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

T.B.C. : ASNP–T–ELEN

Test Booklet Series

A

Serial No. 1013329

TEST BOOKLET

ELECTRICAL ENGINEERING

Time Allowed : Three Hours

Maximum Marks : 300

INSTRUCTIONS

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET *DOES NOT* HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS, ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.

2. **Please note that it is the candidate's responsibility to encode and fill in the Roll Number and Test Booklet Series 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.**

3. You have to enter your Roll Number on the Test Booklet in the Box provided alongside. *DO NOT* write *anything else* on the Test Booklet.

4. This Test Booklet contains **150** items (questions). Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose *ONLY ONE* response for each item.

5. You have to mark all your responses *ONLY* on the separate Answer Sheet provided. See directions in the Answer Sheet.

6. *All* items carry equal marks.

7. Before you proceed to mark in the Answer Sheet the response to various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions sent to you with your Admission Certificate.

8. After you have completed filling in all your responses on the Answer Sheet and the examination has concluded, you should hand over to the Invigilator *only the Answer Sheet.* You are permitted to take away with you the Test Booklet.

9. Sheets for rough work are appended in the Test Booklet at the end.

10. **Penalty for wrong answers :**
    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** 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.

    (iii) If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.

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1. What is the value of b such that the system of homogeneous equations

$$2x + y + 2z = 0$$
$$x + y + 3z = 0$$
$$4x + 3y + bz = 0$$

has non-trivial solution?

   (a) 4

   (b) 6

   (c) 8

   (d) 10

2. The orthogonal trajectories of the hyperbolas

$$x^2 - y^2 = c$$

are

   (a) $x^2 + y^2 = c$

   (b) $x + y = c$

   (c) $xy = c$

   (d) $x^2 + y^2 + 2x = c$

3. The value of the integral $\int_C x^2 y \, dS$, where C is the curve defined by

$$x = 3\cos t, \quad y = 3\sin t, \quad 0 \le t \le \frac{\pi}{2}$$

is

   (a) 20

   (b) 24

   (c) 27

   (d) 31

4. Let D be the region bounded by the closed cylinder $x^2 + y^2 = 16$, $z = 0$, $z = 4$, and $v = 3x^2 i + 6y^2 j + zk$, then by divergence theorem

$$\iiint_D (\nabla \cdot v) \, dV$$

is

   (a) 46π

   (b) 64π

   (c) 84π

   (d) 96π

5. In the Fourier series expansion of the function

$$f(x) = x \sin x, \quad -\pi \le x \le \pi$$

the value of the Fourier coefficient a_1 is

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

   (b) $-\frac{1}{2}$

   (c) $-\frac{2}{3}$

   (d) $-\frac{2}{5}$

6. The partial differential equation formed by the elimination of arbitrary function from

$$z = f(x^2 - y^2)$$

is

   (a) $xp + yq = 0$

   (b) $yp - xq = 0$

   (c) $yp + zq = 0$

   (d) $yp + xq = 0$

7. If one solution of the differential equation

$$(x^2 - y^2 - z^2)p + 2xyq = 2xz$$

is $\dfrac{y}{z} = a$, the other solution is

(a) $x^2 + y^2 + z^2 = b$

(b) $x^2 + y^2 + z^2 = zb$

(c) $x + y + z = b$

(d) $x + y + (1-b)z = 0$

8. The solution of the differential equation

$$p - x^2 = q + y^2$$

is

(a) $z = \left(\dfrac{x^3}{3} + cx\right) + \left(cy + \dfrac{y^3}{3}\right) + c_1$

(b) $z = \left(\dfrac{x^3}{3} - x\right) + \left(cy - \dfrac{y^3}{3}\right) + c_1$

(c) $z = \left(\dfrac{x^3}{3} - cx\right) + \left(cy + \dfrac{y^3}{3}\right) + c_1$

(d) $z = \left(\dfrac{x^3}{3} + cx\right) + \left(cy - \dfrac{y^3}{3}\right) + c_1$

9. The solution of the differential equation

$$p^2 + q^2 = x + y$$

is

(a) $z = \dfrac{2}{3}(a-x)^{\frac{3}{2}} + \dfrac{2}{3}(y+a)^{\frac{3}{2}} + b$

(b) $z = \dfrac{2}{3}(a-x)^{\frac{3}{2}} + \dfrac{2}{3}(y-a)^{\frac{3}{2}} + b$

(c) $z = \dfrac{2}{3}(a+x)^{\frac{3}{2}} + \dfrac{2}{3}(y+a)^{\frac{3}{2}} + b$

(d) $z = \dfrac{2}{3}(a+x)^{\frac{3}{2}} + \dfrac{2}{3}(y-a)^{\frac{3}{2}} + b$

10. The value of the integral $\int_C z^2\,dz$, where C is the arc of the circle $|z| = 2$ from $\theta = 0$ to $\theta = \dfrac{\pi}{3}$, is

(a) $-\dfrac{12}{3}$

(b) $-\dfrac{14}{3}$

(c) $-\dfrac{16}{3}$

(d) $-\dfrac{18}{3}$

11. The value of the integral $\oint_C \dfrac{dz}{z(z^2 + 4)}$, where C is $|z| = 1$, is

(a) 0

(b) $\dfrac{\pi i}{3}$

(c) $2\pi i$

(d) $\dfrac{\pi i}{2}$

12. The mode and modal ordinate of normal distribution respectively are

(a) μ and $\dfrac{1}{\sigma\sqrt{2\pi}}$

(b) $\dfrac{\mu}{2}$ and $\dfrac{1}{\sigma\sqrt{2\pi}}$

(c) μ and $\dfrac{\sigma}{\sqrt{2\pi}}$

(d) $\dfrac{\mu}{2}$ and $\dfrac{\sigma}{\sqrt{2\pi}}$

13. The theoretical density of a metallic solid crystal structure is given by $\rho = \dfrac{nA}{V_C N_A}$, where n is number of atoms associated with each unit cell, A is atomic weight, V_C is volume of the unit cell. N_A will represent

(a) force in newton

(b) number of particles

(c) Avogadro's number

(d) number of turns

14. The value of packing fraction for face-centred cubic (FCC) structure will be nearly

(a) 0·55

(b) 0·65

(c) 0·75

(d) 0·85

15. The total core loss of a specimen of silicon steel is found to be 1500 W at 50 Hz. Keeping the flux density constant, the loss becomes 3000 W, when the frequency is raised to 75 Hz. The eddy current loss at 75 Hz will be

(a) 1·25 kW

(b) 1·50 kW

(c) 1·75 kW

(d) 2·25 kW

16. A very weak form of magnetism that is non-permanent persists only while an external field is being applied. It is induced by a change in the orbital motion of electrons due to an applied magnetic field. This form of magnetism is called

(a) ferromagnetism

(b) ferrimagnetism

(c) paramagnetism

(d) diamagnetism

17. The magnetic moments of diamagnetic material are mainly due to

(a) orbital angular momentum of the electrons

(b) electron spin angular momentum of the electrons only

(c) nuclear spin angular momentum of the electrons only

(d) both electron spin angular momentum and nuclear spin angular momentum of the electrons

18. The magnetic flux density on the surface of an iron face is $1 \cdot 6 \, T$, which is a typical saturation level value for ferromagnetic material. If the value of μ is $4\pi \times 10^{-7} \, H/m$, the force density on the iron face will be nearly

(a) $0 \cdot 25 \times 10^6 \, N/m^2$

(b) $1 \cdot 0 \times 10^6 \, N/m^2$

(c) $2 \cdot 0 \times 10^6 \, N/m^2$

(d) $4 \cdot 0 \times 10^6 \, N/m^2$

19. When a ferromagnetic substance is magnetized, there are small changes in its dimensions. The phenomenon is known as

(a) deformation

(b) polarization

(c) magnetostriction

(d) magnetization

20. In Fe_3O_4, each cubic unit cell contains $8 \, Fe^{2+}$ and $16 \, Fe^{3+}$ ions, the unit cell edge length is $0 \cdot 839 \, nm$ and Bohr magnetons/unit cell is 32 and the value of Bohr magneton is $9 \cdot 27 \times 10^{-24} \, A\text{-}m^2/\text{Bohr magneton}$. The saturation magnetization will be

(a) $1 \times 10^5 \, A/m$

(b) $3 \times 10^5 \, A/m$

(c) $5 \times 10^5 \, A/m$

(d) $7 \times 10^5 \, A/m$

21. Which one of the following statements is *not* correct for Fermi level?

(a) When all the electrons have been accommodated in a metal atom, the number per level drops abruptly to zero, at an energy value E_f called Fermi level.

(b) The magnitude of Fermi level increases with the number of electrons per unit volume of the metal.

(c) The magnitude of Fermi level decreases with the number of electrons per unit volume of the metal.

(d) The extra electrons can only be accommodated in the higher energy levels.

22. Electrons are emitted with zero velocity for a certain metal surface for $c = 3 \times 10^8 \, m/s$ and $Å = 10^{-10} \, m$, when it is exposed to radiations of $\lambda = 6800 \, Å$. The threshold frequency of the metal will be nearly

(a) $2 \cdot 6 \times 10^{14} \, Hz$

(b) $2 \cdot 8 \times 10^{14} \, Hz$

(c) $3 \cdot 6 \times 10^{14} \, Hz$

(d) $4 \cdot 4 \times 10^{14} \, Hz$

23. The materials which possess a permanent magnetic moment in the absence of an external field and manifest very large and permanent magnetizations are

(a) ferromagnetic

(b) antiferromagnetic

(c) ferrimagnetic

(d) superferrimagnetic

24. The magnetic inductance becomes zero inside a superconductor when it is cooled below T_c in a weak external field. The magnetic flux is expelled from the interior of the superconductor. This effect is called

(a) Boltzmann effect

(b) Meissner-Ochsenfeld effect

(c) critical temperature effect

(d) critical flux effect

25. In a network, the number of linearly independent mesh equations (M) is

(a) $B+(N+1)$

(b) $B-(N-1)$

(c) $B+(N-1)$

(d) $B-(N+1)$

where, B is number of branches in a network

N is number of nodes including the reference node

26. Which one of the following never dissipates energy but only stores it?

(a) Pure capacitor

(b) Pure resistor

(c) Conductor

(d) Ideal diode

27. An ideal voltage source is defined as energy source whose terminal voltage (V) is

(a) proportional to load with infinite internal resistance

(b) dependent on the output current

(c) independent of the output current

(d) proportional to load with finite internal resistance

28. Norton's theorem states that any two-terminal linear network with current sources, voltage sources and resistances can be replaced by an equivalent circuit consisting of a

(a) voltage source in parallel with a resistance

(b) voltage source in series with a resistance

(c) current source in series with a resistance

(d) current source in parallel with a resistance

29. An ideal voltage source is a two-terminal element in which the

(a) current i_s is completely independent of the voltage

(b) voltage v_s is completely independent of the current i_s through its terminals

(c) current i_s is completely independent through its terminals

(d) voltage v_s is completely dependent on current i_s through its terminals

30. A circuit consists of a voltage source with 50 V and an internal resistance of 25 Ω. If a load is connected to the voltage source, the maximum power drawn by the load resistance of 25 Ω will be

(a) 15 W

(b) 20 W

(c) 25 W

(d) 30 W

31. When a series R-L circuit is connected to a voltage V at $t = 0$, the current passing through the inductor L at $t = 0^+$ is

(a) $\dfrac{V}{R}$

(b) ∞

(c) 0

(d) $\dfrac{V}{L}$

where, V is voltage applied

R is resistance

L is inductor

32. Which of the following statements for a balanced 3-phase circuit are correct?

1. The total instantaneous power $p = 3P$, where P is the real power per phase.

2. The sum of three currents at any instant is zero.

3. The sum of instantaneous reactive powers is zero.

Select the correct answer.

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

33. In a 3-phase balanced star-connected system, the line voltages are

  (a) 90° ahead of their respective phase voltages

  (b) 90° behind their respective phase voltages

  (c) 30° ahead of their respective phase voltages

  (d) 30° behind their respective phase voltages

34. Which of the following conditions for a 2-port symmetrical electrical network are correct? (Assume standard notations)

  1. $y_{11} = y_{22}$

  2. $A = D$

  3. $h_{11} = h_{22}$

  Select the correct answer.

  (a) 1 and 2 only

  (b) 1 and 3 only

  (c) 2 and 3 only

  (d) 1, 2 and 3

35. Consider the following network function :

$$H(s) = \frac{10s}{(s^2 + 300s + 10^6)}$$

The quality factor Q is

  (a) 5·3

  (b) 4·7

  (c) 3·3

  (d) 2·7

36. Three capacitors of capacitances $10\,\mu F$, $20\,\mu F$ and $40\,\mu F$ are connected in series across 280 V. The charge of each capacitor will be

  (a) $0 \cdot 6 \times 10^{-3}$ C

  (b) $1 \cdot 6 \times 10^{-3}$ C

  (c) $2 \cdot 6 \times 10^{-3}$ C

  (d) $3 \cdot 6 \times 10^{-3}$ C

37. Which one of the following standards is used to check and calibrate laboratory instrument for accuracy and performance?

  (a) International standard

  (b) Voltage standard

  (c) Working standard

  (d) Secondary standard

38. The expected value of the voltage across a resistor is 80 V. However, the measurement gives a value of 79 V. The percentage of accuracy will be nearly

  (a) 92·75%

  (b) 94·25%

  (c) 96·25%

  (d) 98·75%

39. A meter will give a lower indication of the voltage drop that actually existed before the meter was connected. This effect is called

    (a) inductive effect of an instrument

    (b) synchronizing effect of an instrument

    (c) loading effect of an instrument

    (d) capacitive effect of an instrument

40. The basic permanent magnet moving coil (PMMC) mechanism is often called

    (a) d'Arsonval movement

    (b) G Arsonval movement

    (c) current sensitivity

    (d) voltage sensitivity

41. In frequency division multiplexing, a typical telemetry carrier frequency of 230 MHz is used with a bandwidth of

    (a) ± 320 kHz

    (b) ± 490 kHz

    (c) ± 520 kHz

    (d) ± 590 kHz

42. The potential transformer is used to operate voltmeters, potential coils of wattmeters and relays from

    (a) high current lines

    (b) low current lines

    (c) high voltage lines

    (d) low voltage lines

43. The output power wattmeter is designed to measure the output power

    (a) inversely in an arbitrary load

    (b) directly in an arbitrary load

    (c) squared in an arbitrary load

    (d) indirectly in an arbitrary load

44. The nominal ratio K_n for a current transformer is

    (a) $\dfrac{\text{Primary winding current}}{\text{Secondary winding current}}$

    (b) $\dfrac{\text{Rated primary winding current}}{\text{Rated secondary winding current}}$

    (c) $\dfrac{\text{Secondary winding current}}{\text{Primary winding current}}$

    (d) $\dfrac{\text{Rated secondary winding current}}{\text{Rated primary winding current}}$

45. Which one of the following generates an electrical signal directly in response to the physical parameter and does not require an external power source for its operation?

    (a) Active transducer

    (b) Passive transducer

    (c) Amplifier

    (d) Rectifier

46. The output voltage of LVDT is 1.5 V at maximum displacement. At a load of 0.5 MΩ, the deviation from linearity is maximum and it is ± 0.003 V from a straight line through origin. The linearity at the given load will be

(a) $\pm 0.1\%$

(b) $\pm 0.2\%$

(c) $\pm 0.3\%$

(d) $\pm 0.4\%$

47. Force-summing devices are used

(a) to add different forces

(b) to convert the applied force into displacement

(c) to measure forces

(d) to convert the displacement into force

48. Which one of the following can act as inverse transducer, when a voltage is applied across its surfaces?

(a) Electrical resistance potentiometer

(b) LVDT

(c) Capacitive transducer

(d) Piezoelectric crystal

49. What is the full form of the following expression?

$$Y = \Pi M(0, 1, 3, 4)$$

(a) $(A+B+C)(A+B+\overline{C})$
$(A+\overline{B}+\overline{C})(\overline{A}+B+C)$

(b) $(\overline{A}+B+C)(A+\overline{B}+C)$
$(A+B+\overline{C})(\overline{A}+B+C)$

(c) $(A+B+C)(A+\overline{B}+\overline{C})$
$(A+\overline{B}+\overline{C})(\overline{A}+B+\overline{C})$

(d) $(A+B+\overline{C})(A+B+\overline{C})$
$(A+\overline{B}+\overline{C})(\overline{A}+B+C)$

50. Which one of the following operators replaces certain statements of the if-then-else form in C/C++?

(a) , Operator

(b) * Operator

(c) & Operator

(d) ? Operator

51. The necessary steps that the processor has to carry out for fetching an instruction from the memory and executing it, constitute

(a) an interrupt

(b) an addressing

(c) an instruction cycle

(d) a control signal

52. The total storage capacity of a floppy disk having 80 tracks and storing 128 bytes/sector is 163840 bytes. How many sectors does the disk have?

(a) 18

(b) 16

(c) 14

(d) 12

53. Which one of the following buses is used to control the access to and use of data and address buses by various units which share the bus in a computer system?

(a) Data bus

(b) Address bus

(c) Power bus

(d) Control bus

54. If at time t_0, the address from which data is to be retrieved is placed in MAR and at time t_1, the required data is available in MDR, the elapsed time $(t_1 - t_0)$ is called

(a) cycle time of the memory

(b) write time of the memory

(c) read time of the memory

(d) access time of the memory

55. In TFT LCD monitor, TFT stands for

(a) Thick Film Transistor

(b) Thin Film Transistor

(c) Time Film Transistor

(d) Through Film Transistor

56. Which one of the following is the low-level software that schedules tasks, allocates storage, and handles the interface to peripheral hardware?

(a) DMA

(b) CPU

(c) I/O device

(d) Kernel

57. Which one of the following is used for generation of an accurate time delay for event counting, rate generation, complex waveform generation applications?

(a) Programmable timer/counter

(b) DMA controller

(c) Match coprocessor

(d) Programmable interrupt controller

58. The wrapping-up of data and functions into a single unit is known as

(a) encapsulation

(b) abstraction

(c) inheritance

(d) polymorphism

59. Which one of the following file operations is used with random access files to first position read/write pointer to a specific place in file so that the data can be read from, or written to that position?

(a) Read

(b) Write

(c) Seek

(d) Set attribute

60. Which one of the following not only translates the code into machine language but also executes it?

(a) Interpreter

(b) Linker

(c) Loader

(d) Compiler

61. The leakage current I_{CEO} from collector to emitter with the base lead open in common-emitter configuration is

(a) $I_{CO}(1+\beta_{DC})$

(b) $I_{CO}(1+\alpha_{DC})$

(c) $I_{CO}(1-\beta_{DC})$

(d) $I_{CO}(1-\alpha_{DC})$

where, I_{CO} is leakage current from collector to base with the emitter open

α_{DC} is DC current gain in common-base configuration

β_{DC} is DC current gain in common-emitter configuration

62. Which one of the following represents the level of energy of the valence electrons of an atom bound under the effect of electromagnetic force between the electrons and nucleus?

(a) VB

(b) CB

(c) E_C

(d) EB

63. Ripple is the variation of output voltage about DC which is

(a) quite small in a half-rectified wave

(b) same in a half-rectified wave

(c) quite large in a half-rectified wave

(d) same in a full-rectified wave

64. The rise time of certain amplifier is 35 ns. What is the approximate bandwidth of the amplifier?

(a) 10 MHz

(b) 35 MHz

(c) 28·5 MHz

(d) 1 MHz

65. For JFET, $I_{DSS} = 6\,\text{mA}$, $V_P = -4\cdot5\,\text{V}$ and $V_{GS} = -2\,\text{V}$. The value of I_D will be nearly

(a) 0·9 mA

(b) 1·9 mA

(c) 2·7 mA

(d) 3·7 mA

66. If the feedback network is purely resistive, then negative feedback is introduced as feedback voltage V_f and output voltage V_o are in phase, and such amplifier is called

(a) summing amplifier

(b) inverting amplifier

(c) non-inverting amplifier

(d) integrator amplifier

67. Which one of the following amplifiers transmits the input to the output terminals and is used as a buffer amplifier?

(a) Common-emitter amplifier

(b) Common-base amplifier

(c) Common-collector amplifier

(d) Common-source amplifier

68. In the low-frequency range, the gain is influenced by the coupling capacitor C_c. The amplifier behaves like an

(a) R-C high-pass filter

(b) R-C low-pass filter

(c) R-C all-pass filter

(d) R-C notch filter

69. The word 'hybrid' in h-parameters indicates that

(a) the units of four parameters are same

(b) the units of four parameters are hybrid and do not belong to one physical quantity

(c) the parameters are used in transmission line theory

(d) the parameters are used in different types of amplifiers

70. An amplifier has an open-loop gain of 1000. This gain varies by ±100, and feedback is introduced to ensure that the voltage gain varies by not more than ±0·1%. The gain with feedback A_F will be

(a) 5

(b) 10

(c) 15

(d) 20

71. In L-C oscillators, radio frequency choke (RFC) is used

(a) to produce high frequency

(b) to provide stability to oscillator

(c) to prevent high-frequency current flowing through the power supply

(d) to provide positive feedback

72. A sinusoidal oscillator is an amplifier with

(a) negative feedback and does not require any input

(b) negative feedback and does not require any active device

(c) positive feedback and does not require any input

(d) positive feedback and does not require any active device

73. The output signal of an op-amp with a slew rate of 2 V/μs has a maximum value of 10 V. The maximum frequency for undistorted output voltage will be nearly

(a) 32 kHz

(b) 36 kHz

(c) 42 kHz

(d) 46 kHz

74. Non-inverting amplifier with feedback exhibits the characteristics of the perfect

(a) current amplifier

(b) voltage amplifier

(c) current-to-voltage converter

(d) voltage-to-current converter

75. For a 12-bit A/D converter of an input clock frequency of 1 MHz, the maximum conversion required time will be nearly

(a) 2 ms

(b) 4 ms

(c) 6 ms

(d) 8 ms

76. A carrier signal having 10 V peak amplitude is amplitude modulated by three different modulating frequencies with peak amplitude levels of 2 V, 3 V and 4 V respectively. The modulation index of the resultant complex AM signal will be nearly

(a) 0·44

(b) 0·54

(c) 0·62

(d) 0·72

77. An AC signal having constant amplitude of 10 V, but variable frequency is applied across a simple low-pass R-L circuit with a cut-off frequency of 1 kHz. If R is 1 kΩ, the value of L will be nearly

(a) 130 mH

(b) 140 mH

(c) 150 mH

(d) 160 mH

78. It is desired to design a microcontroller-based periodic signal generator with minimum and maximum time period specifications of 125 ns and 100 ms. Then the system clock frequency will be

(a) 8 MHz

(b) 10 MHz

(c) 12 MHz

(d) 14 MHz

79. An amplitude modulated amplifier has a radio frequency output of 50 W at 100% modulation. If the internal loss in the modulator is 10 W, the unmodulated carrier power will be

(a) 10 W

(b) 20 W

(c) 30 W

(d) 40 W

80. The maximum deviation allowed in an FM broadcast system is 75 kHz. If the modulating signal is a single-tone sinusoid of 10 kHz, the bandwidth of the FM signal will be

(a) 140 kHz

(b) 150 kHz

(c) 160 kHz

(d) 170 kHz

81. The Peak Envelope Power (PEP) in suppressed carrier signal is

(a) $\dfrac{V_p^2}{2R_L}$

(b) $\dfrac{2V_p^2}{R_L}$

(c) $\dfrac{V_p^2}{R_L}$

(d) $\dfrac{2V_p^2}{R_L^2}$

where, V_p is peak signal voltage

R_L is load resistance

82. An open-circuit noise voltage generated across a $100\,k\Omega$ resistor over a frequency range of direct current to $20\,kHz$ at room temperature of $25\,°C$ will be nearly

(a) $4·9\,\mu V$

(b) $5·7\,\mu V$

(c) $6·5\,\mu V$

(d) $7·3\,\mu V$

83. A voice signal band limited to $3·4\,kHz$ is sampled at $8\,kHz$ and pulse code modulated using 64 quantization levels. If ten such signals are time division multiplexed using one 5-bit synchronizing word, the minimum channel bandwidth will be

(a) $410\,kHz$

(b) $520\,kHz$

(c) $430\,kHz$

(d) $340\,kHz$

84. Six analog information signals, each band limited to $4\,kHz$, are required to be time division multiplexed and transmitted by a TDM system. The minimum transmission bandwidth of the PAM/TDM channel will be

(a) $40\,kHz$

(b) $32\,kHz$

(c) $24\,kHz$

(d) $16\,kHz$

85. By applying the time-shifting property, what is the z-transform of the following signal?

$$X(z) = \frac{z^{-1}}{1 - 3z^{-1}}$$

(a) $x(n) = (3)^{n+1} \cdot u(n+1)$

(b) $x(n) = (3)^{n-1} \cdot u(n+1)$

(c) $x(n) = (3)^{n+1} \cdot u(n-1)$

(d) $x(n) = (3)^{n-1} \cdot u(n-1)$

86. The relationship between the unit step and delta function is

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

(b) $\int \delta(t)\,dt = r(t)$

(c) $\int r(t)\,dt = r(t)$

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

87. Which one of the following time signals is said to be periodic with period T_p for which the signal is advanced in time and hence it remains unchanged?

(a) Even

(b) Odd

(c) Continuous

(d) Discrete

88. Consider a continuous-time system with input $x(t)$ and output $y(t)$:

$$y(t) = x(\sin t)$$

The system is

(a) causal

(b) non-causal

(c) invertible

(d) time-variant

89. In the Fourier series representation, the condition for the even symmetry is

(a) $x(t) = x(-t)$

(b) $x(t) = -x(-t)$

(c) $x(t) = -x\left(t + \dfrac{T}{2}\right)$

(d) $x(t) = x\left(t + \dfrac{T}{2}\right)$

90. Consider that the signal

$$x_a(t) = 10\cos 2\pi(1000)t + 5\cos 2\pi(5000t)$$

is to be sampled. The Nyquist rate is

(a) 5 kHz

(b) 10 kHz

(c) 15 kHz

(d) 20 kHz

91. The Fourier transform of unit step function $u(t)$ is

(a) $u(t) \leftrightarrow \pi\delta(\omega)$

(b) $u(t) \leftrightarrow \dfrac{1}{j\omega}$

(c) $u(t) \leftrightarrow \pi\delta(\omega) + \dfrac{1}{j\omega}$

(d) $u(t) \leftrightarrow \pi\delta(\omega) - \dfrac{1}{j\omega}$

92. Consider the following signals :

$$x_1(t) = 10\cos(100\pi t); \quad x_2(t) = 10\cos(50\pi t)$$

If both are sampled at $f_s = 75$ Hz, the sampled signals $x_1(n)$ and $x_2(n)$ are

(a) $10\cos\left(\dfrac{2\pi}{3}n\right)$ and $10\cos\left(\dfrac{2\pi}{3}n\right)$

(b) $\cos\left(\dfrac{\pi}{n}\right)$ and $2\cos\left(\dfrac{\pi}{n}\right)$

(c) $\cos\left(\dfrac{2\pi}{n}\right)$ and $\cos\left(\dfrac{\pi}{n}\right)$

(d) $\cos\left(\dfrac{2\pi}{3}n\right)$ and $\cos\left(\dfrac{2\pi}{3}n\right)$

93. When the Fourier transform and inverse transform equations are similar but not quite identical, then this symmetry leads to a property called

(a) proportional

(b) multiplication

(c) convolution

(d) duality

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94. Consider

$$H_a(s) = \frac{1}{(s+1)^2} \text{ and } T = 0 \cdot 1 \text{ s}$$

Using bilinear transformation, $H(z)$ is

(a) $\dfrac{0 \cdot 0476}{(1 - 0 \cdot 9048z)^2}$

(b) $\dfrac{0 \cdot 0476(1+z)^2}{(1 - 0 \cdot 9048z^{-1})^2}$

(c) $\dfrac{0 \cdot 0476}{(1 - 0 \cdot 9048z^{-1})^2}$

(d) $\dfrac{0 \cdot 0476(1+z^{-1})^2}{(1 - 0 \cdot 9048z^{-1})^2}$

95. Which one of the following systems can be represented by the given general difference equation?

$$y(n) = -\sum_{k=1}^{N} a_k y(n-k) + \sum_{k=1}^{N} b_k x(n-k)$$

(a) DFS

(b) CFS

(c) LTI

(d) LSF

96. What is the convolution of the given two sequences?

$$x(n) = e^{-n^2}, \text{ for all } n \quad \text{and}$$
$$h(n) = 3n^2, \text{ for all } n$$

(a) $3 \cdot 521n^2 + 1 \cdot 5$

(b) $1 \cdot 623n + 1$

(c) $1 \cdot 598$

(d) $5 \cdot 318n^2 + 2 \cdot 654$

97. For type 2 system with unit ramp input, the steady-state error e_{ss} is

(a) ∞

(b) $\dfrac{1}{K}$

(c) 0

(d) $\dfrac{1}{1+K}$

98. A transfer function of a linear time-invariant system is defined to be the ratio of the Laplace transform of

(a) the output variable to the Laplace transform of the input variable under the assumption that all the initial conditions are zero

(b) the input variable to the Laplace transform of the output variable under the assumption that all the initial conditions are not zero

(c) the output variable to the Laplace transform of the input variable under the assumption that all the initial conditions are not zero

(d) the input variable to the Laplace transform of the output variable under the assumption that all the initial conditions are zero

99. For a unity feedback control system, the forward path transfer function is given by

$$G(s) = \frac{10}{(0\cdot5\,s + 1)(s + 5)}$$

The position and velocity error constants for this system will be respectively

(a) 2 and ∞

(b) 2 and 0

(c) 20 and ∞

(d) 20 and 0

100. A system is described by the differential equation

$$3\frac{d^2c(t)}{dt^2} + 5\frac{dc(t)}{dt} + c(t) = r(t) + 3r(t-2)$$

The transfer function of the system is

(a) $\dfrac{1 + 3e^{-2s}}{3s^2 - 5s - 1}$

(b) $\dfrac{1 - 3e^{-2s}}{3s^2 - 5s - 1}$

(c) $\dfrac{1 + 3e^{-2s}}{3s^2 + 5s + 1}$

(d) $\dfrac{1 - 3e^{-2s}}{3s^2 + 5s + 1}$

101. The steady-state errors for type 1, type 2 and type 3 systems with parabolic input are respectively

(a) infinite, constant value and zero

(b) constant value, infinite and zero

(c) infinite, zero and constant value

(d) constant value, zero and infinite

102. The Laplace transform of the function

$$f(t) = t^n e^{-at}$$

is

(a) $\dfrac{n!}{(s + a)^{n+1}}$

(b) $\dfrac{n!}{(s - a)^{n-1}}$

(c) $\dfrac{n!}{(s + a)^{n-1}}$

(d) $\dfrac{n!}{(s - a)^{n+1}}$

103. If any root of the characteristic equation has a positive real part or if there is a repeated root on the $j\omega$-axis, the system is

(a) conditionally stable

(b) limitedly stable

(c) stable

(d) unstable

104. Consider the unity feedback system given by

$$G(s) = \frac{1}{(s+1)^2}$$

The phase margin is

(a) 0°

(b) 45°

(c) 120°

(d) 180°

105. For the system having open-loop transfer function

$$G(s)\,H(s) = \frac{K}{s(s+2)(s+3)}$$

the breakaway point is nearly

(a) −0·245

(b) −0·785

(c) −1·585

(d) −3·345

106. A mathematical abstraction to represent or model the dynamics of a system utilizes three types of variables called

(a) time, frequency and amplitude of the input

(b) input, output and time

(c) input, output and state variables

(d) input, output and frequency

107. If it is possible to transfer the system state from any initial state $x(t_0)$ to any other desired state $x(t_f)$ in specified finite time by a control vector $u(t)$, the system is said to be completely

(a) stable

(b) observable

(c) state controllable

(d) unstable

108. If every state $x(t_0)$ can be completely identified by measurements of the output $y(t)$ over a finite time interval, the system is said to be completely

(a) state controllable

(b) observable

(c) unstable

(d) stable

109. If the output voltage in autotransformer is less than the input voltage

   (a) the load current is more than the input current

   (b) the load current is less than the input current

   (c) the load current becomes zero

   (d) the input current becomes zero

110. The maximum field circuit resistance (for a given speed) with which the shunt generator would just excite is known as its

   (a) series field resistance

   (b) critical field resistance

   (c) shunt field resistance

   (d) load field resistance

111. The speed at which the rotating magnetic field revolves is called

   (a) asynchronous speed

   (b) synchronous speed

   (c) constant speed

   (d) variable speed

112. A shunt generator is rated at 240 V full load. At no load, the voltage is 252 V. The voltage regulation will be

   (a) 5%

   (b) 6%

   (c) 7%

   (d) 8%

113. When a compound generator has its series field flux aiding its shunt field flux, the machine is said to be

   (a) differentially compound

   (b) cumulative compound

   (c) series machine

   (d) shunt machine

114. The load torque developed by synchronous motor at which the motor pulls out of the synchronism is called

   (a) breakdown torque

   (b) starting torque

   (c) pull-in torque

   (d) maximum torque

115. A 6-pole, 3-phase induction motor is connected to a 50 Hz supply. If it is running at 970 r.p.m., the slip will be

(a) 3%

(b) 4%

(c) 5%

(d) 6%

116. The stator of a 3-ϕ induction motor has 3 slots per pole per phase. If the supply frequency is 50 Hz, the speed of the rotating stator flux will be

(a) 800 r.p.m.

(b) 1000 r.p.m.

(c) 1200 r.p.m.

(d) 1500 r.p.m.

117. The graph between armature current (I_a) and field current (I_f) of a synchronous motor for a constant load is called

(a) Z-curve

(b) T-curve

(c) C-curve

(d) V-curve

118. In salient-pole machines, the resultant air gap flux is increased as in a cylindrical rotor alternator when armature reaction flux ϕ_a for $\psi = 90°$

(a) leading aids the field flux ϕ_f

(b) lagging aids the field flux ϕ_f

(c) leading opposes the field flux ϕ_f

(d) lagging opposes the field flux ϕ_f

119. A stepper motor has a step angle of 10° and is required to rotate at 200 r.p.m. The pulse rate of the motor will be

(a) 120 steps/s

(b) 130 steps/s

(c) 140 steps/s

(d) 150 steps/s

120. A four-stack VR stepper motor has a step angle of 1·8°. The number of its rotor teeth will be

(a) 48

(b) 50

(c) 52

(d) 54

121. Which one of the following power plants is suitable for supplying peak loads?

(a) Nuclear power plant

(b) Steam power plant

(c) Hydropower plant

(d) Gas turbine power plant

122. The specific rotational speed (N_s) for a water turbine is

(a) $\dfrac{N\sqrt{P_t}}{H^{2\cdot25}}$

(b) $\dfrac{P_t\sqrt{N}}{H^{1\cdot25}}$

(c) $\dfrac{N\sqrt{P_t}}{H^{1\cdot25}}$

(d) $\dfrac{P_t\sqrt{N}}{H^{2\cdot25}}$

where, P_t is output in metric hp

N is actual rotational speed of the turbine

H is effective head in metres

123. A steam power station of 100 MW capacity uses coal of calorific value of 6400 kcal/kg. The thermal efficiency of the station is 30% and electrical generation efficiency is 92%. When the station is working at full load, the coal required per hour will be nearly

(a) 38·3 tonnes

(b) 48·7 tonnes

(c) 54·7 tonnes

(d) 64·3 tonnes

124. The insulation resistances R_1 and R_2 of a live 2-wire network are measured by earthing each main in turn through a milliammeter in series with a high resistance r. When the supply voltage is 500 V, the values of $r = 20000\ \Omega$, $i_1 = 1\ \text{mA}$ and $i_2 = 0\cdot5\ \text{mA}$, the insulation resistances R_1 and R_2 respectively are

(a) 0·47 MΩ and 0·28 MΩ

(b) 0·94 MΩ and 0·28 MΩ

(c) 0·47 MΩ and 0·47 MΩ

(d) 0·94 MΩ and 0·47 MΩ

125. The advantages of supercritical steam power plants are

1. low grade fossil fuels can be used

2. NO_2 emissions are completely eliminated

3. SO_2 emissions are reduced and complete burning of coal occurs

Which of the above advantages are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

126. A 3-phase, 10000 kVA, 11 kV alternator has a sub-transient reactance of 8%. If 3-phase short circuit occurs at its terminals, the fault power will be nearly

(a) 125 MVA

(b) 135 MVA

(c) 145 MVA

(d) 155 MVA

127. The operating time t of a static time-current relay is

(a) $\dfrac{IM}{K^n - I_p^n}$

(b) $\dfrac{KM}{I^n - I_p^n}$

(c) $\dfrac{IM}{K^n + I_p^n}$

(d) $\dfrac{KM}{I^n + I_p^n}$

where, M is time multiple setting

I is multiple of tap current

I_p is multiple of tap current at which pickup occurs

n is characteristic index of the relay

K is design constant of the relay

128. A uniformly distributed load on a distributor of length 500 m is rated at 1 A/m length. The distributor is fed from one end at 220 V. If the loop resistance is 2×10^{-5} Ω/m, the voltage drop at a distance of 400 m from the feeding point will be

(a) 5·2 V

(b) 4·2 V

(c) 3·4 V

(d) 2·4 V

129. Which one of the following distributors is having greater reliability and better flexibility?

(a) Ring main distributor

(b) Tree distributor

(c) Radial distributor

(d) Tapered distributor

130. An existing DC three-wire system is to be converted into a 3-phase, 4-wire system by adding a fourth wire equal in cross-section to each outer wire of the DC system. For the same supply and load voltages to neutral and balanced conditions, the extra power at unity power factor that can be supplied by the AC system will be

(a) 40%

(b) 50%

(c) 60%

(d) 70%

131. Which of the following statements are correct for load flow?

1. Bus admittance matrix is the most economical from the point of view of computer time and memory requirements.

2. The mathematical formulation of the load flow problem results in a system of non-linear equations.

3. In a power system, each node or bus is associated with four quantities.

Select the correct answer.

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

132. Fixed and semi-fixed costs being independent of the amount of energy generated are also called

(a) generating costs

(b) operating costs

(c) running costs

(d) standing costs

133. R, L and C in an SCR circuit meant for protecting against $\frac{dv}{dt}$ and $\frac{di}{dt}$ are 4 Ω, 6 µH and 6 µF respectively. If the supply voltage is 300 V, the maximum permissible value of $\frac{di}{dt}$ is

(a) 30×10^6 A/s

(b) 40×10^6 A/s

(c) 50×10^6 A/s

(d) 60×10^6 A/s

134. A 3 kV, 750 A power electronics circuit has thyristors with 800 V and 175 A rating. If the derating is of 25%, the number of thyristors in series will be

(a) 8

(b) 7

(c) 6

(d) 5

135. Depending on the design principles used, gating circuits are very essential to direct

(a) firing pulses to each transistor in an appropriate region of the supply cycle

(b) pulse distribution

(c) firing pulses to each thyristor in an appropriate region of the supply cycle

(d) synchronization of thyristor

136. Which one of the following commutated converters is working on the principle of natural commutation?

    (a) Series-parallel commutated converter

    (b) Series commutated converter

    (c) Parallel commutated converter

    (d) Line commutated converter

137. In a single-phase full-wave controlled rectifier circuit with midpoint configuration, two SCRs (M-2) and

    (a) an autotransformer with centre-tapped secondary windings are employed

    (b) a three-phase transformer with centre-tapped secondary windings are employed

    (c) a single-phase transformer with centre-tapped secondary windings are employed

    (d) a central tapping transformer with secondary windings are employed

138. The reverse recovery current of a power diode is $10\,\mu s$ and the rate of fall of current is about $200\,A/\mu s$. What is the storage charge?

    (a) 10 mC

    (b) 100 mC

    (c) 400 mC

    (d) 40 mC

139. The advantageous feature of AC drives with a current source DC link converter is

    (a) speed setting range up to $1:100$

    (b) high degree of motor protection

    (c) reduced costs

    (d) control structure more simple

140. When an AC main is ON, the rectifier circuit will supply the power to the inverter as well as to the battery, therefore, it acts as a

    (a) UPS system

    (b) power conditioner

    (c) static switch

    (d) rectifier cum charger

141. Based on the use of resonant tank, the resonant converters are classified as

1. resonant DC link converters

2. resonant AC link converters

3. resonant switch converters

4. load resonant converters

Select the correct answer.

(a) 1, 2, 3 and 4

(b) 1, 2 and 3 only

(c) 1, 2 and 4 only

(d) 2, 3 and 4 only

142. If resonant elements are added to the DC–DC converters, then the resulting converters are known as

(a) semiconductor devices

(b) resonant switch converters

(c) component inductances

(d) multi-resonant switches

143. The resonant technique processes power in sinusoidal form. The power switches are often turned off under

(a) minimum current

(b) zero current

(c) high current

(d) device current

144. DC to DC converters basically consist of two conversion stages, namely

(a) DC to AC resonant inverters and AC to DC rectifier

(b) AC to DC resonant inverters and DC to AC rectifier

(c) DC to AC converters and AC to DC rectifier

(d) AC to DC converters and DC to AC rectifier

Each of the following **six (06)** items consists of two statements, one labeled 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) :

If the capacitance of an overhead line is high, the line draws more charging current, which compensates or cancels the lagging component of load current.

Statement (II) :

The resultant current flowing in the line is reduced.

146. Statement (I) :

Voltage control and reactive power control are interrelated and need to be therefore considered together.

Statement (II) :

The voltage variation at a load is an indication of the unbalance between the reactive power generated and absorbed by that load.

147. Statement (I) :

BIBO stands for Bounded Input Bounded Output. The meaning of the word 'bounded' is some finite value.

Statement (II) :

A system is said to be stable, if it follows ˙BIBO principle, i.e., every bounded input produces bounded output.

148. Statement (I) :

Insulation resistance falls with increase in temperature; in some cases, there is a marked decrease in insulation resistance.

Statement (II) :

The resistivity of the insulator is considerably lowered in the presence of moisture.

149. Statement (I) :

A computer's control unit does not perform any actual processing of jobs, but acts as the central nervous system for other components of the computer systems.

Statement (II) :

It obtains instructions from a program stored in main memory, interprets the instructions and issues signals causing other units of the system to execute them.

150. Statement (I) :

The resistivity of ferrites is very much higher than that of ferromagnetic metals.

Statement (II) :

The ferrites are chemical compounds and electrons in them are subject to restraint of valence forces.

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