SRM VALLIAMMAI ENGINEERING OLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

QUESTION BANK

V SEMESTER

PEC101 WIDE BANDGAP DEVICES

Regulation – 2023

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Prepared by

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QUESTION BANK

SUBJECT : PEC101 WIDE BANDGAP DEVICES

SEM / YEAR: V/ III-year B.E.

UNIT I
WBG DEVICES AND THEIR APPLICATION IN REAL WORLD

Review of semiconductor basics - Operation and characteristics of the SiC Schottky Barrier Diode- SiC DMOSFET and GaN HEMT- Review of Wide bandgap semiconductor technology -Advantages and disadvantages.

PART – A

Q.No	Questions	CO	BT Level	Competence
1.	Define a semiconductor.	CO1	BTL 1	Remembering
2.	What is the bandgap energy of silicon carbide (SiC)?	CO1	BTL 1	Remembering
3.	Explain why SiC is suitable for high-temperature applications.	CO1	BTL 2	Understanding
4.	List two wide bandgap semiconductor materials.	CO1	BTL 1	Remembering
5.	Compare the switching characteristics of SiC SBD and PN diode.	CO1	BTL 2	Understanding
6.	Why does GaN HEMT offer high electron mobility?	CO1	BTL 2	Understanding
7.	What is the full form of DMOSFET?	CO1	BTL 1	Remembering
8.	State one application of GaN HEMT.	CO1	BTL 1	Remembering
9.	Describe the working principle of a SiC Schottky diode.	CO1	BTL 2	Understanding
10.	Differentiate between intrinsic and extrinsic semiconductors.	CO1	BTL 2	Understanding
11.	Write any two advantages of SiC Schottky Barrier Diode.	CO1	BTL 1	Remembering
12.	What is the typical operating temperature range of SiC devices?	CO1	BTL 1	Remembering
13.	Mention any two characteristics of wide bandgap semiconductors.	CO1	BTL 1	Remembering
14.	Name two differences between Si MOSFET and SiC MOSFET.	CO1	BTL 1	Remembering
15.	What is a Schottky barrier?	CO1	BTL 1	Remembering
16.	What type of carriers conduct current in a Schottky diode?	CO1	BTL 1	Remembering
17.	What is the primary advantage of using GaN over Si in power electronics?	CO1	BTL 1	Remembering
18.	Why are wide bandgap materials preferred in high-frequency applications?	CO1	BTL 2	Understanding
19.	Explain the term “2D Electron Gas” in GaN HEMT.	CO1	BTL 2	Understanding
20.	Illustrate how a SiC DMOSFET operates in the on-state.	CO1	BTL 2	Understanding
21	What type of carriers conduct current in a Schottky diode?	CO1	BTL 1	Remembering
22	Compare the conduction mechanism of Schottky diode and PN	CO1	BTL 2	Understanding

	diode.				
23	Why is gate drive design more critical in GaN devices compared to Si?		CO1	BTL 2	Understanding
24	Explain the reason for low switching losses in GaN HEMT.		CO1	BTL 2	Understanding
	PART- B				
1.	(i) Explain the intrinsic and extrinsic semiconductors with examples. (ii) Describe the working of a PN junction with the help of energy band diagrams.	(7) (9)	CO1	BTL 3	Applying
2.	(i) Discuss the characteristics of n-type and p-type semiconductors. (ii) Compare direct and indirect bandgap semiconductors.	(8) (8)	CO1	BTL 4	Analyzing
3.	(i) Define mobility and conductivity. Derive the relation between them. (ii) Explain the effect of temperature on carrier concentration in semiconductors.	(10) (6)	CO1	BTL 4	Analyzing
4.	(i) Explain the construction and working principle of SiC Schottky Barrier Diode. (ii) Discuss the I-V characteristics and switching behavior of SiC SBD.	(8) (8)	CO1	BTL 3	Applying
5.	(i) Compare the performance of Si-based SBD and SiC SBD in high-frequency applications. (ii) List and explain the advantages of SiC SBD over conventional diodes.	(8) (8)	CO1	BTL 4	Analyzing
6.	(i) Draw and explain the energy band diagram of a Schottky junction. (ii) Describe the role of barrier height and its effect on diode performance.	(9) (7)	CO1	BTL 4	Analyzing
7.	(i) Describe the structure and working of a SiC DMOSFET. (ii) Compare Si MOSFET and SiC DMOSFET in terms of on-resistance and thermal performance.	(10) (6)	CO1	BTL 3	Applying
8.	(i) Explain the transfer and output characteristics of SiC DMOSFET. (ii) Discuss the benefits of using SiC DMOSFETs in electric vehicles and power electronics.	(8) (8)	CO1	BTL 3	Applying
9.	(i) Describe the breakdown mechanism in SiC MOSFETs. (ii) Highlight the challenges in gate oxide reliability in SiC DMOSFETs.	(6) (10)	CO1	BTL 3	Applying

10.	(i) Explain the construction and operation of a GaN HEMT. (ii) Discuss the significance of 2DEG in GaN HEMT and how it enhances device performance.	(8) (8)	CO1	BTL 3	Applying
11.	(i) Compare GaN HEMT and Si MOSFET in terms of switching speed and gate drive requirements. (ii) Illustrate the output and transfer characteristics of GaN HEMT.	(8) (8)	CO1	BTL 3	Applying
12.	(i) Analyze the thermal and high-frequency behavior of GaN HEMT. (ii) Explain the design challenges in enhancement-mode GaN HEMTs.	(8) (8)	CO1	BTL 4	Analyzing
13.	(i) Define wide bandgap semiconductors. Give examples and explain their properties. (ii) Compare Si, SiC, and GaN in terms of bandgap, mobility, and thermal conductivity.	(9) (7)	CO1	BTL 3	Applying
14.	(i) Discuss the role of wide bandgap semiconductors in high-power and high-temperature electronics. (ii) Explain how WBG semiconductors enable smaller and lighter systems.	(8) (8)	CO1	BTL 4	Analyzing
15.	(i) Analyze the key differences in fabrication between Si and WBG devices. (ii) Explain how substrate quality affects the performance of SiC and GaN devices.	(9) (7)	CO1	BTL 4	Analyzing
16.	(i) List and explain the advantages of using SiC and GaN devices over silicon. (ii) Highlight the disadvantages and limitations of wide bandgap devices in commercial deployment.	(8) (8)	CO1	BTL 3	Applying
17.	(i) Discuss the cost and reliability issues in SiC and GaN fabrication. (ii) Analyze the role of packaging and thermal management in WBG devices.	(8) (8)	CO1	BTL 4	Analyzing

UNIT II
SWITCHING CHARACTERIZATION OF WBG

Turn-on and Turn-off characteristics of the device- Hard switching loss analysis- Double pulse test set-up.

PART – A

Q. No	Questions	CO	BT Level	Competence

1.	Define turn-on time of a switching device.	CO2	BTL 1	Remembering
2.	What is meant by turn-off delay time?	CO2	BTL 1	Remembering
3.	Explain why switching losses occur during turn-on and turn-off transitions.	CO2	BTL 2	Understanding
4.	Describe how the overlap of voltage and current during switching causes power loss.	CO2	BTL 2	Understanding
5.	State the main components of total switching time.	CO2	BTL 1	Remembering
6.	List any two parameters that affect switching losses.	CO2	BTL 1	Remembering
7.	Why is turn-on loss generally higher than turn-off loss in some devices?	CO2	BTL 2	Understanding
8.	Compare turn-on and turn-off characteristics of a MOSFET.	CO2	BTL 2	Understanding
9.	What is hard switching in power electronic devices?	CO2	BTL 1	Remembering
10.	Name the four intervals of a switching transition.	CO2	BTL 1	Remembering
11.	Explain how hard switching increases device stress.	CO2	BTL 2	Understanding
12.	Discuss the importance of gate resistance in shaping switching behavior.	CO2	BTL 2	Understanding
13.	Define switching loss in a power semiconductor.	CO2	BTL 2	Understanding
14.	What is the purpose of the double pulse test?	CO2	BTL 2	Understanding
15.	Why is the double pulse test preferred over continuous switching tests for loss analysis?	CO2	BTL 1	Remembering
16.	How does inductive load affect switching transitions in a test setup?	CO2	BTL 2	Understanding
17.	Which device parameters are extracted using the double pulse test?	CO2	BTL 1	Remembering
18.	List two advantages of using the double pulse test.	CO2	BTL 1	Remembering
19.	Explain how dv/dt and di/dt affect device reliability during switching.	CO2	BTL 1	Remembering
20.	Describe the role of a clamping circuit in a double pulse test.	CO2	BTL 1	Remembering
21	What type of waveform is typically captured in a double pulse test?	CO2	BTL 2	Understanding
22	Name any two instruments required for conducting a double pulse test.	CO2	BTL 2	Understanding
23	Why is accurate timing critical in a double pulse test setup?	CO2	BTL 1	Remembering
24	Explain how switching energy loss is calculated from double pulse test waveforms.	CO2	BTL 1	Remembering

PART- B

1.	(i) Explain the switching behavior of a power MOSFET during turn-on and turn-off. (ii) Sketch and describe the typical voltage and current waveforms observed during turn-on and turn-off transitions.	(8) (8)	CO2	BTL 4	Analyzing
2.	(i) Define and explain the terms: delay time, rise time, fall time, and storage time. (ii) Describe how gate resistance affects switching times of a power device.	(8) (8)	CO2	BTL 3	Applying
3.	(i) Explain the impact of junction temperature and device capacitance on switching behavior. (ii) Analyze the effect of parasitic inductance on voltage overshoot during switching.	(8) (8)	CO2	BTL 4	Analyzing

4.	(i) Describe how switching losses occur in a power semiconductor during hard switching. (ii) Derive the expression for total switching loss in a single switching cycle.	(8) (8)	CO2	BTL 4	Analyzing
5.	(i) Explain why turn-on loss is typically higher than turn-off loss in some devices. (ii) Illustrate the switching loss distribution using waveforms.	(7) (9)	CO2	BTL 3	Applying
6.	(i) Define hard switching and soft switching with examples. (ii) Explain the drawbacks of hard switching in power converters.	(8) (8)	CO2	BTL 3	Applying
7.	(i) Describe the significance of dv/dt and di/dt during switching transitions. (ii) Explain how these parameters affect device stress and EMI.	(8) (8)	CO2	BTL 4	Analyzing
8.	(i) Explain the purpose and working of a snubber circuit during switching. (ii) Discuss how snubber design affects switching losses.	(8) (8)	CO2	BTL 3	Applying
9.	(i) Describe the working principle of a double pulse test setup. (ii) List and explain the key components used in a double pulse test circuit.	(10) (6)	CO2	BTL 4	Analyzing
10.	(i) Describe the switching characteristics of an IGBT. (ii) Compare the switching performance of IGBT with a power MOSFET.	(8) (8)	CO2	BTL 3	Applying
11.	(i) Sketch and explain the voltage and current waveforms captured during a double pulse test. (ii) Describe how switching energy is calculated using these waveforms.	(8) (8)	CO2	BTL 3	Applying
12.	(i) Explain the need for using a double pulse test to evaluate switching losses. (ii) Describe how the test helps in comparing different devices like SiC, GaN, and Si.	(8) (8)	CO2	BTL 4	Analyzing
13.	(i) Describe the test procedure for a double pulse test on a SiC MOSFET. (ii) Explain the measurement challenges involved in capturing fast switching waveforms.	(8) (8)	CO2	BTL 4	Analyzing
14.	(i) Discuss how varying gate resistance affects switching loss and speed. (ii) Show the changes in waveform due to increased gate resistance using sketches.	(6) (10)	CO2	BTL 4	Analyzing
15.	(i) Compare the switching losses of Si, SiC, and GaN devices using theoretical data. (ii) Explain how wide bandgap devices reduce hard switching losses.	(8) (8)	CO2	BTL 4	Analyzing

16.	(i) Explain how switching losses lead to thermal stress in power devices. (ii) Describe the importance of thermal management in high-frequency hard switching circuits.	(7) (9)	CO2	BTL 3	Applying
17.	(i) Discuss how switching characteristics influence the design of high-frequency converters. (ii) Explain methods to minimize switching losses through design optimization.	(9) (7)	CO2	BTL 3	Applying

UNIT III
DRIVERS FOR WIDE BAND GAP DEVICES

Gate driver- Impact of gate resistance- Gate drivers for wide bandgap power devices - Transient immunity integrated gate drivers

PART - A

Q.No	Questions	CO	BT Level	Competence
1.	What is a gate driver in power electronics?	CO3	BTL 1	Remembering
2.	List two functions of a gate driver circuit.	CO3	BTL 1	Remembering
3.	Define gate resistance.	CO3	BTL 1	Remembering
4.	What is the typical range of gate voltage for SiC MOSFETs?	CO3	BTL 1	Remembering
5.	Explain how gate resistance affects switching speed.	CO3	BTL 2	Understanding
6.	Why do GaN and SiC devices require fast gate drivers?	CO3	BTL 2	Understanding
7.	Name any two types of gate drivers.	CO3	BTL 1	Remembering
8.	List two key characteristics of a good gate driver.	CO3	BTL 1	Remembering
9.	Describe the effect of increasing gate resistance on EMI and switching losses.	CO3	BTL 2	Understanding
10.	Differentiate between gate drivers for Si and WBG devices.	CO3	BTL 2	Understanding
11.	What is transient immunity in gate drivers?	CO3	BTL 1	Remembering
12.	Give two reasons why gate drivers are needed for wide bandgap devices.	CO3	BTL 1	Remembering
13.	Explain the purpose of Miller clamp in gate driver circuits.	CO3	BTL 2	Understanding
14.	Name two WBG devices that require specialized gate drivers.	CO3	BTL 1	Remembering
15.	Why is precise timing important in gate drivers for fast-switching devices?	CO3	BTL 2	Understanding
16.	What is the role of bootstrap circuitry in a gate driver?	CO3	BTL 1	Remembering
17.	State one advantage of isolated gate drivers.	CO3	BTL 1	Remembering
18.	Explain the role of gate drive strength (source/sink current) in switching control.	CO3	BTL 2	Understanding
19.	State one advantage of isolated gate drivers.	CO3	BTL 1	Remembering
20.	List any two parameters affected by gate resistance.	CO3	BTL 1	Remembering
21	Explain the role of gate drive strength (source/sink current) in switching control.	CO3	BTL 2	Understanding
22	Why is precise timing important in gate drivers for fast-	CO3	BTL 2	Understanding

	switching devices?				
23	How does a transient event affect gate driver performance?		CO3	BTL 2	Understanding
24	Describe how integrated gate drivers improve transient immunity		CO3	BTL 2	Understanding
	PART- B				
1.	(i) Explain the key functions and requirements of a gate driver circuit for power electronic switches. (ii) Compare high-side vs low-side gate driving techniques with suitable circuit examples.	(8) (8)	CO3	BTL 3	Applying
2.	(i) Describe the effect of gate resistance on switching speed and electromagnetic interference (EMI) in power converters. (ii) How does gate resistance influence device protection and thermal performance? Illustrate with waveforms.	(9) (7)	CO3	BTL 4	Analyzing
3.	(i) What are the critical design parameters for selecting a gate driver IC for high-power applications? (ii) How do propagation delay and drive strength of a gate driver affect converter performance.	(8) (8)	CO3	BTL 4	Analyzing
4.	(i) Compare gate driving requirements of silicon MOSFETs with those of SiC and GaN devices. (ii) Discuss the challenges in designing gate drivers for wide bandgap devices.	(7) (9)	CO3	BTL 3	Applying
5.	(i) Explain the impact of high dV/dt and dI/dt of WBG devices on gate driver design. (ii) What techniques are used to mitigate these effects? Explain with practical examples.	(8) (8)	CO3	BTL 3	Applying
6.	(i) Describe common gate driver protection features such as under-voltage lockout (UVLO) and desaturation detection. (ii) Explain active Miller clamping and its role in preventing false turn-on.	(8) (8)	CO3	BTL 3	Applying
7.	(i) Define common-mode transient immunity (CMTI) and its relevance in gate driver performance. (ii) How can PCB layout and isolation improve transient immunity in integrated gate drivers?	(8) (8)	CO3	BTL 3	Applying
8.	(i) Compare different isolation methods used in gate drivers: magnetic, capacitive, and optical. (ii) Explain how isolated gate drivers enhance safety and noise immunity in power converters.	(10) (6)	CO3	BTL 3	Applying
9.	(i) Discuss the unique gate drive requirements of GaN HEMTs. (ii) Compare enhancement-mode GaN vs. cascode GaN gate drive strategies.	(10) (6)	CO3	BTL 3	Applying
10.	(i) Describe turn-on and turn-off gate voltages required for SiC MOSFETs.	(8)	CO3	BTL 4	Analyzing

	(ii) Explain the role of negative gate bias and its impact on performance and reliability.	(8)			
11.	(i) Explain the working and advantages of dual-channel gate drivers in half-bridge topologies. (ii) Discuss shoot-through prevention techniques in gate driver circuits.	(9) (7)	CO3	BTL 3	Applying
12.	(i) List and explain PCB layout considerations for high-speed gate driver circuits. (ii) Discuss the role of Kelvin source connections in improving gate driver performance.	(8) (8)	CO3	BTL 4	Analyzing
13.	(i) Explain the concept and advantages of integrated gate drivers in modern power electronics. (ii) Describe how smart gate drivers adapt to device conditions and improve system efficiency.	(8) (8)	CO3	BTL 3	Applying
14.	(i) Discuss the role of digital control and programmability in gate driver design. (ii) Explain how programmable gate resistance and timing can optimize WBG device performance.	(10) (6)	CO3	BTL 4	Analyzing
15.	(i) Explain how gate driver power dissipation is estimated and managed. (ii) Describe thermal management techniques for gate driver ICs in high-frequency applications.	(8) (8)	CO3	BTL 4	Analyzing
16.	(i) List key parameters to consider when selecting a gate driver for a SiC-based inverter. (ii) Evaluate a commercial gate driver (like TI UCC21710 or Infineon 1EDC) and explain its features.	(7) (9)	CO3	BTL 4	Analyzing
17.	(i) Present a case study on gate driver implementation in a high-voltage DC-DC converter using SiC MOSFETs. (ii) Identify challenges and solutions related to transient immunity and EMI in that application.	(8) (8)	CO3	BTL 4	Analyzing

UNIT IV HIGH FREQUENCY DESIGN COMPLEXITY AND PCB DESIGNING

Effects of parasitic inductance - Effects of parasitic capacitance - EMI filter design for high frequency power converters -High frequency PCB design - Conventional power loop design - High frequency power loop optimization - Separation of power from signal PCB.

PART – A

Q. No	Questions	CO	BT Level	Competence
1.	Define parasitic inductance in a power converter circuit.	CO4	BTL 1	Remembering
2.	State two sources of parasitic inductance in a PCB layout.	CO4	BTL 1	Remembering
3.	Explain the effect of parasitic inductance on switching transients.	CO4	BTL 2	Understanding

4.	Why does parasitic inductance cause voltage overshoot during turn-off?		CO4	BTL 2	Understanding
5.	What is parasitic capacitance? Give one common source in power circuits.		CO4	BTL 1	Remembering
6.	Identify two effects of parasitic capacitance on high-speed switching.		CO4	BTL 1	Remembering
7.	Explain how parasitic capacitance influences EMI generation.		CO4	BTL 2	Understanding
8.	Describe the role of parasitic capacitance in common-mode noise.		CO4	BTL 2	Understanding
9.	List two components commonly used in EMI filters.		CO4	BTL 1	Remembering
10.	Define the purpose of an EMI filter in power electronics.		CO4	BTL 1	Remembering
11.	Explain the difference between common-mode and differential-mode noise.		CO4	BTL 2	Understanding
12.	How does a common-mode choke reduce EMI in high-frequency converters?		CO4	BTL 2	Understanding
13.	Mention two PCB layout rules important for high-frequency circuits.		CO4	BTL 1	Remembering
14.	What is the significance of minimizing loop area in high-frequency layout?		CO4	BTL 1	Remembering
15.	Explain how trace impedance affects signal integrity in high-frequency PCBs.		CO4	BTL 2	Understanding
16.	Describe the impact of ground bounce in high-frequency PCB designs.		CO4	BTL 2	Understanding
17.	Define a conventional power loop in a power converter.		CO4	BTL 1	Remembering
18.	List two limitations of conventional power loop design in high-frequency applications.		CO4	BTL 1	Remembering
19.	Explain how stray inductance affects conventional power loop performance.		CO4	BTL 2	Understanding
20.	Describe the typical current path in a conventional power loop.		CO4	BTL 2	Understanding
21	State one objective of high-frequency power loop optimization.		CO4	BTL 1	Remembering
22	Name two techniques used for minimizing parasitic inductance in power loops.		CO4	BTL 1	Remembering
23	Explain how loop compression improves switching performance.		CO4	BTL 2	Understanding
24	Describe the benefit of placing power switches and capacitors close together.		CO4	BTL 2	Understanding
PART- B					
1.	(i) Explain how parasitic inductance is formed in PCB traces and power loops. (ii) Discuss the impact of parasitic inductance on switching waveforms and EMI.	(8) (8)	CO4	BTL 3	Applying
2.	(i) Describe how parasitic inductance causes voltage overshoot during MOSFET turn-off. (ii) Suggest practical methods to reduce parasitic inductance in PCB layout.	(9) (7)	CO4	BTL 3	Applying
3.	(i) What are the primary sources of parasitic capacitance in a power converter circuit? (ii) Explain how parasitic capacitance contributes to common-mode noise and EMI.	(10) (6)	CO4	BTL 3	Applying
4.	(i) Analyze the effect of parasitic capacitance on switching losses in wide bandgap devices.	(8)	CO4	BTL 4	Analyzing

	(ii) Discuss strategies to mitigate the impact of parasitic capacitance in PCB layout.	(8)			
5.	(i) Explain the function of differential-mode and common-mode filters in EMI suppression. (ii) Design a basic EMI filter for a high-frequency buck converter with explanation.	(6) (10)	CO4	BTL 4	Analyzing
6.	(i) Discuss the criteria for selecting inductors and capacitors for an EMI filter. (ii) Compare π-filter and LC filter topologies used in high-frequency converters.	(8) (8)	CO4	BTL 4	Analyzing
7.	(i) Define common-mode and differential-mode noise with waveforms or diagrams. (ii) Suggest methods to reduce both types of noise in a switching power supply.	(10) (6)	CO4	BTL 4	Analyzing
8.	(i) List and explain at least four PCB layout techniques to reduce EMI in high-frequency designs. (ii) Discuss the importance of minimizing loop inductance in gate drive and power loops.	(8) (8)	CO4	BTL 3	Applying
9.	(i) Explain the significance of a continuous ground plane in high-speed PCB design. (ii) Describe the impact of ground bounce and how to minimize it.	(8) (8)	CO4	BTL 3	Applying
10.	(i) Illustrate and explain the conventional power loop in a synchronous buck converter. (ii) Discuss the limitations of conventional loop designs in high-speed switching.	(8) (8)	CO4	BTL 4	Analyzing
11.	(i) Describe how parasitic inductance and capacitance are distributed in a power loop. (ii) Explain the impact of these parasitic on high-frequency operation and EMI.	(7) (9)	CO4	BTL 3	Applying
12.	(i) Explain the key objectives of optimizing power loops for wide bandgap power devices. (ii) Discuss the role of Kelvin source connection and its effect on gate voltage stability.	(8) (8)	CO4	BTL 4	Analyzing
13.	(i) Describe the loop compression technique and its significance in high-frequency PCB layout. (ii) Explain the use of multi-layer PCB stack-up to minimize inductance.	(8) (8)	CO4	BTL 4	Analyzing
14.	(i) Explain how decoupling capacitors help reduce high-frequency noise in power loops. (ii) Discuss placement strategies for bypass capacitors in high-speed PCB design.	(9) (7)	CO4	BTL 4	Analyzing
15.	(i) Explain the importance of separating power and signal paths	(8)	CO4	BTL 3	Applying

	on a PCB. (ii) How does improper routing between power and signal traces affect performance and EMI?	(8)			
16.	(i) Discuss the challenges in designing a PCB for mixed-signal systems (power + control). (ii) Suggest layout practices to prevent interference between analog and power sections.	(6) (10)	CO4	BTL 3	Applying
17.	(i) Consider a 100 kHz buck converter using SiC devices—identify all major parasitic effects and how to mitigate them. (ii) Analyze an EMI filter and high-frequency PCB layout strategy suitable for this application.	(7) (9)	CO4	BTL 3	Applying

UNIT V
APPLICATIONS OF WIDE BANDGAP DEVICES

Consumer electronics applications - Wireless power transfer applications - Electric vehicle applications - Renewable energy sources applications.

PART - A

Q. No	Questions	CO	BT Level	Competence
1.	Define consumer electronics.	CO5	BTL 1	Remembering
2.	Explain the role of SMPS in televisions or laptops.	CO5	BTL 2	Understanding
3.	Give two examples of power converters used in consumer electronics.	CO5	BTL 1	Remembering
4.	Why are compact and low-noise designs important in consumer electronics?	CO5	BTL 2	Understanding
5.	What is the function of a power adapter in a mobile device?	CO5	BTL 2	Understanding
6.	List any two features of energy-efficient power supplies in consumer devices.	CO5	BTL 1	Remembering
7.	What is meant by wireless power transfer?	CO5	BTL 1	Remembering
8.	State two types of wireless power transfer techniques.	CO5	BTL 1	Remembering
9.	Explain the principle of inductive coupling in WPT.	CO5	BTL 2	Understanding
10.	What are the main advantages of wireless charging in mobile devices?	CO5	BTL 2	Understanding
11.	Mention two challenges in implementing high-power WPT systems.	CO5	BTL 1	Remembering
12.	Describe how resonant coupling enhances wireless power efficiency.	CO5	BTL 2	Understanding
13.	Name two types of electric vehicles.	CO5	BTL 1	Remembering
14.	List two power electronic components used in EV drive trains.	CO5	BTL 1	Remembering
15.	What is the function of an on-board charger in an electric vehicle?	CO5	BTL 2	Understanding
16.	Explain how regenerative braking improves energy efficiency in EVs.	CO5	BTL 2	Understanding
17.	Define battery management system (BMS) in EVs.	CO5	BTL 1	Remembering
18.	Why are wide bandgap devices preferred in EV power converters?	CO5	BTL 2	Understanding
19.	Name two renewable energy sources.	CO5	BTL 1	Remembering
20.	What is the role of inverters in solar PV systems?	CO5	BTL 2	Understanding

21	State any two challenges in integrating renewable energy into the grid.		CO5	BTL 1	Remembering
22	Explain the function of a maximum power point tracker (MPPT) in solar systems.		CO5	BTL 2	Understanding
23	Mention two applications of wind energy conversion systems.		CO5	BTL 1	Remembering
24	Describe the need for energy storage in renewable energy applications.		CO5	BTL 2	Understanding
PART- B					
1.	(i). Explain the working principle of wireless charging in mobile phones, highlighting the role of Qi standards. (ii). Discuss the main challenges engineers face in optimizing coil design and placement for efficient wireless charging in consumer devices	(8) (8)	CO5	BTL 4	Analyzing
2.	(i). Describe the benefits of wireless charging technology for consumer electronics in terms of user experience and device durability. (ii). Assess the impact of wireless charging adoption on the design and marketability of portable electronic devices	(9) (7)	CO5	BTL 3	Applying
3.	(i). Discuss how wireless charger networking can improve the usability and efficiency of charging mobile devices in public spaces. (ii). Evaluate the factors influencing user-charger assignment in a wireless charger network, considering cost, location, and availability.	(8) (8)	CO5	BTL 3	Applying
4.	Discuss the comparison the Basic Power Profile (BPP) and Extended Power Profile (EPP) in Qi wireless charging standards.	(16)	CO5	BTL 4	Analyzing
5.	(i). Examine the potential health and safety concerns associated with the widespread use of wireless charging in household appliances. (ii). Discuss the market demand and cost-effectiveness of manufacturing wireless multi-device charging products for consumer use.	(8) (8)	CO5	BTL 4	Analyzing
6.	(i). Explain the differences between inductive coupling, magnetic resonance coupling, and RF/microwave wireless power transfer techniques. (ii). Identify the key technical standards (such as Qi, PMA, A4WP) and their relevance to various wireless power transfer applications	(7) (9)	CO5	BTL 4	Analyzing
7.	(i). Discuss the use of wireless power transfer in medical devices, such as implantable sensors, and its advantages over wired charging. (ii). Explain the challenges of implementing safety features in wireless charging systems for sensitive applications	(8) (8)	CO5	BTL 3	Applying
8.	(i). Evaluate the application of wireless power transfer in Internet of Things (IoT) devices and sensor networks. (ii). Discuss the efficiency and power management challenges in	(11) (5)	CO5	BTL 3	Applying

	deploying wireless power systems for distributed electronics.				
9.	Assess the limitations of current wireless charging technologies in terms of range, alignment, and energy loss.	(16)	CO5	BTL 4	Analyzing
10.	Describe the concept of simultaneous wireless information and power transfer (SWIPT) and its potential applications.	(16)	CO5	BTL 4	Analyzing
11.	(i). Explain the principle of wireless charging for electric vehicles (EVs) using inductive power transfer. (ii). Discuss the benefits and challenges of implementing wireless charging infrastructure for EVs in urban settings.	(9) (7)	CO5	BTL 3	Applying
12.	(i). Compare near-field and far-field wireless power transfer techniques for EV charging in terms of efficiency and practicality. (ii). Discuss the technological advancements required to enable dynamic (in-motion) wireless charging for EVs.	(8) (8)	CO5	BTL 3	Applying
13.	(i). Evaluate the safety and regulatory considerations for deploying wireless charging systems for electric vehicles. (ii). Discuss how wireless charging can influence the adoption and usability of electric vehicles.	(9) (7)	CO5	BTL 4	Analyzing
14.	(i). Assess the integration of wireless charging stations with renewable energy sources for sustainable EV charging. (ii). Examine the environmental impact of large-scale wireless charging infrastructure for electric vehicles.	(8) (8)	CO5	BTL 3	Applying
15.	(i). Describe how wireless power transfer can enhance the flexibility and deployment of renewable energy systems in remote locations. (ii). Discuss the challenges in maintaining power quality and efficiency when integrating wireless power transfer with renewable sources.	(8) (8)	CO5	BTL 3	Applying
16.	(i). Discuss the role of power electronics in enabling wireless power transfer for hybrid renewable energy systems. (ii). Evaluate the potential of wireless power transfer for off-grid renewable energy applications, such as remote sensors and microgrids.	(8) (8)	CO5	BTL 3	Applying
17.	(i). Discuss the future prospects and barriers for large-scale adoption of wireless power transfer in renewable energy sectors. (ii). Examine the impact of wireless power transfer on the design and operation of distributed renewable energy networks.	(8) (8)	CO5	BTL 4	Analyzing