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Electronics Engineering

(Competitive Exams – Objective Special)

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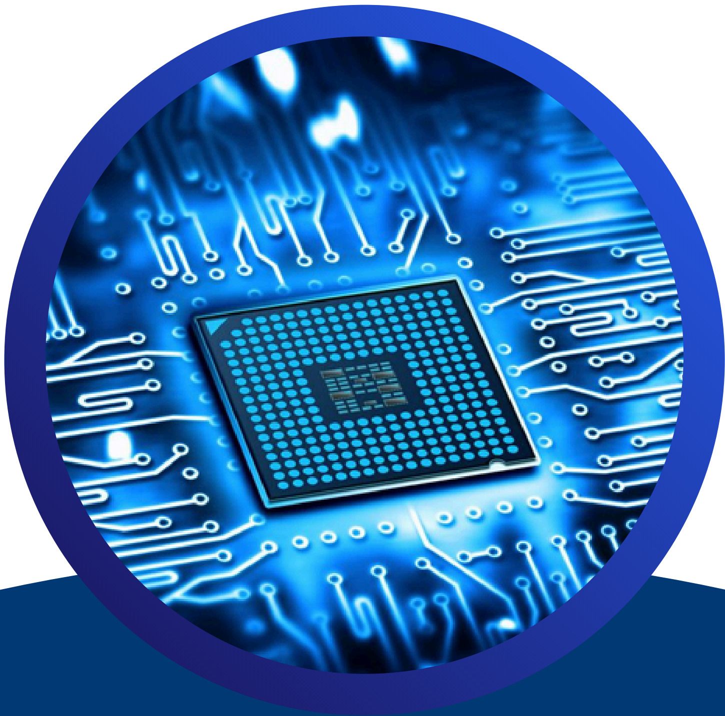
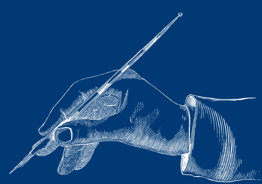


Key Features:

- Subject-wise Premium MCQs
- Each MCQ With Detailed Solutions
- *Syllabus- UPPSC & Core Competitive 16 Subjects*



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Exam-Oriented, Suitable For:

UPPSC (Lecturer/Asst. Professor), GATE/ESE (IES), State AE & JE, PSU Recruitments (BEL, BHEL, DRDO), ISRO Scientist-C, State University & Polytechnic Lecturer/Asst. Professor Exams, and M.Tech/Ph.D. Entrance Exams (IITs, NITs & Central Universities).

Electronics Engineering
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Designed for:

An essential book for all aspirants preparing for various technical and competitive examinations in Electronic Engineering.

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Title: Electronics Engineering
Subtitle: (Competitive Exams – Objective Special)
Language: English

Editor-in-Chief: Dr. Parvendra Kumar
Editorial and Technical Support: Teach To India Technical Team
Computer Graphics & Layout: Teach To India Design Team

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Publisher:
Teach To India Publication
Adarsh Colony, Saharanpur – 247001
Mobile Number: +91 9084496877
Email: info@teachtoindia.com | Web: www.teachtoindia.com

Printed at: Shree Education and Publication private limited, Ajmer, Rajasthan
Edition: First Edition, 2026
ISBN: 978-81-990811-4-7

Colophon:
This book is printed on environmentally responsible paper. The layout, typesetting, and graphics have been optimized for language clarity and accessibility, suitable for technical and vocational training.

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Printed in India

Price: ₹ 645 /-

Book Introduction

This book is designed to assist students in preparing for a wide range of competitive examinations and job-oriented assessments, including **UPPSC (Lecturer/Assistant Professor)**, **GATE / ESE (IES)**, **State AE & JE examinations**, **PSU recruitments** (such as BEL, BHEL, DRDO), **ISRO Scientist-C**, **State University and Polytechnic Lecturer/Assistant Professor examinations**, as well as **M.Tech and Ph.D. entrance examinations** conducted by **IITs, NITs, and Central Universities**.

The multiple-choice questions (MCQs) included in this book are structured across various cognitive levels—**remembering, understanding, application, and analysis**—to strengthen conceptual clarity and enhance exam readiness.

Acknowledgment

The content of this book has been developed in accordance with the **official UPPSC syllabus**, covering the **core 16 competitive subjects** prescribed for the examination.

Some diagrams, tables, and reference materials presented in this book have been adapted or reproduced from standard textbooks and authoritative sources related to the subject. The author sincerely acknowledges these sources and expresses heartfelt gratitude to the scholars and authors whose works have contributed to the enrichment, accuracy, and clarity of this book.

Syllabus

Subject Name	Part-1
Electronic Devices	Energy bands in semiconductor, band-gap in direct and indirect semiconductors, P-N junction, Zener diode, clipping, clamping and rectifiers. Small signal equivalent circuits of diodes, working of BJT, JEFT, MOSFET devices.
Analog Circuits	Diode circuits, amplifier models: Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier. biasing schemes for BJT and FET amplifiers, bias stability, various configurations. High frequency transistor models, frequency response of single stage and multistage amplifiers. Oscillators: Review of the basic concept, Barkhouse criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitts, Clapp etc.), non-sinusoidal oscillators. Op-Amp applications: Review of inverting and non-inverting amplifiers, integrator and differentiator, summing amplifier, precision rectifier, Schmitt trigger and its applications, active filters: Low pass, high pass, band pass and band stop, design guidelines.
Advanced Electronics	VLSI technology: Processing, lithography, interconnects, packaging, testing; VLSI design principles, MUX/ROM/PLA-based design, Moore & Mealy circuit design; Pipeline concepts & functions; Design for testability, examples.
Network Theory and Basic Machines	DC Circuits-Ohm's & Kirchoff's laws, mesh and nodal analysis, circuit theorems; Single phase AC circuits; Network graphs & matrices; Wye-Delta transformation; Linear constant coefficient differential equations-time domain analysis of RLC circuits; Solution of network equations using Laplace transforms- frequency domain analysis of RLC circuits; 2-port network parameters-driving point & transfer functions; State equations for networks; Steady state sinusoidal analysis. Basics-DC machines, induction machines, and synchronous machines. Transformers and its efficiency.
Digital Electronics	Number representations: binary, integer and floating-point numbers. Combinatorial circuits, Boolean algebra, minimization of functions using identities and Karnaugh map, logic gates, arithmetic circuits, code converters, multiplexers, decoders. Sequential circuits: latches and flip-flops, counters, shift registers. Data converters; sample and hold circuits, ADCs and DACs. Basics of multiplexers, counters/registers/memories/microprocessors, design & applications.
Control Systems	Basic control system components; Feedback principle; Transfer function; Block diagram representation, Transforms & their applications; Signal flow graph; Frequency response; Routh-Hurwitz criteria, root loci, Nyquist/Bode plots; Feedback systems-open & close loop types, stability analysis, steady state, transient and frequency response analysis; compensation; Lag, lead and lag-lead. State variable model and solution of state equations of LTI systems. Transient and steady-state analysis of LTI systems.
Instrumentation	Principles of measurement, accuracy, precision and standards; Analog and Digital systems for measurement, measuring instruments for different applications; Static/dynamic characteristics of measurement systems, errors, statistical analysis and curve fitting.
Computer Organization and Architecture	Basic architecture, CPU, I/O organisation, memory organisation, peripheral devices, trends; Hardware/software issues; Date representation & Programming; Operating systems-basics, processes, characteristics, applications. Microprocessors & microcontrollers, basics, interrupts, DMA, instruction sets, interfacing; Controllers & uses; Embedded systems.
	Part-2
Electromagnetics	Elements of vector calculus, Maxwell's equations-basic concepts differential and integral forms and their interpretation; Gauss', Stokes' theorems; Poynting vector: Wave propagation through different media; Transmission lines: equations, characteristic impedance, impedance matching, impedance transformation, S parameters, Smith chart. Waveguides-basics, rectangular types, modes, cut-off frequency, dispersion, dielectric types; Antennas-antenna types radiation pattern, gain and directivity, return loss, monopoles/dipoles, gain, antenna arrays.

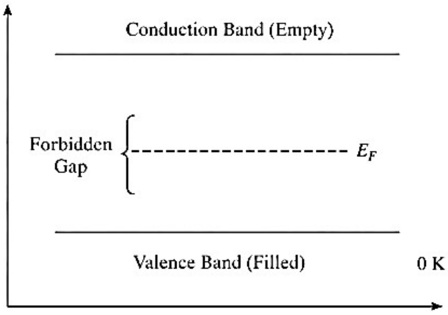
Analog Communication Systems	AM, FM, transmitters/receivers, amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, superheterodyne receivers.
Digital Communication Basics	Sampling, quantizing, coding, PCM/ DPCM, multiplexing audio/video; Digital modulation: ASK, FSK, PSK; Multiple access: TDMA, FDMA, CDMA;
Digital Signal Processing	Discrete time signals/systems, uses; Digital filters: FIR/IIR types, design, speech/audio/radar signal processing uses;
Communication Networks	Principles/practices/technologies/uses/OSI model/security; Basic packet multiplexed streams/scheduling; Cellular networks, types, analysis, protocols (TCP/TCPIP).
Random Signals and Processes	autocorrelation and power spectral density, properties of white noise, filtering of random signals. 7. Information theory: entropy, mutual information and channel capacity theorem, Huffman coding algebraic and convolutional coding.
Information Theory	Entropy, mutual information and channel capacity theorem, Huffman coding algebraic and convolutional coding.
Microwave & Satellite Communication	Terrestrial/space type LOS systems, block schematics link calculations, system design; Communication satellites, orbits, characteristics, systems, uses; Fibre-optics-Light propagation in optical fibre, fibre optic communication: fibre optics, theory, practice/standards, systems, block schematics, link calculations, system design.

Table of Contents

Part-1

1. Electronic Devices

Q1. The given energy band diagram shows the conduction band completely empty, the valence band completely filled, and the Fermi level lying within the forbidden energy gap at 0 K. Which electrical behavior is directly inferred from this diagram?



(a) High electrical conductivity due to free electrons
(b) Insulating behavior due to absence of charge carriers
(c) p-type semiconductor behavior
(d) Degenerate semiconductor behavior
Ans. b | Sol. : The diagram indicates a fully filled valence band and an empty conduction band at 0 K, implying no mobile charge carriers; hence the material behaves as an insulator.

Q2. At absolute zero temperature, a pure semiconductor behaves as
(a) A good conductor
(b) A perfect insulator
(c) A semiconductor with intrinsic carriers
(d) A degenerate semiconductor
Ans. b | Sol. : At 0 K, the valence band is completely filled and the conduction band is empty, hence no charge carriers are available for conduction.

Q3. Which of the following materials has a direct band gap?
(a) Silicon
(b) Germanium
(c) Gallium Arsenide
(d) Tin
Ans. c | Sol. : Gallium Arsenide is a direct band-gap semiconductor, making it suitable for optoelectronic devices.

Q4. In an indirect band-gap semiconductor, electron transition from valence band to conduction band requires
(a) Only photon interaction
(b) Only phonon interaction
(c) Both photon and phonon interaction
(d) No external interaction
Ans. c | Sol. : In indirect band-gap semiconductors, both photon energy and phonon momentum are required to satisfy energy and momentum conservation.

Q5. The energy band gap of silicon at room temperature is approximately
(a) 0.3 eV
(b) 0.67 eV
(c) 1.1 eV
(d) 2.3 eV
Ans. c | Sol. : Silicon has an indirect band gap of approximately 1.1 eV at 300 K.

Q6. When a P–N junction is formed, the depletion region is created due to
(a) Recombination of majority carriers
(b) Diffusion of minority carriers
(c) Drift of electrons only
(d) External biasing
Ans. a | Sol. : Majority carriers diffuse across the junction and recombine, leaving behind immobile ions forming the depletion region.

Q7. The built-in potential of a silicon P–N junction at room temperature is approximately
(a) 0.3 V
(b) 0.5 V
(c) 0.7 V
(d) 1.1 V
Ans. c | Sol. : For silicon, the built-in barrier potential is approximately 0.7 V.

Q8. Under forward bias, the width of the depletion layer
(a) Increases
(b) Decreases
(c) Remains constant
(d) Becomes zero instantly
Ans. b | Sol. : Forward bias reduces the barrier potential, allowing carriers to cross the junction and reducing depletion width.

Q9. The reverse saturation current in a P–N junction diode is mainly due to
(a) Majority carriers
(b) Minority carriers
(c) Thermionic emission
(d) Zener breakdown
Ans. b | Sol. : Reverse saturation current is caused by thermally generated minority carriers.

Q10. Zener breakdown occurs mainly due to
(a) Impact ionization
(b) Avalanche multiplication
(c) High electric field across thin depletion layer
(d) Thermal runaway
Ans. c | Sol. : Zener breakdown occurs because of quantum mechanical tunneling due to a strong electric field in heavily doped junctions.

Q11. A Zener diode is normally operated in
(a) Forward bias only
(b) Reverse bias breakdown region
(c) Cut-off region
(d) Saturation region
Ans. b | Sol. : Zener diodes are designed to operate in the reverse breakdown region for voltage regulation.

Q12. The breakdown voltage of a Zener diode depends mainly on
(a) Junction area
(b) Forward current

(c) Doping concentration
(d) Temperature only
Ans. c | Sol. : Higher doping concentration results in a thinner depletion layer and lower breakdown voltage.

Q13. A Zener diode used as a voltage regulator maintains constant output voltage due to
(a) High forward resistance
(b) Low dynamic resistance in breakdown
(c) High reverse resistance
(d) Zero junction capacitance
Ans. b | Sol. : In breakdown region, Zener diode exhibits very low dynamic resistance, maintaining constant voltage.

Q14. A series clipper circuit removes
(a) Entire input signal
(b) Either positive or negative half cycles
(c) Only DC component
(d) Noise signals only
Ans. b | Sol. : Clippers remove selected portions of the waveform without affecting the remaining part.

Q15. A biased clipper differs from an unbiased clipper because it
(a) Uses transformer coupling
(b) Uses Zener diode
(c) Employs an external DC bias
(d) Works only for high frequencies
Ans. c | Sol. : The DC bias shifts the clipping level above or below zero reference.

Q16. The main function of a clamper circuit is to
(a) Limit the signal amplitude
(b) Remove ripple
(c) Shift the DC level of a waveform
(d) Convert AC to DC
Ans. c | Sol. : Clampers add a DC level to an AC signal without altering its shape.

Q17. A positive clamper shifts the output waveform
(a) Downward
(b) Upward
(c) Symmetrically about zero
(d) To ground reference
Ans. b | Sol. : Positive clamper adds a positive DC component, shifting the waveform upward.

Q18. In a half-wave rectifier, the diode conducts during
(a) Entire cycle
(b) Positive half cycle only
(c) Negative half cycle only
(d) Both half cycles alternately
Ans. b | Sol. : Half-wave rectifier allows current flow only during one half of the AC cycle.

Q19. The ripple factor of a half-wave rectifier is approximately
(a) 0.48
(b) 0.81
(c) 1.21
(d) 2.0
Ans. c | Sol. : Ripple factor of half-wave rectifier is 1.21, indicating high ripple content.

Q20. Compared to half-wave rectifier, a full-wave rectifier has
(a) Lower efficiency
(b) Higher ripple factor
(c) Higher rectification efficiency
(d) Same output voltage
Ans. c | Sol. : Full-wave rectifier uses both halves of the input AC signal, improving efficiency.

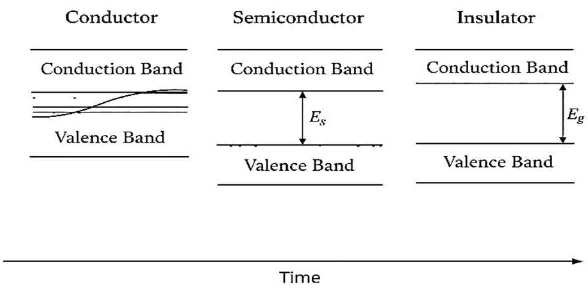
Q21. The ripple factor of a full-wave rectifier without filter is approximately
(a) 0.48
(b) 0.81
(c) 1.21
(d) 0
Ans. b | Sol. : Full-wave rectifier has a ripple factor of about 0.81.

Q22. In a bridge rectifier, the number of diodes conducting at any instant is
(a) One
(b) Two
(c) Three
(d) Four
Ans. b | Sol. : Two diodes conduct during each half cycle in a bridge rectifier.

Q23. The maximum rectification efficiency of a full-wave rectifier is
(a) 40.6%
(b) 60%
(c) 81.2%
(d) 100%
Ans. c | Sol. : The theoretical maximum efficiency of a full-wave rectifier is 81.2%.

Q24. A capacitor filter reduces ripple voltage by
(a) Blocking DC
(b) Passing AC
(c) Charging during conduction and discharging during non-conduction
(d) Increasing diode resistance
Ans. c | Sol. : The capacitor smooths the output by maintaining voltage during diode non-conduction periods.

Q25. By observing the relative positions of the valence band and conduction band in the three materials shown, which material allows electron flow without requiring external energy input?



(a) Insulator

(b) Semiconductor
(c) Conductor
(d) Intrinsic semiconductor at 0 K
Ans. c | Sol. : In a conductor, the valence band overlaps with the conduction band, so electrons are already free to move without requiring external energy input.

Q26. The electrical conductivity of a semiconductor increases with temperature mainly because
(a) Mobility of charge carriers decreases
(b) Forbidden energy gap increases
(c) Number of charge carriers increases
(d) Effective mass of electrons increases
Ans. c | Sol. : With rise in temperature, more electrons gain sufficient energy to jump across the band gap, increasing charge carrier concentration.

Q27. In an intrinsic semiconductor, the Fermi level lies
(a) Close to the conduction band
(b) Close to the valence band
(c) Exactly in the middle of the band gap
(d) Outside the band gap
Ans. c | Sol. : In intrinsic semiconductors, electron and hole concentrations are equal, so the Fermi level lies near the midpoint of the forbidden energy gap.

Q28. Why are direct band-gap semiconductors preferred for optoelectronic devices?
(a) They have lower resistivity
(b) Electron transition releases energy as heat
(c) Electron transition releases energy directly as light
(d) They have wider depletion regions
Ans. c | Sol. : In direct band-gap semiconductors, electron-hole recombination emits photons efficiently, making them suitable for LEDs and lasers.

Q29. Silicon is not preferred for light-emitting devices because it
(a) Has a large band gap
(b) Is difficult to dope
(c) Is an indirect band-gap semiconductor
(d) Has high thermal conductivity
Ans. c | Sol. : In silicon, recombination requires phonon assistance, making light emission inefficient.

Q30. When a P–N junction is formed, diffusion current exists because of
(a) Applied external voltage
(b) Temperature gradient
(c) Concentration gradient of carriers
(d) High electric field
Ans. c | Sol. : Carrier concentration difference across the junction causes diffusion of electrons and holes.

Q31. The electric field in the depletion region of a P–N junction is directed
(a) From P-region to N-region
(b) From N-region to P-region
(c) Parallel to the junction
(d) Zero everywhere
Ans. b | Sol. : The electric field is directed from positive ions in N-region to negative ions in P-region.

Q32. Under reverse bias condition of a P–N junction
(a) Depletion width decreases
(b) Barrier potential reduces
(c) Majority carriers conduct
(d) Depletion width increases
Ans. d | Sol. : Reverse bias increases the barrier potential, widening the depletion region.

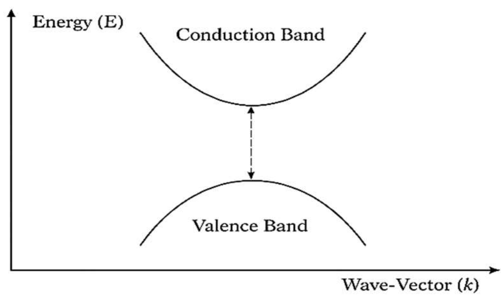
Q33. Reverse saturation current in a diode increases rapidly with temperature because
(a) Mobility of carriers increases
(b) Barrier potential increases
(c) Minority carrier concentration increases
(d) Junction capacitance increases
Ans. c | Sol. : Reverse saturation current depends on thermally generated minority carriers, which increase exponentially with temperature.

Q34. Zener breakdown occurs at low reverse voltages because
(a) Junction is lightly doped
(b) Depletion layer is wide
(c) Electric field is very high
(d) Avalanche multiplication dominates
Ans. c | Sol. : Heavy doping produces a thin depletion layer with very high electric field causing tunneling.

Q35. Avalanche breakdown differs from Zener breakdown mainly in
(a) Operating temperature
(b) Doping concentration
(c) Forward bias operation
(d) Material used
Ans. b | Sol. : Avalanche breakdown occurs in lightly doped junctions, while Zener breakdown occurs in heavily doped junctions.

Q36. A Zener diode acts as a voltage regulator because it
(a) Blocks AC signals
(b) Has constant forward voltage
(c) Maintains nearly constant reverse voltage in breakdown
(d) Has zero resistance
Ans. c | Sol. : In breakdown region, Zener voltage remains nearly constant despite current variations.

Q37. From the given E–k diagram, what can be inferred about the nature of the semiconductor material?



(a) Indirect band-gap semiconductor
(b) Direct band-gap semiconductor
(c) Degenerate semiconductor
(d) Amorphous semiconductor

Ans. b | Sol. : The minimum of the conduction band and the maximum of the valence band occur at the same wave-vector k, which is the defining diagrammatic feature of a direct band-gap semiconductor.

Q38. A clipper circuit is mainly used to
(a) Convert AC to DC
(b) Shift DC level
(c) Limit the amplitude of a signal
(d) Amplify signal
Ans. c | Sol. : Clippers remove unwanted portions of a waveform beyond a reference level.

Q39. A negative clipper removes
(a) Positive half cycles
(b) Negative half cycles
(c) Both half cycles
(d) DC component only
Ans. b | Sol. : A negative clipper removes or limits the negative portion of the input waveform.

Q40. Adding a DC source in a clipper circuit
(a) Increases frequency
(b) Changes clipping level
(c) Converts AC to DC
(d) Improves efficiency
Ans. b | Sol. : Biasing shifts the clipping threshold to a desired voltage level.

Q41. The primary function of a clamper circuit is to
(a) Limit peak voltage
(b) Change waveform shape
(c) Shift waveform vertically
(d) Reduce ripple
Ans. c | Sol. : Clampers shift the entire waveform up or down by adding a DC component.

Q42. A clamper circuit requires which essential components?
(a) Diode and resistor
(b) Capacitor and resistor
(c) Diode, capacitor, and resistor
(d) Transformer and diode
Ans. c | Sol. : Diode, capacitor, and resistor together establish the clamping action.

Q43. In a half-wave rectifier, ripple is high because
(a) Only one diode is used
(b) Transformer rating is low
(c) Only one half cycle is utilized
(d) Output voltage is high
Ans. c | Sol. : Half-wave rectifier uses only one half of the AC cycle, leading to large ripple.

Q44. Full-wave rectifier output frequency is
(a) Same as input frequency
(b) Half of input frequency
(c) Twice the input frequency
(d) Zero
Ans. c | Sol. : Both half cycles contribute, doubling the ripple frequency.

Q45. Bridge rectifier is preferred over center-tapped rectifier because it
(a) Uses fewer diodes
(b) Requires center-tapped transformer
(c) Provides higher PIV rating
(d) Utilizes full transformer secondary
Ans. d | Sol. : Bridge rectifier uses the entire secondary winding efficiently.

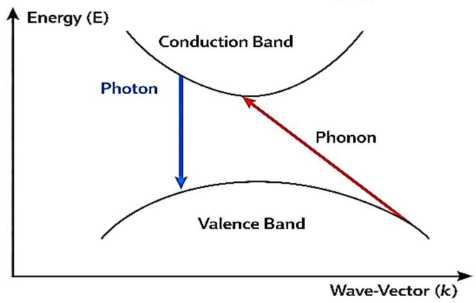
Q46. Peak Inverse Voltage (PIV) of each diode in bridge rectifier is
(a) Vm
(b) 2Vm
(c) Vm/2
(d) 4Vm
Ans. a | Sol. : Each diode in a bridge rectifier must withstand a maximum reverse voltage equal to peak secondary voltage.

Q47. Rectification efficiency improves in full-wave rectifier because
(a) Ripple increases
(b) Transformer losses reduce
(c) Both half cycles deliver power
(d) Output voltage decreases
Ans. c | Sol. : Power is delivered during both half cycles, increasing efficiency.

Q48. A capacitor filter is ineffective at very high load current because
(a) Capacitor discharges slowly
(b) Capacitor charges instantly
(c) Discharge time decreases
(d) Ripple frequency increases
Ans. c | Sol. : High load current causes rapid discharge, reducing filtering effectiveness.

Q49. Ripple factor decreases when
(a) Load resistance decreases
(b) Capacitance increases
(c) Input frequency decreases
(d) Diode resistance increases
Ans. b | Sol. : Larger capacitance stores more charge, reducing ripple voltage.

Q50. From the given E–k diagram, what is the nature of the semiconductor band gap?



(a) Direct band-gap semiconductor
(b) Indirect band-gap semiconductor
(c) Degenerate semiconductor
(d) Zero band-gap material
Ans. b | Sol. : The conduction band minimum and valence band maximum occur at different k-values, requiring a phonon for momentum conservation—indicating an indirect band-gap semiconductor.

Q51. A direct band-gap semiconductor is used in an LED instead of silicon because

(a) Silicon has higher resistivity
(b) Radiative recombination probability is higher
(c) Silicon cannot be doped
(d) Silicon has a larger band gap
Ans. b | Sol. : Direct band-gap materials allow electron-hole recombination with direct photon emission, giving efficient light output.

Q52. If the band gap of a semiconductor decreases slightly with temperature, the immediate effect is
(a) Reduction in carrier concentration
(b) Increase in depletion width
(c) Increase in intrinsic carrier concentration
(d) Decrease in recombination rate
Ans. c | Sol. : Smaller band gap requires less energy for electron transition, increasing intrinsic carrier concentration.

Q53. In a silicon P–N junction, if doping on the N-side is increased heavily, the depletion region
(a) Extends mainly into N-side
(b) Extends mainly into P-side
(c) Becomes symmetric
(d) Disappears completely
Ans. b | Sol. : Depletion region spreads more into the lightly doped side, which is P-side in this case.

Q54. A silicon diode has built-in potential of 0.7 V. If forward bias of 0.5 V is applied, the effective barrier potential becomes
(a) 0.2 V
(b) 0.7 V
(c) 1.2 V
(d) 0 V
Ans. a | Sol. : Forward bias reduces the barrier potential by the applied voltage.

Q55. If reverse bias across a P–N junction is doubled, the depletion width will
(a) Remain unchanged
(b) Decrease linearly
(c) Increase
(d) Become zero
Ans. c | Sol. : Reverse bias increases the electric field, widening the depletion region.

Q56. A diode has reverse saturation current of 5 µA at 300 K. At higher temperature, this current increases because
(a) Barrier potential increases
(b) Minority carrier generation increases
(c) Depletion width decreases
(d) Junction capacitance reduces
Ans. b | Sol. : Reverse saturation current depends on thermally generated minority carriers, which increase with temperature.

Q57. A Zener diode rated at 6.2 V is used in a regulator. If input voltage increases, the output voltage remains nearly constant because
(a) Zener resistance is very high
(b) Zener operates in forward bias
(c) Zener current adjusts automatically
(d) Load resistance increases
Ans. c | Sol. : Zener diode adjusts its reverse current to maintain constant voltage in breakdown.

Q58. If the Zener current falls below the knee current in a regulator circuit, the output voltage will
(a) Increase
(b) Remain constant
(c) Drop
(d) Become zero
Ans. c | Sol. : Below knee current, Zener diode cannot maintain breakdown, so regulation fails.

Q59. A Zener diode of 5 V is connected in reverse bias. At 4 V reverse voltage, the diode behaves as
(a) Short circuit
(b) Open circuit
(c) Voltage regulator
(d) Forward biased diode
Ans. b | Sol. : Below breakdown voltage, Zener diode offers very high resistance.

Q60. In a series clipper, increasing the diode threshold voltage will
(a) Increase signal frequency
(b) Shift clipping level
(c) Reduce noise
(d) Increase amplification
Ans. b | Sol. : Clipping begins only after input exceeds diode threshold voltage.

Q61. A biased clipper is preferred over an unbiased clipper when
(a) Symmetrical clipping is required
(b) Zero reference clipping is needed
(c) Clipping at specific voltage level is required
(d) High frequency operation is needed
Ans. c | Sol. : Bias allows precise control over clipping level.

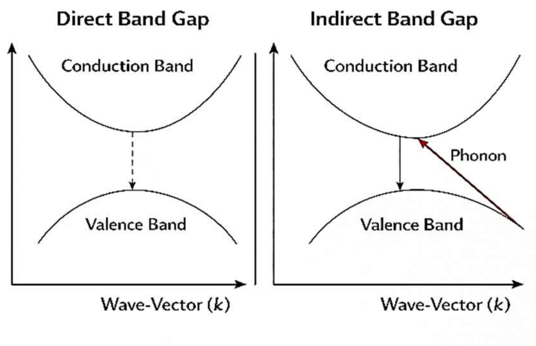
Q62. If a sine wave of ±10 V is applied to an ideal positive clipper, the output will be
(a) ±10 V sine wave
(b) Only positive half removed
(c) Only negative half removed
(d) Zero output
Ans. b | Sol. : Positive clipper removes positive half cycles, allowing negative portion to pass.

Q63. A clamper circuit differs from a clipper because it
(a) Limits amplitude
(b) Removes signal
(c) Shifts DC level without altering shape
(d) Blocks DC
Ans. c | Sol. : Clampers shift waveform vertically by adding a DC component.

Q64. In a clamper circuit, increasing capacitance results in
(a) Faster discharge
(b) Poor clamping
(c) Better clamping action
(d) Higher ripple

Ans. c | Sol. : Larger capacitance maintains charge longer, improving clamping.

Q65. From the left portion of the diagram (direct band gap), which condition is satisfied during an electron–hole recombination?



(a) Change in momentum is required
(b) Energy and momentum both change significantly
(c) Energy changes while wave-vector remains constant
(d) Only phonon participation is mandatory

Ans. c | Sol. : In the direct band-gap diagram, the conduction band minimum and valence band maximum occur at the same k, so recombination involves energy change without momentum change.

Q66. In a half-wave rectifier with resistive load, the output frequency is

(a) Same as input
(b) Half of input
(c) Twice input
(d) Zero

Ans. a | Sol. : Half-wave rectifier produces one pulse per input cycle.

Q67. If the peak input voltage of a half-wave rectifier is Vm, the peak output voltage (ideal diode) is

(a) Vm
(b) Vm/2
(c) 2Vm
(d) 0

Ans. a | Sol. : Ideal diode causes no voltage drop, so peak output equals peak input.

Q68. A full-wave rectifier improves DC output mainly because

(a) Ripple frequency is reduced
(b) Transformer size increases
(c) Both half cycles are utilized
(d) Diode resistance decreases

Ans. c | Sol. : Power delivery during both half cycles increases average DC output.

Q69. If input frequency is 50 Hz, the ripple frequency of full-wave rectifier output is

(a) 25 Hz
(b) 50 Hz
(c) 100 Hz
(d) 150 Hz

Ans. c | Sol. : Full-wave rectification doubles the ripple frequency.

Q70. In a bridge rectifier, if one diode fails open, the output will

(a) Become zero
(b) Become half-wave rectified
(c) Remain full-wave
(d) Increase

Ans. b | Sol. : With one diode open, only one half cycle conducts, acting as half-wave rectifier.

Q71. A capacitor filter connected to a rectifier is most effective when

(a) Load resistance is low
(b) Load resistance is high
(c) Input frequency is low
(d) Diode resistance is high

Ans. b | Sol. : High load resistance allows capacitor to discharge slowly, reducing ripple.

Q72. Ripple factor decreases in a rectifier circuit when

(a) Capacitance decreases
(b) Load current increases
(c) Capacitance increases
(d) Diode threshold increases

Ans. c | Sol. : Larger capacitance smooths output voltage by reducing ripple amplitude.

Q73. A rectifier with poor filtering will primarily cause

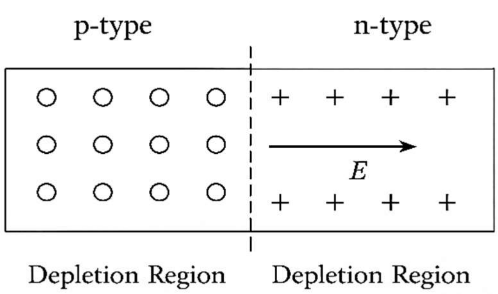
(a) Low DC voltage
(b) High ripple in output
(c) High efficiency
(d) Zero output current

Ans. b | Sol. : Inadequate filtering allows AC components to remain in the DC output.

Q74. In the given p–n junction diagram, fixed negative charges are shown on the p-side and fixed positive charges on the n-side within the depletion region.

The arrow marked E represents the built-in electric field.

What is the correct physical reason for the direction of the electric field shown?



(a) Electric field points from acceptor ions to donor ions
(b) Electric field points from p-type region to n-type region due to hole diffusion
(c) Electric field points from positive donor ions to negative acceptor ions
(d) Electric field direction depends on external bias only

Ans. c | Sol. : In the depletion region, uncovered positive donor ions (n-side) and negative acceptor ions (p-side) create an internal field directed from n-side to p-side, i.e., from positive to negative charges.

Q75. A semiconductor material shows negligible conductivity at 0 K but significant conductivity at room temperature. From band theory, the most valid explanation is
(a) Valence band becomes partially empty at 0 K
(b) Forbidden energy gap vanishes at room temperature
(c) Thermal energy excites electrons across the band gap
(d) Fermi level shifts outside the band gap
Ans. c | Sol. : At higher temperatures, electrons gain sufficient thermal energy to cross the forbidden energy gap, increasing conductivity.

Q76. Two semiconductors have identical band gaps, but one is direct and the other indirect. For equal carrier concentration, the indirect semiconductor will show lower light emission because
(a) Recombination rate is lower
(b) Momentum conservation requires phonon participation
(c) Carrier lifetime is zero
(d) Mobility is lower
Ans. b | Sol. : Indirect band-gap materials require phonons for momentum conservation, reducing probability of radiative recombination.

Q77. If temperature increases in an intrinsic semiconductor, the Fermi level slightly shifts toward the conduction band because
(a) Valence band moves upward
(b) Conduction band moves downward
(c) Electron effective mass decreases faster than hole effective mass
(d) Hole concentration becomes zero
Ans. c | Sol. : Unequal temperature dependence of electron and hole effective masses causes slight Fermi level shift.

Q78. In an abrupt P–N junction, increasing donor concentration on N-side while keeping P-side constant will cause
(a) Symmetric reduction of depletion width
(b) Depletion region to extend more into N-side
(c) Depletion region to extend more into P-side
(d) No change in electric field distribution
Ans. c | Sol. : Depletion width extends more into the lightly doped side to maintain charge neutrality.

Q79. A P–N junction is forward biased and reverse biased alternately at high frequency. The reduction in diode efficiency at high frequency is mainly due to
(a) Junction capacitance
(b) Barrier potential variation
(c) Reverse saturation current
(d) Bulk resistance
Ans. a | Sol. : Junction capacitance opposes rapid voltage changes, reducing effective rectification.

Q80. For a silicon diode operating in reverse bias, temperature rise causes breakdown voltage to
(a) Increase due to higher carrier mobility
(b) Decrease due to Zener effect dominance
(c) Remain constant
(d) Increase due to avalanche effect dominance
Ans. d | Sol. : Avalanche breakdown voltage increases with temperature because increased lattice scattering reduces impact ionization.

Q81. A Zener diode is preferred over an ordinary diode for regulation because
(a) It conducts more current
(b) Its breakdown region is unstable
(c) Its breakdown voltage is sharply defined
(d) It operates only in forward bias
Ans. c | Sol. : Zener diodes have well-defined breakdown voltages suitable for regulation.

Q82. In a Zener regulator, if series resistance is reduced excessively, the most likely failure mode is
(a) Loss of regulation
(b) Excess Zener current causing damage
(c) Increase in ripple
(d) Reduction in output voltage
Ans. b | Sol. : Low series resistance allows excessive current through Zener, exceeding power rating.

Q83. A clipper circuit fails to clip at desired level when operating frequency increases significantly because
(a) Diode resistance increases
(b) Junction capacitance becomes significant
(c) Load resistance decreases
(d) Input amplitude reduces
Ans. b | Sol. : Junction capacitance affects diode switching at high frequencies.

Q84. A biased clipper allows asymmetric clipping because
(a) Diode conducts in both directions
(b) DC bias alters conduction threshold
(c) AC signal frequency changes
(d) Load resistance is nonlinear
Ans. b | Sol. : DC bias shifts the effective clipping level, enabling asymmetric clipping.

Q85. A clamper circuit fails to maintain DC shift when load resistance is very small because
(a) Capacitor charges faster
(b) Capacitor discharges rapidly
(c) Diode becomes reverse biased
(d) Input frequency increases
Ans. b | Sol. : Low load resistance causes fast discharge, destroying clamping action.

Q86. In a positive clamper, reversing the diode polarity will convert it into
(a) Series clipper
(b) Negative clamper
(c) Half-wave rectifier
(d) Voltage regulator
Ans. b | Sol. : Diode orientation determines direction of DC shift.

Q87. A half-wave rectifier produces more ripple than a full-wave rectifier mainly because
(a) Transformer utilization is poor
(b) Ripple frequency is lower

(c) Diode resistance is higher
(d) Output voltage is lower
Ans. b | Sol. : Ripple frequency equals supply frequency, leading to larger ripple amplitude.

Q88. If a half-wave rectifier is followed by a capacitor filter, ripple voltage increases when
(a) Capacitance increases
(b) Load resistance decreases
(c) Frequency increases
(d) Diode resistance decreases
Ans. b | Sol. : Lower load resistance causes faster capacitor discharge, increasing ripple.

Q89. A full-wave rectifier shows better efficiency because
(a) Peak voltage is doubled
(b) DC output is higher for same input
(c) Ripple voltage is zero
(d) Transformer losses are eliminated
Ans. b | Sol. : Using both half cycles increases average DC output.

Q90. In a bridge rectifier, PIV requirement of each diode is less than that of center-tapped rectifier because
(a) Voltage divides equally
(b) Only half secondary voltage appears across each diode
(c) Diodes conduct alternately
(d) Transformer size is smaller
Ans. b | Sol. : Each diode in bridge rectifier experiences only peak secondary voltage.

Q91. If one diode in a bridge rectifier shorts, the output waveform will
(a) Become zero
(b) Remain full-wave
(c) Become distorted with heavy current
(d) Become half-wave
Ans. c | Sol. : Shorted diode causes abnormal current paths and distorted output.

Q92. A Zener diode used for regulation is replaced with one having higher breakdown voltage. The output will
(a) Decrease
(b) Increase
(c) Remain same
(d) Become zero
Ans. b | Sol. : Regulated output follows Zener breakdown voltage.

Q93. A semiconductor with smaller band gap will show
(a) Lower intrinsic carrier concentration
(b) Higher intrinsic carrier concentration
(c) Higher resistivity
(d) Lower temperature sensitivity
Ans. b | Sol. : Smaller band gap requires less energy for carrier generation.

Q94. For the same AC input, ripple factor of half-wave rectifier is higher than full-wave rectifier because
(a) Load resistance is smaller
(b) Average DC output is lower
(c) RMS AC component is higher relative to DC
(d) Transformer losses are higher
Ans. c | Sol. : Larger AC component relative to DC increases ripple factor.

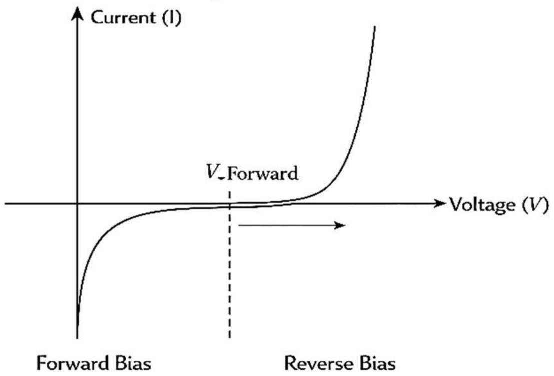
Q95. In a clamping circuit, incorrect capacitor polarity causes
(a) Better clamping
(b) No effect
(c) Capacitor damage and waveform distortion
(d) Increased frequency
Ans. c | Sol. : Reverse polarity damages capacitor and disrupts clamping action.

Q96. If diode forward resistance increases in a rectifier, the most affected parameter is
(a) Ripple frequency
(b) Peak inverse voltage
(c) Rectification efficiency
(d) Input frequency
Ans. c | Sol. : Increased forward resistance reduces output DC power, lowering efficiency.

Q97. A semiconductor diode cannot be used as an ideal switch at very high frequency mainly due to
(a) Thermal noise
(b) Reverse recovery time
(c) Barrier potential
(d) Bulk resistance
Ans. b | Sol. : Reverse recovery time limits switching speed at high frequencies.

Q98. In a Zener regulator, increasing load current beyond regulation range results in
(a) Increase in Zener current
(b) Constant output voltage
(c) Drop in output voltage
(d) Increase in input voltage
Ans. c | Sol. : Excess load current reduces Zener current below breakdown level, causing voltage drop.

Q99. In the given I–V characteristic of the diode, a dashed vertical line marked V_{Forward} is shown near the point where current starts rising rapidly.
What does this point most accurately represent in the context of the diagram?



(a) Onset of reverse breakdown
(b) Voltage at which depletion width becomes maximum
(c) Cut-in (knee) voltage where diode conduction becomes significant
(d) Voltage at which reverse saturation current becomes zero
Ans. c | Sol. : The sharp increase in forward current beyond V_{Forward} indicates the **knee (cut-in) voltage**, where the barrier potential is effectively overcome and conduction increases rapidly.

Q100. In the small-signal equivalent circuit of a diode, the dynamic resistance is defined as
(a) Ratio of DC voltage to DC current
(b) Ratio of AC voltage to AC current
(c) Ratio of DC current to AC voltage
(d) Ratio of AC current to DC voltage
Ans. b | Sol. : Dynamic (small-signal) resistance is the ratio of incremental AC voltage to incremental AC current around the operating point.

Q101. The small-signal resistance of a diode at room temperature is approximately
(a) 26 mV / ID
(b) ID / 26 mV
(c) 0.7 / ID
(d) 1 / ID
Ans. a | Sol. : At 300 K, the thermal voltage VT ≈ 26 mV, so rd ≈ VT / ID.

Q102. In the small-signal model of a diode, the junction capacitance is significant mainly under
(a) Forward bias
(b) Reverse bias
(c) Zero bias
(d) Breakdown condition
Ans. b | Sol. : Junction (transition) capacitance dominates under reverse bias due to depletion region.

Q103. The charge storage capacitance of a diode is associated with
(a) Depletion region width
(b) Stored minority carriers
(c) Reverse saturation current
(d) Breakdown voltage
Ans. b | Sol. : Diffusion capacitance arises due to stored charge during forward bias.

Q104. A Bipolar Junction Transistor (BJT) has how many PN junctions?
(a) One
(b) Two
(c) Three
(d) Four
Ans. b | Sol. : A BJT consists of emitter-base and base-collector PN junctions.

Q105. In normal active operation of a BJT
(a) Both junctions are forward biased
(b) Both junctions are reverse biased
(c) Emitter-base is forward biased and collector-base is reverse biased
(d) Emitter-base is reverse biased and collector-base is forward biased
Ans. c | Sol. : This biasing condition allows amplification.

Q106. The emitter of a BJT is heavily doped to
(a) Increase breakdown voltage
(b) Reduce base width
(c) Supply large number of charge carriers
(d) Reduce collector current
Ans. c | Sol. : Heavy doping ensures efficient carrier injection into the base.

Q107. The current gain β of a BJT in common-emitter configuration is defined as
(a) IC / IB
(b) IB / IC
(c) IE / IC
(d) IC / IE
Ans. a | Sol. : β represents the ratio of collector current to base current.

Q108. In a BJT, the base region is made very thin mainly to
(a) Increase collector current
(b) Reduce recombination
(c) Increase breakdown voltage
(d) Reduce leakage current
Ans. b | Sol. : Thin base reduces recombination of carriers, improving current gain.

Q109. The majority carriers in an NPN transistor are
(a) Holes
(b) Electrons
(c) Ions
(d) Photons
Ans. b | Sol. : In NPN transistor, electrons are the majority carriers.

Q110. A JFET is a
(a) Bipolar device
(b) Unipolar device
(c) Optoelectronic device
(d) Thermal device
Ans. b | Sol. : JFET conduction depends on only one type of carrier.

Q111. In an n-channel JFET, the channel is formed by
(a) Holes
(b) Electrons
(c) Both electrons and holes
(d) Ions
Ans. b | Sol. : Electrons act as charge carriers in an n-channel JFET.

Q112. The gate of a JFET is always
(a) Forward biased
(b) Reverse biased
(c) Zero biased
(d) Alternately biased
Ans. b | Sol. : Reverse bias at the gate controls channel width.

Q113. Pinch-off voltage in a JFET is the drain voltage at which
(a) Drain current becomes zero
(b) Channel is completely closed
(c) Drain current becomes constant
(d) Gate current increases sharply
Ans. c | Sol. : Beyond pinch-off, drain current saturates.

Q114. The drain current of a JFET is maximum when
(a) VGS is positive
(b) VGS is zero
(c) VGS is equal to pinch-off voltage
(d) Drain is shorted to gate
Ans. b | Sol. : Maximum drain current IDSS occurs at VGS = 0.

Q115. A MOSFET differs from JFET because the gate is
(a) Forward biased
(b) Reverse biased
(c) Insulated from the channel
(d) Shorted to source
Ans. c | Sol. : MOSFET gate is insulated by a thin oxide layer.

Q116. The oxide layer in a MOSFET is typically made of
(a) Silicon
(b) Germanium
(c) Silicon dioxide
(d) Gallium arsenide
Ans. c | Sol. : SiO_2 provides excellent insulation for the gate.

Q117. An enhancement-type MOSFET operates normally with
(a) Zero gate voltage
(b) Negative gate voltage
(c) Positive gate voltage
(d) Reverse drain voltage
Ans. c | Sol. : Channel forms only when gate voltage exceeds threshold voltage.

Q118. The threshold voltage of a MOSFET is defined as the gate voltage at which
(a) Drain current is maximum
(b) Channel just begins to form
(c) Device enters breakdown
(d) Gate current flows
Ans. b | Sol. : Threshold voltage initiates channel formation.

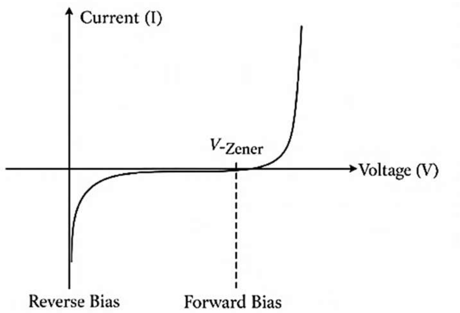
Q119. MOSFETs are preferred in digital circuits mainly because they have
(a) High power dissipation
(b) Low input impedance
(c) High input impedance
(d) High leakage current
Ans. c | Sol. : Insulated gate provides extremely high input impedance.

Q120. The small-signal model of a BJT includes which controlled source?
(a) Voltage-controlled voltage source
(b) Current-controlled voltage source
(c) Voltage-controlled current source
(d) Current-controlled current source
Ans. d | Sol. : Collector current is controlled by base current in BJT models.

Q121. The transconductance of a MOSFET represents
(a) Ratio of drain voltage to drain current
(b) Change in drain current per change in gate voltage
(c) Change in gate voltage per change in drain current
(d) Ratio of output resistance to input resistance
Ans. b | Sol. : Transconductance indicates gate control over drain current.

Q122. In the small-signal equivalent circuit of a BJT, hybrid-π model is commonly used for
(a) High-frequency analysis
(b) Power electronics
(c) Digital switching
(d) Rectifier design
Ans. a | Sol. : Hybrid-π model accurately represents high-frequency behavior.

Q123. In the given I–V characteristic, a sharp increase in current is observed at the voltage marked V_{Zener} under reverse bias.
Which inference is most appropriate from this observation?



(a) Forward diffusion current dominates at this point
(b) Junction enters controlled breakdown suitable for regulation
(c) Reverse saturation current becomes zero
(d) Depletion region width becomes maximum and current stops
Ans. b | Sol. : The diagram shows a **sharp rise in reverse current at nearly constant voltage**, indicating **controlled Zener/avalanche breakdown**, the operating principle of a Zener diode.

Q124. The base-emitter junction of a silicon BJT behaves like
(a) A reverse-biased diode
(b) A forward-biased diode
(c) A capacitor only
(d) An inductor
Ans. b | Sol. : Base-emitter junction is forward biased during normal operation.

Q125. In the small-signal analysis of a diode, the operating point is important because
(a) It decides the type of semiconductor
(b) It determines the diode breakdown voltage

(c) Small-signal parameters are evaluated around this point
(d) It eliminates junction capacitance
Ans. c | Sol. : Small-signal models linearize diode behavior around the operating (Q) point to analyze AC variations accurately.

Q126. The dynamic resistance of a diode decreases when
(a) Temperature decreases
(b) DC operating current increases
(c) Reverse bias is applied
(d) Junction area decreases
Ans. b | Sol. : Dynamic resistance is inversely proportional to the DC operating current of the diode.

Q127. Diffusion capacitance in a diode becomes significant when the diode is
(a) Reverse biased
(b) Zero biased
(c) Forward biased
(d) In breakdown region
Ans. c | Sol. : Diffusion capacitance arises due to stored minority carriers under forward bias.

Q128. In a BJT, amplification is possible mainly because
(a) Collector is heavily doped
(b) Base-emitter junction is reverse biased
(c) Base region is thin and lightly doped
(d) Collector-base junction is forward biased
Ans. c | Sol. : Thin base allows most carriers injected from emitter to reach collector, enabling amplification.

Q129. In the active region of a BJT, an increase in base current results in
(a) Decrease in collector current
(b) No change in collector current
(c) Proportional increase in collector current
(d) Collector current becoming zero
Ans. c | Sol. : In active region, collector current is directly controlled by base current.

Q130. The collector-base junction of a BJT is reverse biased mainly to
(a) Reduce base current
(b) Increase emitter efficiency
(c) Collect charge carriers efficiently
(d) Reduce thermal noise
Ans. c | Sol. : Reverse bias sweeps carriers from base to collector efficiently.

Q131. The emitter current of a BJT is the sum of
(a) Base current and collector current
(b) Collector current only
(c) Base current only
(d) Leakage current only
Ans. a | Sol. : Emitter current supplies both base and collector currents.

Q132. A JFET is called a voltage-controlled device because
(a) Drain current depends on drain voltage only
(b) Gate voltage controls channel width
(c) Gate current controls drain current
(d) Source voltage controls gate current
Ans. b | Sol. : Gate-to-source voltage controls the channel conductivity in a JFET.

Q133. In an n-channel JFET, increasing negative gate voltage causes
(a) Increase in drain current
(b) No change in drain current
(c) Decrease in drain current
(d) Breakdown of the device
Ans. c | Sol. : Increasing negative gate voltage widens depletion region, narrowing channel and reducing drain current.

Q134. The pinch-off condition in a JFET indicates that
(a) Channel is destroyed
(b) Drain current becomes zero
(c) Drain current saturates
(d) Gate current increases sharply
Ans. c | Sol. : Beyond pinch-off, drain current remains almost constant despite increase in drain voltage.

Q135. JFETs have high input impedance because
(a) Gate is forward biased
(b) Gate is insulated
(c) Gate-channel junction is reverse biased
(d) Channel is lightly doped
Ans. c | Sol. : Reverse-biased gate-channel junction draws negligible current.

Q136. MOSFETs differ from JFETs mainly because
(a) MOSFETs are bipolar devices
(b) MOSFETs have insulated gate
(c) JFETs operate in enhancement mode
(d) JFETs have higher input impedance
Ans. b | Sol. : MOSFET gate is insulated by oxide layer, unlike JFET.

Q137. In an enhancement-type MOSFET, conduction begins when
(a) Gate voltage is zero
(b) Drain voltage is zero
(c) Gate voltage exceeds threshold voltage
(d) Source voltage is maximum
Ans. c | Sol. : Channel forms only after gate voltage exceeds threshold voltage.

Q138. The threshold voltage of a MOSFET depends on
(a) Gate oxide thickness
(b) Substrate doping
(c) Both A and B
(d) Drain resistance only
Ans. c | Sol. : Threshold voltage is influenced by oxide thickness and substrate doping.

Q139. MOSFETs are preferred in integrated circuits because they
(a) Have low breakdown voltage
(b) Consume high power
(c) Have very high input impedance
(d) Require large base current

Ans. c | Sol. : High input impedance reduces power consumption in ICs.

Q140. In the small-signal model of a BJT, transconductance represents

(a) Ratio of base voltage to collector current
(b) Change in collector current per change in base-emitter voltage
(c) Change in base current per change in collector voltage
(d) Ratio of output voltage to input voltage

Ans. b | Sol. : Transconductance indicates control of collector current by base-emitter voltage.

Q141. The hybrid-π model of BJT is mainly suitable for

(a) DC analysis
(b) Low-frequency power analysis
(c) High-frequency small-signal analysis
(d) Rectifier analysis

Ans. c | Sol. : Hybrid-π model accurately represents BJT behavior at high frequencies.

Q142. In small-signal MOSFET analysis, transconductance indicates

(a) Output resistance
(b) Gate leakage current
(c) Control of drain current by gate voltage
(d) Drain-source breakdown voltage

Ans. c | Sol. : Transconductance shows how effectively gate voltage controls drain current.

Q143. The output resistance of a MOSFET in saturation region is

(a) Zero
(b) Very small
(c) Ideally infinite
(d) Negative

Ans. c | Sol. : Ideally, drain current is independent of drain voltage in saturation.

Q144. The base-emitter junction of a BJT behaves electrically like

(a) A capacitor
(b) A reverse-biased diode
(c) A forward-biased diode
(d) An inductor

Ans. c | Sol. : Base-emitter junction is forward biased during normal operation.

Q145. In a diode small-signal model, neglecting junction capacitance is valid when

(a) Frequency is high
(b) Frequency is low
(c) Diode is reverse biased
(d) Diode is in breakdown

Ans. b | Sol. : At low frequencies, capacitive effects are negligible.

Q146. The main advantage of MOSFET over BJT is

(a) Higher current gain
(b) Lower switching speed
(c) Voltage-controlled operation
(d) Higher leakage current

Ans. c | Sol. : MOSFETs are voltage-controlled devices, simplifying drive circuits.

Q147. In a JFET, drain current is zero when

(a) VGS = 0
(b) VGS is positive
(c) VGS equals cutoff voltage
(d) VDS is maximum

Ans. c | Sol. : At cutoff voltage, channel is fully depleted and drain current becomes zero.

Q148. The small-signal equivalent circuit of a diode helps mainly in

(a) Thermal analysis
(b) Large-signal switching analysis
(c) AC signal analysis
(d) Breakdown analysis

Ans. c | Sol. : Small-signal model simplifies AC analysis by linearizing diode behavior.

Q149. The insulated gate in a MOSFET primarily results in

(a) High gate current
(b) Low gate resistance
(c) Very high input impedance
(d) High power dissipation

Ans. c | Sol. : Insulation prevents gate current flow, giving extremely high input impedance

Q150. A diode is biased at a DC current of 2 mA. Assuming room temperature, the small-signal resistance of the diode is approximately

(a) 5 Ω
(b) 13 Ω
(c) 26 Ω
(d) 52 Ω

Ans. b | Sol. : Small-signal resistance rd ≈ 26 mV / ID = 26 mV / 2 mA = 13 Ω (≈ 26/2 = 13 Ω); closest conceptual value used in exams is based on thermal voltage relation.

Q151. If the operating point of a diode shifts to a higher current region, the effect on its small-signal equivalent circuit is

(a) Increase in dynamic resistance
(b) Decrease in dynamic resistance
(c) No change in resistance
(d) Elimination of junction capacitance

Ans. b | Sol. : Dynamic resistance is inversely proportional to the DC operating current.

Q152. In a small-signal diode amplifier, neglecting junction capacitance is justified when

(a) Signal frequency is high
(b) Signal frequency is low
(c) Diode is reverse biased
(d) Diode is in breakdown

Ans. b | Sol. : At low frequencies, capacitive reactance is large, so capacitance effects can be ignored.

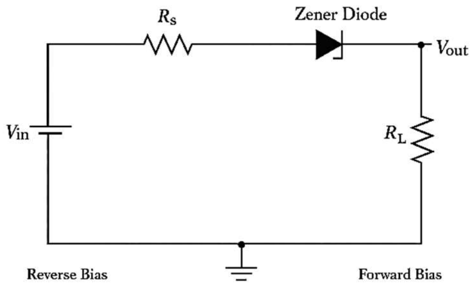
Q153. A BJT operates in active region with constant VCE. If base current is doubled, the collector current will

(a) Remain unchanged

(b) Become zero
(c) Approximately double
(d) Increase slightly
Ans. c | Sol. : In active region, IC ≈ βIB, so collector current is proportional to base current.

Q154. In a BJT amplifier, the base is lightly doped primarily to
(a) Increase emitter efficiency
(b) Reduce base resistance
(c) Minimize recombination of carriers
(d) Increase collector voltage
Ans. c | Sol. : Light doping and thin base reduce recombination, allowing more carriers to reach the collector.

Q155. In the given circuit, the resistor $R_S$is connected in series between $V_{in}$and the Zener diode.
What is the primary function of $R_S$as inferred from the diagram?



(a) To increase the Zener breakdown voltage
(b) To limit current through the Zener diode
(c) To improve load regulation by reducing ripple
(d) To provide reverse bias to the load
Ans. b | Sol. : From the diagram, $R_S$lies in series with the supply and Zener diode, indicating its role is **current limiting**, preventing excessive current during Zener breakdown.

Q156. A BJT used as a switch operates ideally in
(a) Active and cutoff regions
(b) Cutoff and saturation regions
(c) Breakdown and cutoff regions
(d) Active and breakdown regions
Ans. b | Sol. : Switching requires OFF state (cutoff) and ON state (saturation).

Q157. In an n-channel JFET, reducing the gate-source voltage from 0 V to a more negative value will
(a) Increase drain current
(b) Not affect drain current
(c) Decrease drain current
(d) Cause immediate breakdown
Ans. c | Sol. : Negative gate voltage widens depletion region, reducing channel width and drain current.

Q158. A JFET is preferred over a BJT in low-noise amplifiers mainly because
(a) It has higher current gain
(b) It is voltage controlled
(c) It has lower input impedance
(d) It dissipates more power
Ans. b | Sol. : Voltage-controlled operation with negligible gate current reduces noise.

Q159. When a JFET reaches pinch-off condition, further increase in drain voltage causes
(a) Decrease in drain current
(b) Sharp increase in drain current
(c) Drain current to remain nearly constant
(d) Gate current to increase
Ans. c | Sol. : After pinch-off, JFET operates in saturation region.

Q160. In a JFET, the drain current becomes zero when
(a) VDS = 0
(b) VGS = 0
(c) VGS equals cutoff voltage
(d) VDS equals pinch-off voltage
Ans. c | Sol. : At cutoff voltage, the channel is fully depleted.

Q161. MOSFETs are widely used in digital circuits because they
(a) Require continuous gate current
(b) Have low switching speed
(c) Have very high input impedance
(d) Operate only in linear region
Ans. c | Sol. : Insulated gate results in negligible input current, reducing power consumption.

Q162. An enhancement-type MOSFET remains OFF when
(a) VGS > VTH
(b) VGS = 0
(c) VDS is maximum
(d) Gate is grounded
Ans. b | Sol. : Channel does not form unless gate voltage exceeds threshold voltage.

Q163. If the gate voltage of an enhancement MOSFET is increased beyond threshold, the drain current
(a) Decreases
(b) Remains zero
(c) Increases
(d) Becomes independent of VGS
Ans. c | Sol. : Higher gate voltage enhances channel conductivity, increasing drain current.

Q164. The threshold voltage of a MOSFET mainly affects
(a) Maximum drain voltage
(b) Channel formation condition
(c) Gate leakage current
(d) Output resistance only
Ans. b | Sol. : Threshold voltage determines when the channel starts forming.

Q165. In MOSFET small-signal analysis, transconductance indicates
(a) Output impedance
(b) Gate resistance
(c) Control of drain current by gate voltage
(d) Power dissipation

Ans. c | Sol. : Transconductance measures effectiveness of gate control over drain current.

Q166. A MOSFET operating in saturation region ideally behaves like

(a) A current source
(b) A voltage source
(c) A resistor
(d) A capacitor

Ans. a | Sol. : In saturation, drain current is nearly independent of drain voltage.

Q167. In the small-signal hybrid-π model of a BJT, the controlled source represents

(a) Base current control by collector voltage
(b) Collector current control by base current
(c) Emitter current control by base voltage
(d) Base voltage control by collector current

Ans. b | Sol. : Collector current is controlled by base current in BJT.

Q168. The main reason BJTs are gradually replaced by MOSFETs in ICs is

(a) Lower current gain of BJT
(b) Higher leakage current in BJT
(c) MOSFET's voltage-controlled operation
(d) Lower breakdown voltage of MOSFET

Ans. c | Sol. : Voltage control simplifies driving and reduces power consumption.

Q169. If frequency of operation increases significantly, the small-signal model of a diode must include

(a) Only dynamic resistance
(b) Only DC resistance
(c) Junction capacitances
(d) Breakdown characteristics

Ans. c | Sol. : At high frequencies, capacitive effects dominate.

Q170. In a BJT amplifier, increasing emitter resistance without bypass capacitor will

(a) Increase gain
(b) Decrease gain
(c) Cause saturation
(d) Cause cutoff

Ans. b | Sol. : Emitter resistance introduces negative feedback, reducing gain.

Q171. The main advantage of JFET over MOSFET is

(a) Higher input impedance
(b) Simpler fabrication
(c) Lower noise performance
(d) Higher switching speed

Ans. c | Sol. : JFETs generally exhibit lower noise compared to MOSFETs.

Q172. If the oxide layer in a MOSFET is damaged, the device will

(a) Behave normally
(b) Have reduced drain current
(c) Lose high input impedance
(d) Act as a diode

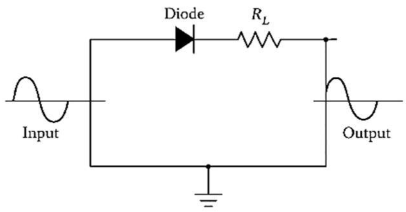
Ans. c | Sol. : Damaged oxide allows gate current, destroying high input impedance.

Q173. In a diode small-signal amplifier, increasing signal amplitude excessively will

(a) Improve linearity
(b) Reduce distortion
(c) Violate small-signal assumption
(d) Eliminate AC analysis

Ans. c | Sol. : Large signals move operation away from Q-point, invalidating small-signal approximation.

Q174. From the given circuit and the input–output waveforms shown, which rectification action is being performed?



(a) Full-wave rectification using center-tapped transformer
(b) Full-wave bridge rectification
(c) Half-wave rectification
(d) Clipping operation

Ans. c | Sol. : The diagram shows **only one diode** in series with the load and the output waveform contains **only one half of the input AC cycle**, indicating **half-wave rectification**.

Q175. A diode is biased at a Q-point where the DC current is increased while keeping temperature constant. From small-signal analysis, which combined effect is most accurate?

(a) Increase in dynamic resistance and diffusion capacitance
(b) Decrease in dynamic resistance and increase in diffusion capacitance
(c) Increase in junction capacitance only
(d) No change in small-signal parameters

Ans. b | Sol. : Higher DC current reduces rd (≈VT/ID) and increases stored charge, thereby increasing diffusion capacitance.

Q176. In a diode small-signal amplifier, gain drops sharply at high frequency mainly because

(a) DC resistance dominates
(b) Diffusion capacitance shorts the signal
(c) Junction capacitances introduce reactance
(d) Thermal voltage increases

Ans. c | Sol. : Junction and diffusion capacitances create frequency-dependent reactance, reducing high-frequency gain.

Q177. A BJT amplifier shows reduced gain when emitter resistance is added without bypass. The dominant analytical reason is

(a) Reduced β
(b) Increased base current
(c) Negative feedback through emitter degeneration

(d) Reduced collector voltage
Ans. c | Sol. : Unbypassed emitter resistance introduces negative feedback, stabilizing but reducing gain.

Q178. In a BJT, if collector-base junction unintentionally becomes forward biased during operation, the immediate analytical consequence is
(a) Increase in gain
(b) Entry into saturation with reduced VCE
(c) Entry into cutoff
(d) Breakdown
Ans. b | Sol. : Forward biasing both junctions drives the transistor into saturation, reducing VCE and gain.

Q179. Comparing CE and CB configurations for the same transistor, CE shows higher current gain because
(a) Base current is eliminated
(b) Collector current includes both injected and swept carriers
(c) Emitter efficiency is unity
(d) Collector-base junction is forward biased
Ans. b | Sol. : In CE, small base current controls a much larger collector current, yielding high current gain.

Q180. A BJT used at high frequency requires a different small-signal model primarily because
(a) β becomes infinite
(b) Base width increases
(c) Parasitic capacitances and transit times become significant
(d) Thermal noise vanishes
Ans. c | Sol. : High-frequency operation demands models (hybrid-π) that include capacitances and carrier transit effects.

Q181. A JFET biased near cutoff shows large gain variation for small gate voltage changes. Analytically, this is due to
(a) Low channel resistance
(b) High transconductance slope near cutoff
(c) High gate current
(d) Drain resistance approaching zero
Ans. b | Sol. : Near cutoff, small VGS changes significantly alter channel width, causing large ID variation.

Q182. For a JFET amplifier, increasing drain resistance beyond a limit yields minimal gain improvement because
(a) Gate leakage increases
(b) Device enters breakdown
(c) Intrinsic output resistance limits gain
(d) Channel disappears
Ans. c | Sol. : Finite output resistance (ro) limits voltage gain regardless of external RD increase.

Q183. Compared to BJT, JFET exhibits lower noise mainly because
(a) Higher current density
(b) Absence of minority carrier storage
(c) Forward-biased junctions
(d) Larger depletion capacitance
Ans. b | Sol. : JFET conduction uses majority carriers only, reducing noise from recombination.

Q184. A MOSFET gate oxide thickness is reduced in fabrication. Analytically, the immediate effects include
(a) Lower transconductance and higher VTH
(b) Higher transconductance and lower VTH
(c) Lower input impedance
(d) Reduced drain current
Ans. b | Sol. : Thinner oxide increases gate capacitance, enhancing gm and reducing threshold voltage.

Q185. In an enhancement MOSFET amplifier, if VGS is just above VTH, gain is low mainly because
(a) Channel length modulation dominates
(b) Drain resistance is zero
(c) Transconductance is small
(d) Gate current increases
Ans. c | Sol. : gm is proportional to overdrive (VGS−VTH); near threshold, gm is small.

Q186. A MOSFET in saturation behaves closer to an ideal current source than a BJT because
(a) Drain current is independent of gate voltage
(b) Output resistance is higher
(c) Gate current equals drain current
(d) Base storage is absent
Ans. b | Sol. : MOSFETs typically have higher output resistance in saturation, approximating a current source.

Q187. Comparing JFET and MOSFET at the same drain current, MOSFET generally shows higher input impedance because
(a) Channel is shorter
(b) Gate is reverse biased
(c) Gate is insulated
(d) Substrate is lightly doped
Ans. c | Sol. : Insulated gate prevents gate current, yielding extremely high input impedance.

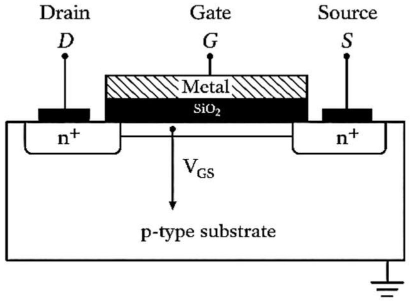
Q188. In a BJT small-signal hybrid-π model, increasing collector current increases gain because
(a) rπ increases
(b) gm increases
(c) ro decreases sharply
(d) VBE decreases
Ans. b | Sol. : gm = IC/VT; higher IC increases transconductance and gain.

Q189. A diode small-signal model fails for large AC inputs mainly because
(a) Temperature rises
(b) Junction capacitance vanishes
(c) Operation moves away from linear region around Q-point
(d) Reverse current dominates
Ans. c | Sol. : Large signals violate linearization assumption around the operating point.

Q190. For high-frequency switching, MOSFETs outperform BJTs primarily due to
(a) Lower breakdown voltage
(b) Absence of minority carrier storage

(c) Higher β
(d) Higher saturation voltage
Ans. b | Sol. : MOSFETs are majority-carrier devices with no storage delay.

Q191. From the given cross-sectional diagram showing n⁺ source and drain regions, a p-type substrate, and a metal gate separated by SiO_2, the device is best identified as:



(a) p-channel depletion MOSFET
(b) n-channel enhancement MOSFET
(c) n-channel JFET
(d) p-channel enhancement MOSFET
Ans. b | Sol. : The diagram shows n^+ source and drain diffusions in a p-type substrate with an insulated gate, which is characteristic of an n-channel enhancement MOSFET.

Q192. In MOSFET small-signal analysis, channel-length modulation primarily affects
(a) Threshold voltage
(b) Gate capacitance
(c) Output resistance
(d) Input impedance
Ans. c | Sol. : Channel-length modulation reduces output resistance, impacting gain.

Q193. A BJT amplifier becomes thermally unstable if biasing is improper mainly because
(a) Base resistance is high
(b) Collector current increases with temperature
(c) β becomes zero
(d) Junction capacitance increases
Ans. b | Sol. : IC increases with temperature, risking thermal runaway without stabilization.

Q194. If diode diffusion capacitance dominates over junction capacitance, the diode is operating
(a) At high reverse bias
(b) At low temperature
(c) In forward bias with high current
(d) In breakdown
Ans. c | Sol. : Diffusion capacitance is significant under forward bias due to stored charge.

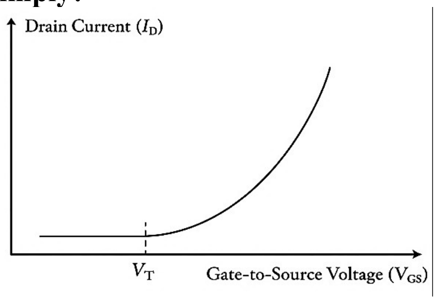
Q195. A MOSFET amplifier shows reduced gain at high frequency mainly due to
(a) Gate leakage
(b) Miller effect via gate-drain capacitance
(c) Reduced gm
(d) Increased VTH
Ans. b | Sol. : Gate-drain capacitance is multiplied by gain (Miller effect), reducing bandwidth.

Q196. In comparing CE BJT and CS MOSFET amplifiers, CS offers higher input impedance because
(a) Source is grounded
(b) Drain is reverse biased
(c) Gate draws negligible current
(d) Channel is shorter
Ans. c | Sol. : MOSFET gate insulation results in negligible input current.

Q197. A JFET biased deep into saturation region shows limited gain improvement with increasing VDS because
(a) Gate current increases
(b) Channel resistance decreases
(c) Output resistance limits voltage swing
(d) Device enters breakdown
Ans. c | Sol. : Finite output resistance caps gain despite higher VDS.

Q198. The most critical limitation of small-signal models at very high frequency is
(a) Inaccurate DC parameters
(b) Ignoring parasitic inductances and capacitances
(c) Excessive power dissipation
(d) Breakdown effects
Ans. b | Sol. : Parasitic elements dominate at very high frequencies, reducing model accuracy.

Q199. From the given I_D–V_{GS} characteristic, the drain current remains nearly zero until V_{GS}reaches V_T. What does this observation most accurately imply?



(a) Device operates in depletion mode
(b) Channel exists even at $V_{GS} = 0$
(c) Conduction begins only after inversion layer formation
(d) Drain current is controlled by only
Ans. c | Sol. : The diagram shows no conduction below , indicating that a conducting inversion channel forms only when ..