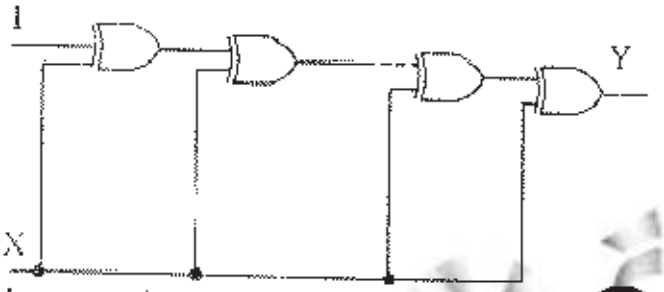
C.S.E.

ELECTRICAL ENGINEERING – 2005

(PRELIMINARY)

Time Allowed : 2 hours *Maximum Marks : 300*

1. 

If the input to the digital circuit consisting of a cascade of 20 XOR gates is X, then the output Y is equal to

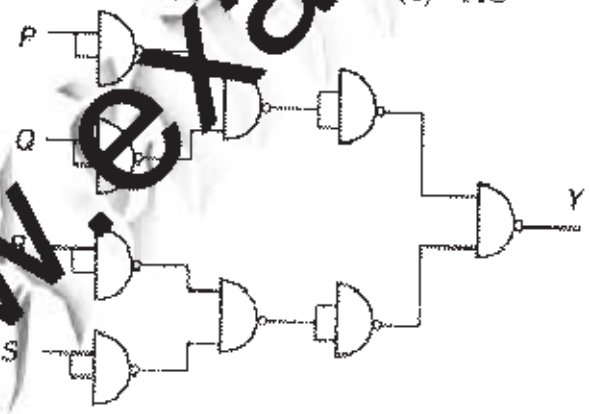
(a) X' (b) X (c) 0 (d) 1

2.

C \ AB	00	01	11	10
0	1	1	ϕ	0
1	0	0	ϕ	0

The minimal products-of-sums function described by the K-map given above is

(a) A+C (b) A'C (c) AC (d) A'C'

3. 

For the circuit show above, the Boolean expression for the output Y in terms of inputs P, Q, R and S is

(a) P'+Q'+R'+S' (b) P+Q+R+S

(c) (P'+Q') (R'+s') (d) (P+Q) (R+S)

4. **If all the messages of a source have the same probability P, then the source entropy H (m) is given by**

(a) - log P (b) +log P

(c) $\frac{P}{1-P}$ (d) $\frac{1-P}{P}$

5. **On the basis of equal carrier powers, the ratio of 'signal-noise ratio of FM and signal-noise ratio of AM' can oe expressed as (assume that detector/ discriminator losses are zero)**

(a) $\frac{S_0 / N_0(FM)}{S_0 / N_0(AM)} = 3m_f$ (b) $\frac{S_0 / N_0(FM)}{S_0 / N_0(AM)} = 3m_f^2$

(c) $\frac{S_0 / N_0(FM)}{S_0 / N_0(AM)} = 4.5m_f^3$ (d) $\frac{S_0 / N_0(FM)}{S_0 / N_0(AM)} = \sqrt{3}\,m_f^3$

6. **To transmit N Signals, each band limited to f_m by TDM, will require a minimum bandwidth of**

(a) f_m Hz (b) $2f_m$ Hz

(c) Nf_m Hz (d) $2Nf_m$ Hz

7. **In a DM system, the granular noise occurs when the modulating signal**

(a) increases linearly (b) increases exponentially

(c) remains constant (d) decreases rapidly

8. **Consider the follwoing statements in connection with PCM system :**

1. PCM is much better for noise immunity as it depends only on the pressure or absence of the pulses at any given time.
2. PCM requires a small bandwidth compared to analog systems.
3. PCM requires very complex encoding and quantizing circuity.
4. PCM has all advantages of frequency modulation

when it comes to noise performance.

Which of the statement given above are correct :

(a) 1, 2 and 4 (b) 1, 3 and 4

(c) 2, 3 and 4 (d) 1, 2 and 3

9. **The frequency spectrum of an amplitude-modulated signal contains**

(a) carrier frequency only

(b) sideband frequencies only

(c) modulating frequency only

(d) carrier and sideband frequencies

10. **An amplitude-modulated analog waveform has a maximum amplitude A_{max} and a minimum amplitude A_{min} (a positive value), then the modulation index is given by**

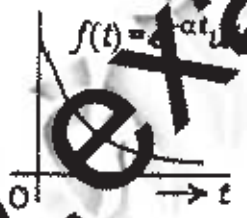
(a) $\frac{A_{min}}{A_{max}}$ (b) $\frac{2A_{min}}{A_{max} + A_{min}}$

(c) $\frac{A_{max} - A_{min}}{A_{max} + A_{min}}$ (d) $\frac{A_{max} - A_{min}}{2(A_{max} + A_{min})}$

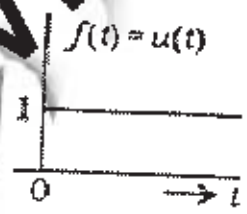
11. **In connection with properties of the Fourier transform, match List–I *(Function of Time)* with List–II *(Spectral Density Function)* and select the correct answer using the code given below the Lists :**

List-I

A. $f(t) = e^{-\alpha t} u(t)$

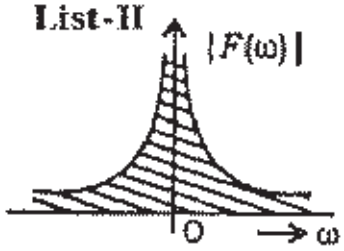


B. $f(t) = u(t)$

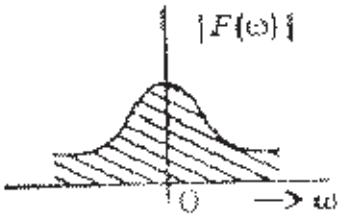


List-II

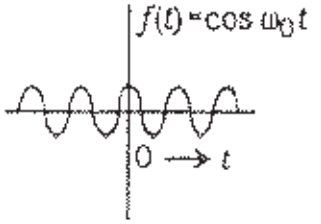
1. $|F(\omega)|$



2. $|F(\omega)|$



C.



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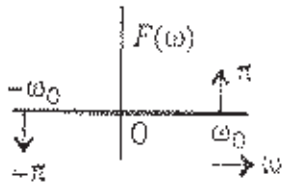
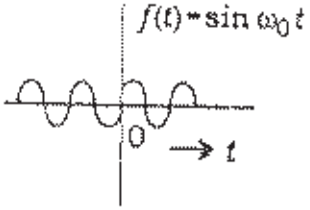


D.

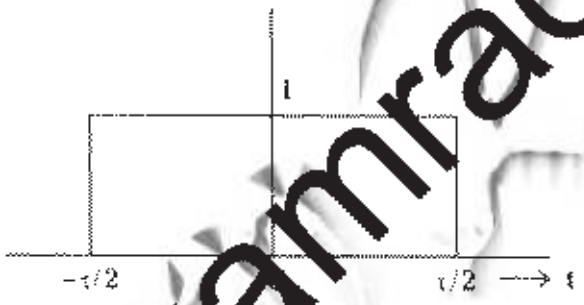


4.

	A	B	C	D
(a)	1	3	2	4
(c)	1	3	4	2

	A	B	C	D
(b)	2	1		3
(d)	2	1		

12.



Fourier transform of the gate function as shown above is

$f(t) = 1$ for $-\tau/2 \le t \le \tau/2$

$= 0$ otherwise

(where τ is the width of the gate function)

The value of $F(\omega)$ is

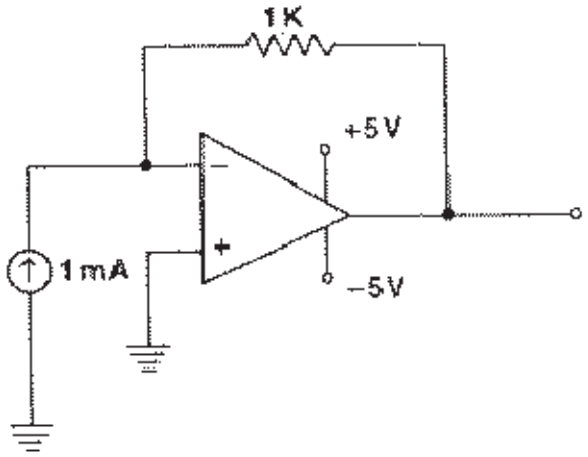
(a) $\dfrac{\sin(\omega\tau)}{\omega\tau}$

(b) $\dfrac{\tau \sin(2\omega\tau)}{2\omega\tau}$

(c) $\dfrac{\tau \sin(\omega\tau/2)}{(\omega\tau/2)}$

(d) $\dfrac{\tau}{2} \cdot \dfrac{\sin(\omega\tau/2)}{(\omega\tau/2)}$

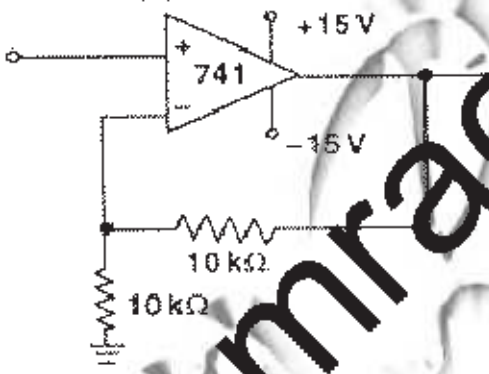
3.



The circuit shown in above figure uses as ideal Op-Amp working with +5 V and –5 V power supplies. The output voltage V_0 is equal to

(a) +5 V (b) +1 V (c) –1 V (d) –5 V

14.



The circuit given above is

(a) peak detector (b) Schmitt trigger

(c) buffer amplifier (d) unity gain amplifier

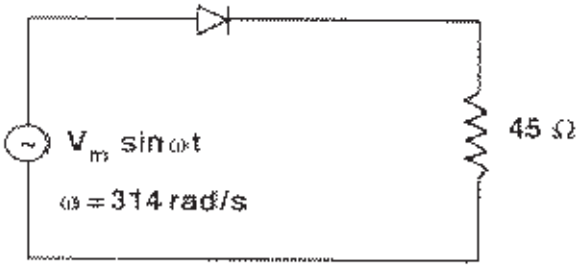
15. **Match List-I (*Scheme of Feedback*) with List-II (*Performance Measure*) and select the correct answer using the code given below the Lists :**

List-I	List-II
A. Current series	1. Input impedance increases, output impedance decreases
B. Current Shunt	2. Input impedance decreases, output impedance decreases
C. Voltage series	3. Input impedance increases,

D.	Voltage	Shunt	4.	Input impedance decreases, output impedance increases

	A	B	C	D		A	B	C	D
(a)	3	4	2	1	(b)	2	1	3	4
(c)	3	4	1	2	(d)	2	4	3	1

16.



The forward resistance of the diode shown in above figure is 5 Ω and the remaining parameters are same as those of an ideal diode. The d.c. component of the source current is

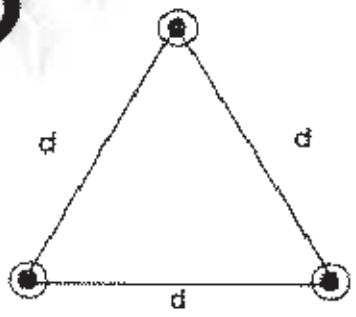
(a) $\frac{V_m}{50\pi}$ (b) $\frac{V_m}{50\pi\sqrt{2}}$

(c) $\frac{V_m}{100\pi\sqrt{2}}$ (d) $\frac{V_m}{50\pi}$

17. The per unit impedance of a circuit element is 0·15. If the base kV and base MVA are halved, then what will be the new value of the per unit impedance of the circuit element ?

(a) 0·075 (b) 0·15 (c) 0·30 (d) 0·60

18.



A bunled conductor has 3 conductors, equilaterally spaced as shown above. D_s is the GMR of the individual conductor. What is the GMR of the bundled conductor?

(a) $(D_s \times d)^{1/3}$ (b) $(D_s \times d)^{1/3}$

(c) $(D_s \times d^2)^{1/3}$ (d) $D_s \times d^2$

19. In a short transmission line, if the impedance of the line is 0·01 + j 0·15 per unit when the load current is 1·0 p.u. at 0·8 lag power factor and the receiving end voltage $V_R = 1{\cdot}0$ p.u., what is the regulation of the line?

(a) 0·8% (b) 0·9%

(c) 9·8% (d) 1%

20. Which one of the following yields the value of sag of conductors between two poles? (W is weight per unit length of conductor in N/m, L is the distance between two poles in meter, T is the tension in conductor in N)

(a) $WL^2/16T$ (b) $WL^2/8T$

(c) $WL^2/2T$ (d) WL^2/T

21. For nominal π-representation of the transmission lines, the ABCD parameters are related to Z and Y of the line, such that C parameter is given by

(a) $C = 1 + (1/2)YZ$ (b) $C = Z$

(c) $C = Z\,(1 + (1/2)YZ)$ (d) $C = Z\,(1 + (1/4)YZ$

22. Which one of the following statements is correct: In a load-duration curve for an integrated power system the uppermost crest represents the energy contributed by

(a) base power station (b) major thermal station

(c) peaking hydro or gas turbine stations

(d) non-conventional power stations

23. Consider the following statements for a single-phase hysteresis motor:

1. Torque is constant from standstill up to synchronous speed N_s.

2. Rotor is provided with narrow slots embedded with bars.
3. Torque at starting is some what more than that at synchronous speed N_s.
4. As the name suggests, only hysteresis torque is produced from zero speed right up to N_s.
5. Rotor material possesses very wide hysteresis loop.

Which of the statements given above are correct?

(a) 1, 2 and 5 (b) 3 and 5
(c) 1 and 4 (d) 2, 3 and 5

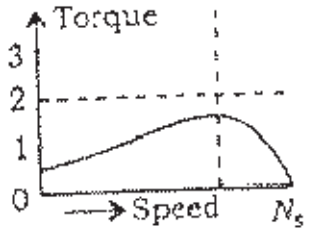
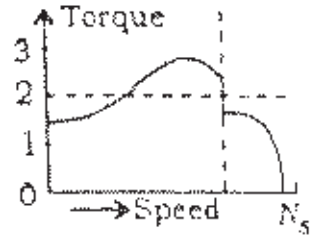
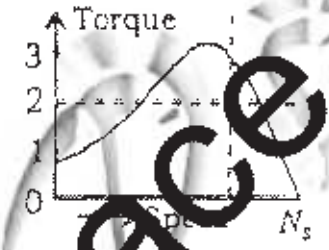
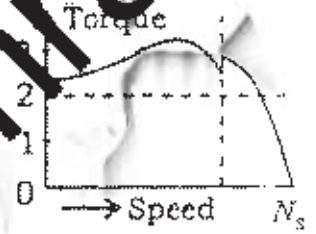
24. **The field current of a synchronous motor is increased while its load is constant. How will its power angle and power factor change?**

(a) Power angle decreases and power factor improves
(b) Power angle remains same throughout but power factor improves
(c) Power angle increases while its power factor gradually decreases
(d) Power angle and power factor both increase

25. **Two alternators (M_1 and M_2) have been properly synchronized and connected in parallel to a common busbar. If there is no load on the busbar, and the field excitation of the second alternator (M_2) is increased gradually by a small amount, from its 'normal' excitation for which the induced e.m.f.'s E_1 and E_2 of the two machines are equal, the armature reaction due to the circulating armature current would be**

(a) magnetising for M_1, but demagetising for M_2
(b) demagnetising for M_1, but magnetising for M_2
(c) magnetising for both M_1 and M_2
(d) demagnetising for both M_1 and M_2

26. **Match List-I** *(Type of Single-phase Induction Motor)* **with List-II** *(Torque-Speed Characteristic)* **and select the correct answer using the code given below the Lists :**

List-I		List-II
A. Capacitor-run motor	1.	
B. Capacitor-start and run motor	2.	
C. Shaded-pole motor	3.	
D. Resistor-split phase motor	4.	

	A	B	C	D		A	B	C	D
(a)	2			3	(b)	2	3	1	4
(c)	3			1	(d)	3	4	1	2

27. **In a 3-phase induction motor, if P_g is the power transferred across the air gap and S is the slip, then the ratio of motor copper loss to the mechanical power developed is given by**

(a) $\frac{S}{1-S}$ (b) S

(c) $\frac{1}{S}$ (d) $\frac{1-S}{S}$

28. To prevent the shifting of the magnetic neutral axis, caused by the 'armature reaction' in a d.c. machine, the most effective method to neutralize the armature flux is to
(a) shift the 'brush-axis'
(b) provide high-reluctance main pole tips
(c) cut horizontal slots in the main poles
(d) place compensating windings on the main-pole faces

29.

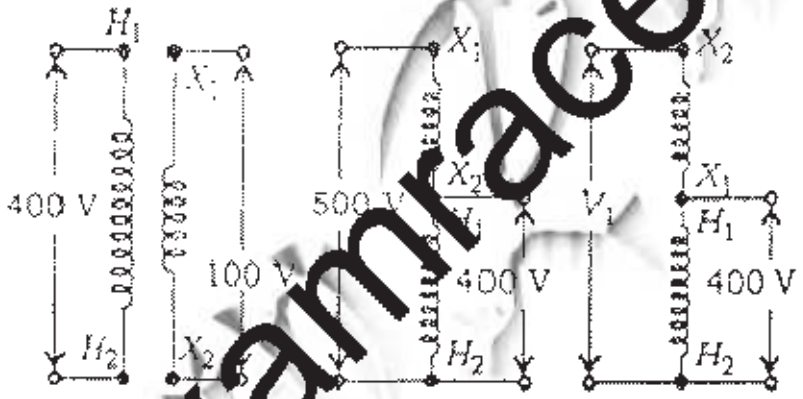


Fig. Fig. 2 Fig. 3

A single-phase two-winding transformer shown above in Fig. [illegible] conected an autotransformer shown in Fig. 2. If the connections of the 100 V winding are reversed as shown in Fig. 3, what is the value of the voltage V_1 required to be applied across treminals X_2 and H_2 to obtain the same 400 V output ?
(a) 500 V (b) 400 V
(c) 300 V (d) 100 V

30. Two transformers with identical voltage ratings are working in parallel to supply a common load. The percentage impedance of one transformer is higher compared to that of the other. The load sharing between the two transformers will

(a) be proportionate to their percentage impedances
(b) be independant of their percentage impedances
(c) be inversely proportional to their respective impedances
(d) depend on the resistance to leakage reactance ratio of each transformer

31. **Consider a system having forward path and feedback path transfer functions as 1/6 [s(s+0·8)] and (1+8s) respectively. Which is the characteristic polynomial of the system?**
(a) $s^2+0{\cdot}8s+16$ (b) $s^2+2{\cdot}8s+16$
(c) $s^2+32{\cdot}8s+16$ (d) $s^2+32s+16$

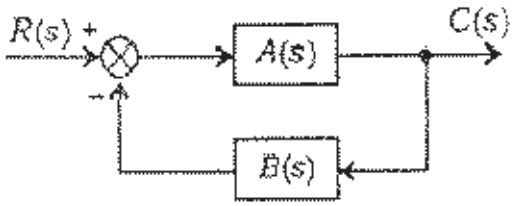
32. **Which of the following correct?**
The feedback affects the control system in the following ways :
1. Increases accuracy but reduces sensitivity of gain to variation in system parameters.
2. Increases bandwith and reduces the effect of non-linearity.
3. Increases tendency towards ocillation or leads even to instability.
Select the correct answer using the code given below :
(a) 1 and 2 (b) 1 and 3
(c) 2 and 3 (d) 1, 2 and 3

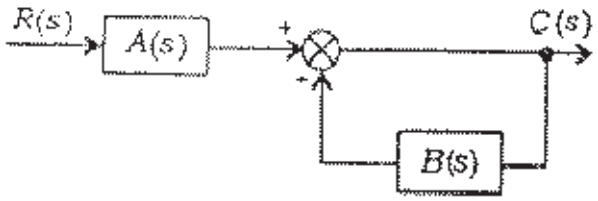
33. **The transfer function**

$$\frac{C(s)}{R(s)} = \frac{A(s)}{1 + B(s)}$$

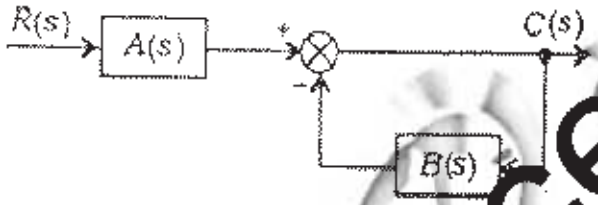
is the simplification of which one of the following block diagrams?
(a)

(b)





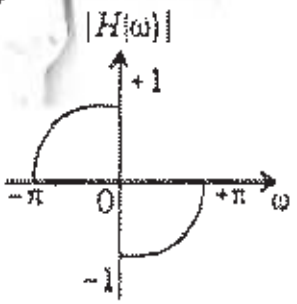
(d)



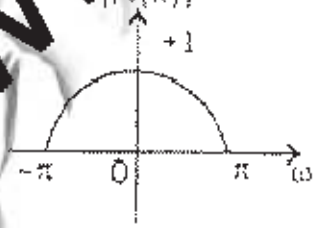
34. Which one of the following figures represents the magnitude plot of the transfer function $H(\omega) = \frac{1+e^{-j\omega}}{2}$?

(a)

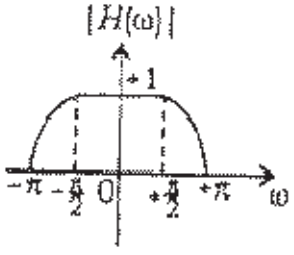
(b)



(c)



(d)



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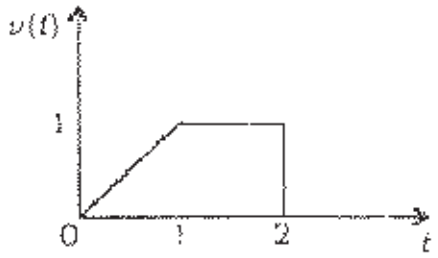


The Laplace transform of v(t) shown in the above figure is

(a) $\frac{1}{s^2}\left(1-e^{-s}\right)-\frac{1}{s}e^{-2s}$ (b) $\frac{1}{s^2}\left(1-e^{-s}\right)-\frac{1}{s}e^{-2s}$

(c) $\frac{1}{s^2}\left(1+e^{-s}\right)+\frac{1}{s}e^{-2s}$ (d) $\frac{1}{s^2}\left(1-e^{-s}\right)-\frac{1}{s}e^{-2s}$

36. If f(t) and F(s) form the Laplace transform pair, then what is the Laplace transform of $f(t/t_0)$?

(a) $t_0F(t_0s)$ (b) $\frac{1}{t_0}F(t_0s)$

(c) $t_0F\left(\frac{1}{t_0}s\right)$ (d) $\frac{1}{t_0}F\left(\frac{1}{t_0}s\right)$

37. What is the steady-state response of a system

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

when unit step input is applied?

(a) 0.5 (b) 1.0

(c) 1.5 (d) 0

38. The forward voltage transfer function of a two-port network is

$$\frac{s+\omega}{s^2+\omega^2}$$

What will be the output voltage if the input voltage is $\delta(t)$?

(a) $\sqrt{2}\sin(\omega t - \pi/4)$ (b) $\cos \omega t - \sin \omega t$

(c) $\cos \omega t$ (d) $\sqrt{2}\sin(\omega t + \pi/4)$

39. Which of the following characteristics of the system are defined by $y(t) = x(t) \cos(100\pi t)$?

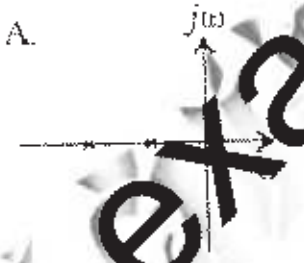
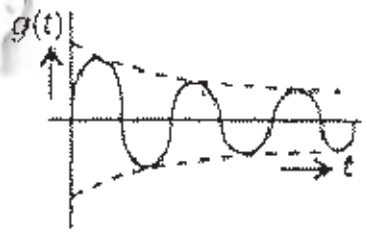
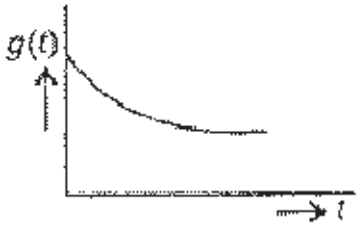
1. It is linear.
2. It is time invariant.
3. It is causal.
4. It is a stable.
5. It is memoryless.

Select the correct answer using the code given below :

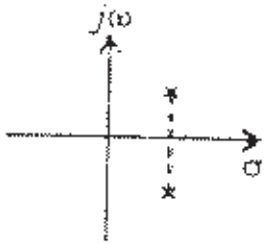
(a) 1, 2, 3 and 4 (b) 2, 3 and 5

(c) 4 and 5 (d) 1, 2, 4 and 5

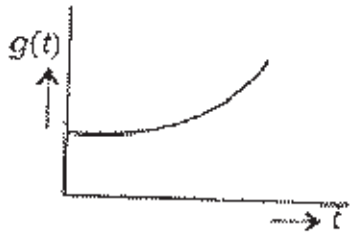
40. Match List-I *(Pole Location)* with List-II *(Time Response due to Initial Condition)* and select the correct answer using the code given below the Lists :

List-I (Pole Location)	List-II (Time Response due to Initial Condition)
A. 	1. 
B. 	2. 

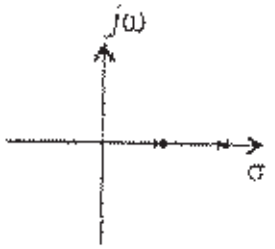
C.



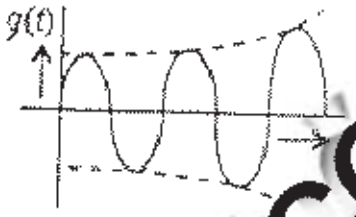
3.



D.



4.



	A	B	C	D		A	B	C	D
(a)	2	1	4	3	(b)	1		4	3
(c)	2	3	1	4	(d)	1	3	2	4

41.

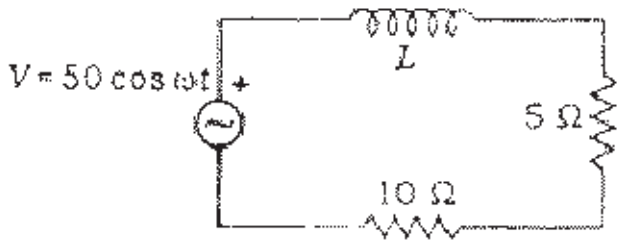
Which one of the following gives the h-parameter matrix for the network shown above?

(a) $\begin{bmatrix} \frac{1}{r_c + r_d} & \mu_{bc} \\ \alpha_{cb} & r_b + r_e \end{bmatrix}$

(b) $\begin{bmatrix} r_b + r_e & \alpha_{cb} \\ \mu_{bc} & \frac{1}{r_c + r_d} \end{bmatrix}$

(c) $\begin{bmatrix} r_b + r_e & \mu_{bc} \\ \alpha_{cb} & \dfrac{1}{r_c + r_d} \end{bmatrix}$ (d) $\begin{bmatrix} \mu_{bc} & \alpha_{cb} \\ r_b + r_e & \dfrac{1}{r_c + r_d} \end{bmatrix}$

42.



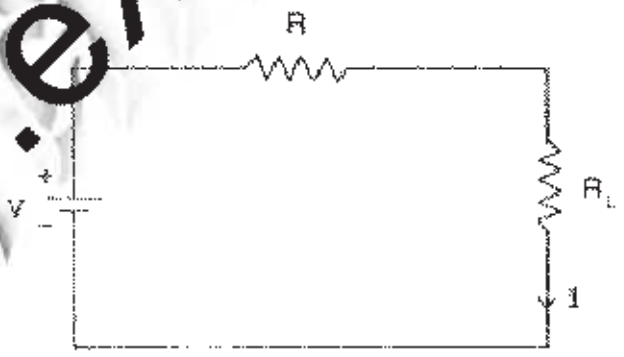
For the a.c. circuit given above, if the power dissipated by the 5 Ω resistor is 10 W, then what is the power factor of the circit?

(a) 0·9 lagging (b) 0·8 lagging
(c) 0·9 leading (d) 0·8 leading

43. A 2-terminal network is one of the R-L-C elements. The element is connected to an a.c. supply. The current through the element is I. When a capacitor is inserted in series between the source and the element, the current through the element becomes 2I. The element

(a) is a resistor (b) is an inductor
(c) is a capacitor (d) cannot be a single element

44.



For the above circuit, if the current I=3 A and 1·5 A for $R_L = 0$ and 2 Ω respectively, then what is the value of I for $R_L = 1\Omega$?

(a) 0·5 A (b) 1·0 A

(c) 2·0 A (d) 3·0 A

45.

$$A = \begin{array}{c} \begin{matrix} 1 & 2 & 3 & 4 & 5 & 6 \end{matrix} \\ \begin{bmatrix} 1 & -1 & -1 & -1 & 0 & 0 \\ 0 & 1 & 0 & 0 & -1 & 1 \\ 0 & 0 & 1 & 0 & 1 & 0 \end{bmatrix} \end{array}$$

For the reduced incidence matrix given above, which is the set of branches forming a tree?

(a) 1, 2, 3 (b) 2, 4, 6

(c) 2, 3, 5 (d) 1, 4, 6

46.

What is the value of the current I in the circuit shown above?

(a) 6 A (b) 3 A

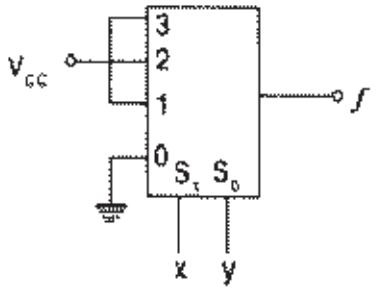
(c) 3 A (d) 9 A

47. The 4-bit, 2's complement representation of a decimal number is 1000. What is the number?

(a) −8 (a) 0

(a) −7 (a) −8

48.

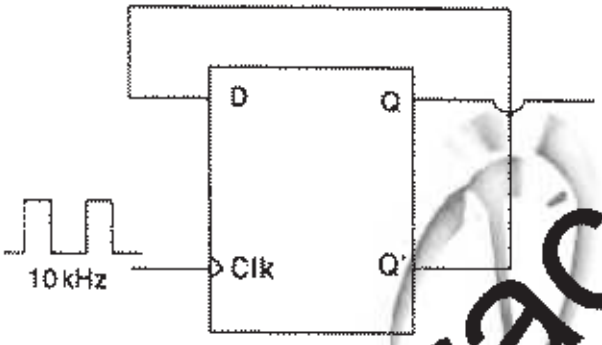


The output f of the 4-to-1 MUX shown in the above figure is

(a) $(xy)' + x$ (b) $x + y$

(c) $x' + y'$ (d) $xy + x'$

49.

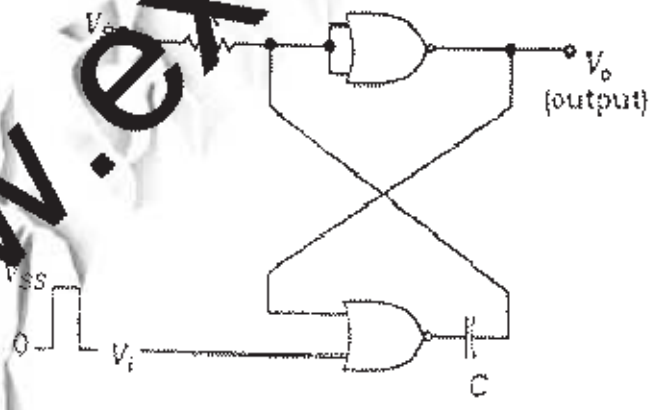


The frequency of the clock signal applied to the rising edge triggered D flip-flop shown in the figure given above is 10 kHz. What is the frequency of the signal available at Q ?

(a) 20 kHz (b) 10 kHz

(c) 5 kHz (d) 2·5 kHz

50.



The circuit in the figure given above has two CMOS NOR gates. This circuit functions as a/an

(a) flip-flop
(b) monostable multivibrator
(c) Schmitt trigger
(d) astable multivibrator

51. What is the number of the comparators required in a 3-bit comparator-type ADC?

(a) 2
(b) 3
(c) 7
(d) 8

52. The available multiple access and broadcasting systems are

1. SPADE
2. TDMA
3. FDMA
4. CDMA
5. SDMA

Which of the above are employed for satellite communications?

(a) 1, 2 and 3
(b) 2, 3 and 4
(c) 1 and 4
(d) 1, 2, 3, 4 and 5

53. If the maximum Radar range is to be doubled, the power of the Rader transmitter is to be increased (keeping all other parameters intact)

(a) two times
(b) four times
(c) eight times
(d) sixteen times

54. Which one of the following statements is correct? If a periodic signal exhibits half-wave symmetry, then in the trigonometric Fourier series

(a) all the sine terms vanish
(b) all the cosine terms vanish
(c) the constant term vanishes
(d) all the even harmonics vanish

55. How are vector processors and array processors classified?

(a) Single-instruction, Single-data (SISD) computers
(b) Single-instruction, Multipledata (SIMD) computers
(c) Multiple-instruction, Single data (MISD) computers
(d) Multiple-instruction, Multipledata (MIMD) computers

56. **What is/are the disadvantage(s) of Gauss-Seidel method over Newton's method in load-flow programmes?**

(a) More iteration

(b) More memory requirement and less accuracy

(c) Less iterations but more memory

(d) More accuracy and more memory

57. **Match List-I with List-II and select the correct answer using the code given below the Lists :**

List-I	List-II
A. Buchholz relay	1. Long lines
B. Mho relay	2. Short lines
C. Impedance relay	3. Medium lines
D. Reactance relay	4. Transformers

	A	B	C	D		A	B	C	D
(a)	4	1	3	2	(b)	3	2	1	4
(c)	4	3	2	1	(d)	3	4	2	1

58. **If the fault current is 2000 A, the relay setting is 50% and CT ratio is 400 : 5, then what is the plug setting multiplier?**

(a) 25 (b) 15

(c) 50 (d) 10

59. **In a static over-current relay, how are inverse time characteristics obtained?**

(a) By using a transistor amplifier

(b) By using an integrating circuit

(c) By using a transistor switch

(d) By using a differentiating circuit

60. **Satisfactory turn-off of a thyristor takes place if the reverse bias period of the device, after its current has become zero, is**

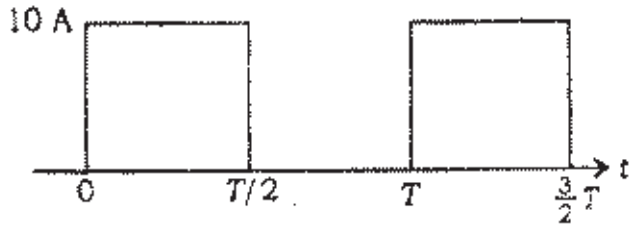
(a) greater than its turn-off time

(b) less than its turn-off time

(c) greater than the circuit time-constant

(d) less than the circuit time-constant

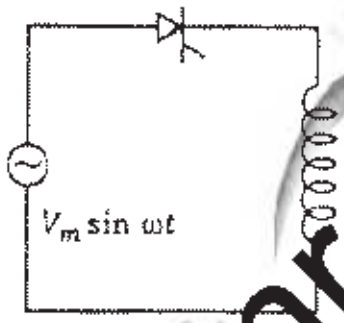
61.



A MOSFET rated for 20 A, carries a periodic current as shown in the above figure. The on-state resistance of the MOSFET is 0·2 ohm. What is the average on-state power loss of device per cycle ?

(a) 20 W (b) 15 W
(c) 10 W (d) 5 W

62.



A half-wave thyristor converter supplies a purely inductive load as shown in the above figure. If the triggering angle of the thyristor is 120°, then what is its extinction angle ?

(a) 120° (b) 180°
(c) 200° (d) 240°

63. **Match List-I with List-II and select the correct answer using the code given below the Lists :**

List-I (Converter)	List-II (Application)
A. Fully controlled converter	1. Improved time power factor
B. Half-controlled converter	2. Soft starter for a.c.

motor

C. 3-phase a.c. voltage controller
D. Cycloconverter

3. Speed reversal
4. Smooth low speed reversible high power a.c. drives
5. Synchronous motor control

	A	B	C	D
(a)	3	1	2	4
(c)	3	4	2	1

	A	B	C	D
(b)	2	4	5	1
(d)	2	1	5	4

64. **Which of the following are the advantages of free wheeling of load current in phase-controlled converters?**

1. It reduces reactive power demand of the converter.
2. It improves the displacement factor.
3. It improves distortion factor.
4. It requires larger indictance to provide continuous conduction.

Select the correct answer using the code given below:
(a) 1, 2, 3 and 4 (b) 1, 2 and 3
(c) 1 and 4 (d) 2, 3 and 4

65. **Which of the following are the functions of feedback diodes in a McMurray inverter?**

1. To free-wheel the load current.
2. To provide required reverse bias across the outgoing thyristor.
3. To provide the return path for the reactive current of load.
4. To provide a path for the excess of communication current above the load current.

Select the correct answer using the code given below:
(a) 2, 3 and 4 (b) 2 and 4
(c) 1, 2 and 3 (d) 3 and 4

66. **A 3-phase induction motor operates at constant slip frequency while the stator frequency is varied from**

0 to rated value. Which one of the following statements is correct?

The torque developed by the motor is

(a) proportional to speed

(b) proportional to square of speed

(c) inversely proportional to speed

(d) constant in the complete range up to base speed

Directions : The following 6 (six) items consist of two statements : one labelled as the 'Assertion (A)' and the other as 'Reason (R)'. You are to examine these two statements carefully and select the answers to these items using the code given below :

(a) Both A and R are individually *true* and R is the *correct* explanation of A.

(b) Both A and R are individually *true* but R is *not* the *correct* explanation of A.

(c) A is *true* but R is *false*.

(d) A is *false* but R is *true*.

67. **Assertion (A)** : A signal has to be sampled at twice the maximum frequency of the signal to recover it from the sampled signal.

Reason (R) : Sampling is to be done at Nyquist rate to avoid aliasing.

68. **Assertion (A)** : For a good degree of relative stability, a control system should have a phase margin of about 40^0 and a gain margin of 0·5.

Reason (R) : A large gain margin or a large phase margin corresponds to a highly oscillatory system, and a very small gain margin or a phase margin approaching 0^0 indicates a very stable but sluggish system.

69. **Assertion (A)** : $SiCl_4$ is added to Cl_2 in order to dry etch aluminium

anisotropically.

Reason (R) : Cl_2 etches aluminium while $SiCl_4$ etches native aluminium oxide and also provides anisotropy by forming sidewall inhibitors.

70. Assertion (A) : In discrete as well as IC device fabrication, wet oxidation of Si into its natural oxide is preferred.

Reason (R) : The rate of growth of wet oxidation is lower than that for dry oxidation, hence a better quality oxide can be grown.

71. Assertion (A) : Differential amplifier is biased with a current source for high CMRR.

Reason (R) : Differential amplifier will have higher gain for common mode signals.

72. Assertion (A) : A self-controlled synchronous motor fed from a CSI, need not have damper windings.

Reason (R) : Damper windings are responsible for subtransient reactance in synchronous motors.

73. Assertion (A) : Given a unity feedback system with $G(s) = \frac{K}{s(s+4)}$

the value of K damping ratio of 0·5 is

(a) 1 (b) 16 (c) 4 (d) 2

74. **Match List–I with List–II and select the correct answer using the code given below the Lists :**

List-I (Characteristic Equation)	List-II (Nature of Unit Step Response)
A. $s^2 + 8s + 15 = 0$	1. Undamped

B. $s^2 + 24s + 225 = 0$ 2. Underdamped

C. $s^2 + 20 \cdot 25 = 0$ 3. Critically damped

D. $s^2 + 20s + 100 = 0$ 4. Overdamped

	A	B	C	D		A	B	C	D
(a)	1	3	2	4	(b)	4	3	1	2
(c)	1	4	3	2	(d)	4	2	1	3

75. Given the matrix

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix}$$

What are the eigenvalues of A?

(a) $-1, -2, -3$ (b) $-1, 2, -3$

(c) $0, 0, -6$ (d) $-6, -11, -6$

76. Consider the following statements based on gain margin and phase of a system:

1. For stable systems, the gain cross-over frequency is less than phase cross-over frequency.
2. For unstable systems, the gain cross-over frequency is greater than phase cross-over frequency.
3. For marginally stable systems, the gain cross-over frequency is equal to phase cross-over frequency.

Which of the statements given above are correct?

(a) 1 and 2 (b) 2 and 3

(c) 1 and 3 (d) 1, 2 and 3

77. Which one of the following represents the transfer function of a phase-lag controller?

(a) $\frac{1 - aTs}{1 + Ts}$, $a < 1$ (b) $\frac{1 + aTs}{1 + Ts}$, $a > 1$

(c) $\frac{1 + aTs}{1 + Ts}$, $a < 1$ (d) $\frac{1 - aTs}{1 + Ts}$, $a > 1$

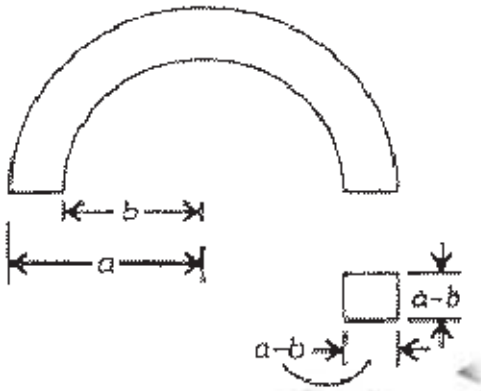
78. In order to reduce the steady-state error of a control

system, which one of the following control schemes will be employed?

(a) Cascade PD (b) Cascade PI

(c) Rate feedback (d) Integral feedback

79.



The resistance measured between the two ends of the toroid shown in the above figure is R. What would be the resistance if both a and b are doubled?

(a) 2R (b) R

(c) R/2 (d) R/4

80.

A square loop and an infinitely long conductor, each carries a current I as shown in the figure given above. What is the force on the loop?

(a) $\frac{\mu_0 I^2}{4\pi}$ away from the conductor

(b) $\frac{\mu_0 I^2}{4\pi^2}$ towards the conductor

(c) $\frac{\mu_0 I^2}{4\pi} \log_e 2$ away from the conductor

(d) $\frac{\mu_0 I^2}{4\pi} \log_e 2$ towards the conductor

81. **A metallic sphere with charge –Q is placed inside a hollow conducting sphere with radius R carrying a charge + Q. Potential at a given point outside the hollow sphere**

(a) depends on the positions of the metallic sphere

(b) is solely decided by the charge on the outer sphere

(c) is always zero whatever may be the position of the inner sphere

(d) is zero only when both spheres are concentric

82.

The magnetic vector potential at the point P due to the current loop shown in the above figure is in the direction of

(a) $\vec{a}_x$ (b) $\vec{a}_y$

(c) $\vec{a}_z$ (d) $\frac{\vec{a}_x + \vec{a}_y}{\sqrt{2}}$

83. **Which one of the following statements is correct? When an electromagnetic wave strikes the air-dielectric interface at an angle**

(a) the normal electric field components have the same

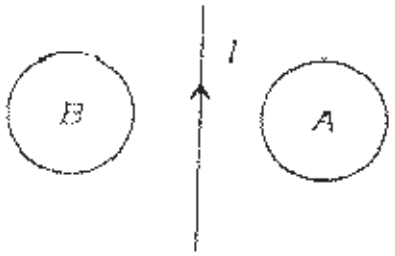
value

(b) the tangential magnetic field components are continuous

(c) the electromagnetic wave is reflected back according to Snell's law

(d) the electromagnetic wave is diffracted

84.



For the current I decreasing in the indicated direction, the e.m.f. in the two loops A and B shown in the figure above, is in the direction

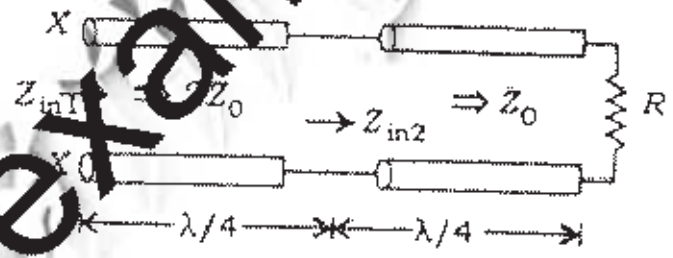
(a) clockwise in A and anticlockwise in B

(b) anticlockwise in A and clockwise in B

(c) clockwise in both A and B

(d) anticlockwise in both A and B

85.



A structure consisting of two loss-less lines, each λ/4 long and terminated in a resistance R, is shown in the figure given above. The lines have characteristic impedances of $2Z_0$ and Z_0 respectively as shown. What

is the impedance measured at the end XX?

(a) R (b) 4R

(c) Z_0^2/R (d) $4Z_0^2/R$

86. Match List–I *(Expression)* with List–II *(Coefficient)* and select the correct answer using the code given below the Lists :

List-I (Expression)	List-II (Coefficient)
A. $\rho = \frac{Z_L - Z_0}{Z_L + Z_0}$	1. Reflection coefficient for voltage
B. $\rho = \frac{Z_0 - Z_L}{Z_L + Z_0}$	2. Transmission coefficient for voltage
C. $\rho = \frac{2Z_L}{Z_0 + Z_L}$	3. Reflection coefficient for current
D. $\rho = \frac{2Z_0}{Z_0 + Z_L}$	4. Transmmission coefficient for current
	5. Standing-wave ratio

	A	B	C	D
(a)	1	2	5	4
(c)	1	3	2	4

	A	B	C	D
(b)	4	3	2	1
(d)	4	2	5	1

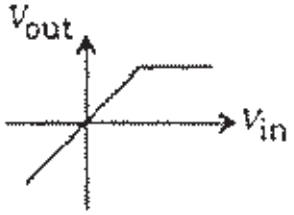
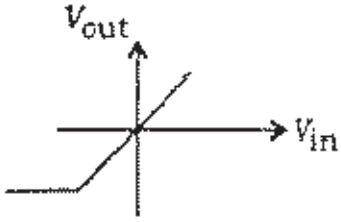
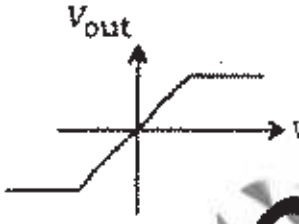
87. In a rectangular waveguide, what is the ratio of wave impedance for TM mode to wave impedance for TE mode *(i.e.,* X_{TM}/Z_{TE}*)* ?

(a) 1 (b) $\frac{1}{\sqrt{1-(f_c/f)^2}}$

(c) $\{1-(f_c/f)^2\}$ (d) $\{1-(f_c/f)\}$

88. Match List–I *(Transfer Characteristics of Clipper*

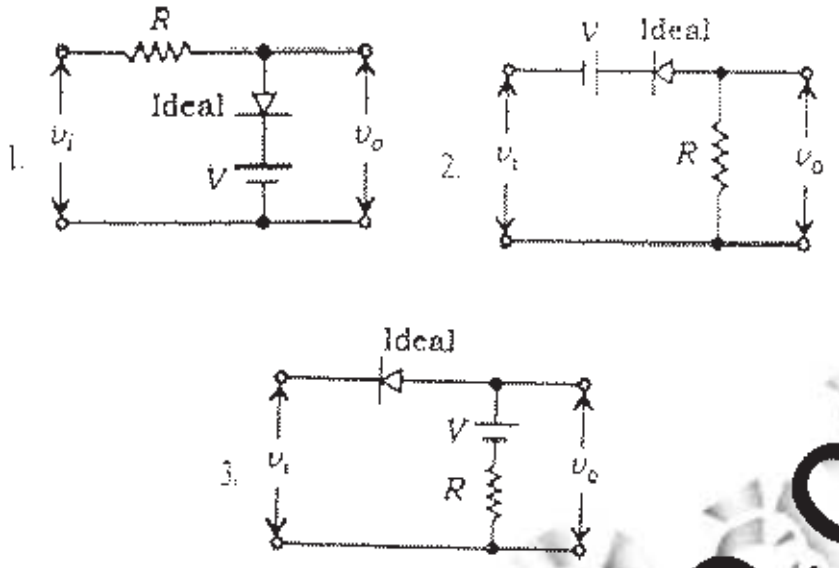
Circuit/Rectifier) **with List-II** *(Type of Clipper/ Rectifier)* **and select the correct answer using the code given below the Lists :**

List-I (Transfer Characteristics of Clipper Circuit/Rectifier)	List-II (Type of Clipper/ Rectifier)
A. 	1. Doubled-ended clipper
B. 	2. Positive clipper
C. 	3. Negative clipper
D. 	4. Full-wave positive rectifier and not a clipper

	A	B	C	D
(a)	1	2	3	4
(c)	1	2	4	3

	A	B	C	D
(b)	2	3	4	1
(d)	2	3	1	4

89. **Consider the following circuits:**



Which of the following circuits will yield the following input-output characteristics for the clipper?

$v_o = v_i$ **for** $v_i < V$

$= V$ **for** $v_i \geq V$

Select the correct answer using the code given below:

(a) 1 only (b) 2 only

(c) 1 and 3 (d) 1, 2 and 3

90. **By addition of small amount of which one of the following can the quality of SiO_2 in IC fabrication be improved?**

(a) Boron (b) Chlorine

(c) Zirconium (d) Indium

91. **Consider the following statements:**

A multiple zone process is used for refining Si from impurities having segregation coefficient K<1. The ingot is held vertically and the zone is moved from bottom to top of the ingot. After each run

1. the top end of the ingot contains maximum inpurities and is to be cut thrown before the next run.

2. the bottom end of the ingot contains maximum impurities and is to be cut and thrown before the next run.
3. there is no need of cutting the bottom end before the next run as it contains minimum impurities.

Which of the statements given above is/are correct ?

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

92. **Which of the following statements are correct ?**
1. Molecular Beam Epitaxy (MBE) is a physical evaporation process while Vapour Phase Epitaxy (VPE) involves chemical reaction.
2. In-situ etching of silicon is possible only in MBE but not in VPE system.
3. MBE of silicon is carried out at a lower temperature compared to VPE.
4. The growth rate of the exitaxial film can be accurately controlled during BME than during VPE.

Select the correct answer using the code given below :

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

93. **Consider the following statements :**

Rapid Thermal Annealing (RTA) is preferred over conventional furance annealing after ion-implantation because

1. RTA does not cause any change in the doping profile.
2. Thermal budget is lower if RTA is used.
3. RTA is carried out at lower termperature.

Which of the statements given above is/are correct ?

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

94. **Consider the following statements :**

CZ method of crystal pulling is a popular technique for converting bulk material to single crystal because

1. it requires a seed of single crystal to initiate the growth.

2. the seed crystal should be pure and defect free for high quality growth.
3. intentionally doped single crystals cannot be obtained by this technique.

Which of the statements given above are correct?

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

95. **What is the correct sequence of the following steps during isolation by LOCOS technique?**

1. Si etching
2. Growth of thin pad oxide
3. Deposition and patterning of silicon nitride
4. Growth of SiO_2

Select the correct answer using the code given below:

(a) 1 – 3 – 4 – 2 (b) 2 – 3 – 1 – 4
(c) 4 – 2 – 1 – 3 (d) 3 – 1 – 4 – 2

96. **Consider the following statements about ferrites:**

1. Ferrites have high resistivity.
2. Ferrites have low eddy current losses.
3. Ferrites are used as core materials in high frequency (MHz) transformers.

Which one of the statements given above are correct?

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

97. **A necessary but not sufficient condition for a crystal to show ferro-electricity is**

(a) absence of centre of symmetry
(b) presence of centre of symmetry
(c) presence of both translational and rotational symmetry
(d) absence of both translational and rotational symmetry

98. **In a dielectric material there are four contributions to the total polarisation. Out of these only one is dependent on temperature and this contribution is**

(a) electronic polarisation
(b) space-charge polarisation

(c) ionic polarisation
(d) orientational polarisation

99. **If m = permanent dipole moment, k = Boltzmann constant and T = absolute temperature, then orientational polarisability is equal to**

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

(c) $3kTm$ (d) $3kTm^2$

100. **Which one of the following statements is correct? Copper and silicon are forming a junction; at thermal equilibrium**

(a) the Fermi levels in the two materials are at the same energy level irrespective of the number of free electrons in copper and silicon

(b) the Fermi level of copper is at a higher energy level compared to that of silicon as copper has more free electrons

(c) the Fermi level of silicon is at a higher energy level compared to that of copper as silicon has more free electrons

(d) copper and silicon, being in thermal equilibrium, will have the same specific heat and Fermi levels have no relation to thermal equilibrium

101. **The life time of the minority carriers in p-n junction solar cells is determined by**

(a) Hall effect experiment
(b) Haynes-Shockley experiment
(c) electron beam induced current decay experiment
(d) secondary Ion Mass Spectros-copy experiment

102. **For a crystal, which one of the following statements is correct?**

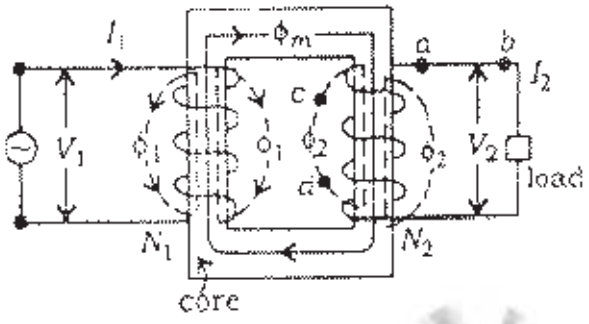
(a) The total number of possible wave functions in any energy band is equal to the number of unit cells
(b) The total number of possible wave functions in any energy band is equal to twice the number of unit cells

according to Pauli principle

(c) The total number of possible wave functions in any energy band is equal to the total number of free electrons in the band

(d) The number of possible wave functions in any energy band is independent of the number of unit cells

103.



turns ratio N_1/N_2

The figure given above shows a two winding core-type transformer. The instantaneous directions of the primary current I_1, the mutual flux ϕ_m and the primary leakage flux ϕ_1 are as indicated in the figure; the corresponding directions, at the same instant, of the secondary current I_2, and the secondary leakage flux ϕ_2 would be

(a) I_2, a to b; and ϕ_2, c to d

(b) I_2, b to a; and ϕ_2, d to c

(c) I_2, a to b; and ϕ_2, d to c

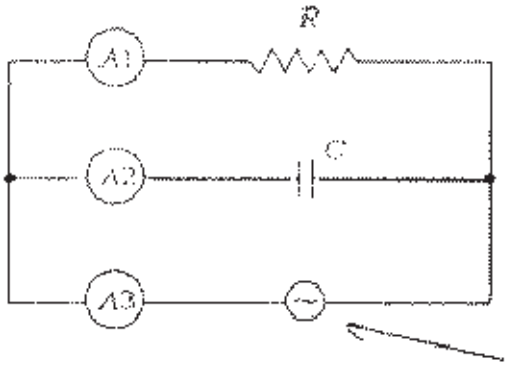
(d) I_2, b to a; and ϕ_2, d to c

104. While measuring the value of distributed capacitance by Q-meter the resonances were obtained with values of tuning capacitor as C_1 and C_2 for the frequencies adjusted to f_1 and $2f_1$ respectively. What is the value of the distributed capacitance?

(a) $\frac{C_1 - 2C_2}{2}$ (b) $\frac{C_1 - 4C_2}{2}$

(c) $\frac{C_1 - 2C_2}{3}$ (d) $\frac{C_1 - 4C_2}{3}$

105.



In the figure shown above, A1, A2 and A3 are ideal ammeters. If A2 and A3 read 4A and 5A respectively, what is the reading of A1?

(a) 1 A
(b) 3 A
(c) 9 A
(d) Cannot be calculated without the values of R and C

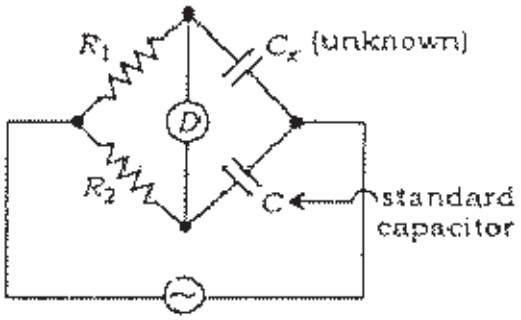
106. **Wagner's Earth Device is used for a.c. bridge circuits for**

(a) eliminating the effect of earth capacitances
(b) eliminating the effect of earth capacitances
(c) eliminating the effect of stray electrostatic fields
(d) shielding the bridge elements

107. **While measuring a coil having a resistance of 1 Ω, resonance occurred when the oscillator frequency was 10 MHz and the variable capacitor was set at $\left(\frac{100}{\pi}\right)$ pf. What is the effective value of Q of the coil?**

(a) 200 (b) 254
(c) 314 (d) 542

108.



The above diagram shows De Sauty method to measure the unknown capacitance (C_x).C_x is given by

(a) $C_x = C\frac{R_2}{R_1}$ (b) $C_x = C\frac{R_2^2}{R_1^2}$

(c) $C_x = C\frac{R_1}{R_2}$ (d) $C_x = C\frac{R_1}{R_2}$

109. A resistance is measured by the voltmeter-ammeter method. The voltmeter reading is 50 V on 100 V scale and ammeter reading is 50 mA on 100 mA scale. If both the meters are guaranteed for accuracy within 2% of full scale, what is the limit within which resistance can be measured ?

(a) 10 Ω (b) 20 Ω

(c) 40 Ω (d) 80 Ω

110. A resistance of 110 Ω is specified using significant figures as indicated below :

1. 110 Ω 2. 110·0 Ω 3. 0·000110 MΩ

For the above three indications, which one of the following statements is correct ?

(a) 1 represents greater precision than 2 and 3

(b) 2 represents greater precision but 1 and 3 represent same precision

(c) 2 and 3 represent same precision

(d) 3 is more precise than 1 and 2

111. A 35 V d.c. supply is connected across a combined resistance of 600 Ω and an unknown resistance of R Ω in series. If a voltmeter having a resistance of 1·2 kΩ is connected across 600 Ω resistor and reads 5 V, then what is the value of the resistance R?
(a) 120 Ω (b) 500 Ω
(c) 1·7 kΩ (d) 2·4 kΩ

112. Consider the following components:
1. SRAM 2. EPROM
3. USART 4. PORT
Which of the above components are not found on-chip in a microprocessor but may be found on-chip in a microcontroller?
(a) 1, 2, 3 and 4 (b) 1, 2 and 3
(c) 1, 2 and 4 (d) 3 and 4

113. In memory-mapped I/O scheme, all data transfer instructions of 8085 microprocessor can be used only for
(a) Memory devices (b) I/O devices
(c) Ports (d) Memory and I/O devices

114. Assembler directives are required
(a) only in hand assembling
(b) only in machine assembling
(c) in hand assembling as well as machine assembling
(d) only when there is an operating system

115. A microprocessor using a 3 MHz clock has three 'T' states in each machine cycle. If an instruction cycle needs 4 machine cycles, how much time will be taken to complete the execution of this instruction?
(a) 333 ns (b) 1333 ns
(c) 3 μs (d) 4 μs

116. How many general pupose 8-bit registers are there in 8085 microprocessor?
(a) 3 (b) 6
(c) 9 (d) 12

117. **Consider the following:**

1. Small capacity
2. Fast memory access
3. Needs refreshing
4. Very costly

The essential characteristics of a Cache memory include

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

118. **An instruction cycle is the time in which, a hard-wired controller completes four functions. What is the correct sequence of these functions?**

(a) Fetch - update - decode - execute
(b) Fetch - decode - update - execute
(c) Decode - execute - fetch - update
(d) Execute - decode - fetch - update

119. **Consider the following four components found in the ALU of a computer:**

1. XOR gates
2. Half-adder
3. Full subtractor
4. Shifter

Which of the above components are combinational circuits?

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

120. **Which of the following addressing modes imply that the operand is stored separately in the main memory?**

1. Indirect
2. Immediate
3. Indexed

Select the correct answer using the code given below:

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