)$ to a delayed unit sample $\delta(n - k)$. The system will be

(a) Shift invariant

(b) Shift variant

(c) Scale invariant

(d) Scale variant

86. Consider the analog signal

$x_a(t) = 3 \cos 100 \pi t.$

The minimum sampling rate F_s required to avoid aliasing will be

(a) 100 Hz

(b) 200 Hz

(c) 300 Hz

(d) 400 Hz

87. The response of the system $y(n) = x(n)$ to the following input signal

$$x(n) = \begin{cases} |n|, & -3 \le n \le 3 \\ 0, & \text{otherwise} \end{cases}$$

(a) Is delayed from input

(b) Is exactly same as the input

(c) Leads the input

(d) Varies with signal

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88. The complex exponential Fourier representation for the signal

$x(t) = \cos \omega_0 t$ is

(a) $\sum_{k=-\infty}^{\infty} c_k e^{-jk\omega_0 t}$

(b) $\sum_{k=-\infty}^{\infty} c_k e^{-j\omega_0 t}$

(c) $\sum_{k=-\infty}^{\infty} c_k e^{2jk\omega_0 t}$

(d) $\sum_{k=-\infty}^{\infty} c_k e^{jk\omega_0 t}$

89. The continuous LTI system is described by

$$\frac{dy(t)}{dt} + 2y(t) = x(t).$$

Using the Fourier transform,

for $x(t) = e^{-t}\, u(t)$, the output $y(t)$ will be

(a) $(e^{-t} - e^{2t})\, u(t)$

(b) $(e^{t} + e^{-2t})\, u(t)$

(c) $(e^{-t} - e^{-2t})\, u(t)$

(d) $(e^{t} + e^{2t})\, u(t)$

90. The discrete Fourier series representation for the following sequence

$x(n) = \cos \frac{\pi}{4} n$ is

(a) $\frac{1}{2} e^{j\Omega_0 n} + \frac{1}{2} e^{-j\Omega_0 n}$ and $\Omega_0 = \frac{\pi}{8}$

(b) $\frac{1}{2} e^{-j\Omega_0 n} + \frac{1}{2} e^{-2j\Omega_0 n}$ and $\Omega_0 = \frac{\pi}{4}$

(c) $\frac{1}{2} e^{-j\Omega_0 n} + \frac{1}{2} e^{-j\Omega_0 n}$ and $\Omega_0 = \frac{\pi}{6}$

(d) $\frac{1}{2} e^{j\Omega_0 n} + \frac{1}{2} e^{j7\Omega_0 n}$ and $\Omega_0 = \frac{\pi}{4}$

91. Consider the discrete-time sequence

$$x(n) = \cos\left(\frac{n\pi}{8}\right).$$

When sampled at frequency $f_s = 10$ kHz, then f_0, the frequency of the sampled continuous time signal which produced this sequence will at least be

(a) 625 Hz

(b) 575 Hz

(c) 525 Hz

(d) 475 Hz

92. How many bits are required in an A/D converter with a B+1 quantizer to get a signal-to-quantization noise ratio of at least 90 dB for a Gaussian signal with range of $\pm 3\sigma_x$?

(a) B + 1 = 12 bits

(b) B + 1 = 14 bits

(c) B + 1 = 15 bits

(d) B + 1 = 16 bits

93. Let x(n) be a left-sided sequence that is equal to zero for $n > 0$. If $X(z) = \frac{3z^{-1} + 2z^{-2}}{3 - z^{-1} + z^{-2}}$, then x(0) will be

(a) 0

(b) 2

(c) 3

(d) 4

94. The noise variance σ_ε^2 at the output of $H(z) = \frac{0{\cdot}5z}{z - 0{\cdot}6}$ with respect to input will be nearly

(a) 40%

(b) 50%

(c) 60%

(d) 70%

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95. If the complex multiply operation takes 1 μs, the time taken to compute 1024-point DFT directly will be nearly

(a) 3·45 s
(b) 2·30 s
(c) 1·05 s
(d) 0·60 s

96. Consider the following data to design a low-pass filter

Cut-off frequency $\omega_c = \frac{\pi}{2}$,

Stop band ripple $\delta_s = 0{\cdot}002$,

Transition bandwidth no larger than $0{\cdot}1\ \pi$.

Kaiser window parameters β and N respectively are

(a) 2·99 and 45
(b) 4·99 and 45
(c) 2·99 and 65
(d) 4·99 and 65

97. A transfer function $G(s) = \frac{1 - sT}{1 + sT}$ has a phase angle of $(-2 \tan^{-1} \omega T)$ which varies from 0° to –180° as ω is increased from 0 to ∞. It is the transfer function for

(a) All pass system
(b) Low pass system
(c) High pass system
(d) Band pass system

98. The open-loop and closed-loop transfer functions of a system are respectively given by

$$G(s) = \frac{K}{j\omega\tau + 1}\text{; (open loop)},$$

$$G(s) = \frac{\frac{K}{(1+K)}}{j\omega\tau_c + 1}\text{; (closed loop).}$$

The ratio of the bandwidth of closed loop to open loop system is

(a) K
(b) (1 + K)
(c) $(1 + K)^2$
(d) $\frac{K^2}{(1+K)}$

99. The system sensitivity of open loop and closed loop system are respectively

(a) 1 and $\frac{1}{1+GH}$
(b) $\frac{1}{1+GH}$ and 1
(c) $\frac{1}{GH}$ and 1
(d) 1 and $\frac{1}{GH}$

100. The steady state error of a type-1 system to a unit step input is

(a) $\frac{1}{(1+K_p)}$
(b) 0
(c) ∞
(d) $\frac{1}{K_v}$

101. The direction of the net encirclements of the origin of Real-Imaginary plane in a Nyquist plot for the system to be stable is

(a) Clockwise of the origin
(b) Counter-Clockwise of the origin
(c) Left hand side s-plane
(d) Right hand side s-plane

102. A unity negative feedback control system has an open-loop transfer function as

$$G(s) = \frac{K(s+1)(s+2)}{(s+0{\cdot}1)(s-1)}.$$

The range of values of K for which the closed loop system is stable will be

(a) $0 < K < 0{\cdot}3$
(b) $K > 0{\cdot}3$
(c) $K > 3$
(d) $K < 0{\cdot}3$

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103. The lag system of a 'lag-lead compensator' has one pole and one zero. Then pole and zero are

(a) Real and pole is to the left of zero

(b) Real and pole is to the right of zero

(c) Imaginary and pole is above zero

(d) Imaginary and pole is below zero

104. A system with characteristic equation

$$F(s) = s^4 + 6s^3 + 23s^2 + 40s + 50$$

will have closed loop poles such that

(a) All poles lie in the left half of the s-plane and no pole lies on imaginary axis

(b) Two poles lie symmetrically on the imaginary axis of the s-plane

(c) All four poles lie on the imaginary axis of the s-plane

(d) All four poles lie in the right half of the s-plane

105. A unity feedback (negative) system has open loop transfer function

$$G(s) = \frac{K}{s(s+2)}.$$

The closed loop system has a steady-state unit ramp error of 0·1. The value of gain K should be

(a) 20

(b) 30

(c) 40

(d) 50

106. Transfer function of discrete time system derived from state model is given by

(a) $C(zI - A)^{-1} B + D$

(b) $C(zI - A)^{-1} D + B$

(c) $B(zI - A)^{-1} D + C$

(d) $D(zI - A)^{-1} B + C$

107. The closed-loop response of a system subjected to a unit step input is

$$c(t) = 1 + 0{\cdot}2\, e^{-60\,t} - 1{\cdot}2\, e^{-10\,t}.$$

The expression for the closed loop transfer function is

(a) $\frac{100}{(s+60)(s+10)}$

(b) $\frac{600}{(s+60)(s+10)}$

(c) $\frac{60}{(s+60)(s+10)}$

(d) $\frac{10}{(s+60)(s+10)}$

108. If it is possible to transfer the system state $x(t_0)$ to any desired state $x(t)$ in specified finite time by a control vector $u(t)$, then the system is said to be

(a) Completely observable

(b) Completely state controllable

(c) Random state system

(d) Steady state controlled system

109. Consider the following statements regarding parallel connection of 3-phase transformers :

1. The secondaries of all transformers must have the same phase sequence.
2. The phase displacement between primary and secondary line voltages must be the same for all transformers which are to be operated in parallel.
3. The primaries of all transformers must have the same magnitude of line voltage.

Which of the above statements are correct ?

(a) 1, 2 and 3

(b) 1 and 3 only

(c) 1 and 2 only

(d) 2 and 3 only

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110. A 500 kVA transformer has an efficiency of 95% at full load and also at 60% of full load, both at upf. The efficiency η of the transformer at $\frac{3}{4}^{th}$ full load will be nearly

(a) 98%

(b) 95%

(c) 92%

(d) 87%

111. What is the condition of retrogressive winding in dc machines ?

(a) $Y_b > Y_f$

(b) $Y_b < Y_f$

(c) $Y_b = Y_f$

(d) $Y_b = 0{\cdot}5\ Y_f$

112. What is the useful flux per pole on no load of a 250 V, 6-pole shunt motor having a wave connected armature winding with 110 turns, armature resistance of 0·2 Ω and armature current 13·3 A at no load speed of 908 rpm ?

(a) 12·4 mWb

(b) 22·6 mWb

(c) 24·8 mWb

(d) 49·5 mWb

113. The cross-magnetizing effect of the armature reaction can be reduced by

(a) Making pole shoes flat faced

(b) Making the main field ampere-turns larger compared to the armature-ampere turns

(c) Increasing the flux density under one half of the pole

(d) Keeping the direction of rotation of generator in the same direction as motor

114. A 500 kW, 500 V, 10-pole, dc generator has a lap wound armature with 800 conductors. If the pole face covers 75% of pole pitch, the number of pole-face conductors in each pole of a compensating winding will be

(a) 12

(b) 10

(c) 8

(d) 6

115. Cogging in an induction motor is caused

(a) If the number of stator slots are unequal to number of rotor slots

(b) If the number of stator slots are an integral multiple of rotor slots

(c) If the motor is running at fraction of its rated speed

(d) Due to 5^{th} harmonic

116. A 500 hp, 6-pole, 3-phase, 440 V, 50 Hz induction motor has a speed of 950 rpm on full-load. The full load slip and the number of cycles the rotor voltage makes per minute will be respectively

(a) 10% and 150

(b) 10% and 125

(c) 5% and 150

(d) 5% and 125

117. Effective armature resistance R_a(eff) of a synchronous machine is

(a) $\dfrac{\text{Short circuit load loss (per phase)}}{(\text{Short circuit armature current})^2}$

(b) $\dfrac{\text{Short circuit load loss (per phase)}}{\text{Short circuit load current}}$

(c) $\dfrac{\text{Total short circuit load loss}}{\text{Short circuit armature current}}$

(d) $\dfrac{\text{Total short circuit load loss}}{\text{Short circuit load current}}$

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118. A 3-phase synchronous motor has 12-poles and operates from 440 V, 50 Hz supply. If it takes a line current of 100 A at 0·8 power factor leading, its speed and torque are nearly

(a) 500 rpm and 1165 N-m

(b) 1000 rpm and 2330 N-m

(c) 500 rpm and 2330 N-m

(d) 1000 rpm and 1165 N-m

119. Which of the following are the advantages of using a stepper motor ?

(a) Compatibility with transformers and sensors needed for position sensing

(b) Compatibility with digital systems and sensors are not required for position and speed sensing

(c) Resonance effect often exhibited at low speeds and decreasing torque with increasing speed

(d) Easy to operate at high speeds and compatible with analog systems

120. The disadvantage of hunting in synchronous machines is

(a) Fault occurs in the supply system

(b) Causes sudden change in inertia

(c) Causes large mechanical stresses and fatigue in the rotor shaft

(d) Causes harmonics

121. Consider the following statements for a large national interconnected grid :

1. Better load frequency control
2. Same total installed capacity can meet lower demands
3. Better hydro / thermal / nuclear / renewable co-ordination and energy conservation

Which of the above statements are correct?

(a) 1 and 3 only

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1, 2 and 3

122. A single-phase transformer is rated 110/440 V, 2·5 kVA. Leakage reactance measured from the low-tension side is 0·06 Ω. The per unit leakage reactance will be

(a) 0·0062/unit

(b) 0·0124/unit

(c) 0·0496/unit

(d) 0·1983/unit

123. A concentric cable has a conductor diameter of 1 cm and an insulation thickness of 1·5 cm. When the cable is subjected to a test pressure of 33 kV, the maximum field strength will be nearly

(a) 41,000 V

(b) 43,200 V

(c) 45,400 V

(d) 47,600 V

124. Radio influence voltage (RIV) generated on a transmission line conductor surface is ***not*** affected by

(a) System voltage

(b) Corona discharges on the conductors

(c) Rain

(d) Nearby radio receivers

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125. Consider the following properties regarding insulation for cables :

1. A low specific resistance
2. High temperature withstand
3. High dielectric strength

Which of the above properties of insulation are correct while using cables ?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

126. Which one of the following faults occurs more frequently in a power system ?

(a) Grounded star-delta
(b) Double line faults
(c) LLG faults
(d) Single line-to-ground (LG) faults

127. The maximum permissible time of de-energization of the faulty circuit is dependent on

(a) Voltage of the system
(b) The number of conductors involved
(c) Load carried by the faulty circuit
(d) Fault current and its duration

128. Which one of the following is used for communication with the aim of achieving high figure of merit in HVDC circuit breakers ?

(a) Oil interrupter
(b) Air interrupter
(c) Vacuum interrupter
(d) SF_6 interrupter

129. Which of the following buses are used to form bus admittance matrix for load flow analysis ?

1. Load bus
2. Generator bus
3. Slack bus

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

130. In a 3-phase, 60 Hz, 500 MVA, 15 kV, 32-pole hydroelectric generating unit, the values of ω_{syn} and ω_{msyn} will be nearly

(a) 754 rad/s and 47·6 rad/s
(b) 377 rad/s and 46·7 rad/s
(c) 377 rad/s and 23·6 rad/s
(d) 754 rad/s and 23·6 rad/s

131. The methods adopted for improving the steady state stability of power system are

1. Quick response excitation system
2. Higher excitation voltages
3. Maximum power transfer by use of series capacitor or reactor

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

132. The HVDC system uses

(a) Rectifier station at sending end and inverter station at receiving end
(b) Inverter station at sending as well as at the receiving end
(c) Rectifier station at sending end as well as at the receiving end
(d) Inverter station at sending end and rectifier station at receiving end

133. Which one of the following is ***not*** required for Power diode ?

(a) High speed operation
(b) Fast communication
(c) Small recovery time
(d) Low on-state voltage drop

134. The reverse recovery time of a diode is $t_{rr} = 3\ \mu s$ and the rate of fall of the diode current is $\frac{di}{dt} = 30\ A/\mu s$. The storage charge Q_{RR} and the peak inverse current I_{RR} will be respectively

(a) 135 μC and 90 A
(b) 270 μC and 90 A
(c) 270 μC and 60 A
(d) 135 μC and 60 A

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135. The i_g–v_g characteristics of a thyristor is a straight line passing through origin with a gradient of $2{\cdot}5 \times 10^3$. If $P_g = 0{\cdot}015$ watt, the value of gate voltage will be nearly

(a) 5·0 V
(b) 6·1 V
(c) 7·5 V
(d) 8·5 V

136. A single-phase 220 V, 1 kW heater is connected to half wave controlled rectifier and is fed from a 220 V, 50 Hz ac supply. When the firing angle $\alpha = 90°$, the power absorbed by the heater will be nearly

(a) 1000 W
(b) 750 W
(c) 500 W
(d) 250 W

137. When we compare the half bridge converter and full bridge converter

1. The maximum collector current of a full bridge is only double that of the half bridge.
2. Full bridge uses 4-power switches instead of 2, as in the double bridge.
3. Output power of a full bridge is twice that of a half bridge with the same input voltage and current.

Which of the above statements are correct ?

(a) 1, 2 and 3
(b) 1 and 2 only
(c) 1 and 3 only
(d) 2 and 3 only

138. A single-phase fully controlled bridge converter is connected with RLE load where R = 5 Ω, L = 4 mH and E = 50 V. This converter circuit is supplied from 220 V, 50 Hz ac supply. When the firing angle is 60°, the average value of the load current will be nearly

(a) 12·2 A
(b) 9·8 A
(c) 6·4 A
(d) 4·2 A

139. Consider the following statements regarding ac drives :

1. For the same kW rating, ac motors are 20% to 40% light weight as compared to dc motors.
2. The ac motors are more expensive as compared to same kW rating dc motors.
3. The ac motors have low maintenance as compared to dc motors.

Which of the above statements are correct ?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

140. A 3-phase induction motor drives a blower where load torque is directly proportional to speed squared. If the motor operates at 1450 rpm, the maximum current in terms of rated current will be nearly

(a) 2·2
(b) 3·4
(c) 4·6
(d) 6·8

141. Consider the following statements :

1. SMPS generates both the electromagnetic and radio frequency interference due to high switching frequency.
2. SMPS has high ripple in output voltage and its regulation is poor.
3. The output voltage of SMPS is less sensitive with respect to input voltage variation.

Which of the above statements are correct ?

(a) 1 and 3 only
(b) 2 and 3 only
(c) 1 and 2 only
(d) 1, 2 and 3

142. Consider the following features with respect to the flyback converters :

1. It is used mostly in application below 100 W.
2. It is widely used for high-output voltage.
3. It has low cost and is simple.

Which of the above statements are correct ?

(a) 1, 2 and 3
(b) 1 and 2 only
(c) 1 and 3 only
(d) 2 and 3 only

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143. Consider the following statements regarding the function of dc-dc converter in a dc motor :

1. It acts as a regenerative brake.
2. It controls the speed of motor.
3. It controls the armature voltage of a dc motor.

Which of the above statements are correct ?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

144. The power supplies which are used extensively in industrial applications are required to meet

1. Isolation between the source and the load
2. High conversion efficiency
3. Low power density for reduction of size and weight
4. Controlled direction of power flow

Which of the above specifications are correct ?

(a) 1, 2 and 3 only
(b) 1, 3 and 4 only
(c) 1, 2 and 4 only
(d) 2, 3 and 4 only

Directions : *Each of the next six (06) items consists of two statements, one labelled as 'Statement (I)' and the other as 'Statement (II)'. You are to examine these two statements carefully and select the answers to these items using the codes given below :*

Codes :

(a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I).

(b) Both Statement (I) and Statement (II) are individually true, but Statement (II) is ***not*** the correct explanation of Statement (I).

(c) Statement (I) is true, but Statement (II) is false.

(d) Statement (I) is false, but Statement (II) is true.

145. *Statement (I) :*
Soft iron does not retain magnetism permanently.
Statement (II) :
Soft iron has no retentivity.

146. *Statement (I) :*
Reaction turbines are generally used for sites with high head and low flow.
Statement (II) :
Kaplan and Francis turbines are reaction turbines.

147. *Statement (I) :*
One can formulate problems more efficiently in a high-level language and need not have a precise knowledge of the architecture of the computer.
Statement (II) :
High level languages permit programmers to describe tasks in a form which is problem oriented than computer oriented.

148. *Statement (I) :*
Sign magnitude representation is generally used in implementing the integer portion of the ALU.
Statement (II) :
In sign magnitude representation there are two representations of 0.

149. *Statement (I) :*
When a non-linear resistor, in series with a linear resistor, both being non-inductive, is connected to a voltage source, the current in the circuit cannot be determined by using Ohm's law.
Statement (II) :
If the current-voltage characteristic of the non-linear resistor is known, the current-voltage characteristic of the series circuit can be obtained by graphical solution.

150. *Statement (I) :*
Soft magnetic materials, both metallic and ceramic are used for making transformers core, whereas, hard magnetic materials both metallic and ceramic are used for making permanent magnets.
Statement (II) :
Magnetic materials, both metallic and ceramic are classified as soft or hard according to the magnetic hysteresis loop being narrow or broad.