ENGINEERING SERVICES
EXAMINATION-(P)2018

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

T.B.C. : SKP–D–ELX **Test Booklet Series**

Serial No. 0062933

TEST BOOKLET

A

ELECTRONICS AND TELECOMMUNICATION 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 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 (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 **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.

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

1. Consider the following statements regarding the formation of *P-N* junctions :

1. Holes diffuse across the junction from *P*-side to *N*-side.
2. The depletion layer is wiped out.
3. There is continuous flow of current across the junction.
4. A barrier potential is set up across the junction.

Which of the above statements are correct?

(a) 1 and 3

(b) 2 and 3

(c) 1 and 4

(d) 2 and 4

2. Silicon devices can be employed for a higher temperature limit (190 °C to 200 °C) as compared to germanium devices (85 °C to 100 °C). With respect to this, which of the following are incorrect?

1. Higher resistivity of silicon
2. Higher gap energy of silicon
3. Lower intrinsic concentration of silicon
4. Use of silicon devices in high-power applications

Select the correct answer using the code given below.

(a) 1, 2 and 4

(b) 1, 2 and 3

(c) 1, 3 and 4

(d) 2, 3 and 4

3. For an *n*-channel silicon JFET with $a = 2 \times 10^{-4}$ cm and channel resistivity $\rho = 5\ \Omega$-cm, $\mu_n = 1300\ \text{cm}^2/\text{V-s}$ and $\varepsilon_0 = 9 \times 10^{-12}$ F/m, the pinch-off voltage, V_p, is nearly

(a) 2·30 V

(b) 2·85 V

(c) 3·25 V

(d) 3·90 V

4. In tunnel diode, the Fermi level lies

(a) inside valence band of *p*-type and inside conduction band of *n*-type semiconductors

(b) in the energy band gap but closer to conduction band of *n*-type semiconductors

(c) in the energy band gap but closer to valence band of *p*-type semiconductors

(d) in the energy band gap but above valence band of *p*-type and below conduction band of *n*-type semiconductors

5. The h_{FE} values in the specification sheet of a transistor are $h_{FE(\max)} = 225$ and $h_{FE(\min)} = 64$. What value of h_{FE} is to be adopted in practice?

(a) 64

(b) 100

(c) 120

(d) 225

6. A transistor is connected in CE configuration with $V_{CC} = 10$ V. The voltage drop across the 600 Ω resistor in the collector circuit is 0·6 V. If $\alpha = 0{\cdot}98$, the base current is nearly

(a) 6·12 mA

(b) 2·08 mA

(c) 0·98 mA

(d) 0·02 mA

7. An amplifier, without feedback, has a gain A. The distortion at full output is 10%. The distortion is reduced to 2% with negative feedback (feedback factor $\beta = 0{\cdot}03$). The values of A and A' (i.e., the gain with feedback) are, respectively, nearly

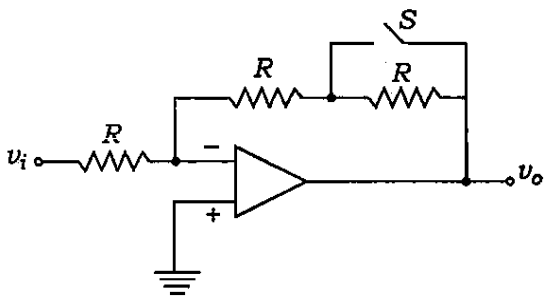
(a) 133·3 and 18·5

(b) 133·3 and 26·7

(c) 201·3 and 26·7

(d) 201·3 and 18·5

8. The magnitude of the gain $\frac{v_o}{v_i}$ in the inverting op-amp circuit shown in the figure is x with switch S open. When switch S is closed, the magnitude of the gain will be



(a) x (b) $\frac{x}{2}$

(c) $2x$ (d) $\frac{2}{x}$

9. An op-amp is used in a notch filter. The notch frequency is 2 kHz, lower cut-off frequency is 1·8 kHz and upper cut-off frequency is 2·2 kHz. Then Q of the notch filter is

(a) 3·5

(b) 4·0

(c) 4·5

(d) 5·0

10. In op-amp based inverting amplifier with a gain of 100 and feedback resistance of 47 kΩ, the op-amp input offset voltage is 6 mV and input bias current is 500 nA. The output offset voltage due to an input offset voltage and an input bias current, are

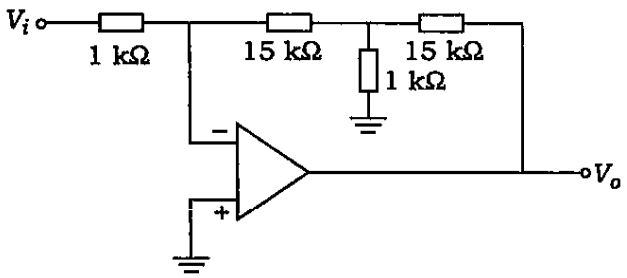
(a) 300 mV and 23·5 mV

(b) 606 mV and 47·0 mV

(c) 300 mV and 47·0 mV

(d) 606 mV and 23·5 mV

11. What is the gain of the amplifier circuit as shown in the figure?



(a) 255

(b) 31

(c) −31

(d) −255

12. The Kirchhoff's current law works on the principle of conservation of

1. charge
2. energy
3. power

Which of the above is/are correct?

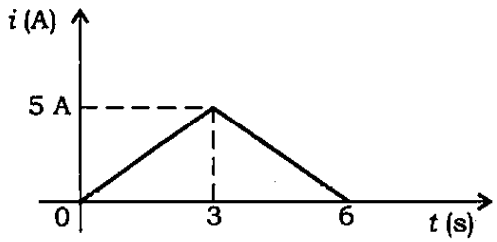
(a) 1 only

(b) 2 only

(c) 3 only

(d) 1, 2 and 3

13. A waveform shown in the figure is applied to a resistor of 20 Ω. The power dissipated in the resistor is



(a) 100 W

(b) 600 W

(c) 900 W

(d) 1000 W

14. A coil of wire of 0·01 mm^2 area of 1000 turns is wound on a core. It is subjected to a flux density of 100 mWb/mm^2 by a 1 A current. The energy stored in the coil is

(a) 2·0 J

(b) 1·5 J

(c) 1·0 J

(d) 0·5 J

15. A sinusoidal voltage waveform has frequency 50 Hz and RMS voltage 30 V. The equation representing the waveform is

(a) $V = 30\sin 50t$

(b) $V = 60\sin 20t$

(c) $V = 42{\cdot}42\sin 314t$

(d) $V = 84{\cdot}84\sin 314t$

16. The current in a coil of self-inductance of 4 H changes from 10 A to 2 A in t seconds and the induced e.m.f. is 40 V. The time t is

(a) 0·2 s

(b) 0·4 s

(c) 0·6 s

(d) 0·8 s

17. Consider the following statements with respect to a relay :

1. A relay is energized if NC contacts are opened.
2. The pickup current is the minimum relay coil current required to keep a relay energized.

Which of the above statements is/are correct?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

18. A 20 kVA, 2000/200 V, single-phase transformer has a leakage impedance of 8%. What voltage applied to the HV side will result in full-load current flow in the LV side, when the LV side is short-circuited?

(a) 64 V

(b) 86 V

(c) 132 V

(d) 160 V

19. The no-load current of a 220 V DC motor is 2 A with corresponding running speed of 1200 r.p.m. The full-load current is 40 A with an armature resistance being 0·25 Ω. Assuming constant flux during this range of speed, the full-load speed will be

(a) 864 r.p.m.

(b) 948 r.p.m.

(c) 1148 r.p.m.

(d) 1200 r.p.m.

20. A 100 kVA, single-phase transformer has a full-load copper loss of 600 W and iron loss of 500 W. The maximum efficiency occurs at a load of nearly

(a) 82·1 kVA

(b) 83·3 kVA

(c) 91·3 kVA

(d) 98·1 kVA

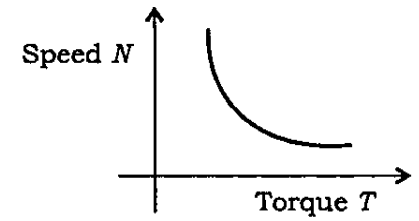
21. The starting current in an induction motor is 5 times the full-load current, while the full-load slip is 4%. The ratio of starting torque to full-load torque is

(a) 1·4 *(b)* 1·2

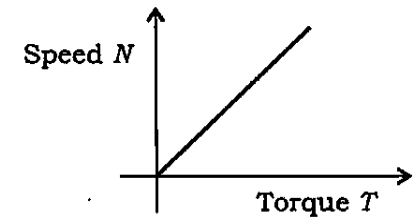
(c) 1·0 *(d)* 0·8

22. The applicable speed-torque curve for a DC series motor is

(a)



(b)



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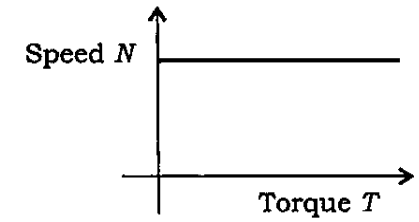
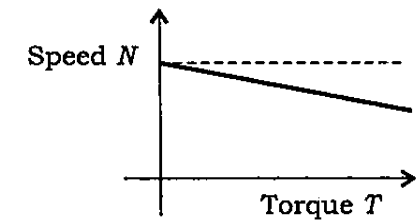


(d)



23. A transformer has a core loss of 140 W at 40 Hz, and 99 W at 30 Hz. The hysteresis and eddy-current losses at 50 Hz, respectively, are

(a) 110 W and 30 W

(b) 135 W and 30 W

(c) 110 W and 50 W

(d) 135 W and 50 W

24. If a transformer is designed for maximum efficiency at rated current and voltage, the full-load copper loss will be

(a) much less than the core loss

(b) much greater than the core loss

(c) equal to the core loss

(d) Not definable by these given parameters

25. A shunt generator has an induced e.m.f. of 224 V. When supplying a load, the terminal voltage falls to 204 V. The armature and shunt field resistances are 0·05 Ω and 20 Ω, respectively. The load current, neglecting the armature reaction, is

(a) 376·0 A *(b)* 389·8 A

(c) 400·0 A *(d)* 410·2 A

26. A single-phase, 1100/200 V, 50 Hz transformer has a core with a square cross-section, each side being 15 cm. The maximum flux density in the core is not to exceed 12000 lines/cm^2. The primary and secondary number of turns are, respectively

(a) 1100 and 200

(b) 550 and 100

(c) 275 and 75

(d) 184 and 33

27. A short-circuit test performed on high-voltage side of 20 kVA, 2000/400 V, single-phase transformer gave the results as 60 V, 4 A, 100 W. If the low-voltage side is delivering full-load current at 0·8 p.f. lag, at 400 V, the voltage applied to the high-voltage side is nearly

(a) 2190 V *(b)* 2170 V

(c) 2150 V *(d)* 2132 V

28. During short-circuit test of a transformer, core losses are negligible because

(a) the current on the secondary side is rated current

(b) the voltage on the secondary side is zero

(c) the voltage applied on the primary side is low

(d) full-load current is not supplied to the transformer

29. Electrochemical breakdown in a dielectric occurs at

(a) very low temperatures only

(b) very high temperatures only

(c) very high temperatures concurrent with high humidity of the surroundings

(d) very low temperatures concurrent with ambient humidity above 50%

30. Which of the following are the properties of Polytetrafluoroethylene?

1. Extreme heat resistant
2. Low resistance to most chemical reagents
3. Excellent insulating properties over a wide range of temperature
4. Non-hygroscopicity

Select the correct answer using the code given below.

(a) 1, 2 and 3

(b) 1, 3 and 4

(c) 1, 2 and 4

(d) 2, 3 and 4

31. For elements of the iron group, the net orbital dipole moment in the solid state is

(a) zero

(b) 10–20

(c) 10000–12000

(d) infinity

32. Which of the following statements are correct in respect of magnetic materials with magnetic susceptibility $\frac{M}{H} = \chi$?

1. χ is dimensionless.
2. The relative permeability of the medium equals $1+\chi$.
3. For non-magnetic medium, χ equals -1.

Select the correct answer using the code given below.

(a) 1, 2 and 3

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1 and 2 only

33. Which of the following represent the properties of carbon nanotubes?

1. High electrical conductivity
2. Very high tensile strength
3. High thermal conductivity
4. Low thermal expansion coefficient

Select the correct answer using the code given below.

(a) 1, 2 and 3 only

(b) 1, 2 and 4 only

(c) 1, 3 and 4 only

(d) 1, 2, 3 and 4

34. An ammeter of 0–25 A range has a guaranteed accuracy of 1% of full-scale reading. The current measured is 5 A. The limiting error is

(a) 2%

(b) 3%

(c) 4%

(d) 5%

35. A variable reluctance tachometer has 180 teeth on its rotor. The speed of the shaft on which it is mounted is 1200 r.p.m. The frequency of the output pulses is

(a) 4800/s

(b) 3600/s

(c) 2400/s

(d) 1800/s

36. What will be seen on the screen of a CRO, when a sinusoidal voltage signal is applied to the vertical deflection plate of this CRO with no simultaneous signal applied to the horizontal deflection plate?

(a) A horizontal line

(b) A vertical line

(c) A sinusoidal signal

(d) A spot at the centre of the screen

37. The Wheatstone bridge consists of a power source, 3 known resistors, a resistor whose value is to be measured and a null detector. Which of the following is ***not*** a source of errors in a Wheatstone bridge?

(a) Limiting errors of the known resistors

(b) Poor sensitivity of the null detector

(c) Fluctuations in the power supply voltage

(d) Thermal e.m.f.s in the bridge circuit

38. A vector impedance meter measures

(a) the magnitude of the impedance

(b) the power dissipation in the impedance

(c) the phase angle of the impedance

(d) both the magnitude and the phase angle of the impedance

39. A vector voltmeter can be used to measure

1. complex insertion loss
2. two-port network parameters
3. amplifier gain and phase shift
4. harmonic distortion

Which of the above are correct?

(a) 1, 2 and 4

(b) 1, 2 and 3

(c) 1, 3 and 4

(d) 2, 3 and 4

40. A 0–1 mA FSD ammeter is to be used to measure 0–100 mA full-scale deflection using a shunt. If the internal resistance of the meter is 200 Ω, what is the required shunt resistance?

(a) 4·04 Ω

(b) 3·03 Ω

(c) 2·02 Ω

(d) 1·01 Ω

41. In a 3-input CMOS NAND gate, the substrate terminals of NMOS transistors are grounded (lowest potential available in the circuit) and the substrate terminals of PMOS transistors are connected to V_{DD} (maximum positive potential available in the circuit). Which of the following transistors may suffer in this circuit from body bias effect?

(a) 2 NMOS transistors

(b) 2 PMOS transistors

(c) 1 NMOS transistor

(d) 1 PMOS transistor

42. A strain gauge with gauge factor 4 and resistance 250 Ω undergoes a change of 0·15 Ω during a test. The measured strain is

(a) 150×10^{-4}

(b) 15×10^{-4}

(c) $1{\cdot}5 \times 10^{-4}$

(d) $0{\cdot}15 \times 10^{-4}$

43. Unbonded strain gauge is mainly used in a

(a) pressure transducer

(b) force transducer

(c) vibration transducer

(d) displacement transducer

44. A displacement of ±12·5 mm results in a secondary voltage of 5 V in an LVDT. If the then secondary voltage is 3·2 V, the absolute value of the corresponding displacement would be

(a) 4 mm

(b) 6 mm

(c) 8 mm

(d) 10 mm

45. In large radar installations, it is required to translate the angular position of a shaft into digital information. This is most generally achieved by employing a code wheel. For unambiguous sensing of the shaft position, one employs a/an

(a) octal code

(b) BCD code

(c) binary Gray code

(d) natural binary code

46. An *R-L-C* series circuit is excited by a DC voltage. If $R = 40\ \Omega$, $L = 0{\cdot}2$ H and $C = 100\ \mu$F, the resulting current response is said to be

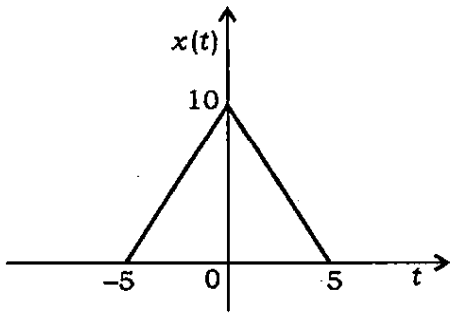
(a) critically damped

(b) undamped

(c) over-damped

(d) under-damped

47. If $x(t)$ is as shown in the figure, its Laplace transform is



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

(b) $\dfrac{2e^{+5s} - 4 + 2e^{-5s}}{s^2}$

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

(d) $\dfrac{2e^{+5s} + 4 - 2e^{-5s}}{s^2}$

48. The value of critical current density in a superconductor depends upon

1. temperature
2. magnetic field strength
3. penetration depth

Which of the above are correct?

(a) 1, 2 and 3

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1 and 2 only

49. The maximum current in a series *R-L-C* network with variable frequency excitation is 1 A, when the applied voltage is 10 V. The inductance has a value of 0·1 H. The *Q*-factor at the maximum current is 10. Then the value of *C* is

(a) 0·01 μF

(b) 0·1 μF

(c) 1·0 μF

(d) 10 μF

50. In a two-element series network, the instantaneous voltages across the elements are

$\sin 314t$ and $3\sqrt{2}\sin(314t+45°)$

The resultant voltage across the combination is expressed as $V\cos(314t+\theta)$. Then the values of V and θ are

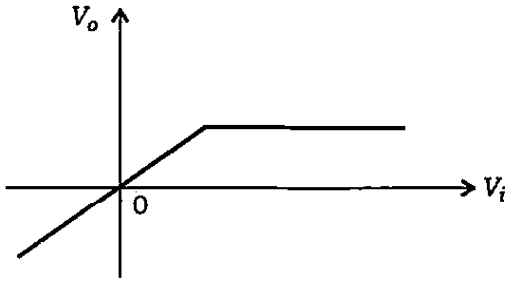
(a) 5 and 36·8°

(b) 3·5 and 36·8°

(c) 5 and –53·2°

(d) 3·5 and –53·2°

51. The voltage transfer characteristic as shown in the figure will relate to a



1. voltage regulator
2. half-wave rectifier
3. full-wave rectifier

Which of the above is/are correct?

(a) 1 only

(b) 2 only

(c) 1 and 2

(d) 1 and 3

52. The gain of a bipolar transistor drops at high frequencies. This is due to

(a) coupling and bypass capacitors

(b) early effect

(c) inter-electrode transistor capacitances

(d) the fact that reactance becomes high

53. A sample of germanium is made p-type by addition of indium at the rate of one indium atom for every $2{\cdot}5 \times 10^8$ germanium atoms. Given, $n_i = 2{\cdot}5 \times 10^{19}/m^3$ at 300 K and the number of germanium atoms per $m^3 = 4{\cdot}4 \times 10^{28}$. What is the value of n_p ?

(a) $3{\cdot}55 \times 10^{18}/m^3$

(b) $3{\cdot}76 \times 10^{18}/m^3$

(c) $7{\cdot}87 \times 10^{18}/m^3$

(d) $9{\cdot}94 \times 10^{18}/m^3$

54. For a transistor

$$h_{ie} = 1\,k\Omega, \quad h_{fe} = 30\ \Omega, \quad h_{re} \simeq 0,$$

$$h_{oe} = 20 \times 10^{-6}\ \mho \quad \text{and} \quad R_L = 2{\cdot}5\,k\Omega$$

The transistor is used in a single-stage CE amplifier. The voltage gain and power gain, respectively, are

(a) 75 and 1750

(b) 25 and 2250

(c) 75 and 2250

(d) 25 and 1750

55. An ADC has a total conversion time of 200 μs. What is the highest frequency that its analog input should be allowed to contain?

(a) 2·5 kHz

(b) 25 kHz

(c) 250 kHz

(d) 0·25 kHz

56. In case of high-pass filter, the transfer function should be with

1. 1 pole and 1 zero
2. 2 poles and 2 zeros
3. 2 poles and 1 zero

Which of the above are correct?

(a) 1, 2 and 3

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1 and 2 only

57. Consider the following opinions regarding the advantage and disadvantage of a Mealy model :

1. Advantage : Less number of states (hence less hardware)
   Disadvantage : Input transients are directly conveyed to output
2. Advantage : Output remains stable over entire clock period
   Disadvantage : Input transients persist for long duration at output

Which of the above is/are correct?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

58. A resistance strain gauge is used to measure stress of steel which is stressed to 1200 kg/cm^2. If the gauge factor is 2·5 and the Young's modulus of steel is 2×10^6 kg/cm^2, the percentage change in resistance of the gauge is

(a) 0·05%

(b) 0·10%

(c) 0·15%

(d) 0·25%

59. In a 4-stage ripple counter, the propagation delay of a flip-flop is 30 ns. If the pulse width of the strobe is 30 ns, the maximum frequency at which the counter operates reliably is nearly

(a) 9·7 MHz

(b) 8·4 MHz

(c) 6·7 MHz

(d) 4·4 MHz

60. For what minimum value of propagation delay in each flip-flop will a 10-bit ripple counter skip a count, when it is clocked at 10 MHz?

(a) 5 ns

(b) 10 ns

(c) 20 ns

(d) 40 ns

61. In a master-slave JK flip-flop

(a) both master and slave are positive-edge-triggered

(b) both master and slave are negative-edge-triggered

(c) master is positive-edge-triggered and slave is negative-edge-triggered

(d) master is negative-edge-triggered and slave is positive-edge-triggered

62. The phase detector circuit in the phase-locked loop demodulators recognizes

(a) voltage changes between the input and VCO signals

(b) frequency changes between the input and VCO signals

(c) impedance changes between the input and VCO signals

(d) resistance changes between the input and VCO signals

63. Consider the following statements for signal flow graph :

1. It represents linear as well as non-linear systems.
2. It is not unique for a given system.

Which of the above statements is/are correct?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

64. Thc power spectral density of the stationary noise process $N(t)$, having auto-correlation $R_{uu}(\tau) = Ke^{-3|\tau|}$, is

(a) $\frac{3K}{3+\omega^2}$

(b) $\frac{3K}{3-\omega^2}$

(c) $\frac{6K}{9+\omega^2}$

(d) $\frac{6K}{9-\omega^2}$

65. A discrete time signal is given as

$$x[n] = \cos\frac{\pi n}{9} + \sin\left[\frac{\pi n}{7} + \frac{1}{2}\right]$$

The period N for the periodic signal is

(a) 126

(b) 32

(c) 252

(d) 64

66. The angle θ_{AB} between the vectors $A = 3a_x + 4a_y + a_z$ and $B = 2a_y - 5a_z$ is nearly

(a) 83·7°

(b) 73·7°

(c) 63·7°

(d) 53·7°

67. When a transmission line section is first short-circuited, and then open-circuited, it shows input impedances of 25 Ω and 100 Ω, respectively. The characteristic impedance of the transmission line is

(a) 25 Ω

(b) 50 Ω

(c) 75 Ω

(d) 100 Ω

68. A signal

$$m(t) = 10\cos(2\pi 100t)$$

is frequency-modulated. The resulting FM signal is

$$x(t) = 20\cos\{2\pi 10^6 t + 15\sin(2\pi 100t)\}$$

The FM bandwidth is nearly

(a) 3·2 kHz

(b) 9·6 kHz

(c) 32 kHz

(d) 100 kHz

69. The minimum value of modulation index β for an FM system required to produce a noticeable improvement in SNR over a comparable AM system with $\mu = 1$ is

(a) 0·61

(b) 0·52

(c) 0·47

(d) 0·38

70. Consider the following statements pertaining to FIR filters :

1. These are non-recursive and hence stable.
2. These have high coefficient sensitivity.
3. These have linear phase characteristics.
4. These are realized using feedback structures.

Which of the above statements are correct?

(a) 1 and 4

(b) 2 and 3

(c) 1 and 3

(d) 2 and 4

71. A signal is band-limited to 3·6 kHz and three other signals are band-limited to 1·2 kHz each. These signals are to be transmitted by means of time-division multiplexing. If each signal is sampled at its Nyquist rate, then the speed of the commutator (by assuming 6 samples per rotation) is

(a) 864000 r.p.m.

(b) 144000 r.p.m.

(c) 86400 r.p.m.

(d) 14400 r.p.m.

72. 1 Mbps BPSK receiver detects waveform $s_1(t) = A\cos\omega_0 t$ or $s_2(t) = -A\cos\omega_0 t$ with a matched filter. If $A = 1\,\text{mV}$, then the average bit error probability assuming single-sided noise power expected density $N_0 = 10^{-11}\,\text{W/Hz}$ is nearly

(a) $Q(0{\cdot}63)$

(b) $Q(0{\cdot}16)$

(c) $Q(\sqrt{0{\cdot}1})$

(d) $Q(\sqrt{0{\cdot}3})$

73. The outputs of 18 numbers of 20 Hz low-pass filters are sampled, multiplexed and A/D converted. If the sampling is at the Nyquist rate of 40 samples/s, corresponding to signal of 20 Hz bandwidth, and if we use 3 bits/sample to represent each voltage sample, the bit rate is

(a) $1{\cdot}9\times10^3$ bits/s

(b) 19×10^3 bits/s

(c) $2{\cdot}16\times10^3$ bits/s

(d) $21{\cdot}6\times10^3$ bits/s

74. The minimum double-sided Nyquist bandwidth for a QPSK modulator with an input data rate equal to 10 Mbps and a carrier frequency of 70 MHz is

(a) 72·5 MHz

(b) 67·5 MHz

(c) 25·0 MHz

(d) 5·0 MHz

75. The value of $\nabla \cdot A$, where

$$A = 3xy\vec{a}_x + x\vec{a}_y + xyz\vec{a}_z$$

at a point (2, −2, 2) is

(a) −10

(b) −6

(c) 2

(d) 4

76. The unit-impulse response of a system is $16e^{-2t} - 8e^{-t}$. Its unit-step response is

(a) $8 + e^{-t} - 4e^{-2t}$

(b) $8 + e^{-t} + 4e^{-2t}$

(c) $8e^{-t} - 8e^{-2t}$

(d) $e^{-t} - 4e^{-2t}$

77. The low-frequency asymptote in the Bode plot of

$$G(s) = \frac{6(s^2 + 10s + 100)}{s^2(50s^2 + 15s + 1)}$$

has a slope of

(a) −10 dB/dec

(b) −20 dB/dec

(c) −40 dB/dec

(d) −60 dB/dec

78. For the open-loop system

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

the breakaway point is

(a) −0·23

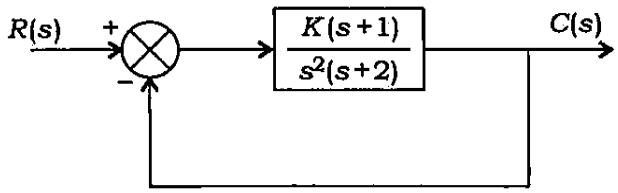
(b) −0·42

(c) −1·47

(d) −3·47

79. Consider the stability of the system shown in the figure when analyzed with a positive real value of gain K in

1. open-loop configuration
2. closed-loop configuration



Which of the following statements is correct?

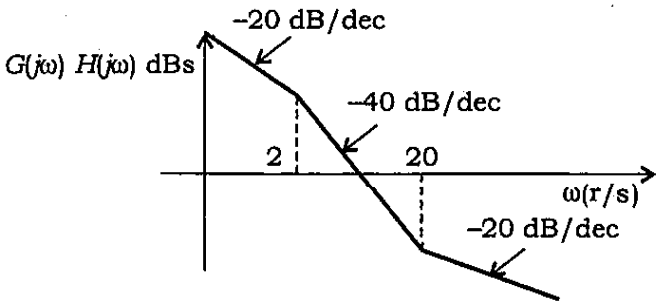
(a) Both 1 and 2 are stable

(b) 1 is stable and 2 is unstable

(c) 1 is unstable and 2 is stable

(d) Both 1 and 2 are unstable

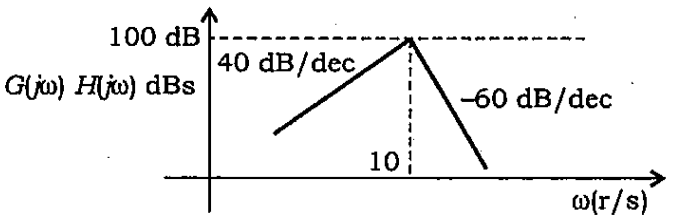
80. The open-loop transfer function $G(s)\,H(s)$ of the Bode plot as shown in the figure is



(a) $\dfrac{Ks(s+2)}{s+20}$ *(b)* $\dfrac{K(s+20)}{s(s+2)}$

(c) $\dfrac{K(s+2)}{s(s+20)}$ *(d)* $\dfrac{Ks(s+20)}{s+2}$

81. Which one of the following transfer functions represents the Bode plot as shown in the figure (where K is constant)?



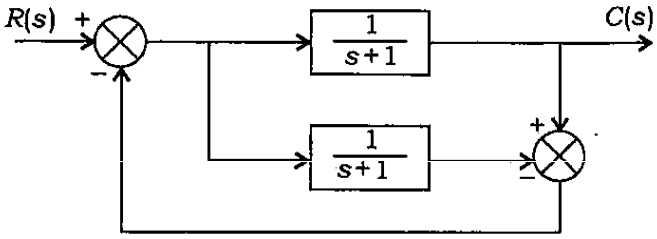
(a) $\dfrac{Ks^2}{\left(1+\dfrac{s}{10}\right)^3}$

(b) $\dfrac{Ks^2}{\left(1+\dfrac{s}{10}\right)^4}$

(c) $\dfrac{Ks^2}{\left(1+\dfrac{s}{10}\right)^5}$

(d) $\dfrac{Ks^2}{\left(1+\dfrac{s}{10}\right)^2}$

82. The closed-loop transfer function $\dfrac{C(s)}{R(s)}$ of the system represented by the block diagram in the figure is



(a) $\dfrac{1}{(s+1)^2}$

(b) $\dfrac{1}{s+1}$

(c) $s+1$

(d) 1

83. In a unity feedback control system, the open-loop transfer function is

$$G(s)=\frac{K(s+2)}{s^2(s^2+\quad+12)}$$

Then the error constants K_p, K_v and K_a, respectively, are

(a) ∞, ∞ and $\dfrac{K}{6}$

(b) 0, 0 and $\dfrac{K}{6}$

(c) $\dfrac{K}{6}$, 0 and 0

(d) $\dfrac{K}{6}$, ∞ and ∞

84. Settling time is the time required for the system response to settle within a certain percentage of

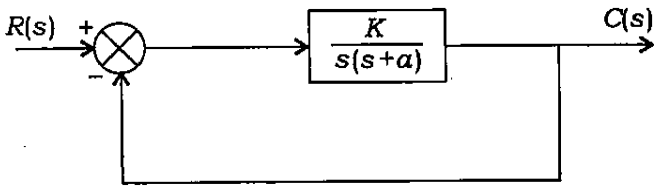
(a) maximum value

(b) final value

(c) input amplitude value

(d) transient error value

85. A unity feedback system is shown in the figure. What is the magnitude of K so that the system is under-damped?



(a) $K = 0$

(b) $K = \frac{a^2}{4}$

(c) $K < \frac{a^2}{4}$

(d) $K > \frac{a^2}{4}$

86. The transfer function $G(s)$ of a PID controller is

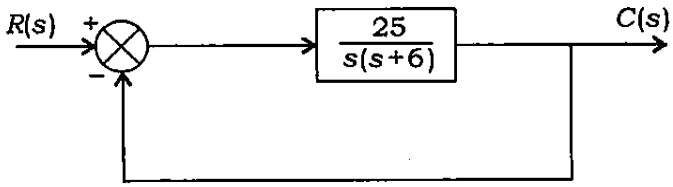
(a) $K_1 + K_2 s + K_3 s^2$

(b) $K_1 + \frac{K_2}{s} + K_3 s$

(c) $K_1 + \frac{K_2}{s}$

(d) $K_1 s + K_2 s^2 + K_3 s^3$

87. For a closed-loop system shown in the figure, what is the settling time for ±2% settling of the steady-state condition, assuming unit-step input?



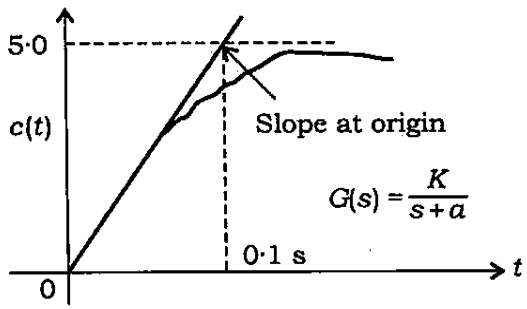
(a) 0·33 s

(b) 1·33 s

(c) 2·33 s

(d) 3·33 s

88. A unit-step input to a first-order system $G(s)$ yields a response as shown in the figure. This can happen when the values of K and a, respectively, are



(a) 10 and 10

(b) 5 and 10

(c) 10 and 5

(d) 5 and 5

89. The open-loop transfer function of a system is

$$\frac{10K}{1+10s}$$

When the system is converted into a closed-loop with unity feedback, the time constant of the system is reduced by a factor of 20. The value of K is

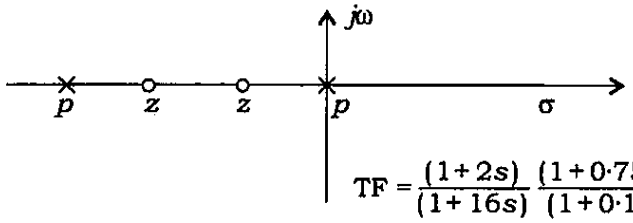
(a) 1·9

(b) 1·6

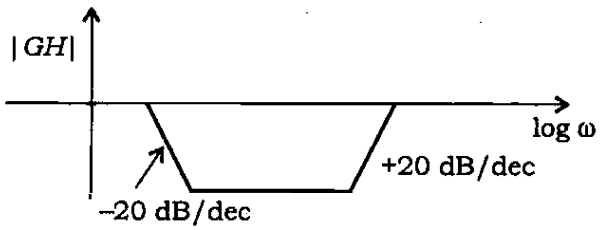
(c) 1·3

(d) 1·0

90. The pole-zero configuration of the transfer function of a compensator and the corresponding Bode plot are shown in the figure. The configuration is indicative of



$$TF = \frac{(1+2s)}{(1+16s)}\frac{(1+0{\cdot}75s)}{(1+0{\cdot}1s)}$$



(a) lag compensator

(b) lag-lead compensator

(c) P-D compensator

(d) lead compensator

91. Consider that a level of the memory hierarchy has a hit rate of 80%. Memory requests take 10 ns to complete if they hit in the level, and memory requests that miss in the level take 100 ns to complete. The average access time of the level is

(a) 110 ns

(b) 100 ns

(c) 80 ns

(d) 28 ns

92. A program structure that permits repeated operation of a particular sequence of instructions is known as

(a) subroutine

(b) loop

(c) module

(d) microprogramming

93. If

$$V = \frac{10}{r^2}\sin\theta\cdot\cos\phi$$

the electric flux density at $\left(2, \frac{\pi}{2}, 0\right)$ is

(a) $32{\cdot}1\vec{a}_r$ pC/m^2

(b) $22{\cdot}1\vec{a}_r$ pC/m^2

(c) $10{\cdot}2\vec{a}_r$ pC/m^2

(d) $5{\cdot}8\vec{a}_r$ pC/m^2

94. In an n-turn coil, the flux through each turn is $(t^3 - 4t)$ mWb. The magnitude of the induced e.m.f. in the coil at $t = 5$ s is 7·1 V. The number of turns in the coil is

(a) 10

(b) 100

(c) 121

(d) 1000

95. Consider the following statements :

1. For an isotropic medium, ε is a scalar constant.
2. For a homogeneous medium, ε, μ and σ are constant throughout the region.
3. In an anisotropic medium, D and E have the same direction.
4. For certain crystalline medium, ε varies with the direction of E.

Which of the above statements are correct?

(a) 1, 2 and 3

(b) 1, 3 and 4

(c) 1, 2 and 4

(d) 2, 3 and 4

96. If a 75 Ω line is terminated by a load of $(120 + j80)$ Ω, the maximum and minimum impedances over the line are nearly

(a) 135 Ω and 28 Ω

(b) 190·5 Ω and 28 Ω

(c) 135 Ω and 16 Ω

(d) 190·5 Ω and 16 Ω

97. A product-of-sums (POS) expression leads to what kind of logic circuit?

(a) OR-AND circuit

(b) NOR-NOR circuit

(c) AND-OR-INVERT circuit

(d) NAND-NAND circuit

98. In a certain material medium, a propagating electromagnetic wave attains 60% of the velocity of light. The distance at which the electromagnetic wave (f – 10 MHz) will have the same magnitude for the induction as well as the radiation fields is nearly

(a) 57·4 m

(b) 29·0 m

(c) 5·8 m

(d) 2·9 m

99. A measure of the mismatch between the maximum and minimum voltage and current variations along the transmission line is called SWR, i.e., standing wave ratio. SWR indicates how much power is delivered to the load, and how much is lost in the line. When SWR is 1, the percent reflected power is zero. When SWR is 1·5, the percent reflected power will be

(a) 4

(b) 8

(c) 25

(d) 40

100. A communication link operating at 3 GHz has a 22·5 W transmitter connected to an antenna of 2·5 m^2 effective aperture. The receiving antenna has effective aperture of 0·5 m^2 and is located at 15 km line-of-sight distance from the transmitting antenna (assume lossless, matched antennas). The power delivered to the receiver is

(a) 12·5 μW

(b) 125 μW

(c) 12·5 mW

(d) 125 mW

101. For a WR 90 waveguide, the cut-off frequency for TE_{20} mode is 16 GHz. Then the cut-off frequency for TE_{11} mode will be

(a) $4\sqrt{3}$ GHz

(b) $6\sqrt{3}$ GHz

(c) $8\sqrt{5}$ GHz

(d) $16\sqrt{5}$ GHz

102. During wave propagation in an air-filled rectangular waveguide

1. wave impedance is never less than the free-space impedance
2. propagation constant is an imaginary number
3. TEM mode is possible if the dimensions of the waveguide are properly chosen

Which of the above are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

103. For a 4-element broadside antenna array, ψ equals

(a) $\sin\phi$

(b) $\pi\cos\phi$

(c) $\frac{\cot\phi}{\sqrt{2}\pi}$

(d) $\pi\sin\phi$

104. The open-loop transfer function of a system has two poles on the imaginary axis, one in the left-half and the other in the right-half, together with a zero at the origin of coordinates and also two zeros in the left-half of the s-plane. The closed-loop response for unity feedback will be stable if the encirclement of the critical point $(-1, j0)$ is

(a) -1

(b) $+1$

(c) -2

(d) $+2$

105. The steady-state error for a 'Type 0' system for unit-step input is 0·2. In a certain instance, this error possibility was removed by insertion of a unity gain block. Thereafter, a unit ramp was applied. The nature of the block and new steady-state error in this changed configuration will, respectively, be

(a) integrator; 0·25

(b) differentiator; 0·25

(c) integrator; 0·20

(d) differentiator; 0·20

106. Which one of the following refers to the frequency ω_k in the frequency response of an FIR filter?

(a) $\frac{16\pi}{M}(k+\alpha)$

(b) $\frac{8\pi}{M}(k+\alpha)$

(c) $\frac{4\pi}{M}(k+\alpha)$

(d) $\frac{2\pi}{M}(k+\alpha)$

107. Three processors with their respective process IDs given by P_1, P_2 and P_3, having estimated completion time of 8 ms, 4 ms and 2 ms, respectively, enter a ready queue together in the order P_1, P_2 and P_3. What is the average turn time in the Round Robin Scheduling Algorithm with time 2 ms?

(a) 10 ms

(b) 15 ms

(c) 20 ms

(d) 25 ms

108. In the following 8085 assembly language program, assume that the carry flag is initially reset. What is the content of the accumulator after the execution of the program?

```
MVI  A,  04H
RRC
MOV  B, A
RLC
RLC
ADD  B
RRC
```

(a) 02H

(b) 05H

(c) 15H

(d) 25H

109. The technique for using one set of addresses inside a network and remapping those addresses to a different set of addresses that are seen outside the local network on the Internet is called

(a) network address translation

(b) address resolution

(c) network address mapping

(d) virtual LAN

110. What type of network is the Internet?

(a) Circuit-switched network

(b) Message-switched network

(c) Packet-switched network

(d) Cell-switched network

111. Which of the following statements is correct in respect of TCP and UDP protocols?

(a) TCP is connection-oriented, whereas UDP is connectionless.

(b) TCP is connectionless, whereas UDP is connection-oriented.

(c) Both are connectionless.

(d) Both are connection-oriented.

112. A fixed radar station transmits 100 kW at 3 GHz. The smallest ocean-going ship has a radar cross-section of 200 m^2. The radar antenna gain is 16 dB. If detection requires a minimum of 1 nW/m^2 at the radar antenna, the effective range of the radar is nearly

(a) 7·1 km

(b) 8·4 km

(c) 70·7 km

(d) 84·0 km

113. A receiving antenna with a gain of 40 dB looks at a sky with a noise temperature of 15 K. The loss between the antenna and LNA input due to the feed horn is 0·4 dB, and the LNA has a noise temperature of 40 K. The $\frac{G}{T}$ value is

(a) 11·2 dB/K

(b) 13·4 dB/K

(c) 20·6 dB/K

(d) 39·0 dB/K

114. A company operating taxicabs communicates from its central office with the help of an antenna at the top of a 16 m tower. The antenna on the taxicabs is 1·44 m above the ground. The communication distance between the central office and a taxicab ***cannot*** exceed

(a) 18·6 km

(b) 24·0 km

(c) 50·0 km

(d) 62·3 km

115. The linear velocity of a satellite, when in a circular orbit, is

(a) directly proportional to its mass

(b) directly proportional to the square root of its mass

(c) directly proportional to the square of its mass

(d) independent of its mass

116. For a system with a wavelength of 23·5 cm and a depression angle of $\sin^{-1} 0{\cdot}94$, the surface relief below which the surface will appear smooth is determined as limited nearly to

(a) 2·8 cm

(b) 3·1 cm

(c) 3·5 cm

(d) 4·0 cm

117. The orbital period of a satellite in a circular orbit of 500 km above the Earth's surface, taking mean radius of the Earth as 6400 km and Kepler's constant μ as 4×10^5 km^3/s^2 is nearly

(a) 1·6 hours

(b) 2·4 hours

(c) 3·2 hours

(d) 6·4 hours

118. What is/are the advantage(s) of step-index mono-mode fibre optical cable?

1. Manufacturing process is simple.
2. Bandwidth of several GHz-km is possible.
3. Splicing is easier.

Select the correct answer using the code given below.

(a) 1 only

(b) 2 only

(c) 3 only

(d) 1, 2 and 3

119. Consider the following set of processes :

Process	P_1	P_2	P_3	P_4	P_5
Burst time	10 ms	29 ms	3 ms	7 ms	12 ms

First Come First Serve (FCFS), non-preemptive Shortest Job First (SJF) and Round Robin (RR) (quantum = 10 ms) Scheduling Algorithms for this process set would imply which of the following features?

1. The SJF policy results in less than half of the average waiting time obtained with FCFS scheduling.
2. The RR algorithm gives an intermediate value for the average waiting time.
3. Deterministic modelling takes a particular predetermined workload, and designs the performance of each algorithm for that workload.

Select the correct answer using the code given below.

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 1 and 3 only

(d) 2 and 3 only

120. The cut-off wavelength for an optical fibre with 5 μm core diameter and core cladding indices of refraction 1·484 and 1·402 is nearly

(a) 0·5 μm

(b) 1 μm

(c) 3 μm

(d) 6 μm

***Directions* :**

Each of the following **thirty (30)** items consists of two statements, one labeled as Statement I and the other as Statement II. Examine these two statements carefully and select the correct answer to each of these items using the code given below.

Code :

(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

121. Statement I :

The width of depletion layer of a *P-N* junction is increased under reverse bias.

Statement II :

Junction breakdown occurs under reverse bias.

122. Statement I :

In ideal case, the inverting and non-inverting input terminals of an operational amplifier are almost at the same potential.

Statement II :

It is common practice to connect the inverting and non-inverting terminals to the same point.

123. Statement I :

Optocouplers are used to isolate low-voltage circuits from high voltages.

Statement II :

Optocouplers are used to separate AC and DC ground.

124. Statement I :

Two ideal current sources with currents I_1 and I_2 cannot be connected in parallel.

Statement II :

Superposition theorem cannot be applied to ideal current sources if these sources are connected in cascade.

125. Statement I :

When a transformer is loaded, there is a change in its secondary voltage expressed as a percentage of secondary voltage on no-load, and this change is called its regulation.

Statement II :

The change in secondary voltage is due to the transformer impedance and the load current. The regulation could be zero for leading load condition.

126. Statement I :

Series DC motors are used for cranes and locomotives.

Statement II :

Series DC motors provide high starting torques, a requisite for such applications.

127. Statement I :

An induction motor always runs at a speed less than its synchronous speed.

Statement II :

Synchronous speed of induction motor depends on the frequency of supply and number of poles.

128. Statement I :

If a squirrel-cage motor is started at full rated voltage, the power supply could be damaged.

Statement II :

For squirrel-cage induction motors, starting current is high and power factor at starting is low.

129. Statement I :

The increase of temperature of a dielectric causes increase of electronic polarizability.

Statement II :

Orientational polarization in dielectric is inversely proportional to temperature.

130. Statement I :

The break statement provides an early exit from *for*, *while*, *do/while* and *switch* structures, and the execution continues with the first statement after the structure.

Statement II :

The continue statement, used in *while*, *for*, *do/while* loop, skips the remaining statements in the body of that structure, and proceeds with the next iteration of the loop.

131. Statement I :

A thermocouple transducer is based on Seebeck effect.

Statement II :

In a thermocouple transducer used for temperature measurement, the cold junction is usually kept in ice bath.

132. Statement I :

A salient-pole rotor placed in a magnetic field can produce an e.m.f. proportional to the speed of the rotating machine because of its variable reluctance characteristic.

Statement II :

The above device is essentially a frequency tachometer using a suitable pulse-shaping circuit and an electronic counter.

133. Statement I :

Sensors are almost always transducers, but transducers are not necessarily sensors.

Statement II :

Sensors are transducers that convert a physical quantity to a measurable quantity.

134. Statement I :

Piezoelectric transducers have very good frequency response.

Statement II :

Piezoelectric transducers can be used for measurement of both dynamic and static phenomena.

135. Statement I :

A symmetrical two-port network is bound to be reciprocal.

Statement II :

A symmetrical network will have the same magnitude of image impedance at both the ports.

136. Statement I :

The maximum number of logic gate inputs that can be driven from the output of a single logic gate is called 'fan-out'.

Statement II :

'Fan-out' is due to the current sourcing when the output is high, and is due to the current sinking when the output is low. Thus two different values for 'fan-out' may result.

137. Statement I :

PLA contains a fixed AND array and a programmable OR array.

Statement II :

PROM contains a fixed AND array and a programmable OR array.

138. Statement I :

Stack works on the principle of LIFO.

Statement II :

Stack pointer contains address of the top of the stack.

139. Statement I :

I/O devices can be accessed using IN and OUT instructions.

Statement II :

Arithmetic and logic operations can be directly performed with I/O data.

140. Statement I :

On executing the HLT instruction, the microprocessor enters into a halt state and all the buses are tri-stated.

Statement II :

On executing the HLT instruction, the microprocessor is disconnected from the system bus till the reset is pressed.

141. Statement I :

Stack is organized as 8-bit storage in the microprocessor.

Statement II :

Stack is a set of memory locations in R/W memory reserved for storing information temporarily during the execution of a program.

142. Statement I :

Static RAM memory devices retain data for as long as power is supplied.

Statement II :

SRAM is used when the size of read/write memory required is large.

143. Statement I :

The stator winding of a control transformer in a synchro pair has a high impedance per phase.

Statement II :

The rotor of the control transformer is cylindrical in shape.

144. Statement I :

The transportation lag in a system can be easily handled by using Bode plot.

Statement II :

The magnitude plot is unaffected, and only the phase plot shifts by $-\omega T$ rad due to the presence of e^{-st}.

145. Statement I :

Isolated I/O method isolates memory and I/O addresses.

Statement II :

In isolated I/O method, memory and I/O interfaces have their own individual address space.

146. Statement I :

Peripherals are electromechanical and/or electromagnetic devices.

Statement II :

All the peripherals are digital and parallel.

147. Statement I :

The internal interrupt is initiated by some exceptional condition caused by the program itself rather than by an external event.

Statement II :

External interrupt depends on external conditions that are independent of the program being executed at the time.

148. Statement I :

Swapping is sometimes called 'roll-out/ roll-in'.

Statement II :

Swapping is utilized in systems designed to support time-sharing.

149. Statement I :

MS DOS and Windows products have always used implicit mounting when an attempt is first made to access the media.

Statement II :

Unix has traditionally used explicit mount command to access the removable medium.

150. Statement I :

Virtual memory is designated virtual because there is no such memory inside the computer.

Statement II :

Virtual memory uses some space of the hard disk as an extension of the primary storage of the computer.

SPACE FOR ROUGH WORK

SPACE FOR ROUGH WORK

SPACE FOR ROUGH WORK

SPACE FOR ROUGH WORK

★★★