



Paper - II

Booklet Code

A

Electronic Science

SUBJECT CODE : 14

Test Booklet No.

Roll No. :

(Figures as per admission card)

Roll No. (in words) :

OMR Sheet No. :

Name and Signature of Invigilator/s

Signature : _____

Name : _____

Time : 2 Hours

Maximum Marks : 200

Number of Pages in this Booklet : 24

Number of Questions in this Booklet : 100

Instructions for the Candidates

- Write your roll number in the space provided on the top of this page.
- This paper consists of hundred (100) multiple-choice type of questions.
- At the commencement of examination, the test booklet will be given to you. In the first 5 minutes, you are requested **To Open the Booklet and Compulsorily Examine it as Below:**
 - To have access to the Test Booklet, tear off the paper seal on the edge of the cover page. Do not accept a booklet without sticker seal or open booklet.
 - Tally the number of pages and number of questions in the booklet with the information printed on the cover page. Faulty booklets due to pages/questions missing or duplicate or not in serial order or any other discrepancy should be got replaced immediately by a correct booklet from the invigilator within the period of 5 minutes. Afterwards, neither the Test Booklet will be replaced nor any extra time will be given.
 - After the verification is over, the Test Booklet Number should be entered in the OMR Sheet and the OMR Sheet Number should be entered on this Test Booklet.
- Each item has four alternative responses marked (A), (B), (C) and (D). You have to darken the circle as indicated below on the correct response against each item.
Example : (A) (B) (C) (D)
where (C) is the correct response.
- Your responses to the questions are to be indicated in the **OMR Sheet kept inside this Booklet**. If you mark at any place other than in the circles, the OMR Sheet will not be evaluated.
- Read the instructions given in OMR Sheet carefully. Fill the Booklet Code of Paper-II in OMR Sheet **Compulsorily**.
- Rough Work is to be done in the end of this booklet.
- If you write your name or put any mark on any part of the OMR Answer Sheet, except for the space provided for the relevant entries, which may disclose your identity, you will render yourself liable to disqualification.
- You have to return the OMR answer Sheet to the invigilators at the end of the examination compulsorily and must NOT carry it with you outside the Examination Hall.
- You can take away test booklet and carbon copy of OMR Answer Sheet after the examination.
- Use only Blue/Black Ball point pen.**
- Use of any calculator, electronic gadgets or log table, etc. is prohibited.**
- There is no negative mark for incorrect answer.**




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1. Given below are two statements, one labelled as Assertion (a) and the other labelled as Reason (r). Read the statements and choose the correct answer from the code given below :

Assertion(a): In a pure semiconductor, the number of electrons in the conduction band is equal to the number of holes in the valence band.

Reason (r): When an electron moves from the valence band to the conduction band, it leaves behind a hole in the valence band.

- (A) Both assertion (a) and reason (r) are true, and reason (r) is the correct explanation of assertion (a).
- (B) Both assertion (a) and reason (r) are true, but reason (r) is not the correct explanation of assertion (a).
- (C) Assertion (a) is true, but reason (r) is false.
- (D) Assertion (a) is false, but reason (r) is true.

2. Which of the following statements is correct regarding the energy bands in solids?

- (A) The valence band is always empty at absolute zero temperature.
- (B) The conduction band is always completely filled with electrons at any temperature.
- (C) The energy gap between the valence band and conduction band is smaller in conductors than in semiconductors.
- (D) The energy gap between the valence band and conduction band in insulators is negligible.

3. Match List-I and List-II and select the correct answer from the codes given below:

	List- I		List-II
P	Depletion Region	1	The potential barrier that prevents free movement of charge carriers
Q	Forward Bias	2	The region where no free charge carriers exist due to recombination
R	Reverse Bias	3	The condition where the P-N junction conducts current
S	Barrier Potential	4	The condition where the P-N junction does not conduct current

Codes:

	P	Q	R	S
(A)	2	3	4	1
(B)	4	1	2	3
(C)	1	4	3	2
(D)	2	1	3	4



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4. Given below are two statements:
- Statement I:** The Fermi level in a semiconductor lies exactly at the midpoint between the conduction band and the valence band at absolute zero temperature.
- Statement II:** In an n-type semiconductor, the Fermi level shifts towards the conduction band due to the higher concentration of electrons.
- In the light of the above statements, choose the most appropriate answer from the codes given below:
- (A) Both Statement I and Statement II are true.
- (B) Both Statement I and Statement II are false.
- (C) Statement I is true, but Statement II is false.
- (D) Statement I is false, but Statement II is true.
5. Which of the following statements is true regarding the breakdown of a diode?
- (A) Avalanche breakdown occurs due to the tunneling of electrons through a narrow depletion region.
- (B) Zener breakdown occurs at high reverse bias voltage in lightly doped diodes.
- (C) Avalanche breakdown occurs when the reverse bias voltage causes the acceleration of minority carriers, leading to impact ionization.
- (D) Zener breakdown is characterized by the gradual increase in current with increasing reverse bias voltage.
6. Which of the following correctly describes the behavior and characteristics of a Tunnel Diode?
- (A) The tunnel diode operates based on conventional charge carrier diffusion across the depletion region.
- (B) The negative resistance region of the tunnel diode occurs due to quantum tunneling at forward bias voltages near zero.
- (C) The tunnel diode shows high resistance at all applied forward bias voltages due to heavy doping.
- (D) In a tunnel diode, the forward current always increases with increasing forward voltage.
7. Which of the following is true regarding the characteristics of a Schottky junction Diode?
- (A) The Schottky junction always forms an ohmic contact between the metal and semiconductor.
- (B) A Schottky barrier is formed when the metal has a work function lower than that of the semiconductor.
- (C) The metal-semiconductor junction has a lower forward voltage drop compared to a p-n junction diode.
- (D) In a Schottky junction, the depletion region extends primarily into the metal due to its lower carrier concentration.

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8. Which of the following statements is correct regarding low-dimensional semiconductor devices?
- (A) In quantum wells, charge carriers are confined in two dimension, allowing free movement in the other two dimensions.
 - (B) Quantum wires restrict carrier motion in three dimensions, leaving charge carriers free to move in the remaining one dimension.
 - (C) In quantum dots, charge carriers are confined in all three spatial dimensions, leading to discrete energy levels.
 - (D) None of the above.
9. Which of the following statements is true regarding High Electron Mobility Transistor (HEMT)?
- (A) The high electron mobility in HEMT is achieved by confining electrons in a quantum well formed at the interface of two materials with different bandgaps.
 - (B) HEMTs rely on the transport of holes rather than electrons for high-speed operation.
 - (C) The use of a highly doped channel in HEMT is responsible for the increased electron mobility.
 - (D) HEMTs are typically used in low-frequency applications due to their limited speed performance.
10. Which of the following statements is true regarding the operation of an LED?
- (A) An LED emits light when it is reverse biased.
 - (B) The colour of the light emitted by an LED depends on the material's energy bandgap.
 - (C) LEDs are made of materials with large bandgaps, similar to insulators.
 - (D) The intensity of light from an LED decreases as the forward current increases.
11. Which of the following methods is commonly used for the synthesis of carbon nanotubes (CNTs)?
- (A) Ball milling
 - (B) Chemical Vapor Deposition
 - (C) Electroplating
 - (D) Laser Ablation
12. Which of the following methods is commonly used for growing single crystals of semiconductors like silicon?
- (A) Czochralski Process
 - (B) Electrochemical Deposition
 - (C) Molecular Beam Epitaxy
 - (D) Solid-State Sintering

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13. Which of the following lithography techniques is most commonly used in semiconductor fabrication for creating patterns on a silicon wafer?
- (A) Photolithography
 - (B) Electron Beam Lithography
 - (C) X-ray Lithography
 - (D) Nanoimprint Lithography
14. Which of the following statements about X-ray Diffraction (XRD) is correct?
- (A) The Bragg's Law, $n\lambda = 2d\sin\theta$, relates the wavelength of X-rays to the spacing between crystal planes and the diffraction angle.
 - (B) XRD can only be used for crystalline materials and provides no information about amorphous structures.
 - (C) The intensity of the diffracted X-rays is independent of the atomic form factor and the orientation of the crystal.
 - (D) XRD patterns can provide direct quantitative analysis of the phases present in a mixture using the Scherrer equation.
15. Which of the following factors is critical in achieving atomic resolution in Transmission Electron Microscopy (TEM)?
- (A) The energy of the incident electron beam, which should be low to minimize sample damage.
 - (B) The numerical aperture of the objective lens, as a higher aperture increases the diffraction limit.
 - (C) The sample thickness, as thicker samples lead to multiple scattering and reduced image clarity.
 - (D) The use of phase contrast imaging, which relies on inelastic scattering for high-resolution imaging.
16. Which of the following statements best describes the behavior of thin film active and passive devices?
- (A) Thin film transistors (TFTs) are passive devices and do not exhibit any amplification properties.
 - (B) Thin film capacitors are classified as active devices due to their ability to store and release electrical energy.
 - (C) The performance of thin film active devices like TFTs is largely dependent on the mobility of charge carriers in the deposited thin film material.
 - (D) Thin film resistors are typically designed with materials that have high conductivity to minimize energy loss.



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17. Given below are two statements:

Statement I: In MOSFETs, the threshold voltage can be adjusted by changing the doping concentration of the substrate.

Statement II: Scaling down the MOSFET dimensions improves performance by reducing power consumption and increasing switching speed, but also exacerbates short-channel effects.

In the light of the above statements, choose the most appropriate answer from the codes given below:

- (A) Both Statement I and Statement II are true
- (B) Both Statement I and Statement II are false
- (C) Statement I is true, but Statement II is false
- (D) Statement I is false, but Statement II is true
18. Given below are two statements:

Statement I: Scaling down MOS devices uniformly (Dennard scaling) reduces power density, allowing for higher performance and more compact designs.

Statement II: As MOS devices are scaled down, non-ideal effects such as increased leakage currents, short-channel effects, and mobility degradation become more prominent.

In the light of the above statements, choose the most appropriate answer from the codes given below:

- (A) Both Statement I and Statement II are true
- (B) Both Statement I and Statement II are false
- (C) Statement I is true, but Statement II is false
- (D) Statement I is false, but Statement II is true

19. Which of the following statements accurately differentiates between CMOS and NMOS structures?

- (A) CMOS circuits are faster than NMOS circuits due to the symmetrical use of both p-type and n-type transistors.
- (B) NMOS devices utilize both p-type and n-type transistors, whereas CMOS only uses n-type transistors.
- (C) CMOS circuits are preferred in high-power applications because they consume more power compared to NMOS circuits.
- (D) In CMOS technology, power dissipation occurs only during the switching of transistors, whereas in NMOS, there is continuous static power dissipation.



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20. Given below are two statements, one labelled as Assertion (a) and the other labelled as Reason (r). Read the statements and choose the correct answer from the code given below:

Assertion (a): charge coupled devices (ccds) are widely used in digital imaging applications such as cameras and telescopes.

Reason (r):ccds are capable of transferring charge across the chip with minimal loss, which allows them to capture high-quality images with low noise.

Code:

- (A) Both assertion (a) and reason (r) are true, but reason (r) is not the correct explanation of assertion (a).
- (B) Both assertion (a) and reason (r) are true, and reason (r) is the correct explanation of assertion (a).
- (C) Assertion (a) is true, but reason (r) is false.
- (D) Assertion (a) is false, but reason (r) is true.
21. Which of the following correctly describes an important aspect of VLSI (Very Large Scale Integration) design?
- (A) VLSI design focuses solely on reducing the power consumption of integrated circuits.

- (B) In VLSI, millions or billions of transistors are integrated onto a single chip to perform complex functions.
- (C) VLSI designs are limited to analog circuits and do not include digital circuits.
- (D) VLSI technology is only used for memory design and not for logic or signal processing circuits.

22. Match List-I and List-II and select the correct answer from the codes given below:

	List I		List II
P	Single Sideband (SSB)	1	A form of amplitude modulation that uses only one sideband, improving bandwidth efficiency.
Q	Frequency Modulation (FM)	2	Modulation technique where the amplitude of the carrier wave varies with the message signal.
R	Phase Modulation (PM)	3	Modulation technique where the phase of the carrier wave changes according to the message signal.
S	Amplitude Modulation (AM)	4	Modulation technique where the frequency of the carrier wave varies with the message signal.

Codes:

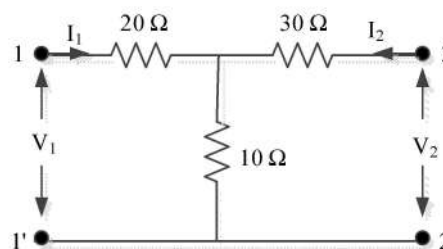
	P	Q	R	S
(A)	4	2	3	1
(B)	4	1	2	3
(C)	1	4	3	2
(D)	2	1	3	4


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23. Which of the following statements correctly describes the principle of a superheterodyne receiver?
- (A) The receiver directly amplifies the incoming radio frequency (RF) signal to the audio frequency (AF) for processing.
- (B) The superheterodyne receiver converts the incoming RF signal to an intermediate frequency (IF) by mixing it with a locally generated oscillator signal.
- (C) This type of receiver only works for AM signals and is not suitable for FM or digital signals.
- (D) The superheterodyne principle eliminates the need for tuning circuits by using a fixed frequency oscillator.
24. An amplitude-modulated (AM) signal has a carrier frequency of 1 MHz and is modulated by a message signal with a maximum amplitude of 2 V. If the modulation index is 0.5, what is the total power of the AM signal?
- (A) 10.5 W (B) 11.25 W
- (C) 15.25 W (D) 20.5 W
25. A communication system has a signal power of 50 mW and a noise power of 5 mW. What is the Signal to Noise Ratio (SNR) in decibels (dB)?
- (A) 10 dB (B) 12 dB
- (C) 14 dB (D) 15 dB
26. An optical fiber has a core refractive index of 1.48 and a cladding refractive index of 1.46. What is the critical angle for total internal reflection at the core-cladding interface?
- (A) 61.0° (B) 64.0°
- (C) 75.0° (D) 80.57°
27. Which of the following statements about optical sources used in fiber optic communication is correct?
- (A) Light Emitting Diodes (LEDs) provide higher bandwidth than Laser Diodes (LDs).
- (B) Laser Diodes are typically more efficient than LEDs for long-distance communication due to their coherence and monochromatic properties.
- (C) LEDs are preferred for long-haul transmission because they have a narrower emission spectrum compared to Laser Diodes.
- (D) Both LEDs and Laser Diodes operate equally well in the infrared region of the spectrum.


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28. Which of the following statements about satellite communication systems is true?
- (A) Geostationary satellites orbit at an altitude of approximately 2,000 km and provide global coverage.
- (B) The frequency bands commonly used in satellite communication include C-band, Ku-band, and Ka-band, each serving different applications and coverage needs.
- (C) Low Earth Orbit (LEO) satellites are used exclusively for broadcasting services and cannot support communication links.
- (D) The propagation delay in satellite communication is negligible due to the short distances involved.
29. Which of the following statements accurately describes a fundamental aspect of the Internet of Things (IoT)?
- (A) IoT devices can only operate with a constant internet connection to transmit data.
- (B) IoT is primarily focused on connecting devices for data sharing and remote monitoring without human intervention.
- (C) All IoT devices are limited to low-power consumption and must operate on batteries.
- (D) IoT applications do not require security measures because the devices are not exposed to the internet.
30. Which of the following is a common application of WDM?
- (A) Cable television networks
- (B) Radio broadcasting
- (C) Cellular phone networks
- (D) Optical fiber communication systems
31. For the network given below, what would be the value of z_{22} , if the estimated z-parameters are $z_{11} = 30 \Omega$ and $z_{12} = z_{21} = 10 \Omega$

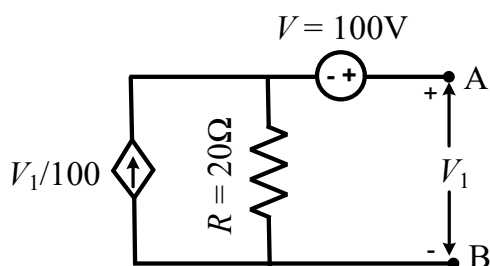


- (A) 10Ω
- (B) 20Ω
- (C) 30Ω
- (D) 40Ω



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32. Compute the Thevenin's equivalent voltage across the terminals A and B from the circuit shown below :



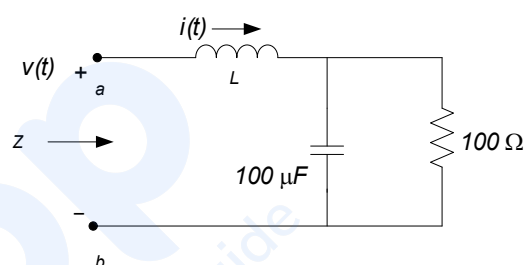
- (A) 75 V
(B) 100 V
(C) 125 V
(D) 150 V
33. Consider a unity feedback system with forward transfer function given by

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

The steady state error in the output of the system for a unit step input is

- (A) 0.91
(B) 0.45
(C) 0.67
(D) 0.12

34. The voltage $v(t)$ across the terminals a and b as shown in the figure, is a sinusoidal voltage having a frequency $\omega = 100$ radian/s. When the inductor current $i(t)$ is in phase with the voltage $v(t)$, the magnitude of the impedance Z (in Ω) seen between the terminals a and b is :



- (A) 70 (B) 20
(C) 50 (D) 0.25
35. The range of K for which all the roots of the equation $s^3 + 3s^2 + 2s + K = 0$ are in the left half of the complex s -plane is :
- (A) $0 < K < 6$
(B) $0 < K < 16$
(C) $6 < K < 36$
(D) $6 < K < 16$
36. Consider a continuous-time system with input $x(t)$ and output $y(t)$ given by $y(t) = x(t) \cos(t)$. This system is :

- (A) linear and time-invariant
(B) Non-linear and time-invariant
(C) linear and time-varying
(D) Non-linear and time-varying



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37. Match List-I and List-II and select the correct answer from the codes given below:

	List I (Control System Term)		List II (Definition)
P	Open-loop system	1	System with feedback
Q	Closed-loop system	2	No feedback involved
R	PID Controller	3	Proportional, Integral, and Derivative
S	Stability Criterion (Routh-Hurwitz)	4	Analyses stability without solving equations

Codes:

- | | | | | |
|-----|---|---|---|---|
| | P | Q | R | S |
| (A) | 1 | 2 | 3 | 4 |
| (B) | 3 | 4 | 1 | 2 |
| (C) | 2 | 1 | 3 | 4 |
| (D) | 4 | 3 | 2 | 1 |
38. Loop transfer function of a feedback system is $G(s)H(s) = \frac{s+3}{s^2(s-3)}$.

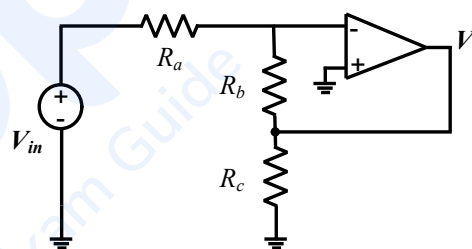
Take the Nyquist contour in the clockwise direction. Then the Nyquist plot of $G(s)H(s)$ encircles $-1 + j0$

- (A) Once in clockwise direction
 (B) Twice in clockwise direction
 (C) Once in anticlockwise direction
 (D) Twice in anticlockwise direction

39. Which among the following represents the precise condition of reciprocity for transmission parameters?

- (A) $AB - CD = 1$
 (B) $AD - BC = 1$
 (C) $AC - BD = 1$
 (D) None of the above

40. Assuming the OP-AMP to be ideal, the voltage gain of the amplifier shown below is :



- (A) $-R_b / R_a$
 (B) $-R_c / R_a$
 (C) $-(R_b // R_c) / R_a$
 (D) $-(R_b + R_c) / R_a$

41. In a uniformly doped BJT, assume that N_e , N_b , and N_c are the emitter, base and collector doping in atoms/cm³, respectively. If the emitter injection efficiency of the BJT is close unity, which one of the following conditions is TRUE?

- (A) $N_e = N_b = N_c$
 (B) $N_e \gg N_b$ and $N_b \gg N_c$
 (C) $N_e = N_b$ and $N_b < N_c$
 (D) $N_e < N_b < N_c$



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42. In a BJT, the region of operation where both junctions are forward-biased is called :

(A) Active Region
(B) Saturation Region
(C) Cutoff Region
(D) Inverse Active Region

43. In a Bipolar Junction Transistor (BJT), the region where the transistor operates as a switch is :

(A) Active Region
(B) Cutoff Region
(C) Saturation Region
(D) Breakdown Region

44. Match List-I and List-II and select the correct answer from the codes given below:

	List I		List II
P	LED	1	Heavy doping
Q	Avalanche Photodiode	2	Coherent radiation
R	Tunnel diode	3	Spontaneous emission
S	LASER	4	Current gain

Codes:

	P	Q	R	S
(A)	1	2	4	3
(B)	2	3	1	4
(C)	3	4	1	2
(D)	2	1	4	3

45. A transformer coupled with Class A large signal amplifier has maximum and minimum values of collector-emitter voltage of 25 V and 5 V. The collector efficiency will be approximately :

(A) 62.8%
(B) 58.2%
(C) 33.3%
(D) 48.3%

46. In a junction transistor, the collector cutoff current I_{CBO} reduces considerably by doping the :

(A) Emitter with high level impurity
(B) Emitter with low level impurity
(C) Collector with high level impurity
(D) Collector with low level impurity



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47. Match List-I and List-II and select the correct answer from the codes given below:

	List I		List II
P	Common Emitter	1	Voltage Amplification
Q	Common Base	2	Current Amplification
R	Common Collector (Emitter Follower)	3	High Gain Amplification
S	Differential Amplifier	4	Impedance Matching

Codes :

- | | | | | |
|-----|---|---|---|---|
| | P | Q | R | S |
| (A) | 3 | 1 | 4 | 2 |
| (B) | 1 | 2 | 3 | 4 |
| (C) | 4 | 3 | 2 | 1 |
| (D) | 3 | 2 | 4 | 1 |
48. To avoid thermal runaway in the design of analog circuit, the operating point of the BJT should be such that it satisfies the condition
- (A) $V_{CE} = 0.5 V_{CC}$
- (B) $V_{CE} \leq 0.5 V_{CC}$
- (C) $V_{CE} \geq 0.5 V_{CC}$
- (D) $V_{CE} \leq 0.78 V_{CC}$

49. In a class C power amplifier has an input signal with frequency of 200 kHz and the width of collector pulses of $0.1 \mu\text{s}$, then the duty cycle of the amplifier is :

- (A) 1%
- (B) 2%
- (C) 10%
- (D) 20%

50. A three-phase voltage source inverter with ideal devices operating in 180° conduction mode is feeding a balanced star-connected resistive load. The DC voltage input is V_{dc} . The peak of the fundamental component of the phase voltage is

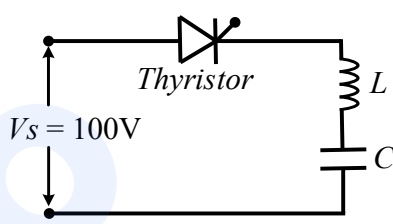
- (A) $\frac{V_{dc}}{\pi}$
- (B) $\frac{2V_{dc}}{\pi}$
- (C) $\frac{3V_{dc}}{\pi}$
- (D) $\frac{4V_{dc}}{\pi}$

51. A charger supplies 100 W at 20 V for charging the battery of a laptop. The power devices, used in the converter inside the charger, operate at a switching frequency of 200 kHz. Which power device is best suited for this purpose?

- (A) IGBT
- (B) Thyristor
- (C) MOSFET
- (D) BJT



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52. A solar cell of 350 V is feeding power to an ac supply of 440 V, 50 Hz through a 3-phase fully controlled bridge converter. A large inductance is connected in the dc circuit to maintain the dc current at 20 A. If the solar cell resistance is 0.5Ω , then each thyristor will be reverse biased for a period of :
- (A) 125°
 (B) 120°
 (C) 60°
 (D) 55°
53. The main reason for connecting a pulse transformer at the output stage of thyristor triggering circuit is to
- (A) Amplify the power of the triggering pulse
 (B) Provide electrical isolation
 (C) Reduce the turn on time of thyristor
 (D) Avoid spurious triggering of the thyristor due to noise
54. Which of the given device is the most suitable power device for a higher frequency (above 100 kHz) switching application?
- (A) SCR
 (B) Power MOSFET
 (C) GTO
 (D) BJT
55. Thyristor in figure given below is initially OFF and is triggered with single pulse of width of $10\mu\text{s}$. It is given that $L = 40/\pi \mu\text{F}$ and $C = 40/\pi \mu\text{F}$. Assuming that latching and holding current of the thyristor are zero and initial charge on C is zero. Then thyristor conducts for :
- 
- (A) $10 \mu\text{s}$
 (B) $40 \mu\text{s}$
 (C) $100 \mu\text{s}$
 (D) 1.6 ms
56. For discontinuous conduction in a single phase semiconverter, if extinction angle $\beta > \pi$ and firing angle is α , then freewheeling diode conducts for :
- (A) α
 (B) β
 (C) $\pi - \alpha$
 (D) $\beta - \pi$
57. Find the RMS value of the output voltage of the step-down chopper. If source voltage V_s , duty ratio d and R as the load resistance.
- (A) $V_s \cdot \sqrt{d}$
 (B) $d \cdot V_s$
 (C) $V_s / \sqrt{d}$
 (D) $V_s \cdot \sqrt{(1-d)}$



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58. The ripple in load current of step-down dc-dc converter is maximum if duty cycle is :

(A) $=0.5$ (B) <0.5
(C) >0.5 (D) $=1$

59. Match List-I and List-II and select the correct answer from the codes given below:

	List I (Device)		List II (Characteristic)
P	SCR	1	Bidirectional control of AC power
Q	DIAC	2	Unidirectional control of DC and AC
R	TRIAC	3	Trigger device for TRIAC
S	Power Transistor	4	Voltage and current protection

Codes:

P Q R S
(A) 2 3 1 4
(B) 1 4 2 3
(C) 4 2 3 1
(D) 3 1 4 2

60. Which equipment is essential for measuring time-domain waveforms in electrical signals?

(A) CRO (Cathode Ray Oscilloscope)
(B) Digital Storage Oscilloscope (DSO)
(C) LCR Meter
(D) Spectrum Analyzer

61. If an LVDT has a sensitivity of 0.5 V/mm, what will be the output voltage if the core is displaced by 4 mm?

(A) 0.5 V (B) 1.0 V
(C) 2.0 V (D) 2.5 V

62. A 10-mA ammeter has a resistance of $50\ \Omega$. It has to be converted to 1 A ammeter. The value of shunt resistance is :

(A) $5\ \Omega$ (B) $0.05\ \Omega$
(C) $0.5\ \Omega$ (D) $50\ \Omega$

63. Low resistance is measured by :

(A) Schering bridge
(B) Maxwell's bridge
(C) Kelvin's double bridge
(D) Hay's bridge

64. A zero to 500 V voltmeter has a guaranteed accuracy of 1% on full scale reading. The percentage error when the meter reads 95V is

(A) 5.20% (B) 19%
(C) 2.38% (D) 4.16%

65. The bandwidth of a CRO is from 0 to 35 Hz. The fastest rise time which a square wave can have, in order that it is accurately reproduced by the CRO is :

(A) $0.175\ \mu\text{s}$
(B) $17.8\ \mu\text{s}$
(C) 10 ns
(D) 100 ns



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66. Match List-I and List-II and select the correct answer from the codes given below:

	List I		List II
P	MEMS Sensors	1	IoT applications
Q	ECG Sensor	2	Heart electrical activity monitoring
R	Photoelectric Sensor	3	Light detection
S	Pressure Sensor	4	Measuring pressure variations

Codes:

- | | | | | |
|-----|---|---|---|---|
| | P | Q | R | S |
| (A) | 4 | 3 | 2 | 1 |
| (B) | 2 | 4 | 1 | 3 |
| (C) | 1 | 2 | 3 | 4 |
| (D) | 3 | 1 | 4 | 2 |
67. In bioinstrumentation, what type of sensor is commonly used to measure blood oxygen saturation levels in medical applications?
- (A) Thermistor
(B) Photodiode
(C) Strain gauge
(D) Capacitive sensor
68. Which of the following phenomena is the basis for the operation of a piezoelectric sensor commonly used in bioinstrumentation?
- (A) Photoelectric effect
(B) Hall effect
(C) Magnetoresistance
(D) Conversion of mechanical stress into electrical charge

69. Which rhythm is the principal component of the EEG that indicates the alertness of the brain?

(A) Alpha rhythm
(B) Gamma rhythm
(C) Beta rhythm
(D) Theta rhythm

70. Which of the following statements about Micro-Electro-Mechanical Systems (MEMS) is true?

(A) MEMS devices are typically larger than traditional electronic components and are not suitable for miniaturization.
(B) MEMS technology integrates mechanical elements, sensors, actuators, and electronics on a common silicon substrate.
(C) MEMS devices are only used in consumer electronics and have no applications in medical devices or automotive systems.
(D) MEMS technology primarily relies on vacuum technology for its operation.

71. What characteristic differentiates TTL logic family from CMOS regarding noise?

(A) TTL has higher noise immunity than CMOS.
(B) CMOS has higher noise immunity than TTL.
(C) Both have similar noise immunity levels.
(D) Noise immunity is not a relevant factor in comparing these families.



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72. How do voltage swings in ECL (Emitter Coupled Logic) compare to TTL under high-frequency conditions?
- (A) ECL has larger voltage swings to improve noise immunity.
 (B) ECL has smaller voltage swings to reduce propagation delay.
 (C) ECL and TTL voltage swings are equivalent.
 (D) ECL uses adaptive voltage swings based on frequency.
73. Given the Boolean expression $(A + B'C')(A'B + BC) + A'B'C$. What is the fully simplified form using Boolean algebra?
- (A) $B'C + AB'C$
 (B) $B'C + A'B$
 (C) $C.B'C + AB$
 (D) $D.B'C$
74. How do edge-triggered and level-triggered flip-flops differ in their operational base?
- (A) Edge-triggered operate on the clock level; level-triggered operate on the clock transition.
 (B) Edge-triggered operate on the clock transition; level-triggered operate on the clock level.
 (C) Both operate on the clock level but at different voltages.
 (D) Both operate on the clock transition but at different times.
75. Calculate the maximum output frequency of a 4-bit binary ripple counter if the delay of each flip-flop is 25 ns :
- (A) 10 MHz
 (B) 5 MHz
 (C) 2.5 MHz
 (D) 1 MHz
76. A DAC has a reference voltage of 10 V and is an 8-bit converter. What is the smallest change in voltage that can be resolved (LSB)?
- (A) 39.0625 mV
 (B) 78.125 mV
 (C) 19.53125 mV
 (D) 156.25 mV
77. A 4-bit synchronous counter using JK flip-flops has J and K permanently tied to logic 1. If the counter starts at 0, how many clock cycles will it take to return to 0?
- (A) 8 cycles
 (B) 15 cycles
 (C) 16 cycles
 (D) 10 cycles
78. In a 1024x8 SRAM chip, how many address lines are needed to uniquely select each memory location?
- (A) 16 lines
 (B) 8 lines
 (C) 10 lines
 (D) 12 lines



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79. Given below are two statements, one labelled as Assertion (a) and the other labelled as Reason (r). Read the statements and choose the correct answer from the code given below:
Assertion (a) : CPLDs are suitable for implementing logic functions with known, fixed designs.
Reason (r) : CPLDs consist of programmable logic blocks and a fixed interconnection architecture.
Code:
 (A) Both (a) and (r) are true and (r) is correct explanation of (a)
 (B) Both (a) and (r) are true and (r) is not correct explanation of (a)
 (C) (a) is true, but (r) is false
 (D) (a) is false, but (r) is true
80. Given below are two statements:
Statement I: In digital electronics, asynchronous counters are also known as ripple counters due to the way the clock input is applied to the flip-flops.
Statement II: Asynchronous counters offer a significant advantage in terms of speed compared to synchronous counters because they do not require any additional logic to manage the clock signal.
 In light of the above statements, choose the most appropriate answer from the codes given below:
 (A) Both Statement I and Statement II are correct.
 (B) Both Statement I and Statement II are incorrect
 (C) Statement I is correct and Statement II is incorrect.
 (D) Statement I is incorrect and Statement II is correct.
81. Which 8086 instruction is used to set up a procedure for handling hardware interrupts?
 (A) INT (B) INTO
 (C) IRET (D) STI
82. What is the maximum memory addressability of the 8086 microprocessor?
 (A) 1 MB (B) 640 KB
 (C) 1 GB (D) 512 KB
83. For interfacing with high-speed I/O devices, which 8086 mode is generally recommended?
 (A) Minimum mode
 (B) Maximum mode
 (C) Test mode
 (D) Simple mode
84. 8051 microcontroller interfacing with an LCD display typically utilizes which type of communication?
 (A) USB communication
 (B) Wireless communication
 (C) Serial communication
 (D) Parallel communication
85. How does the 8086 microprocessor handle multiply operations in terms of its instruction set?
 (A) Uses a dedicated MUL instruction
 (B) Requires manual implementation using shift and add instructions
 (C) Utilizes a co-processor
 (D) Both (A) and (C)



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86. For the 8086 microprocessor, what is the hexadecimal offset from the segment base if the physical address is 12345H and the segment register contains 1000H?
- (A) 2345H (B) 12345H
(C) 1000H (D) 22345H
87. What is the main function of the Queue in the 8086 microprocessor's instruction pre-fetch mechanism?
- (A) To hold data only.
(B) To store instructions before they are executed.
(C) To enhance the processing speed by parallel instruction fetching.
(D) To align data in memory.
88. Consider the following program:
- ```

MOV SI, OFFSET ARRAY
MOV CX, 5
MOV AX, 0
SUM_LOOP:
ADD AL, [SI]
INC SI
LOOP SUM_LOOP

HLT

```
- This program assumes an array of 5 bytes stored at a label ARRAY in memory, which is summed into the AX register. If the initial values in the array are 1, 2, 3, 4, and 5, what is the final value in AX after the program executes?
- (A) 0 (B) 10  
(C) 15 (D) 5
89. Given below are two statements:
- Statement I:** In the given assembly program, the LOOP instruction decreases the value in the CX register and continues the loop until CX equals zero.
- Statement II:** The INC SI instruction is used to ensure that the SI register always points to the next word (2 bytes) in the array.
- In light of the above statements, choose the most appropriate answer from the codes given below:
- (A) Both Statement I and Statement II are correct.  
(B) Both Statement I and Statement II are incorrect  
(C) Statement I is correct and Statement II is incorrect.  
(D) Statement I is incorrect and Statement II is correct.
90. Gauss's Law relates the electric flux through a closed surface to:
- (A) The total electric field inside the surface  
(B) The total charge enclosed by the surface  
(C) The potential difference across the surface  
(D) The magnetic field passing through the surface
91. *Maxwell added a term to Ampère's Law to account for changing electric fields. This term is known as the:*
- (A) Electric displacement current  
(B) Magnetic flux  
(C) Displacement current  
(D) Polarization current



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92. In free space, a plane electromagnetic wave propagating in the +z-direction has its electric field oscillating in which direction if the magnetic field oscillates in the +x-direction?
- (A) +y-direction  
(B) -y-direction  
(C) +x-direction  
(D) -x-direction
93. A transmission line has a VSWR of 3:1. This implies that:
- (A) The reflection coefficient is 1  
(B) The maximum voltage is three times the minimum voltage  
(C) The load is perfectly matched  
(D) There is no standing wave on the line
94. Eddy currents are loops of electrical current induced within conductors by a changing magnetic field. According to Lenz's Law, these currents produce a magnetic field that:
- (A) Enhances the original changing magnetic field  
(B) Has no relation to the original magnetic field  
(C) Opposes the original changing magnetic field  
(D) Acts in the direction of the current flow
95. For a solenoid of finite length  $L$  and radius  $R$ , carrying a current  $I$  with  $n$  turns per unit length, the magnetic field at a point along the axis a distance  $x$  from one end is given by:
- (A)  $\mu_0 n I \left( \frac{L}{\sqrt{R^2 + L^2}} \right)$   
(B)  $\frac{\mu_0 n I}{2} \left( \frac{L}{\sqrt{R^2 + L^2}} \right)$   
(C)  $\frac{\mu_0 n I}{2} \left( \frac{x}{\sqrt{R^2 + x^2}} \right)$   
(D)  $\mu_0 n I \left( \frac{x}{\sqrt{R^2 + x^2}} \right)$
96. The first minimum in the diffraction pattern of a single slit of width  $a$  occurs at an angle  $\theta$  where:
- (A)  $a \sin \theta = \lambda / 2$   
(B)  $a \sin \theta = 3\lambda / 4$   
(C)  $a \sin \theta = \lambda$   
(D)  $a \sin \theta = 2\lambda$
97. The cutoff frequency  $f_c$  for the  $TE_{10}$  mode in a rectangular waveguide with broad dimension  $a$  is given by:
- (A)  $\frac{c}{2a}$  (B)  $\frac{c}{a}$   
(C)  $\frac{c}{\sqrt{a^2 + b^2}}$  (D)  $\frac{c}{\pi a}$



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98. Given below are two statements:

**Statement I:** According to Maxwell's equations, a changing magnetic field will always induce a non-conservative electric field, described by Faraday's law of electromagnetic induction.

**Statement II:** In a vacuum, the electric field and magnetic field components of an electromagnetic wave are in phase with each other.

In light of the above statements, choose the most appropriate answer from the codes given below:

- (A) Both Statement I and Statement II are correct.
- (B) Both Statement I and Statement II are incorrect
- (C) Statement I is correct and Statement II is incorrect.
- (D) Statement I is incorrect and Statement II is correct.

99. Given below are two statements:

**Statement I:** In electrostatics, if the electric field inside a conductor is non-zero, then free charges are still moving within the conductor.

**Statement II:** The boundary condition at the surface of a conductor states that the tangential component of the electric field just outside a conductor is equal to the surface charge density divided by the permittivity of free space.

In light of the above statements, choose the most appropriate answer from the codes given below:

- (A) Both Statement I and Statement II are correct.
- (B) Both Statement I and Statement II are incorrect
- (C) Statement I is correct and Statement II is incorrect.
- (D) Statement I is incorrect and Statement II is correct.

100. Given below are two statements, one labelled as Assertion (a) and the other labelled as Reason (r). Read the statements and choose the correct answer from the code given below:

**Assertion (a) :** Gunn diodes are widely used in microwave ovens for generating microwaves.

**Reason (r) :** Gunn diodes generate microwaves through the transferred electron mechanism in materials like GaAs.

- (A) Both (a) and (r) are true and (r) is correct explanation of (a)
- (B) Both (a) and (r) are true and (r) is not correct explanation of (a)
- (C) (a) is true, but (r) is false
- (D) (a) is false, but (r) is true



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