



Kot Bhalwal, Jammu



Model Institute of Engineering
& Technology (Autonomous)
Dr. Arun K. Gupta Teaching-Learning Centre

Department of Electrical Engineering

Details of Lesson Plan

S.No.	Particulars	Details
1.	Course Name	Smart Grid
2.	Course Code	EE-604
3.	Academic Year	2024-2025
4.	Semester	6th
5.	Number of Lesson plans	29
6.	Faculty Assigned	Parveen Kumar

Faculty Signature

Lesson Plan No. 1	Course Name: Smart Grid	Course No.: EE-604
--------------------------	--------------------------------	---------------------------

Objectives	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> Students will understand the evolution of the electric grid, from its inception to modern smart grids. Students analyze the challenges and innovations associated with each stage of development.
Teaching Aids (if any)	<ol style="list-style-type: none"> Whiteboard and markers PowerPoint slides (optional) Handouts or reading materials on power electronics basics Use of Nearpod tool for online quiz
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) <ul style="list-style-type: none"> Begin the lesson by discussing the importance of electricity in modern society. Ask students what they know about the electric grid and its history. Development (30 minutes) <ol style="list-style-type: none"> Present a brief overview of the early development of electricity and its distribution. Discuss the contributions of key figures such as Nikola Tesla and Thomas Edison. Introduce the concept of centralized power generation and distribution. Exercise (5 minutes) – <ul style="list-style-type: none"> Divide students into small groups and provide them with handouts containing diagrams of historical electric grid systems. Ask each group to analyze the diagrams and identify key components and functions of early electric grids. Encourage discussion and questions about how these early systems operated and their limitations. Use Nearpod to collect responses and discuss the answers.
Closure	<ol style="list-style-type: none"> Recap the main points covered in the lesson. Assign research homework for students to explore the impact of early electric grids on society and industry. <p>Spend 5 minutes to wrap up and consolidate the learning's.</p>
Evaluation	<ol style="list-style-type: none"> Reflective Questions (What, Why, Who?). Allow students to answer and discuss. Nearpod Quiz on Smart Grid. <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>

Lesson Plan No. 2	Course Name: Smart Grid	Course No.: EE-604
--------------------------	--------------------------------	---------------------------

Objectives	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> Students will understand the concept of a smart grid, its components, and its importance in modern energy systems. Students will also learn key definitions associated with smart grids.
Teaching Aids (if any)	<ol style="list-style-type: none"> Whiteboard and markers PowerPoint slides (optional) Handouts or reading materials on power electronics basics Use of Nearpod tool for online quiz
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) <ul style="list-style-type: none"> Begin the lesson by discussing the importance of electricity in modern society and the challenges faced by traditional power grids. Introduce the concept of a smart grid as a modernized electrical grid that uses digital technology to monitor and manage the flow of electricity more efficiently. Development (30 minutes) <ol style="list-style-type: none"> Present a brief overview of the early development of electricity and its distribution. Discuss the contributions of key figures such as Nikola Tesla and Thomas Edison. Introduce the concept of centralized power generation and distribution. Exercise (5 minutes) – <ul style="list-style-type: none"> Divide students into small groups and provide them with handouts containing diagrams of historical electric grid systems. Ask each group to analyze the diagrams and identify key components and functions of early electric grids. Encourage discussion and questions about how these early systems operated and their limitations. Use Nearpod to collect responses and discuss the answers.
Closure	<ol style="list-style-type: none"> Recap the main points covered in the lesson. Assign research homework for students to explore the impact of early electric grids on society and industry. <p>Spend 5 minutes to wrap up and consolidate the learning's.</p>
Evaluation	<ol style="list-style-type: none"> Reflective Questions (What, Why, Who?). Allow students to answer and discuss. Nearpod Quiz on Smart Grid. <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>

Lesson Plan No. 3	Course Name: Smart Grid	Course No.: EE-604
--------------------------	--------------------------------	---------------------------

Objectives	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> a. Students will understand the functions, opportunities, and barriers of smart grid technology, including its potential benefits and challenges in modern energy systems.
Teaching Aids (if any)	<ol style="list-style-type: none"> a. Whiteboard and markers b. PowerPoint slides (optional) c. Handouts or reading materials on power electronics basics d. Use of Nearpod tool for online quiz
Teaching Development	<ol style="list-style-type: none"> 1. Introduction (10 minutes) <ul style="list-style-type: none"> - Begin the lesson by revisiting the concept of a smart grid briefly, emphasizing its modernized and digitally enhanced nature compared to traditional power grids. - Introduce the concept of a smart grid as a modernized electrical grid that uses digital technology to monitor and manage the flow of electricity more efficiently. 2. Development (30 minutes) <ol style="list-style-type: none"> a. Present a slideshow or use visual aids to discuss the functions of a smart grid, including: <ul style="list-style-type: none"> - Enhanced reliability and resilience - Improved efficiency in electricity generation, transmission, and distribution - Integration of renewable energy sources and distributed energy resources (DERs) - Optimization of energy use through demand response programs and real-time monitoring b. Highlight how these functions contribute to a more sustainable, flexible, and adaptable energy infrastructure. 3. Exercise (5 minutes) – <ul style="list-style-type: none"> - Divide the class into small groups and assign each group one opportunity or barrier related to smart grid technology. - Have each group discuss and brainstorm potential strategies or solutions for addressing their assigned opportunity or barrier. - Encourage groups to consider both technical and non-technical factors in their discussions. - Use Nearpod to collect responses and discuss the answers.
Closure	<ol style="list-style-type: none"> 1. Summarize the key points covered in the lesson, emphasizing the multifaceted nature of smart grid technology and its potential to transform the energy landscape. 2. Encourage students to continue exploring the topic and consider their role in shaping the future of energy systems. Spend 5 minutes to wrap up and consolidate the learning's.



Evaluation

- Assess students based on their participation in group discussions, the quality of their contributions, and their ability to critically analyze the opportunities and barriers of smart grid technology.
 - Nearpod Quiz on Smart Grid.
- Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 4	Course Name: Smart Grid	Course No.: EE-604
--------------------------	--------------------------------	---------------------------

Objectives	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> Students will be able to define conventional and smart grids. Students will understand the differences between conventional and smart grids. Students will analyze the advantages and disadvantages of both types of grids. Students will evaluate the potential impact of smart grids on energy efficiency and sustainability.
Teaching Aids (if any)	<ol style="list-style-type: none"> Whiteboard and markers PowerPoint slides (optional) Handouts or reading materials on power electronics basics Use of Nearpod tool for online quiz
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) <ul style="list-style-type: none"> Begin by asking students what they know about electricity grids and how electricity is distributed. Introduce the concept of conventional grids and smart grids. Define each term briefly: <ul style="list-style-type: none"> Conventional Grid: A traditional electricity grid that relies on centralized generation, unidirectional flow of electricity, and limited monitoring and control capabilities. Smart Grid: An advanced electricity grid that integrates digital communication technology, two-way flow of electricity and information, and advanced monitoring and control capabilities to improve efficiency, reliability, and sustainability. Development (30 minutes) <ol style="list-style-type: none"> Discuss the characteristics and components of conventional grids. Bi-directional flow of electricity and real-time communication between various grid components Advanced monitoring and control systems (e.g., smart meters, sensors, automation) Enhanced grid resilience and ability to integrate renewable energy sources Exercise (5 minutes) – <ul style="list-style-type: none"> Divide the class into small groups and assign each group to research and prepare a brief presentation on a specific aspect of smart grids (e.g., renewable energy integration, demand response, grid resilience). Use Nearpod to collect responses and discuss the answers.
Closure	<ol style="list-style-type: none"> Recap the main points covered in the lesson. Encourage students to think about the role of smart grids in the

	<p>future of energy distribution and the potential benefits for society and the environment.</p> <p>Spend 5 minutes to wrap up and consolidate the learning's.</p>
Evaluation	<ol style="list-style-type: none"> 1. Participation in class discussions and activities 2. Accuracy and depth of understanding demonstrated in group presentations 3. Completion and comprehension of any assigned follow-up questions or reflections on the topic. <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>

Lesson Plan No. 5	Course Name: Smart Grid	Course No.: EE-604
--------------------------	--------------------------------	---------------------------

Objectives	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> Students will understand the current state of development of smart grid systems. Students will learn about the key standards and protocols used in smart grid technology. Students will analyze the significance of standards in ensuring interoperability and reliability in smart grid systems. Students will evaluate the potential impact of smart grid standards on energy efficiency and sustainability.
Teaching Aids (if any)	<ol style="list-style-type: none"> Whiteboard and markers PowerPoint slides (optional) Handouts or reading materials on power electronics basics Use of Nearpod tool for online quiz
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) <ul style="list-style-type: none"> Start the lesson by asking students if they have heard about smart grid systems and what they understand about them. Briefly explain the concept of smart grids, emphasizing their role in modernizing the electricity grid through digital communication, advanced monitoring, and control capabilities. Development (30 minutes) <ol style="list-style-type: none"> Evolution from conventional grids to smart grids Adoption of digital technologies, such as sensors, smart meters, and automation Integration of renewable energy sources and distributed energy resources Implementation of demand response programs and grid optimization techniques resilience and ability to integrate renewable energy sources Exercise (5 minutes) – <ul style="list-style-type: none"> Discuss the importance of standards in ensuring interoperability, compatibility, and cybersecurity in smart grid systems. Facilitate a class discussion on the potential benefits of standardization in smart grids, such as improved reliability, efficiency, and scalability. Use Nearpod to collect responses and discuss the answers.
Closure	<ol style="list-style-type: none"> Recap the main points covered in the lesson. Summarize the key points discussed during the lesson, emphasizing the importance of standards in driving innovation and ensuring the



	successful deployment of smart grid technologies. Spend 5 minutes to wrap up and consolidate the learning's.
Evaluation	<ol style="list-style-type: none">1. Participation in class discussions and activities2. Accuracy and depth of understanding demonstrated in group presentations3. Completion and comprehension of any assigned follow-up questions or reflections on the topic. Spend 5 minutes to evaluate student assimilation of the lesson contents



Lesson Plan No. 6	Course Name: Smart Grid	Course No.: EE-604
--------------------------	--------------------------------	---------------------------

Objectives	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> Students will understand the functions, opportunities, and barriers of smart grid technology, including its potential benefits and challenges in modern energy systems.
Teaching Aids (if any)	<ol style="list-style-type: none"> Whiteboard and markers PowerPoint slides (optional) Handouts or reading materials on power electronics basics Use of Nearpod tool for online quiz
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) <ul style="list-style-type: none"> Begin the lesson by revisiting the concept of a smart grid briefly, emphasizing its modernized and digitally enhanced nature compared to traditional power grids. Introduce the concept of a smart grid as a modernized electrical grid that uses digital technology to monitor and manage the flow of electricity more efficiently. Development (30 minutes) <ol style="list-style-type: none"> Present a slideshow or use visual aids to discuss the functions of a smart grid, including: <ul style="list-style-type: none"> Enhanced reliability and resilience Improved efficiency in electricity generation, transmission, and distribution Integration of renewable energy sources and distributed energy resources (DERs) Optimization of energy use through demand response programs and real-time monitoring Highlight how these functions contribute to a more sustainable, flexible, and adaptable energy infrastructure. Exercise (5 minutes) – <ul style="list-style-type: none"> Divide the class into small groups and assign each group one opportunity or barrier related to smart grid technology. Have each group discuss and brainstorm potential strategies or solutions for addressing their assigned opportunity or barrier. Encourage groups to consider both technical and non-technical factors in their discussions. Use Nearpod to collect responses and discuss the answers.
Closure	<ol style="list-style-type: none"> Summarize the key points covered in the lesson, emphasizing the multifaceted nature of smart grid technology and its potential to transform the energy landscape. Encourage students to continue exploring the topic and consider their role in shaping the future of energy systems. Spend 5 minutes to wrap up and consolidate the learning's.



Evaluation

- Assess students based on their participation in group discussions, the quality of their contributions, and their ability to critically analyze the opportunities and barriers of smart grid technology.
 - Nearpod Quiz on Smart Grid.
- Spend 5 minutes to evaluate student assimilation of the lesson contents



Lesson Plan No. 7	Course Name: Smart Grid	Course No.: EE-604
--------------------------	--------------------------------	---------------------------

Objectives	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> Students will be able to define conventional and smart grids. Students will understand the differences between conventional and smart grids. Students will analyze the advantages and disadvantages of both types of grids. Students will evaluate the potential impact of smart grids on energy efficiency and sustainability.
Teaching Aids (if any)	<ol style="list-style-type: none"> Whiteboard and markers PowerPoint slides (optional) Handouts or reading materials on power electronics basics Use of Nearpod tool for online quiz
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) <ul style="list-style-type: none"> Begin by asking students what they know about electricity grids and how electricity is distributed. Introduce the concept of conventional grids and smart grids. Define each term briefly: <ul style="list-style-type: none"> Conventional Grid: A traditional electricity grid that relies on centralized generation, unidirectional flow of electricity, and limited monitoring and control capabilities. Smart Grid: An advanced electricity grid that integrates digital communication technology, two-way flow of electricity and information, and advanced monitoring and control capabilities to improve efficiency, reliability, and sustainability. Development (30 minutes) <ol style="list-style-type: none"> Discuss the characteristics and components of conventional grids. Bi-directional flow of electricity and real-time communication between various grid components Advanced monitoring and control systems (e.g., smart meters, sensors, automation) Enhanced grid resilience and ability to integrate renewable energy sources Exercise (5 minutes) – <ul style="list-style-type: none"> Divide the class into small groups and assign each group to research and prepare a brief presentation on a specific aspect of smart grids (e.g., renewable energy integration, demand response, grid resilience). Use Nearpod to collect responses and discuss the answers.
Closure	<ol style="list-style-type: none"> Recap the main points covered in the lesson. Encourage students to think about the role of smart grids in the



	<p>future of energy distribution and the potential benefits for society and the environment.</p> <p>Spend 5 minutes to wrap up and consolidate the learning's.</p>
Evaluation	<ol style="list-style-type: none">1. Participation in class discussions and activities2. Accuracy and depth of understanding demonstrated in group presentations3. Completion and comprehension of any assigned follow-up questions or reflections on the topic. <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>



Lesson Plan No. 8	Course Name: Smart Grid	Course No.: EE-604
--------------------------	--------------------------------	---------------------------

Objectives	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> Students will understand the current state of development of smart grid systems. Students will learn about the key standards and protocols used in smart grid technology. Students will analyze the significance of standards in ensuring interoperability and reliability in smart grid systems. Students will evaluate the potential impact of smart grid standards on energy efficiency and sustainability.
Teaching Aids (if any)	<ol style="list-style-type: none"> Whiteboard and markers PowerPoint slides (optional) Handouts or reading materials on power electronics basics Use of Nearpod tool for online quiz
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) <ul style="list-style-type: none"> Start the lesson by asking students if they have heard about smart grid systems and what they understand about them. Briefly explain the concept of smart grids, emphasizing their role in modernizing the electricity grid through digital communication, advanced monitoring, and control capabilities. Development (30 minutes) <ol style="list-style-type: none"> Evolution from conventional grids to smart grids Adoption of digital technologies, such as sensors, smart meters, and automation Integration of renewable energy sources and distributed energy resources Implementation of demand response programs and grid optimization techniques resilience and ability to integrate renewable energy sources Exercise (5 minutes) – <ul style="list-style-type: none"> Discuss the importance of standards in ensuring interoperability, compatibility, and cybersecurity in smart grid systems. Facilitate a class discussion on the potential benefits of standardization in smart grids, such as improved reliability, efficiency, and scalability. Use Nearpod to collect responses and discuss the answers.
Closure	<ol style="list-style-type: none"> Recap the main points covered in the lesson. Summarize the key points discussed during the lesson, emphasizing the importance of standards in driving innovation and ensuring the



	successful deployment of smart grid technologies. Spend 5 minutes to wrap up and consolidate the learning's.
Evaluation	<ol style="list-style-type: none">1. Participation in class discussions and activities2. Accuracy and depth of understanding demonstrated in group presentations3. Completion and comprehension of any assigned follow-up questions or reflections on the topic. Spend 5 minutes to evaluate student assimilation of the lesson contents



Lesson Plan No. 9	Course Name: Smart Grid	Course No.: EE-604
--------------------------	--------------------------------	---------------------------

Objectives	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> Students will gain an understanding of smart meters and advanced metering infrastructure (AMI), including their functions, benefits, and implications for energy management and utility operations..
Teaching Aids (if any)	<ol style="list-style-type: none"> Whiteboard and markers PowerPoint slides (optional) Handouts or reading materials on power electronics basics Use of Nearpod tool for online quiz
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) <ul style="list-style-type: none"> Explain what AMI is and how it integrates with smart meters. Describe the components of AMI, including communication networks, data management systems, and meter data analysis tools. Discuss the benefits of AMI in enabling utilities to manage electricity distribution more effectively and improve customer service. Development (30 minutes) <ol style="list-style-type: none"> Summarize key concepts covered in the lesson. Facilitate a brief discussion or reflection activity where students can share their thoughts on the potential impact of smart meters and AMI on future energy systems and society. Exercise (5 minutes) – <ul style="list-style-type: none"> Organize a field trip to a local utility facility or renewable energy installation where students can observe smart meters and AMI systems in action and engage in hands-on learning activities. Use Nearpod to collect responses and discuss the answers.
Closure	<ol style="list-style-type: none"> Recap the main points covered in the lesson. Encourage students to think about the role of smart grids in the future of energy distribution and the potential benefits for society and the environment. Spend 5 minutes to wrap up and consolidate the learning's.
Evaluation	<ol style="list-style-type: none"> Students can be assessed based on their participation in class discussions, completion of reflection activities, and understanding demonstrated through responses to questions during the lesson. Optionally, students can be assigned a follow-up project or research assignment where they explore a specific aspect of smart meters or AMI in more depth and present their findings to the class. Spend 5 minutes to evaluate student assimilation of the lesson contents



Lesson Plan No.10	Course Name: Smart Grid	Course No.: EE-604
Objectives	At the end of the lesson the student shall be able to: <ol style="list-style-type: none">Explore the technology behind smart meters and advanced metering infrastructure (AMI).Analyze the benefits and challenges of implementing real-time pricing.Discuss case studies and real-world applications.	
Teaching Aids (if any)	<ol style="list-style-type: none">Whiteboard and markersPowerPoint slides (optional)Handouts or reading materials on power electronics basicsUse of Nearpod tool for online quiz	
Teaching Development	<ol style="list-style-type: none">Introduction (10 minutes)<ul style="list-style-type: none">Briefly introduce the topic and outline the objectives of the lesson.Explain the relevance of real-time pricing in modern energy management.Development (30 minutes)<ol style="list-style-type: none">Summarize key concepts covered in the lesson.Facilitate a brief discussion or reflection activity where students can share their thoughts on the potential impact of smart meters and AMI on future energy systems and society.Exercise (5 minutes) –<ul style="list-style-type: none">Ask students what they know about smart meters and how they think pricing for electricity works.Introduce key terms: Smart Meters, Advanced Metering Infrastructure (AMI), Real-Time Pricing (RTP). Use Nearpod to collect responses and discuss the answers.	
Closure	<ol style="list-style-type: none">Recap the main points covered in the lesson.Encourage students to think about the role of smart grids in the future of energy distribution and the potential benefits for society and the environment. <p>Spend 5 minutes to wrap up and consolidate the learning's.</p>	
Evaluation	<ol style="list-style-type: none">Students can be assessed based on their participation in class discussions, completion of reflection activities, and understanding demonstrated through responses to questions during the lesson.Optionally, students can be assigned a follow-up project or research assignment where they explore a specific aspect of smart meters or AMI in more depth and present their findings to the class. <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>	



Lesson Plan No. 11	Course Name: Smart Grid	Course No.: EE-604
---------------------------	--------------------------------	---------------------------

Objectives	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> Students will be able to differentiate between the static and dynamic characteristics of Silicon Controlled Rectifiers (SCRs). Understand their significance, and apply this knowledge to analyze SCR circuits.
Teaching Aids (if any)	<ol style="list-style-type: none"> Whiteboard and markers PowerPoint slides (optional) Handouts or reading materials on power electronics basics Use of Nearpod tool for online quiz
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) <ul style="list-style-type: none"> Welcome students and provide an overview of the lesson objectives. Recap briefly on the basic theory of operation of SCRs covered in previous lessons. Development (20 minutes) <ol style="list-style-type: none"> Define static characteristics and their importance in SCR analysis. Discuss the following static characteristics: <ul style="list-style-type: none"> Forward and reverse voltage ratings Forward and reverse blocking capability Forward and reverse leakage current Breakover voltage Explain the graphical representation of static characteristics on the SCR datasheet. Exercise (15 minutes) – <ul style="list-style-type: none"> Compare and contrast static and dynamic characteristics. Discuss how static characteristics define the fundamental behavior of SCRs, while dynamic characteristics describe their transient response. Highlight the importance of understanding both static and dynamic characteristics in SCR circuit design and analysis. Present real-world applications where static and dynamic characteristics play a crucial role in SCR performance. Discuss case studies of SCR circuits in power control, motor drives, and voltage regulation. Analyze the impact of different SCR characteristics on circuit behavior and performance. Use Nearpod to collect responses and discuss the answers.
Closure	<ol style="list-style-type: none"> Summarize the key points discussed in the lesson. Emphasize the importance of understanding both static and dynamic characteristics for effective SCR circuit design and



	<p>troubleshooting.</p> <p>Spend 5 minutes to wrap up and consolidate the learnings</p>
Evaluation	<ol style="list-style-type: none">1. Evaluate students' understanding through class participation, responses to questions, and engagement in discussions.2. Assign a brief quiz or problem-solving activity to assess comprehension of static and dynamic characteristics of SCRs.3. Nearpod Quiz on power Electronics. <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>



Lesson Plan No.12	Course Name: Smart Grid	Course No.: EE-604
Objectives	At the end of the lesson the student shall be able to: a. Begin the lesson by asking students if they have heard about snubber circuits and what they understand about them. b. Introduce the concept of snubber circuits, explaining that they are used to protect electronic components from voltage spikes or transients.	
Teaching Aids (if any)	a. Whiteboard and markers b. PowerPoint slides c. Handouts or reading materials on power electronics basics d. Use of Nearpod tool for online quiz	
Teaching Development	<ol style="list-style-type: none">Introduction (10 minutes)<ul style="list-style-type: none">- Present an overview of snubber circuits, covering the following points:<ul style="list-style-type: none">- Purpose: To suppress voltage transients, reduce switching losses, and improve the reliability of electronic systems.- Types: Discuss different types of snubber circuits, including RC snubbers, RCD snubbers, and RC snubber networks.- Components: Explain the role of resistors, capacitors, and diodes in snubber circuitsDevelopment (30 minutes)<ol style="list-style-type: none">Discuss the working principles of each type of snubber circuit and their typical applications in electronic circuits.Explain the advantages and disadvantages of using snubber circuits in electronic designs, such as increased component count, added complexity, and improved system reliability.Optionally, demonstrate the construction and behavior of basic snubber circuits using electronic components.Exercise (5 minutes) –<ul style="list-style-type: none">- Divide the class into small groups and assign each group to design a basic snubber circuit for a given electronic application (e.g., a flyback converter, a motor drive).- Provide students with access to simulation software (if available) to simulate their snubber circuit designs and analyze their performance.- Encourage students to discuss their design choices and the trade-offs involved in selecting snubber components. <p>Use Nearpod to collect responses and discuss the answers.</p>	
Closure	<ol style="list-style-type: none">Summarize the key points covered in the lesson.Encourage students to explore additional resources or conduct further experiments to deepen their understanding of snubber	



	<p>circuits. Spend 5 minutes to wrap up and consolidate the learnings</p>
Evaluation	<ol style="list-style-type: none">1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.2. Evaluate students' understanding through class participation, responses to questions, and engagement in discussions.3. Completion and comprehension of any assigned follow-up questions or reflections on the topic.4. Nearpod Quiz on power Electronics. <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>



Lesson Plan No. 13	Course Name: Smart Grid	Course No.: EE-604
Objectives	At the end of the lesson the student shall be able to: a. Students will understand the basic theory of operation of a Silicon Controlled Rectifier (SCR) b. Students will understand its structure, characteristics, and applications.	
Teaching Aids (if any)	a. Whiteboard and markers b. PowerPoint slides (optional) c. Handouts or reading materials on power electronics basics d. Use of Nearpod tool for online quiz	
Teaching Development	<ol style="list-style-type: none">Introduction (10 minutes)<ul style="list-style-type: none">Welcome students to the lesson and introduce the topic of Silicon Controlled Rectifiers (SCRs).Explain the importance of SCRs in electronics and power control systems.Development (30 minutes)<ol style="list-style-type: none">Discuss the classification of semiconductor devices into two categories: diodes and transistors.Briefly review the operation principles of diodes and transistors to provide context for understanding SCRs.Exercise (5 minutes) –<ul style="list-style-type: none">Discuss the operating principle of an SCR in forward and reverse bias conditions.Explain the role of the gate signal in triggering the SCR into conduction.Discuss the latching and holding current characteristics of SCRs.Introduce the concept of forward and reverse blocking voltage. Switch-mode power supplies <p>Use Nearpod to collect responses and discuss the answers.</p>	
Closure	<ol style="list-style-type: none">Highlight the various applications of SCRs in power control systems, such as phase control, voltage regulation, and power switching.Provide examples of devices or systems where SCRs are commonly used. <p>Spend 5 minutes to wrap up and consolidate the learnings</p>	
Evaluation	<ol style="list-style-type: none">Reflective Questions (What, Why, Who?). Allow students to answer and discuss.	



	<ol style="list-style-type: none">2. Evaluate students' understanding through class participation, questions, and any assignments or quizzes related to the topic.3. Review any misconceptions or areas of confusion before concluding the lesson.4. Nearpod Quiz on power Electronics. <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>
--	--



Lesson Plan No. 14	Course Name: Smart Grid	Course No.: EE-604
Objectives	At the end of the lesson the student shall be able to: a. Begin the lesson by asking students if they have heard about snubber circuits and what they understand about them. b. Introduce the concept of snubber circuits, explaining that they are used to protect electronic components from voltage spikes or transients.	
Teaching Aids (if any)	a. Whiteboard and markers b. PowerPoint slides c. Handouts or reading materials on power electronics basics d. Use of Nearpod tool for online quiz	
Teaching Development	<ol style="list-style-type: none">Introduction (10 minutes)<ul style="list-style-type: none">- Present an overview of snubber circuits, covering the following points:<ul style="list-style-type: none">- Purpose: To suppress voltage transients, reduce switching losses, and improve the reliability of electronic systems.- Types: Discuss different types of snubber circuits, including RC snubbers, RCD snubbers, and RC snubber networks.- Components: Explain the role of resistors, capacitors, and diodes in snubber circuitsDevelopment (30 minutes)<ol style="list-style-type: none">Discuss the working principles of each type of snubber circuit and their typical applications in electronic circuits.Explain the advantages and disadvantages of using snubber circuits in electronic designs, such as increased component count, added complexity, and improved system reliability.Optionally, demonstrate the construction and behavior of basic snubber circuits using electronic components.Exercise (5 minutes) –<ul style="list-style-type: none">- Divide the class into small groups and assign each group to design a basic snubber circuit for a given electronic application (e.g., a flyback converter, a motor drive).- Provide students with access to simulation software (if available) to simulate their snubber circuit designs and analyze their performance.- Encourage students to discuss their design choices and the trade-offs involved in selecting snubber components. <p>Use Nearpod to collect responses and discuss the answers.</p>	
Closure	<ol style="list-style-type: none">Summarize the key points covered in the lesson.Encourage students to explore additional resources or conduct further experiments to deepen their understanding of snubber	



	<p>circuits. Spend 5 minutes to wrap up and consolidate the learnings</p>
Evaluation	<ol style="list-style-type: none">1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.2. Evaluate students' understanding through class participation, responses to questions, and engagement in discussions.3. Completion and comprehension of any assigned follow-up questions or reflections on the topic.4. Nearpod Quiz on power Electronics. <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>



Lesson Plan No. 15	Course Name: Smart Grid	Course No.: EE-604
Objectives	At the end of the lesson the student shall be able to: a. Students will understand the operation, characteristics, and differences in performance of converters (both half-wave and full-wave) with resistive (R), resistive-inductive (RL), and resistive-inductive-capacitive (RLE) loads, with and without freewheeling diode.	
Teaching Aids (if any)	a. Whiteboard and markers b. PowerPoint slides c. Handouts or reading materials on power electronics basics d. Use of Nearpod tool for online quiz	
Teaching Development	<ol style="list-style-type: none">1. Introduction (10 minutes)<ul style="list-style-type: none">- Brief overview of converter circuits and their role in power electronics.- Explanation of half-wave and full-wave rectifiers.- Introduction to resistive (R), resistive-inductive (RL), and resistive-inductive-capacitive (RLE) loads.2. Development (30 minutes)<ol style="list-style-type: none">a. Half-Wave Converter Operationb. Full-Wave Converter Operation without Freewheeling Diodec. Full-Wave Converter Operation with Freewheeling Dioded. Performance Analysis3. Exercise (5 minutes) –<ul style="list-style-type: none">- Divide the class into small groups and assign each group to Discussion on practical applications and considerations when selecting converter configurations for specific loads.- Case studies and examples showcasing real-world applications and challenges. <p>Use Nearpod to collect responses and discuss the answers.</p>	
Closure	<ol style="list-style-type: none">1. Summarize the key points covered in the lesson.2. Encourage students to explore additional resources or conduct further experiments to deepen their understanding of converter circuits. <p>Spend 5 minutes to wrap up and consolidate the learnings</p>	
Evaluation	<ol style="list-style-type: none">1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.2. Evaluate students' understanding through class participation, responses to questions, and engagement in discussions.3. Completion and comprehension of any assigned follow-up questions or reflections on the topic.4. Nearpod Quiz on power Electronics. <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>	



Lesson Plan No. 16	Course Name: Smart Grid	Course No.: EE-604
---------------------------	--------------------------------	---------------------------

Objectives	At the end of the lesson the student shall be able to: a. Students will comprehend the principles, operation, and applications of three-phase fully controlled converters, including the analysis of different firing strategies and their effects on output waveforms and performance.
Teaching Aids (if any)	a. Whiteboard and markers b. PowerPoint slides c. Handouts or reading materials on power electronics basics d. Use of Nearpod tool for online quiz
Teaching Development	1. Introduction (10 minutes) - Overview of three-phase power systems and their significance in electrical engineering. - Introduction to the need for three-phase power conversion and its applications in industrial and commercial sectors. 2. Development (30 minutes) a. Discussion of practical applications of three-phase fully controlled converters, such as motor drives, AC voltage regulation, and reactive power compensation systems. b. Case studies and examples showcasing real-world implementations in industrial settings. 3. Exercise (5 minutes) – - Divide the class into small groups and assign each group to Discussion on practical applications and considerations when selecting converter configurations for specific loads. - Case studies and examples showcasing real-world applications and challenges. Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the key points covered in the lesson. 2. Encourage students to explore additional resources or conduct further experiments to deepen their understanding of converter circuits. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Evaluate students' understanding through class participation, responses to questions, and engagement in discussions. 3. Completion and comprehension of any assigned follow-up questions or reflections on the topic. 4. Nearpod Quiz on power Electronics. Spend 5 minutes to evaluate student assimilation of the lesson contents



Lesson Plan No. 17	Course Name: SMART GRID	Course No.: EE-604
---------------------------	--------------------------------	---------------------------

Objectives	At the end of the lesson the student shall be able to: a. Students will comprehend the principles, operation, and applications of three-phase fully controlled converters, including the analysis of different firing strategies and their effects on output waveforms and performance.
Teaching Aids (if any)	a. Whiteboard and markers b. PowerPoint slides c. Handouts or reading materials on power electronics basics d. Use of Nearpod tool for online quiz
Teaching Development	1. Introduction (10 minutes) - Overview of three-phase power systems and their significance in electrical engineering. - Introduction to the need for three-phase power conversion and its applications in industrial and commercial sectors. 2. Development (30 minutes) a. Discussion of practical applications of three-phase fully controlled converters, such as motor drives, AC voltage regulation, and reactive power compensation systems. b. Case studies and examples showcasing real-world implementations in industrial settings. 3. Exercise (5 minutes) – - Divide the class into small groups and assign each group to Discussion on practical applications and considerations when selecting converter configurations for specific loads. - Case studies and examples showcasing real-world applications and challenges. Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the key points covered in the lesson. 2. Encourage students to explore additional resources or conduct further experiments to deepen their understanding of converter circuits. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Evaluate students' understanding through class participation, responses to questions, and engagement in discussions. 3. Completion and comprehension of any assigned follow-up questions or reflections on the topic. 4. Nearpod Quiz on power Electronics. Spend 5 minutes to evaluate student assimilation of the lesson contents



Lesson Plan No. 18	Course Name: Smart Grid	Course No.: EE-604
Objectives	At the end of the lesson the student shall be able to: a. Students will understand the operation, characteristics, and differences in performance of converters (both half-wave and full-wave) with resistive (R), resistive-inductive (RL), and resistive-inductive-capacitive (RLE) loads, with and without freewheeling diode.	
Teaching Aids (if any)	a. Whiteboard and markers b. PowerPoint slides c. Handouts or reading materials on power electronics basics d. Use of Nearpod tool for online quiz	
Teaching Development	<ol style="list-style-type: none">1. Introduction (10 minutes)<ul style="list-style-type: none">- Brief overview of converter circuits and their role in power electronics.- Explanation of half-wave and full-wave rectifiers.- Introduction to resistive (R), resistive-inductive (RL), and resistive-inductive-capacitive (RLE) loads.2. Development (30 minutes)<ol style="list-style-type: none">a. Half-Wave Converter Operationb. Full-Wave Converter Operation without Freewheeling Diodec. Full-Wave Converter Operation with Freewheeling Dioded. Performance Analysis3. Exercise (5 minutes) –<ul style="list-style-type: none">- Divide the class into small groups and assign each group to Discussion on practical applications and considerations when selecting converter configurations for specific loads.- Case studies and examples showcasing real-world applications and challenges. <p>Use Nearpod to collect responses and discuss the answers.</p>	
Closure	<ol style="list-style-type: none">1. Summarize the key points covered in the lesson.2. Encourage students to explore additional resources or conduct further experiments to deepen their understanding of converter circuits. <p>Spend 5 minutes to wrap up and consolidate the learnings</p>	
Evaluation	<ol style="list-style-type: none">1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.2. Evaluate students' understanding through class participation, responses to questions, and engagement in discussions.3. Completion and comprehension of any assigned follow-up questions or reflections on the topic.4. Nearpod Quiz on power Electronics. <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>	



Lesson Plan No. 19	Course Name: Smart Grid	Course No.: EE-604
Objectives	At the end of the lesson the student shall be able to: a. Understand the principles and operation of single-phase half-wave controlled converters. b. Analyze the waveforms and performance characteristics of these converters. c. Calculate relevant parameters such as average output voltage, ripple factor, and efficiency. d. Identify applications and limitations of single-phase half-wave-controlled converters.	
Teaching Aids (if any)	a. Whiteboard and markers b. PowerPoint slides c. Handouts or reading materials on power electronics basics d. Use of Nearpod tool for online quiz	
Teaching Development	<ol style="list-style-type: none">Introduction (10 minutes)<ul style="list-style-type: none">Briefly introduce the concept of power electronic converters.Explain the significance of single-phase half-wave-controlled converters in various industrial applications.Highlight the objectives of the lesson.Development (30 minutes)<ol style="list-style-type: none">Explain the structure and basic working principle of a single-phase half-wave-controlled converter.Draw the circuit diagram and discuss the function of each componentDiscuss the role of the thyristor in controlling the load current.Explain how gating signals control the firing angle of the thyristor.Exercise (5 minutes) –<ul style="list-style-type: none">Divide the class into small groups and assign each group to design a basic half wave circuit for a given electronic application (e.g., a flyback converter, a motor drive).Provide students with access to simulation software (if available) to simulate their snubber circuit designs and analyze their performance.Encourage students to discuss their design choices and the trade-offs involved in selecting snubber components. <p>Use Nearpod to collect responses and discuss the answers.</p>	
Closure	<ol style="list-style-type: none">Summarize the key points covered in the lesson.Encourage students to explore additional resources or conduct further experiments to deepen their understanding of converter circuits.	



	Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	<ol style="list-style-type: none">1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.2. Evaluate students' understanding through class participation, responses to questions, and engagement in discussions.3. Completion and comprehension of any assigned follow-up questions or reflections on the topic.4. Nearpod Quiz on power Electronics. <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>



Lesson Plan No. 20	Course Name: Smart Grid	Course No.: EE-604
--------------------	-------------------------	--------------------

Objectives	At the end of the lesson the student shall be able to: a. Students will be able to differentiate between the static and dynamic characteristics of Silicon Controlled Rectifiers (SCRs). b. Understand their significance, and apply this knowledge to analyze SCR circuits.
Teaching Aids (if any)	a. Whiteboard and markers b. PowerPoint slides (optional) c. Handouts or reading materials on power electronics basics d. Use of Nearpod tool for online quiz
Teaching Development	<ol style="list-style-type: none">Introduction (10 minutes)<ul style="list-style-type: none">Welcome students and provide an overview of the lesson objectives.Recap briefly on the basic theory of operation of SCRs covered in previous lessons.Development (20 minutes)<ol style="list-style-type: none">Define static characteristics and their importance in SCR analysis.Discuss the following static characteristics:<ul style="list-style-type: none">Forward and reverse voltage ratingsForward and reverse blocking capabilityForward and reverse leakage currentBreakover voltageExplain the graphical representation of static characteristics on the SCR datasheet.Exercise (15 minutes) –<ul style="list-style-type: none">Compare and contrast static and dynamic characteristics.Discuss how static characteristics define the fundamental behavior of SCRs, while dynamic characteristics describe their transient response.Highlight the importance of understanding both static and dynamic characteristics in SCR circuit design and analysis. Present real-world applications where static and dynamic characteristics play a crucial role in SCR performance.Discuss case studies of SCR circuits in power control, motor drives, and voltage regulation.Analyze the impact of different SCR characteristics on circuit behavior and performance.Use Nearpod to collect responses and discuss the answers.
Closure	<ol style="list-style-type: none">Summarize the key points discussed in the lesson.Emphasize the importance of understanding both static and dynamic characteristics for effective SCR circuit design and



	<p>troubleshooting.</p> <p>Spend 5 minutes to wrap up and consolidate the learnings</p>
Evaluation	<ol style="list-style-type: none">1. Evaluate students' understanding through class participation, responses to questions, and engagement in discussions.2. Assign a brief quiz or problem-solving activity to assess comprehension of static and dynamic characteristics of SCRs.3. Nearpod Quiz on power Electronics. <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>



Lesson Plan No. 21	Course Name: Smart Grid	Course No.: EE-604
Objectives	At the end of the lesson the student shall be able to: a. Students will understand the basic theory of operation of a Silicon Controlled Rectifier (SCR) b. Students will understand its structure, characteristics, and applications.	
Teaching Aids (if any)	a. Whiteboard and markers b. PowerPoint slides (optional) c. Handouts or reading materials on power electronics basics d. Use of Nearpod tool for online quiz	
Teaching Development	<ol style="list-style-type: none">Introduction (10 minutes)<ul style="list-style-type: none">Welcome students to the lesson and introduce the topic of Silicon Controlled Rectifiers (SCRs).Explain the importance of SCRs in electronics and power control systems.Development (30 minutes)<ol style="list-style-type: none">Discuss the classification of semiconductor devices into two categories: diodes and transistors.Briefly review the operation principles of diodes and transistors to provide context for understanding SCRs.Exercise (5 minutes) –<ul style="list-style-type: none">Discuss the operating principle of an SCR in forward and reverse bias conditions.Explain the role of the gate signal in triggering the SCR into conduction.Discuss the latching and holding current characteristics of SCRs.Introduce the concept of forward and reverse blocking voltage. Switch-mode power supplies <p>Use Nearpod to collect responses and discuss the answers.</p>	
Closure	<ol style="list-style-type: none">Highlight the various applications of SCRs in power control systems, such as phase control, voltage regulation, and power switching.Provide examples of devices or systems where SCRs are commonly used. <p>Spend 5 minutes to wrap up and consolidate the learnings</p>	
Evaluation	<ol style="list-style-type: none">Reflective Questions (What, Why, Who?). Allow students to answer and discuss.	



	<ol style="list-style-type: none">2. Evaluate students' understanding through class participation, questions, and any assignments or quizzes related to the topic.3. Review any misconceptions or areas of confusion before concluding the lesson.4. Nearpod Quiz on power Electronics. <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>
--	--



Lesson Plan No. 22	Course Name: Smart Grid	Course No.: EE-604
Objectives	At the end of the lesson the student shall be able to: a. Begin the lesson by asking students if they have heard about snubber circuits and what they understand about them. b. Introduce the concept of snubber circuits, explaining that they are used to protect electronic components from voltage spikes or transients.	
Teaching Aids (if any)	a. Whiteboard and markers b. PowerPoint slides c. Handouts or reading materials on power electronics basics d. Use of Nearpod tool for online quiz	
Teaching Development	<ol style="list-style-type: none">Introduction (10 minutes)<ul style="list-style-type: none">- Present an overview of snubber circuits, covering the following points:<ul style="list-style-type: none">- Purpose: To suppress voltage transients, reduce switching losses, and improve the reliability of electronic systems.- Types: Discuss different types of snubber circuits, including RC snubbers, RCD snubbers, and RC snubber networks.- Components: Explain the role of resistors, capacitors, and diodes in snubber circuitsDevelopment (30 minutes)<ol style="list-style-type: none">Discuss the working principles of each type of snubber circuit and their typical applications in electronic circuits.Explain the advantages and disadvantages of using snubber circuits in electronic designs, such as increased component count, added complexity, and improved system reliability.Optionally, demonstrate the construction and behavior of basic snubber circuits using electronic components.Exercise (5 minutes) –<ul style="list-style-type: none">- Divide the class into small groups and assign each group to design a basic snubber circuit for a given electronic application (e.g., a flyback converter, a motor drive).- Provide students with access to simulation software (if available) to simulate their snubber circuit designs and analyze their performance.- Encourage students to discuss their design choices and the trade-offs involved in selecting snubber components. <p>Use Nearpod to collect responses and discuss the answers.</p>	
Closure	<ol style="list-style-type: none">Summarize the key points covered in the lesson.Encourage students to explore additional resources or conduct further experiments to deepen their understanding of snubber	



	<p>circuits. Spend 5 minutes to wrap up and consolidate the learnings</p>
Evaluation	<ol style="list-style-type: none">1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.2. Evaluate students' understanding through class participation, responses to questions, and engagement in discussions.3. Completion and comprehension of any assigned follow-up questions or reflections on the topic.4. Nearpod Quiz on power Electronics. <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>



Lesson Plan No. 23	Course Name: Smart Grid	Course No.: EE-604
Objectives	At the end of the lesson the student shall be able to: a. Understand the principles and operation of single-phase half-wave controlled converters. b. Analyze the waveforms and performance characteristics of these converters. c. Calculate relevant parameters such as average output voltage, ripple factor, and efficiency. d. Identify applications and limitations of single-phase half-wave-controlled converters.	
Teaching Aids (if any)	a. Whiteboard and markers b. PowerPoint slides c. Handouts or reading materials on power electronics basics d. Use of Nearpod tool for online quiz	
Teaching Development	1. Introduction (10 minutes) - Briefly introduce the concept of power electronic converters. - Explain the significance of single-phase half-wave-controlled converters in various industrial applications. - Highlight the objectives of the lesson. 2. Development (30 minutes) a. Explain the structure and basic working principle of a single-phase half-wave-controlled converter. b. Draw the circuit diagram and discuss the function of each component c. Discuss the role of the thyristor in controlling the load current. d. Explain how gating signals control the firing angle of the thyristor. 3. Exercise (5 minutes) – - Divide the class into small groups and assign each group to design a basic half wave circuit for a given electronic application (e.g., a flyback converter, a motor drive). - Provide students with access to simulation software (if available) to simulate their snubber circuit designs and analyze their performance. - Encourage students to discuss their design choices and the trade-offs involved in selecting snubber components. Use Nearpod to collect responses and discuss the answers.	
Closure	1. Summarize the key points covered in the lesson. 2. Encourage students to explore additional resources or conduct further experiments to deepen their understanding of converter circuits.	



	Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	<ol style="list-style-type: none">1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.2. Evaluate students' understanding through class participation, responses to questions, and engagement in discussions.3. Completion and comprehension of any assigned follow-up questions or reflections on the topic.4. Nearpod Quiz on power Electronics. <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>



Lesson Plan No. 24	Course Name: Smart grid	Course No.: EE-604
---------------------------	--------------------------------	---------------------------

Objectives	At the end of the lesson the student shall be able to: a. Students will comprehend the principles, operation, and applications of three-phase fully controlled converters, including the analysis of different firing strategies and their effects on output waveforms and performance.
Teaching Aids (if any)	a. Whiteboard and markers b. PowerPoint slides c. Handouts or reading materials on power electronics basics d. Use of Nearpod tool for online quiz
Teaching Development	<ol style="list-style-type: none">Introduction (10 minutes)<ul style="list-style-type: none">Overview of three-phase power systems and their significance in electrical engineering.Introduction to the need for three-phase power conversion and its applications in industrial and commercial sectors.Development (30 minutes)<ol style="list-style-type: none">Discussion of practical applications of three-phase fully controlled converters, such as motor drives, AC voltage regulation, and reactive power compensation systems.Case studies and examples showcasing real-world implementations in industrial settings.Exercise (5 minutes) –<ul style="list-style-type: none">Divide the class into small groups and assign each group to Discussion on practical applications and considerations when selecting converter configurations for specific loads.Case studies and examples showcasing real-world applications and challenges. <p>Use Nearpod to collect responses and discuss the answers.</p>
Closure	<ol style="list-style-type: none">Summarize the key points covered in the lesson.Encourage students to explore additional resources or conduct further experiments to deepen their understanding of converter circuits. <p>Spend 5 minutes to wrap up and consolidate the learnings</p>
Evaluation	<ol style="list-style-type: none">Reflective Questions (What, Why, Who?). Allow students to answer and discuss.Evaluate students' understanding through class participation, responses to questions, and engagement in discussions.Completion and comprehension of any assigned follow-up questions or reflections on the topic.Nearpod Quiz on power Electronics. <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>



Lesson Plan No. 25	Course Name: Smart grid	Course No.: EE-604
Objectives	At the end of the lesson the student shall be able to: a. Understand the principles and operation of single-phase half-wave controlled converters. b. Analyze the waveforms and performance characteristics of these converters. c. Calculate relevant parameters such as average output voltage, ripple factor, and efficiency. d. Identify applications and limitations of single-phase half-wave-controlled converters.	
Teaching Aids (if any)	a. Whiteboard and markers b. PowerPoint slides c. Handouts or reading materials on power electronics basics d. Use of Nearpod tool for online quiz	
Teaching Development	1. Introduction (10 minutes) - Briefly introduce the concept of power electronic converters. - Explain the significance of single-phase half-wave-controlled converters in various industrial applications. - Highlight the objectives of the lesson. 2. Development (30 minutes) a. Explain the structure and basic working principle of a single-phase half-wave-controlled converter. b. Draw the circuit diagram and discuss the function of each component c. Discuss the role of the thyristor in controlling the load current. d. Explain how gating signals control the firing angle of the thyristor. 3. Exercise (5 minutes) – - Divide the class into small groups and assign each group to design a basic half wave circuit for a given electronic application (e.g., a flyback converter, a motor drive). - Provide students with access to simulation software (if available) to simulate their snubber circuit designs and analyze their performance. - Encourage students to discuss their design choices and the trade-offs involved in selecting snubber components. Use Nearpod to collect responses and discuss the answers.	
Closure	1. Summarize the key points covered in the lesson. 2. Encourage students to explore additional resources or conduct further experiments to deepen their understanding of converter circuits.	



	Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	<ol style="list-style-type: none">1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.2. Evaluate students' understanding through class participation, responses to questions, and engagement in discussions.3. Completion and comprehension of any assigned follow-up questions or reflections on the topic.4. Nearpod Quiz on power Electronics. <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>



Lesson Plan No. 26	Course Name: Smart Grid	Course No.: EE-604
--------------------	-------------------------	--------------------

Objectives	At the end of the lesson the student shall be able to: a. Students will gain an understanding of smart meters and advanced metering infrastructure (AMI), including their functions, benefits, and implications for energy management and utility operations..
Teaching Aids (if any)	a. Whiteboard and markers b. PowerPoint slides (optional) c. Handouts or reading materials on power electronics basics d. Use of Nearpod tool for online quiz
Teaching Development	1. Introduction (10 minutes) - Explain what AMI is and how it integrates with smart meters. - Describe the components of AMI, including communication networks, data management systems, and meter data analysis tools. - Discuss the benefits of AMI in enabling utilities to manage electricity distribution more effectively and improve customer service. 2. Development (30 minutes) a. Summarize key concepts covered in the lesson. b. Facilitate a brief discussion or reflection activity where students can share their thoughts on the potential impact of smart meters and AMI on future energy systems and society. 3. Exercise (5 minutes) – - Organize a field trip to a local utility facility or renewable energy installation where students can observe smart meters and AMI systems in action and engage in hands-on learning activities. Use Nearpod to collect responses and discuss the answers.
Closure	1. Recap the main points covered in the lesson. 2. Encourage students to think about the role of smart grids in the future of energy distribution and the potential benefits for society and the environment. Spend 5 minutes to wrap up and consolidate the learning's.
Evaluation	1. Students can be assessed based on their participation in class discussions, completion of reflection activities, and understanding demonstrated through responses to questions during the lesson. 2. Optionally, students can be assigned a follow-up project or research assignment where they explore a specific aspect of smart meters or AMI in more depth and present their findings to the class. Spend 5 minutes to evaluate student assimilation of the lesson contents



Lesson Plan No. 27	Course Name: Smart Grid	Course No.: EE-604
Objectives	At the end of the lesson the student shall be able to: a. Students will be able to define conventional and smart grids. b. Students will understand the differences between conventional and smart grids. c. Students will analyze the advantages and disadvantages of both types of grids. d. Students will evaluate the potential impact of smart grids on energy efficiency and sustainability.	
Teaching Aids (if any)	a. Whiteboard and markers b. PowerPoint slides (optional) c. Handouts or reading materials on power electronics basics d. Use of Nearpod tool for online quiz	
Teaching Development	<ol style="list-style-type: none">1. Introduction (10 minutes)<ul style="list-style-type: none">- Begin by asking students what they know about electricity grids and how electricity is distributed.- Introduce the concept of conventional grids and smart grids. Define each term briefly:- Conventional Grid: A traditional electricity grid that relies on centralized generation, unidirectional flow of electricity, and limited monitoring and control capabilities.- Smart Grid: An advanced electricity grid that integrates digital communication technology, two-way flow of electricity and information, and advanced monitoring and control capabilities to improve efficiency, reliability, and sustainability.2. Development (30 minutes)<ol style="list-style-type: none">a. Discuss the characteristics and components of conventional grids.b. Bi-directional flow of electricity and real-time communication between various grid componentsc. Advanced monitoring and control systems (e.g., smart meters, sensors, automation)d. Enhanced grid resilience and ability to integrate renewable energy sources3. Exercise (5 minutes) –<ul style="list-style-type: none">- Divide the class into small groups and assign each group to research and prepare a brief presentation on a specific aspect of smart grids (e.g., renewable energy integration, demand response, grid resilience). <p>Use Nearpod to collect responses and discuss the answers.</p>	
Closure	<ol style="list-style-type: none">1. Recap the main points covered in the lesson.2. Encourage students to think about the role of smart grids in the	



	<p>future of energy distribution and the potential benefits for society and the environment.</p> <p>Spend 5 minutes to wrap up and consolidate the learning's.</p>
Evaluation	<ol style="list-style-type: none">1. Participation in class discussions and activities2. Accuracy and depth of understanding demonstrated in group presentations3. Completion and comprehension of any assigned follow-up questions or reflections on the topic. <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>



Lesson Plan No. 28	Course Name: Smart Grid	Course No.: EE-604
Objectives	At the end of the lesson the student shall be able to: <ol style="list-style-type: none">Students will understand the current state of development of smart grid systems.Students will learn about the key standards and protocols used in smart grid technology.Students will analyze the significance of standards in ensuring interoperability and reliability in smart grid systems.Students will evaluate the potential impact of smart grid standards on energy efficiency and sustainability.	
Teaching Aids (if any)	<ol style="list-style-type: none">Whiteboard and markersPowerPoint slides (optional)Handouts or reading materials on power electronics basicsUse of Nearpod tool for online quiz	
Teaching Development	<ol style="list-style-type: none">Introduction (10 minutes)<ul style="list-style-type: none">Start the lesson by asking students if they have heard about smart grid systems and what they understand about them.Briefly explain the concept of smart grids, emphasizing their role in modernizing the electricity grid through digital communication, advanced monitoring, and control capabilities.Development (30 minutes)<ol style="list-style-type: none">Evolution from conventional grids to smart gridsAdoption of digital technologies, such as sensors, smart meters, and automationIntegration of renewable energy sources and distributed energy resourcesImplementation of demand response programs and grid optimization techniquesresilience and ability to integrate renewable energy sourcesExercise (5 minutes) –<ul style="list-style-type: none">Discuss the importance of standards in ensuring interoperability, compatibility, and cybersecurity in smart grid systems.Facilitate a class discussion on the potential benefits of standardization in smart grids, such as improved reliability, efficiency, and scalability. <p>Use Nearpod to collect responses and discuss the answers.</p>	
Closure	<ol style="list-style-type: none">Recap the main points covered in the lesson.Summarize the key points discussed during the lesson, emphasizing the importance of standards in driving innovation and ensuring the	



	successful deployment of smart grid technologies. Spend 5 minutes to wrap up and consolidate the learning's.
Evaluation	<ol style="list-style-type: none">1. Participation in class discussions and activities2. Accuracy and depth of understanding demonstrated in group presentations3. Completion and comprehension of any assigned follow-up questions or reflections on the topic. Spend 5 minutes to evaluate student assimilation of the lesson contents



Lesson Plan No. 29	Course Name: Smart Grid	Course No.: EE-604
--------------------	-------------------------	--------------------

Objectives	At the end of the lesson the student shall be able to: a. Students will understand the functions, opportunities, and barriers of smart grid technology, including its potential benefits and challenges in modern energy systems.
Teaching Aids (if any)	a. Whiteboard and markers b. PowerPoint slides (optional) c. Handouts or reading materials on power electronics basics d. Use of Nearpod tool for online quiz
Teaching Development	<ol style="list-style-type: none">Introduction (10 minutes)<ul style="list-style-type: none">Begin the lesson by revisiting the concept of a smart grid briefly, emphasizing its modernized and digitally enhanced nature compared to traditional power grids.Introduce the concept of a smart grid as a modernized electrical grid that uses digital technology to monitor and manage the flow of electricity more efficiently.Development (30 minutes)<ol style="list-style-type: none">Present a slideshow or use visual aids to discuss the functions of a smart grid, including:<ul style="list-style-type: none">Enhanced reliability and resilienceImproved efficiency in electricity generation, transmission, and distributionIntegration of renewable energy sources and distributed energy resources (DERs)Optimization of energy use through demand response programs and real-time monitoringHighlight how these functions contribute to a more sustainable, flexible, and adaptable energy infrastructure.Exercise (5 minutes) –<ul style="list-style-type: none">Divide the class into small groups and assign each group one opportunity or barrier related to smart grid technology.Have each group discuss and brainstorm potential strategies or solutions for addressing their assigned opportunity or barrier.Encourage groups to consider both technical and non-technical factors in their discussions.Use Nearpod to collect responses and discuss the answers.
Closure	<ol style="list-style-type: none">Summarize the key points covered in the lesson, emphasizing the multifaceted nature of smart grid technology and its potential to transform the energy landscape.Encourage students to continue exploring the topic and consider their role in shaping the future of energy systems. Spend 5 minutes to wrap up and consolidate the learning's.



Evaluation

- Assess students based on their participation in group discussions, the quality of their contributions, and their ability to critically analyze the opportunities and barriers of smart grid technology.
 - Nearpod Quiz on Smart Grid.
- Spend 5 minutes to evaluate student assimilation of the lesson contents