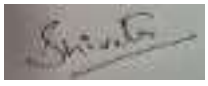
Department of Electronics and Communication Engineering

Details of Lesson Plan

S.No.	Particulars	Details
1.	Course Name	Advanced Mobile Technologies
2.	Course Code	ECE-701(B)
3.	Academic Year	2024-2025
4.	Semester	7th
5.	Number of Lesson plans	48
6.	Faculty Assigned	Ms. Shiveta Bhat



Faculty Signature

Lesson Plan No. 0	Course Name: Advanced Mobile Technologies Introduction to Course	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Understand the evolution of mobile communication from 1G to 5G. b. Articulate the basic concepts, key features, architecture and challenges of 5G networks. c. Explore the current state, challenges, and future trends in 5G and beyond. d. Recognize the potential and applications of Terahertz and 6G technology.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction** (5 minutes) - Ask questions. - How did the transition from 1G to 5G impact mobile communication technology? - What key features distinguish each generation (1G, 2G, 3G, 4G, 5G)? - How do modern applications like video streaming benefit from 4G and 5G technologies? - What are the expected advancements in communication with the introduction of 6G? - **The evolution of mobile networks**: Mobile communication has evolved from simple voice services in 1G to advanced data services in 5G. Each generation brought significant improvements in speed, connectivity, and services. - **Impact on society and technology**: The study of mobile networks is crucial for understanding modern communication, enabling technological advancements, and driving global connectivity. - Highlight the importance of mobile technology in daily life. - Discuss course outcomes. **Development** (30 minutes) a **Why Mobile Communication Evolution?** - Discuss the importance of mobile communication in today's digital age. - Benefits of Mobile Communication Evolution • Resource Sharing • Enhanced Communication • Data Exchange and Connectivity - Show a video on the Evolution of Mobile Communication:

	- **YouTube Video:** "The Evolution of Mobile Networks: From 1G to 5G" **https://youtu.be/bGxhPG3H5BQ?si=wC0lhbDttD-G8i5g** **b Career & Job Perspective** - Network Engineer, 5G Solutions Architect, and Wireless Communication Specialist. - Discussion on certifications: • Cisco Certified Network Professional (CCNP) • Certified Wireless Network Professional (CWNP) • 5G Network Specialist Certification - Introduction to networking courses available on platforms like Coursera and LinkedIn Learning **c Future Trends in Mobile Communication (10 minutes):** - Real-time examples and emerging technologies: • 6G and Terahertz Communication: • **Network Function Virtualization (NFV)** • **Internet of Things (IoT)** • Software-Defined Networking (SDN) - Discuss how these trends are shaping the future of mobile communication and job opportunities
Closure	1. Summarize the lesson, correlating with learning outcomes 2. Encourage students to explore further reading and online resources **Suggested Reading:** "Wireless Communications" by T.L Singal, Chapter 13, pp 517-530. "An Introduction to LTE: LTE, LTE-Advanced, SAE, VoLTE and 4G Mobile Communications" by Christopher Cox, Chapter 1, pp 1-17. "5G Mobile and Wireless Communications Technology" by Afif Osseiran, José F. Monserrat, and Patrick Marsch, Chapter 3, pp 50-71.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. **1.** What is mobile communication, and why is it important in today's connected world? **2.** Can you think of some everyday activities that rely on mobile networks? **3.** Which career roles in mobile communication and networking interest you the most, and why? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 1	Course Name: Advanced Mobile Technologies Topic: Introduction to Mobile Technology	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Articulate the basic concept of mobile technology and its components. b. Explain the evolution of mobile technology. c. Illustrate the various applications of mobile technology. d. Appreciate the advantages of mobile technology in real-life applications.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction** (5 minutes) - Introduce the basics of mobile technology. - Discuss the evolution of mobile technology. - Talk about the different types of mobile devices available in the market today. - Define mobile technology formally. - Highlight the importance of mobile technology in daily life. **Development** (30 minutes) a Mobile Technology - Introduce the concept of mobile technology. - Show a video on the evolution of mobile technology. - Introduce the concept of mobile network systems (2G, 3G, 4G, 5G). b Applications and Benefits - Illustrate various applications of mobile technology (e.g., communication, navigation, mobile apps, remote work). - Discuss the advantages of mobile technology: c Interfacing and Utilities - Highlight the importance of mobile technology interfacing with other devices and systems (e.g., IoT). - Discuss utilities and tools associated with mobile technology (e.g., mobile operating systems, app stores). - Exercise (5 minutes) – Give students time to discuss the various applications and benefits of mobile technology.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture

	https://youtu.be/d7zeaz-NjmM 3. Homework Ask students to make a chart explaining the evolution of mobile technology discussing the advancement in features over the time. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. **1.** What are the essential components of a mobile communication system? **2.** Why is mobile technology critical for global communication and connectivity? **3.** Who benefits the most from advancements in mobile technology? Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 2	Course Name: Advanced Mobile Technologies Topic: Analog voice systems in 1G, digital radio systems in 2G	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Describe the key characteristics and functionality of analog voice systems in 1G and digital radio systems in 2G. b. Compare and contrast the transition from analog to digital systems, focusing on improvements in voice and messaging services. c. Identify and explain the impact of these technologies on modern communication practices.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction** (5 minutes) - Are you familiar with 1G and 2G networks? - What are the main differences between analog and digital communication systems? - How do you use voice and messaging services on your device? - Introduce the basics of analog and digital radio systems. - Discuss the evolution of mobile communication technologies from 1G to 2G. - Define key terms such as analog voice systems, digital radio systems, and voice/messaging services formally. - Highlight the importance of these technologies in the development of mobile communication. **Development** (30 minutes) a Analog Voice Systems in 1G - Describe the concept and characteristics of 1G technology and analog voice systems. - Show a video on the history and impact of 1G systems. - Explain how analog voice systems operate and their limitations (e.g., limited capacity, susceptibility to interference). b Digital Radio Systems in 2G - Describe the concept and characteristics of 2G technology and digital radio systems. - Show a video or provide a detailed explanation of the transition from analog to digital systems. - Compare and contrast the improvements made with digital systems, including better voice quality, increased capacity, and the introduction of SMS (Short Message Service). b. Voice and Messaging Services - Illustrate the evolution and impact of voice and messaging services with the advent of 2G technology. - Explain the benefits and advancements in digital voice and

	messaging services, such as improved reliability and enhanced features. - Discuss how these advancements have influenced modern communication practices. - Exercise (5 minutes) – Give students time to discuss the evolution of voice and messaging services and the benefits of digital technologies over analog systems.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/FwtVorAfEss 3. Homework Ask students to create a chart or timeline illustrating the evolution from 1G to 2G technologies, highlighting advancements in voice and messaging services. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What were the primary limitations of analog voice systems in 1G mobile networks? 2. What improvements did digital radio systems in 2G introduce over the analog systems of 1G? Why? 3. Why was the transition from analog to digital technology in mobile networks important for enhancing voice quality and security? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 3	Course Name: Advanced Mobile Technologies Topic: 2.5 G (GPRS)	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Describe the key features and functionality of 2.5G technology, with a focus on General Packet Radio Service (GPRS). b. Explain how GPRS improved upon 2G technology and its impact on mobile communications. c. Illustrate the various applications and benefits of GPRS technology
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction** (5 minutes) - Introduce the basics of 2.5G technology and GPRS. - Discuss the evolution from 2G to 2.5G. - Define GPRS formally and explain its role in enhancing mobile networks. - Highlight the importance of GPRS in the development of mobile communication technologies. **Development** (30 minutes) a Introduction to GPRS - Describe GPRS as a key feature of 2.5G technology. - Explain the fundamental concepts of GPRS, including packet-switched data transmission. b Enhancements from 2G to GPRS - Compare 2G and GPRS technologies, focusing on: - Improved data transfer rates (from 9.6 kbps in 2G to up to 114 kbps in GPRS) - Introduction of packet-switched data for more efficient data transmission - Support for new services such as multimedia messaging (MMS) and mobile internet browsing - Discuss how GPRS provided a stepping stone towards 3G technology by enabling more sophisticated data services. c Applications and Benefits - Discuss the various applications of GPRS technology. - Explain the benefits of GPRS. - Exercise (5 minutes) – Give students time to discuss examples of applications enabled by GPRS and how it improved their mobile experiences.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture

	https://blogmech.com/what-is-2-5g-technology-second-and-a-half-generation/ 3. Homework Ask students to create a table detailing the improvements brought by GPRS over 2G technology, highlighting key applications and benefits. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What were the key features of 2.5G (GPRS) that distinguished it from earlier 2G networks? 2. Why was the introduction of GPRS considered a significant step towards mobile data services and internet access? 3. How did GPRS change mobile user behavior? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 4	Course Name: Advanced Mobile Technologies Topic: 2.75 G (EDGE)	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Explain the key advancements and features of 2.75G technology, focusing on EDGE (Enhanced Data rates for GSM Evolution). b. Compare the improvements made by EDGE over GPRS, including enhancements in data speeds and network efficiency. c. Analyze the role of EDGE in the transition from 2G to 3G technologies and its significance in the evolution of mobile networks.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction** (5 minutes) - What do you know about EDGE or 2.75G technology? - How might EDGE technology differ from GPRS in terms of performance? - Why do you think advancements in mobile technology are important? - Introduce the basics of 2.75G technology and EDGE. - Discuss the evolution from 2.5G (GPRS) to 2.75G (EDGE). - Define EDGE formally and explain its role in improving mobile network performance. - Highlight the importance of EDGE in advancing mobile communication technologies. **Development** (30 minutes) a Introduction to EDGE - Describe EDGE as an enhancement over 2.5G technology (GPRS). - Explain the core concepts of EDGE, including its enhanced data rates and improved modulation techniques. b Comparing EDGE and GPRS - Compare EDGE with GPRS, focusing on: o Data transfer rate improvements (from up to 114 kbps in GPRS to up to 384 kbps in EDGE) o Enhanced data transmission through 8PSK (8 Phase Shift Keying) modulation o Improved network capacity and efficiency - Discuss how these improvements affected mobile communication services and user experience. c Impact and Applications - Analyze the impact of EDGE technology on mobile services. - Discuss the benefits of EDGE technology:

	- Exercise (5 minutes) – Give students time to discuss how EDGE improved upon GPRS and the impact it had on mobile services and user experience.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://blogmech.com/what-is-2-5g-technology-second-and-a-half-generation/ 3. Homework Ask students to create a table comparing EDGE and GPRS, highlighting key advancements, applications, and the role of EDGE in the evolution of mobile networks. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What technological advancements did EDGE bring to mobile networks compared to GPRS? 2. Why was EDGE considered a crucial step towards faster mobile data speeds before the transition to 3G? 3. Who were the primary users of EDGE technology, and how did it influence their mobile internet experience? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 5	Course Name: Advanced Mobile Technologies Topic: 3G UMTS (IMT 2000), 3G services and data rates	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Explain the key advancements and features of 3G UMTS technology, emphasizing its role in the IMT 2000 standard. b. Compare the improvements made by 3G over 2.75G EDGE, including enhancements in data speeds and network capabilities. c. Analyze the impact of 3G technology on mobile communication services and its significance in the evolution of mobile networks.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction** (5 minutes) - Define UMTS as part of the 3G family of standards within the IMT 2000 framework. - What do you know about 3G technology and UMTS? - How might 3G technology differ from EDGE in terms of performance and services? - Why do you think advancements in mobile technology are crucial? **Development** (30 minutes) a Introduction to 3G UMTS - Describe UMTS as an enhancement over 2.75G technology (EDGE). - Explain core concepts of UMTS, including: o Wideband CDMA (W-CDMA) as the air interface technology. o Increased data rates and capacity for supporting multimedia services. - Compare 3G UMTS with 2.75G EDGE, focusing on: b Impact and Applications - Analyze the impact of 3G UMTS technology on mobile services. - Discuss the global adoption and standardization of 3G UMTS as part of the IMT 2000 standard. - Exercise (5 minutes) – - Have students discuss how 3G UMTS improved upon EDGE in terms of speed, capacity, and user experience. - Discuss the new services and applications made possible by 3G technology.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation

	from students on these. 2. Suggested Video Lecture https://youtu.be/7IAYkjRzsoU 3. Homework Ask students to create a table comparing 3G UMTS and 2.75G EDGE, highlighting key advancements, applications, and the role of UMTS in the evolution of mobile networks. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What were the major innovations introduced with 3G UMTS (IMT-2000) compared to previous mobile network generations? 2. Why was the introduction of higher data rates in 3G critical for the development of mobile services. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 6	Course Name: Advanced Mobile Technologies Topic: 4G (IMT Advanced)	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Describe the core features and technological advancements of 4G networks, focusing on the IMT Advanced standards. b. Distinguish between 3G and 4G technologies. c. Evaluate the impact of 4G technology on the expansion of mobile services and its role in supporting modern applications.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction** (5 minutes) - What do you know about 4G technology and its capabilities? - How do you think 4G technology differs from 3G in terms of speed and service quality? - Why are advancements in mobile networks crucial for modern applications like IoT and streaming services? **Development** (30 minutes) a **Introduction to 4G (IMT Advanced)** - Define 4G as part of the IMT Advanced family of standards. - Briefly discuss the evolution from 3G UMTS to 4G LTE (Long Term Evolution). - Explain the use of technologies like OFDM (Orthogonal Frequency-Division Multiplexing) and MIMO (Multiple Input Multiple Output) to enhance data throughput and spectrum efficiency. - Highlight support for all-IP (Internet Protocol) networks, leading to improved integration of services and applications. **b Comparing 3G and 4G Technologies** - **Data Transfer Rates and Latency:** o 3G UMTS: Speeds up to 2 Mbps, with latency in tens of milliseconds. o 4G LTE: Speeds exceeding 100 Mbps (up to 1 Gbps in some cases), with reduced latency (around 10 milliseconds). - **Network Architecture:** o Transition from circuit-switched and packet-switched networks (3G) to fully IP-based architecture (4G). o Enhanced capacity for handling high volumes of data traffic, supporting more users and devices simultaneously. - **Service and Application Support:** o Introduction of HD video streaming, real-time gaming, and more reliable video conferencing. o Enhanced support for Internet of Things (IoT) applications due to improved network efficiency and lower latency.

	- Exercise (5 minutes) – - Have students discuss how 4G technology has transformed mobile services and user experiences, compared to 3G. - Encourage students to consider the future implications of these technologies, including the transition to 5G.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/Vx9Gt3PfD1U 3. Homework Ask students to create a table comparing 3G UMTS and 4G LTE, highlighting key advancements, applications, and the role of 4G in the evolution of mobile networks.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What were the defining features of 4G (IMT-Advanced) compared to 3G, particularly in terms of data rates and services? 2. Why did 4G technology enable the rise of applications such as HD video streaming, mobile gaming, and IoT devices? 3. Who were the primary beneficiaries of 4G's increased speed and capacity, and how did it shape the digital economy and mobile user experience? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 7	Course Name: Advance Mobile Technology Topic: LTE	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Explain the key features and technological advancements of LTE (Long Term Evolution). b. Identify the differences between LTE and previous mobile network technologies. c. Assess the impact of LTE on mobile communication services.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - LTE technology and its capabilities - How does LTE improve upon previous generations like 3G and even early 4G technologies? - Why is high-speed and low-latency important for mobile applications today? **Development (30 minutes)** a Introduction to LTE - Define LTE as a key standard within 4G networks - LTE Network Capabilities - LTE Network Requirements - Explain the use of MIMO (Multiple Input Multiple Output) technology to enhance data throughput and spectrum efficiency. - Emphasize the all-IP network architecture, which supports seamless integration of voice, data, and multimedia services. - Comparing LTE with Previous Technologies - - **Exercise (5 minutes) –** - Ask students to discuss on how LTE technology has changed the landscape of mobile communication compared to previous generations.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/OrDID6d54RY 3. Homework Ask students to create a table comparing LTE and earlier 4G technologies, highlighting key advancements, applications, and the impact of LTE on modern mobile services.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What are the key technological advancements in LTE that differentiate it from previous mobile communication standards?

	2. Why was LTE developed, and what challenges in mobile communication was it designed to address? 3. Who benefits most from the implementation of LTE, and in what ways? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 8	Course Name: Advance Mobile Technology Topic: VoLTE	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Articulate the key features and technological principles behind VoLTE (Voice over LTE). b. Compare VoLTE with traditional voice services over 2G and 3G networks, highlighting improvements in call quality and network efficiency.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Introduction to VoLTE and how it differs from traditional voice calls? - Why do you think advancements in voice communication technology are important? - What benefits might users experience with VoLTE compared to older technologies? **Development (30 minutes)** a Introduction to VoLTE - Define VoLTE as a technology that enablsses high-quality voice calls over LTE networks. - VoLTE Network Capabilities - VoLTE Network Requirements - Briefly discuss the transition from circuit-switched voice networks to all-IP-based systems with VoLTE. - Discuss the benefits of using LTE's high-speed data network for voice communication. **Exercise (5 minutes) –** - Consider the implications of VoLTE for future communication technologies, including the transition to 5G.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/Vx9Gt3PfD1U 3. Homework Ask students to create a comparison table of VoLTE versus traditional voice services, focusing on aspects like call quality, network efficiency, and user experience.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. **1.** What are the key differences between VoLTE and traditional voice

	services in mobile networks? **2.** Why is VoLTE considered more efficient and beneficial compared to older voice technologies like 2G and 3G? **3.** Who benefits from the adoption of VoLTE, and how does it enhance the user experience? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 9	Course Name: Advance Mobile Technology Topic: OFDM	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Explain the role of OFDM (Orthogonal Frequency-Division Multiplexing) in advanced mobile technologies. b. Identify the specific benefits OFDM provides to mobile communication systems, including spectral efficiency, robustness to interference, and support for high data rates.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - What do you know about OFDM and its use in mobile networks? - How might OFDM improve mobile communication compared to older technologies? - Why is it important for mobile networks to efficiently manage bandwidth and interference? **Development (30 minutes)** a Introduction to VoLTE - Define OFDM as a fundamental technology in advanced mobile communication systems. - Briefly discuss the transition from traditional modulation techniques to OFDM in LTE and 5G networks. - OFDM Modulator - OFDM system Working - Frequency Time representation - Uses of OFDM - **Exercise (5 minutes) –** - Ask students students to discuss the advantages of OFDM in advanced mobile technologies and how it has transformed mobile communications.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/4I-Qbc_inIc https://youtu.be/J6CuUcKhlHU 3. Homework Ask students to write a short note on the role of OFDM in the evolution from 4G LTE to 5G, highlighting specific technological advancements and their implications for mobile services.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and

	discuss. **1.** What challenges in wireless communication does OFDM address, and how does it manage to do so? **2.** Why is OFDM chosen as the modulation technique in technologies like LTE and Wi-Fi? **3.** How does OFDM handle issues like interference and multipath fading in communication systems? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 10	Course Name: Advance Mobile Technology Topic: LTE Advanced Pro (3GPP Release 13+)	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Describe the key features and enhancements introduced in LTE Advanced Pro (3GPP Release 13+). b. Explain the technological advancements that distinguish LTE Advanced Pro from earlier LTE and LTE-Advanced versions.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - What do you know about LTE Advanced Pro and how it builds on previous LTE technologies? - Why do you think continual improvements in mobile network technology are necessary? - What new capabilities do you think LTE Advanced Pro introduces that were not present in earlier LTE releases? - **Development (30 minutes)** a Introduction to VoLTE - Define LTE Advanced Pro as a further evolution of LTE and LTE-Advanced, starting from 3GPP Release 13. - Briefly discuss the role of LTE Advanced Pro in enhancing existing LTE networks while paving the way for 5G technologies. What are R13 and R14? What will LTE-A Pro do? How will it do it? - **Exercise (5 minutes) –** - Ask students students to discuss the significance of LTE Advanced Pro in the context of mobile network evolution and its impact on both operators and end-users
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/OrDID6d54RY 3. Homework Ask students to create a presentation or report on the advancements in LTE Advanced Pro (3GPP Release 13+), focusing on a specific feature or technology and its real-world applications.

Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What key enhancements and features distinguish LTE Advanced Pro from earlier versions of LTE and LTE Advanced? 2. Why was LTE Advanced Pro introduced, and how does it address the growing demands for higher data rates and more efficient spectrum usage? 3. How does LTE Advanced Pro contribute to the evolution towards 5G, and what role does it play in bridging the gap between LTE and 5G technologies? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 11	Course Name: Advance Mobile Technology Topic: 5G (IMT 2020) 5G potential and applications	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Understand and articulate the core features and technological advancements of 5G (IMT 2020). b. Recognize the transformative potential of 5G across various sectors. c. Evaluate the specific use cases and real-world applications of 5G, considering both current deployments and future possibilities.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - What are your current perceptions of 5G technology? - How do you think 5G might change everyday technologies and services? - What industries or sectors do you think will benefit most from 5G? - **Development (30 minutes)** a Introduction to IMT-2020 - Usage scenario - Provide a brief overview of 5G technology and its significance as the next generation of mobile networks. - Highlight the major goals and capabilities that differentiate 5G from previous technologies. - IMT-2020 Capabilities - Block Diagram - Architecture of 5G - Spectrum Diverse Applications and Use Cases of 5G - **Exercise (5 minutes) –** - Encourage students to identify potential challenges and ethical considerations associated with widespread 5G adoption.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/qwg3viAUuRQ https://youtu.be/khsqASfv2T4 3. Homework Ask students to research and present a report on a specific 5G application or case study, detailing its implementation, benefits, and challenges.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and

	discuss. 1. What are the key technological innovations in 5G that enable it to support new and diverse applications compared to previous generations of mobile networks? 2. Why is 5G considered a transformative technology for industries like healthcare, transportation, and smart cities? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 12	Course Name: Advance Mobile Technology Topic: Introduction to enhanced mobile broadband (eMBB)	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Understand and explain the concept and core features of eMBB in the context of 5G technology. b. Recognize the applications and benefits of eMBB in various sectors. c. Evaluate real-world use cases and implications of eMBB.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - What do you know about 5G and its key features? - Have you heard of eMBB? What do you think it might involve? - How do you think high-speed and high-capacity data can transform daily life and industries? - - **Development (30 minutes)** a Explain eMBB and how it fits within the 5G framework as defined by IMT-2020. - Highlight the importance of eMBB in providing high-speed - Key Drivers of eMBB - Nature and purpose of eMBB - **Exercise (5 minutes)** - Engage students in a discussion on potential challenges associated with eMBB, such as data privacy and network security.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/1QUxP3UXH6k 3. Homework Ask students to research and present a report on the use cases for eMBB across the three deployment Scenarios
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What advancements in 5G technology make Enhanced Mobile Broadband (eMBB) possible, and how does it improve user experiences compared to previous networks? 2. Why is eMBB essential for supporting emerging applications like

	immersive media and cloud-based services in 5G networks? 3. How does eMBB contribute to the broader goals of 5G, particularly in enabling high-speed connectivity in densely populated areas? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 13	Course Name: Advance Mobile Technology Topic: Introduction to enhanced mobile broadband (eMBB)	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Understand and explain the concept and core features of eMBB in the context of 5G technology. b. Recognize the applications and benefits of eMBB in various sectors. c. Evaluate real-world use cases and implications of eMBB.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Ask questions. - What do you know about 5G and its key features? - Have you heard of eMBB? What do you think it might involve? - How do you think high-speed and high-capacity data can transform daily life and industries? - - **Development (30 minutes)** Three deployment scenarios for eMBB. - Performance characteristics of eMBB's. - Examples of use cases for eMBB across the three deployment scenarios - Discuss the key features and capabilities - **Exercise (5 minutes)** - Engage students in a discussion on potential challenges associated with eMBB, such as data privacy and network security.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/1QUxP3UXH6k 3. Homework Ask students to research and present a report on the use cases for eMBB across the three deployment Scenarios
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What advancements in 5G technology make Enhanced Mobile Broadband (eMBB) possible, and how does it improve user experiences compared to previous networks?

	2. Why is eMBB essential for supporting emerging applications like immersive media and cloud-based services in 5G networks? 3. How does eMBB contribute to the broader goals of 5G, particularly in enabling high-speed connectivity in densely populated areas? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 14	Course Name: Advance Mobile Technology Topic: Ultra-Reliable Low Latency Communications (URLLC)	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Understand and articulate the core features of URLLC. b. Identify and analyze various applications and sectors that benefit from URLLC. c. Critically evaluate the potential challenges, and limitations associated with URLLC.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - What do you know about 5G and its different features? - Have you heard of URLLC? What do you think it might involve? - Why do you think ultra-reliability and low latency are important in modern communications? - **Development (30 minutes)** a **Introduction to URLLC in 5G** - Explain URLLC and its role in the 5G ecosystem as defined by IMT-2020. - Highlight the significance of achieving ultra-reliable and low-latency communications for critical applications. - Discuss the Key Features and Capabilities of URLLC . - **Exercise (5 minutes)** - Engage students in a discussion on potential risks or challenges in ensuring ultra-reliable and low-latency communication and how might these challenges affect the deployment of URLLC-dependent technologies in everyday life?
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/QvCmowEz8PE 3. Homework Ask students to research and present a report on the two important applications of URLLC in critical missions.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and

	discuss. 1. What are the key characteristics of Ultra-Reliable Low Latency Communications (URLLC), and how do they differ from other 5G use cases like eMBB? 2. Why is URLLC critical for applications such as autonomous vehicles and remote surgery, and what challenges does it address in these scenarios? 3. How does URLLC ensure high reliability and low latency, and what technological innovations make these capabilities possible in 5G networks? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 15	Course Name: Advance Mobile Technology Topic: Ultra-Reliable Low Latency Communications (URLLC)	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Understand and articulate the core features of URLLC. b. Identify and analyze various applications and sectors that benefit from URLLC. c. Critically evaluate the potential challenges, and limitations associated with URLLC.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - What do you know about 5G and its different features? - Have you heard of URLLC? What do you think it might involve? - Why do you think ultra-reliability and low latency are important in modern communications? - **Development (30 minutes)** a **Introduction to URLLC in 5G** - Describe how the 5G architecture supports URLLC, including edge computing, network slicing, and the use of new radio - Nature and purpose of URLLC technologies. - Key drivers of URLLC. . - **Exercise (5 minutes)** - Engage students in a discussion on potential risks or challenges in ensuring ultra-reliable and low-latency communication and how might these challenges affect the deployment of URLLC-dependent technologies in everyday life?
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/QvCmowEz8PE 3. Homework Ask students to research and present a report on the two important applications of URLLC in critical missions.
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.

	2. What are the key characteristics of Ultra-Reliable Low Latency Communications (URLLC), and how do they differ from other 5G use cases like eMBB? 3. Why is URLLC critical for applications such as autonomous vehicles and remote surgery, and what challenges does it address in these scenarios? 4. How does URLLC ensure high reliability and low latency, and what technological innovations make these capabilities possible in 5G networks? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 16	Course Name: Advance Mobile Technology Topic: Massive Machine Type Communications (MMTC)	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Understand the core features of mMTC in 5G. b. Identify and discuss the various applications and benefits of mMTC. c. Assess the challenges, limitations, and considerations associated with the implementation and deployment of mMTC.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Ask questions. - What do you know about 5G and its different features? - Have you heard of mMTC? What do you think it might involve? - **Development (30 minutes)** a Introduction to mMTC in 5G - Explain what mMTC is and its significance within the 5G ecosystem, particularly in supporting a vast number of IoT devices. - Highlight the importance of mMTC in enabling smart cities, industrial IoT, and other large-scale deployments of connected devices. - **Exercise (5 minutes)** - Engage students in a discussion on challenges that might arise from connecting so many devices to the internet and how could mMTC affect data privacy and security?
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/ZTm_gQ_vmsU https://youtu.be/rMdslj_fumc 3. Homework Ask students to present a report on description of the application and its use of mMTC.and is benefits .
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss.

	1. What defines Massive Machine Type Communications (mMTC), and how does it facilitate communication for a vast number of connected devices? 2. Why is mMTC essential for the Internet of Things (IoT), and what specific challenges does it address in managing and connecting large-scale deployments of devices? 3. How does mMTC contribute to the overall goals of 5G, particularly in terms of scalability and efficiency in supporting diverse IoT applications? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 17	Course Name: Advance Mobile Technology Topic: Massive Machine Type Communications (MMTC)	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Understand the core features of mMTC in 5G. b. Identify and discuss the various applications and benefits of mMTC. c. Assess the challenges, limitations, and considerations associated with the implementation and deployment of mMTC.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Ask questions. - What do you know about 5G and its different features? - Have you heard of mMTC? What do you think it might involve? - **Development (30 minutes)** a Introduction to mMTC in 5G - Key drivers of Mmtc - Nature and purpose of mMTC • Performance requirements for mMTC. • Overview of the IOT. • Relationship between mMTC and IoT. • Relationship between mMTC defined by ITU-R, and two concepts introduced by 3GPP: NB-IoT and eMTC. • Two important applications of mMTC - **Exercise (5 minutes)** - Engage students in a discussion on challenges that might arise from connecting so many devices to the internet and how could mMTC affect data privacy and security?
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/ZTm_gQ_vmsU https://youtu.be/rMdslj_fumc 3. Homework Ask students to present a report on description of the application and its

	use of mMTC.and is benefits .
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What defines Massive Machine Type Communications (mMTC), and how does it facilitate communication for a vast number of connected devices? 2. Why is mMTC essential for the Internet of Things (IoT), and what specific challenges does it address in managing and connecting large-scale deployments of devices? 3. How does mMTC contribute to the overall goals of 5G, particularly in terms of scalability and efficiency in supporting diverse IoT applications? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 18	Course Name: Advance Mobile Technology Topic: D2D communications	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Articulate the concept and technological aspects of D2D communications in 5G. b. Identify and evaluate the practical applications and benefits of D2D communications, focusing on its impact on various industries and user experiences. c. Analyze the technical, security, and regulatory challenges involved in deploying D2D communications.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Ask questions. - What do you understand by "Device-to-Device communications"? - Can you think of situations where direct communication between devices might be beneficial? - How might D2D communications differ from traditional cellular communication? - **Development (30 minutes)** a Introduction to D2D Communications in 5G - Explain what D2D communications are and how they enable devices to communicate directly without going through a base station. - Highlight the significance of D2D in the context of 5G, where it can improve efficiency, reduce latency, and enhance spectrum utilization. - Discuss the Key Features and Capabilities Typical use cases of D2D in Cellular networks Multi Hop D2D Communications Issues in D2D communication Merits of D2D communication - **Exercise (5 minutes)** - Ask students to have a discussion on the security concerns that might arise from allowing devices to communicate directly?
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture

	https://youtu.be/wemGoruvqI8 3. Homework Ask students to present a report on description of the application and how D2D communications are utilized.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What is Device-to-Device (D2D) communication, and how does it differ from traditional network communication methods? 2. Why is D2D communication beneficial for improving network efficiency and user experience, particularly in scenarios with high device density or intermittent network coverage? 3. How does D2D communication support new applications and services, such as localized content sharing and enhanced emergency services, within the context of 5G and beyond? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 19	Course Name: Advance Mobile Technology Topic:	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Understand and explain the concept and components of V2X communications in 5G. b. Identify and assess the various applications and benefits of V2X communications.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Introduce the concept of V2X technology and its relevance in modern transportation. - Briefly discuss the evolution of communication technologies in vehicles. - Define V2X technology formally. - Highlight the importance of V2X technology in enhancing road safety and efficiency. - **Development (30 minutes)** a Understanding V2X Technology - Explain what V2X stands for: Vehicle-to-Everything. - Discuss the different components of V2X technology: Vehicle-to-Vehicle (V2V), Vehicle-to-Infrastructure (V2I), Vehicle-to-Pedestrian (V2P), and Vehicle-to-Network (V2N). - Illustrate various applications of V2X technology, such as traffic management, accident prevention, navigation, and communication with pedestrians and infrastructure. - Discuss the advantages of V2X technology. - Highlight the importance of V2X technology interfacing with other systems. - **Exercise (5 minutes)** - Ask students to have a discuss the various applications and benefits of V2X technology.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/--OdhLEertk 3. Homework Ask students to create a presentation or report on the potential future

	developments and challenges of V2X technology. They should include advancements in features and discuss potential societal impacts.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What is V2X communication, and how does it enhance smart transportation? 2. Why is V2X important for road safety and traffic efficiency? 3. How does V2X support autonomous vehicles and smart city development? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 20	Course Name: Advance Mobile Technology Topic: Spectrum for 5G, spectrum access/sharing	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Understand the different frequency bands used in 5G technology. b. Explain the importance of spectrum allocation and access for 5G.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Introduce the concept of spectrum in wireless networks and its importance. - Define key terms: spectrum, frequency bands, and spectrum allocation. - **Development (30 minutes)** a Spectrum for 5G - Discuss the different frequency ranges used in 5G, categorized into low-band, mid-band, and high-band (millimeter wave) spectrum. ▪ **Low-Band Spectrum**: <1 GHz, provides wide coverage and good penetration. ▪ **Mid-Band Spectrum**: 1-6 GHz, offers a balance of coverage and capacity. ▪ **High-Band Spectrum**: >24 GHz (millimeter waves), provides high data rates but limited coverage and penetration. - **Exercise (5 minutes)** - Ask students to have a group discussion or a small exercise where they analyze a case study on spectrum allocation in a specific region.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/V29Est6Nsfk?t=341 https://youtu.be/zoiIMXTLO8w 3. Homework Ask students to research and prepare a report on how different countries are managing spectrum allocation for 5G. They should focus on the challenges and innovative solutions adopted in at least two different regions.

Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. **1.** What types of spectrum are utilized for 5G, and how do they impact network performance and coverage? **2.** Why is spectrum access and sharing critical for maximizing the efficiency and deployment of 5G networks? **3.** How do spectrum management strategies and sharing agreements influence the availability and quality of 5G services? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 21	Course Name: Advance Mobile Technology Topic: Spectrum for 5G, spectrum access/sharing	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Describe the concepts of spectrum sharing and the various methods used. b. Appreciate the challenges and solutions in spectrum management for 5G networks
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Introduce the concept of spectrum in wireless networks and its importance. - Define key terms: spectrum, frequency bands, and spectrum allocation. - **Development (30 minutes)** a Spectrum Access and Sharing - Discuss how operators gain access to spectrum, including licensing, auctions, and unlicensed spectrum use. - Introduce the concept of spectrum sharing and its importance in efficiently utilizing spectrum resources. - Explain different spectrum sharing techniques: ▪ **Dynamic Spectrum Sharing (DSS)**: Allows 4G and 5G to share the same frequency bands. ▪ **Licensed Shared Access (LSA)**: Shared use of spectrum among multiple users with coordination. ▪ **Unlicensed Spectrum and Shared Spectrum Access**: Utilization of unlicensed bands (e.g., Wi-Fi) for 5G use. - **Exercise (5 minutes)** - Ask students to have a group discussion or a small exercise where they analyze a case study on spectrum allocation in a specific region.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/V29Est6Nsfk?t=341 https://youtu.be/zoiIMXTLO8w 3. Homework

	Ask students to research and prepare a report on how different countries are managing spectrum allocation for 5G. They should focus on the challenges and innovative solutions adopted in at least two different regions.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What types of spectrum are utilized for 5G, and how do they impact network performance and coverage? 2. Why is spectrum access and sharing critical for maximizing the efficiency and deployment of 5G networks? 3. How do spectrum management strategies and sharing agreements influence the availability and quality of 5G services? Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 22	Course Name: Advance Mobile Technology Topic: Millimeter wave	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Understand what millimeter wave (mmWave) communication is and its significance in modern telecommunications. b. Explain the technical characteristics and challenges associated with mmWave communication. c. Describe the applications and advantages of mmWave technology. d. Recognize the role of mmWave communication in the development of 5G networks.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Define millimeter wave communication and explain its place within the electromagnetic spectrum (30 GHz to 300 GHz). - Highlight the growing interest in mmWave technology due to its potential in 5G networks and beyond. - **Development (30 minutes)** - Introduction to Millimeter Wave - Explain that mmWave frequencies range from 30 GHz to 300 GHz, with corresponding wavelengths ranging from 10 mm to 1 mm. - Discuss the availability of large bandwidths in the mmWave spectrum, allowing for high data rates and capacity. - Describe how mmWaves have higher attenuation and limited penetration through obstacles like walls, compared to lower frequencies. - Discuss the shorter range and susceptibility to atmospheric absorption and rain fade. - challenges. - Explain the role of mmWave in enabling the high-capacity, low-latency features of 5G networks, particularly in dense urban areas. - **Exercise (5 minutes)** - Assign a group activity where students design a conceptual plan for deploying mmWave technology in a smart city, considering aspects like coverage, infrastructure, and use cases. - **Exercise (5 minutes)** - Ask students to discuss about the evolution of mmW Technologies

Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/x1F5zft6Qtk 3. Homework Ask students to write a brief essay on the impact of mmWave communication on a specific industry, such as healthcare, entertainment, or transportation. They should discuss both the benefits and challenges.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What makes mmWave frequencies unique compared to lower frequency bands? 2. Why is mmWave crucial for achieving high data rates in 5G? 3. What challenges does mmWave face in terms of range and obstacles? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 23	Course Name: Advance Mobile Technology Topic: New Radio (NR)	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Understand New Radio (NR) and its significance in the 5G ecosystem. b. Explain the technical characteristics and features of NR. c. Describe the applications and advantages of NR in various industries.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Define New Radio (NR) as the new radio access technology developed for 5G. - Explain NR's position within the 5G framework, focusing on its importance for delivering high-speed data, increased capacity, and low latency. **Development (30 minutes)** a Overview of New Radio (NR) - Discuss the two frequency ranges in NR: FR1 (sub-6 GHz) and FR2 (millimeter waves). - Highlight the flexibility of NR in supporting a wide range of frequencies, bandwidths, and deployment scenarios. - Primary Requirements - Benefits - Deployment Modes - Spectrum of NR - 5G and LTE: Key differences and bridging the gap - **Exercise (5 minutes)** Ask students to discuss the significance of Deployment modes in 5G Network.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/dxVbB-OYHmY https://youtu.be/MwCemE5N8pc 3. Homework Ask students to write a brief notes on the potential impact of NR on a specific industry, such as automotive (for autonomous vehicles),

	entertainment (for AR/VR experiences), or public safety (for critical communications).
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What is New Radio (NR), and how does it differ from previous radio access technologies? 2. Why is NR essential for the success of 5G networks? 3. How does NR support advanced features like ultra-low latency and high capacity? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 24	Course Name: Advanced Mobile Technology Topic: Standalone and non-standalone mode	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Understand the differences between Standalone (SA) and Non-Standalone (NSA) modes in 5G networks. b. Explain the technical architecture and components of both SA and NSA modes. c. Describe the advantages and challenges of deploying SA and NSA modes.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Introduce the concepts of Standalone (SA) and Non-Standalone (NSA) modes in the 5G context. - Explain the need for different deployment modes and the transition from NSA to SA. **Development (30 minutes)** a Standalone (SA) Mode - Describe SA mode as a fully independent 5G network architecture. - Advantages - Challenges b Non-Standalone (NSA) Mode - 5G-NSA architecture requirements - Advantages - Challenges - **Exercise (5 minutes)** Divide students into groups to create diagrams of both SA and NSA architectures. Each group should explain the flow of data and control signals in their respective diagrams.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/9c0nehuw4Cg 3. Homework Ask students to write a brief essay comparing the potential future of telecommunications infrastructure if networks universally adopt SA mode versus continuing with NSA mode.

Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What are the key differences between Standalone (SA) and Non-Standalone (NSA) modes in 5G? 2. Why might an operator choose to deploy NSA mode before transitioning to SA mode? 3. How does SA mode enhance 5G capabilities compared to NSA mode? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 25	Course Name: Advanced Mobile Technology Topic: Non-Orthogonal Multiple Access (NOMA)	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Understand the concept of Non-Orthogonal Multiple Access (NOMA) and its significance in 5G networks. b. Explain the technical principles behind NOMA, including power domain multiplexing and successive interference cancellation (SIC).
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Introduce NOMA as a new multiple access technique used in 5G. - Explain the need for more efficient spectrum usage in 5G and how NOMA addresses this challenge. - **Development (30 minutes)** a Basics of NOMA - Non-Orthogonal Schemes for Efficient Multiple Access - NOMA - Power Domain Multiplexing - Successive Interference Cancellation (SIC) - Working of SIC - NOMA for Downlink and uplink - **Exercise (5 minutes)** Assign students to groups and have them design a simple NOMA system for a hypothetical scenario (e.g., a base station serving three users with varying channel conditions).
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/nTnojnApJ-4 3. Homework Ask students to write a brief essay discussing the potential impact of NOMA on future wireless communications, including its benefits and potential drawbacks.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What is NOMA, and how does it differ from traditional methods? 2. Why is NOMA useful for increasing spectrum efficiency?

	3. How does NOMA manage user interference? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 26	Course Name: Advanced Mobile Technology Topic: Non-Orthogonal Multiple Access (NOMA)	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Understand the concept of Non-Orthogonal Multiple Access (NOMA) and its significance in 5G networks. b. Describe the advantages of NOMA over traditional multiple access schemes. c. Discuss the practical applications and challenges of implementing NOMA in real-world scenarios.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Ask questions. - Introduce NOMA as a new multiple access technique used in 5G. - Explain the need for more efficient spectrum usage in 5G and how NOMA addresses this challenge. - **Development (30 minutes)** a Basics of NOMA - Imperfectness in NOMA - Spectral Efficiency and Energy Efficiency b Advantages of NOMA - Improved Spectral Efficiency - Better User Fairness c Challenges and Solutions - Interference Management - Complexity of SIC - - **Exercise (5 minutes)** Assign students to groups and have them design a simple NOMA system for a hypothetical scenario (e.g., a base station serving three users with varying channel conditions).
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/nTnojnApJ-4 3. Homework Ask students to write a brief essay discussing the potential impact of NOMA on future wireless communications, including its

	benefits and potential drawbacks.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What is NOMA, and how does it differ from traditional methods? 2. Why is NOMA useful for increasing spectrum efficiency? 3. How does NOMA manage user interference? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 27	Course Name: Advanced Mobile Technology Topic: Massive MIMO	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Understand the concept of Massive MIMO (Multiple Input Multiple Output) and its role in 5G networks. b. Describe the benefits of Massive MIMOs c. Discuss the challenges associated with Massive MIMO and potential solutions.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Ask questions. - Briefly introduce Massive MIMO and its significance in 5G networks. - Ask students questions to gauge their prior knowledge and to engage them in the topic. - **Development (30 minutes)** a Massive MIMO - MIMO Mechanism - Explain the basic concept of MIMO (Multiple Input Multiple Output) and how it allows for multiple data signals to be transmitted and received simultaneously. - Discuss how traditional MIMO systems operate with a few antennas. - Describe baseband beamforming, a technique used in MIMO systems to direct signal energy towards specific users. - Explain how beamforming improves signal quality and reduces interference. - Explain Massive MIMO as an extension of traditional MIMO, utilizing a large number of antennas (tens to hundreds) at the base station. - Discuss the benefits of Massive MIMO - Increased Capacity - Improved Spectral Efficiency - Better Signal Quality - Discuss the challenges of Massive MIMO - Design and Implementation Complexity - Computational Requirements - Power Consumption - **Exercise (5 minutes)**

	Ask students to discuss the significance of using Massive MIMO in 5G Network. Also, mention the importance beam formation.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/RwZn3VEzHBc 3. Homework Ask students to write a brief essay highlighting the importance of beam formation and how it improves signal quality and network capacity.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What is Massive MIMO, and how does it improve network capacity? 2. Why is Massive MIMO important for 5G performance? 3. How does Massive MIMO handle multiple user signals simultaneously? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 28	Course Name: Advanced Mobile Technology Topic: Beam Formation	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Understand the concept of beamforming and its role in Massive MIMO within 5G networks. b. Describe the benefits of beamforming. c. Discuss the challenges associated with beamforming and potential solutions.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Briefly introduce beamforming and its significance in 5G networks. - Ask students questions to gauge their prior knowledge and to engage them in the topic. - **Development (30 minutes)** a Beam Formation in Massive MIMO - Concept of Beamforming o Definition o Mechanism o Visualization - Types of Beamforming o Analog Beamforming. o Digital Beamforming o Hybrid Beamforming - Benefits of Beamforming o Improved Signal Quality o Increased Capacity o Enhanced Coverage - Challenges of Beamforming o Design and Implementation Complexity o Computational Requirements o Environmental Factors - Potential Solutions o Advanced Algorithms: o Efficient Hardware o Adaptive Beamforming - **Exercise (5 minutes)** Ask students to divide into small groups.and assign each group a task of discussing the significance of beamforming in 5G

	networks and how it improves network performance. Each group should present their discussion points, focusing on the practical implications of beamforming.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/RwZn3VEzHBcS 3. Homework Ask students to write a brief essay on the role of beamforming in improving the performance of 5G networks and how it addresses specific challenges in wireless communication.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What is beamforming, and how does it enhance signal quality in wireless communication? 2. Why is beamforming critical for improving efficiency in technologies like Massive MIMO and 5G? 3. How does beamforming direct signals to specific users or areas to minimize interference? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 29	Course Name: Advanced Mobile Technology Topic: Flexible Frame Structure	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Understand the concept of flexible frame structure in 5G networks. b. Describe the benefits of flexible frame structure. c. Discuss the challenges associated with flexible frame structure and potential solutions.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Ask questions. - Briefly introduce the concept of flexible frame structure and its significance in 5G networks. - Ask students questions to gauge their prior knowledge and to engage them in the topic. - **Development (30 minutes)** a Flexible Frame Structure in 5G - Explain that a flexible frame structure in 5G allows dynamic adjustment of time and frequency resources to meet varying service requirements and user demands. - Discuss how 5G uses a scalable numerology that includes subcarrier spacing, slot duration, and symbol duration to adapt to different scenarios. b Components of Frame Structure - Subcarrier Spacing - Slot and Symbol Duration - Bandwidth Parts (BWPs) c Benefits of Flexible Frame Structure - Adaptability - Efficiency - Scalability d Challenges of Flexible Frame Structure - Complexity in Design - Resource Management - Compatibility e Potential Solutions - Advanced Resource Allocation Algorithms - Efficient Network Management - Standardization and Interoperability

	- **Exercise (5 minutes)** Ask students to divide into small groups.and assign each group a task of discussing the significance of flexible frame structure in 5G networks and how it improves network performance.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/RwZn3VEzHBc 3. Homework Ask students to write a brief essay on the role of flexible frame structure in enhancing the performance and adaptability of 5G networks and how it addresses specific challenges in wireless communication.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What is a Flexible Frame Structure in 5G, and how does it differ from traditional frame structures? 2. Why is a Flexible Frame Structure important for optimizing network performance and resource allocation? 3. How does a Flexible Frame Structure support diverse use cases and varying network demands? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 30	Course Name: Advanced Mobile Technology Topic: Flexible Frame Structure	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Understand the concept of flexible frame structure in 5G networks. b. Describe the benefits of flexible frame structure. c. Discuss the challenges associated with flexible frame structure and potential solutions.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Ask questions. - Briefly introduce the concept of flexible frame structure and its significance in 5G networks. - Ask students questions to gauge their prior knowledge and to engage them in the topic. - **Development (30 minutes)** a Flexible Frame Structure in 5G - Explain that a flexible frame structure in 5G allows dynamic adjustment of time and frequency resources to meet varying service requirements and user demands. - Discuss how 5G uses a scalable numerology that includes subcarrier spacing, slot duration, and symbol duration to adapt to different scenarios. b Components of Frame Structure - Subcarrier Spacing - Slot and Symbol Duration - Bandwidth Parts (BWPs) c Benefits of Flexible Frame Structure - Adaptability - Efficiency - Scalability d Challenges of Flexible Frame Structure - Complexity in Design - Resource Management - Compatibility e Potential Solutions - Advanced Resource Allocation Algorithms - Efficient Network Management - Standardization and Interoperability

	- **Exercise (5 minutes)** Ask students to divide into small groups.and assign each group a task of discussing the significance of flexible frame structure in 5G networks and how it improves network performance.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/RwZn3VEzHBc 3. Homework Ask students to write a brief essay on the role of flexible frame structure in enhancing the performance and adaptability of 5G networks and how it addresses specific challenges in wireless communication.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What is a Flexible Frame Structure in 5G, and how does it differ from traditional frame structures? 2. Why is a Flexible Frame Structure important for optimizing network performance and resource allocation? 3. How does a Flexible Frame Structure support diverse use cases and varying network demands? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 31	Course Name: Advanced Mobile Technology Topic: Service Data Adaptation Protocol (SDAP)	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Understand the concept of Service Data Adaptation Protocol (SDAP) in 5G networks. b. Describe the key functions and components of SDAP. c. Discuss the importance of SDAP in Quality of Service (QoS) management and data flow control in 5G networks.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Briefly introduce the Service Data Adaptation Protocol (SDAP), its role, and significance in 5G networks. - Emphasize SDAP's function in handling QoS for different applications in a 5G environment. - What do you know about data flow management in networks? - Why is QoS important in mobile communication? - **Development (30 minutes)** **a. Role of SDAP in 5G Networks** - Explain the primary function of SDAP: mapping QoS flows to data radio bearers (DRBs). - Highlight SDAP's role in ensuring the correct QoS for different data flows. **b. Key Components of SDAP** - QoS Flow Identification - Describe how SDAP identifies and handles different QoS flows based on unique identifiers (QFI). - Data Radio Bearer (DRB) Mapping - Explain the process of mapping QoS flows to appropriate DRBs to meet service requirements. **c. Benefits of SDAP in 5G** - Discuss how SDAP ensures: - Efficient QoS management. - Improved user experience with seamless data flow handling. - Enhanced adaptability for diverse 5G applications (e.g., URLLC, eMBB, mMTC). **d. Challenges Associated with SDAP** - Complexity in implementation.

	- QoS policy enforcement under varying network conditions. - Interoperability between different vendors and technologies. **e. Potential Solutions** - Advanced QoS scheduling algorithms. - Enhanced network management strategies. - Standardization for better interoperability. - **Exercise (5 minutes)** Divide students into small groups and assign each group the task of discussing: - How SDAP supports QoS management in 5G. - Why SDAP is crucial for maintaining service quality across various 5G applications.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/L5lIFHF_iCo 3. Homework Ask students to write a short essay on "The Role of SDAP in Managing QoS and Enhancing 5G Network Performance."
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What is SDAP, and how does it function in 5G networks? 2. Why is SDAP critical for ensuring QoS in 5G? 3. Who benefits from the efficient implementation of SDAP in 5G networks? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 32	Course Name: Advanced Mobile Technology Topic: Centralized RAN, Open RAN,	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Discuss RAN in 5G and various types of RAN's based on CU, DU and RU. b. Understand the concepts of Centralized RAN (C-RAN) and Open RAN in 5G networks. c. Describe the benefits and challenges associated with C-RAN and Open RAN.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Briefly introduce C-RAN and Open RAN, their purpose, and their roles in 5G networks. - Highlight their importance in improving network efficiency and adaptability. - What do you know about traditional RAN architecture? - Why do you think there is a need for more flexible RAN solutions? - **Development (30 minutes)** **a. Centralized RAN (C-RAN)** - Explain the concept: C-RAN centralizes the baseband processing functions in a centralized location, separate from remote radio units (RRUs). - **Key Components:** 1. Baseband Unit (BBU) Pooling 2. Remote Radio Heads (RRHs) 3. High-Speed Fronthaul - **Benefits of C-RAN:** 1. Enhanced resource utilization through BBU pooling. 2. Reduced operational costs. 3. Simplified network management. - **Challenges of C-RAN:** 1. High fronthaul bandwidth requirements. 2. Latency concerns. 3. Complex implementation.\ **b. Open RAN** - Explain the concept: Open RAN decouples hardware and software in RAN architecture, promoting interoperability between vendors. **- Key Principles of Open RAN:**

	1. **Disaggregation of Hardware and Software** 2. **Open Interfaces and Standards** • **Benefits of Open RAN:** 1. Vendor neutrality and reduced dependency on proprietary solutions. 2. Lower costs through competition. 3. Innovation and faster deployment of new services. • **Challenges of Open RAN:** 1. Integration complexity. 2. Performance optimization. 3. Security concerns with open interfaces. **c. Potential Solutions for Both Architectures** • Advanced fronthaul technologies to address C-RAN latency. • Collaborative testing and standardization for Open RAN. • Enhanced security protocols for Open RAN interfaces. - **Exercise (5 minutes)** Divide students into small groups and assign each group the task of discussing - The benefits of C-RAN and Open RAN. - How these architectures improve 5G network performance and flexibility.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/DT9uegpD-Ak https://youtu.be/Ma-NBj_1e-0 3. Homework Ask students to write a short essay on Comparing C-RAN and Open RAN: Their Roles in Shaping the Future of 5G Networks.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What are C-RAN and Open RAN, and how do they differ from traditional RAN? 2. Why are C-RAN and Open RAN important in the evolution of 5G networks? 3. How can the challenges of C-RAN and Open RAN be addressed effectively? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 33	Course Name: Advanced Mobile Technology Topic: Multi-access edge computing (MEC)	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Discuss RAN in 5G and various types of RAN's based on CU, DU and RU. b. Understand the concepts of Centralized RAN (C-RAN) and Open RAN in 5G networks. c. Describe the benefits and challenges associated with C-RAN and Open RAN.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Briefly introduce C-RAN and Open RAN, their purpose, and their roles in 5G networks. - Highlight their importance in improving network efficiency and adaptability. - What do you know about traditional RAN architecture? - Why do you think there is a need for more flexible RAN solutions? - **Development (30 minutes)** - Centralized RAN (C-RAN) - Key Components: 1. Baseband Unit (BBU) Pooling 2. Remote Radio Heads (RRHs) 3. High-Speed Fronthaul - Benefits of C-RAN: 1. Enhanced resource utilization through BBU pooling. 2. Reduced operational costs. 3. Simplified network management. - Challenges of C-RAN: 1. High fronthaul bandwidth requirements. 2. Latency concerns. 3. Complex implementation.\ - Open RAN - Key Principles of Open RAN: 1. Disaggregation of Hardware and Software 2. Open Interfaces and Standards - Benefits of Open RAN: 1. Vendor neutrality and reduced dependency on proprietary

	solutions. 2. Lower costs through competition. 3. Innovation and faster deployment of new services. - Challenges of Open RAN: 1. Integration complexity. 2. Performance optimization. 3. Security concerns with open interfaces. - Potential Solutions for Both Architectures 1. Advanced fronthaul technologies to address C-RAN latency. 2. Collaborative testing and standardization for Open RAN. 3. Enhanced security protocols for Open RAN interfaces. - **Exercise (5 minutes)** Divide students into small groups and assign each group the task of discussing - The benefits of C-RAN and Open RAN. - How these architectures improve 5G network performance and flexibility.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/DT9uegpD-Ak https://youtu.be/Ma-NBj_1e-0 3. Homework Ask students to write a short note on Comparing C-RAN and Open RAN: Their Roles in Shaping the Future of 5G Networks.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What are C-RAN and Open RAN, and how do they differ from traditional RAN? 2. Why are C-RAN and Open RAN important in the evolution of 5G networks? 3. How can the challenges of C-RAN and Open RAN be addressed effectively? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 34	Course Name: Advanced Mobile Technology Topic: Network Function Virtualization (NFV)	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Discuss the concept and framework of Network Function Virtualization (NFV). b. Explain the architecture of NFV, including its components and how it works. c. Describe the benefits and challenges associated with NFV in modern networks.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Briefly introduce NFV, its purpose, and how it transforms traditional network functions. - Highlight the role of NFV in reducing dependency on proprietary hardware and enabling network flexibility. - **Development (30 minutes)** - Concept of NFV - Key Features o Software-Defined: Network functions implemented in software. o Hardware-Agnostic: Functions run on general-purpose hardware. - Architecture of NFV - NFV Framework Components o Virtualized Network Functions (VNFs) o NFV Infrastructure (NFVI) o NFV Management and Orchestration (NFV MANO) - Working of NFV o VNFs are deployed on virtual machines or containers, using resources from NFVI. o NFV MANO manages and orchestrates VNFs, ensuring scalability and efficiency. - Benefits of NFV - Cost-Effectiveness - Flexibility and Scalability - Faster Deployment - Challenges of NFV - Performance Issues - Integration Complexity - Security Concerns

	- Solutions for NFV Challenges
	- Enhanced Orchestration
	- Optimized Hardware
	- Robust Security Protocols
	
	- **Exercise (5 minutes)**
	- Divide students into small groups and assign them to discuss the following:
	  - The benefits of NFV for service providers and end-users.
	  - How NFV compares to traditional networking approaches.

	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/xGZaZTnvR9A 3. Homework Ask students to write a short note on How NFV is Shaping the Future of Network Management.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What is NFV, and how does it differ from traditional network architectures? 2. Why is NFV considered a key enabler for modern networks like 5G? 3. How can the challenges of NFV be effectively addressed? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 35	Course Name: Advanced Mobile Technology Topic: 5G penetration in developed countries	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Understand the current state of 5G penetration in developed countries. b. Evaluate the impact of 5G on various industries in developed economies. c. Analyze the challenges and future opportunities for 5G expansion.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - What do they know about 5G? - Where do they think 5G is most widely used, and why? - Present key statistics: - 89% of the population in developed regions has 5G access. - Europe, North America, and the Asia-Pacific lead in coverage - Highlight 5G's importance in transforming industries, including healthcare, transportation, and manufacturing. - - **Development (30 minutes)** - Current Status of 5G in Developed Countries - Explain penetration levels: - Europe: ~68% coverage. - Americas: ~59% coverage. - Asia-Pacific: ~42% coverage - Factors Driving Adoption - Example: Phasing out 3G networks in favor of 5G by 2025 in Europe. - Impact on Industries - Smart Cities - Healthcare - Manufacturing - Entertainment - Challenges: - Infrastructure costs and rural coverage gaps. - Security concerns with broader network access - Opportunities: - Collaboration among telecom operators for affordable rollouts. - Expansion of edge computing to maximize 5G potential.

	- **Exercise (5 minutes)** - Divide students into small groups and assign them to discuss the How 5G penetration improves societal and industrial outcomes.
	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/xGZaZTnvR9A 3. Homework Ask students to write a short note comparing the role of 5G in developed and developing countries.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What makes 5G adoption faster in developed regions? 2. Which industries benefit the most from 5G, and how? 3. How can developed countries bridge the remaining coverage gaps? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 36	Course Name: Advanced Mobile Technologies Topic: Stronger backhaul requirements	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Explain the significance of stronger backhaul requirements for modern networks, especially in 5G and beyond. b. Analyze the challenges and solutions related to backhaul infrastructure development. c. Evaluate the role of technologies such as fiber optics, millimeter waves, and satellite links in meeting backhaul demands.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - What connects the core network to the radio access network (RAN)? - Why might stronger backhaul be critical for technologies like 5G? - Define backhaul: - Emphasize the role of backhaul in data flow, latency reduction, and bandwidth management in modern communication systems. - **Development (30 minutes)** - Why Stronger Backhaul Requirements? - Modern applications driving increased backhaul demands - Technologies for Stronger Backhaul - Fiber Optic Networks - Microwave and Millimeter Waves - Satellite Links - Integrated Access and Backhaul (IAB) - Challenges in Meeting Backhaul Demands - Solutions and Future Directions - **Exercise (5 minutes)** - Assign groups to evaluate a backhaul scenario: - Urban high-density area. - Rural or remote region.
	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/xGZaZTnvR9A 3. Homework Ask students to write a short note on Evaluating the Role of Fiber

	and mmWave in Strengthening Backhaul for 5G Networks.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. Discuss how policy and technology can address the challenges in providing strong backhaul for underserved regions. countries bridge the remaining coverage gaps? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 37	Course Name: Advanced Mobile Technologies Topic: Dynamic spectrum access and usage of unlicensed spectrum	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Define Dynamic Spectrum Access (DSA) and explain its significance in modern wireless communication. b. Understand the role of unlicensed spectrum in communication networks, including its benefits and challenges. c. Analyze how DSA enables efficient spectrum utilization. d. Explore real-world applications of DSA and unlicensed spectrum technologies.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- Introduction (5 minutes) - Dynamic Spectrum Access (DSA): A method that allows networks to dynamically utilize underused spectrum bands. - Unlicensed Spectrum: Frequencies (e.g., ISM bands) available for open use without exclusive licenses. - What are the primary challenges of 5G that previous generations like 4G did not encounter? - How might network flexibility and accessibility be affected by new 5G requirements? - - Development (30 minutes) - Concept of Dynamic Spectrum Access (DSA) - Benefits - What is Unlicensed Spectrum? - Define unlicensed spectrum and its common uses in Wi-Fi and other wireless technologies. - 5G and Unlicensed Spectrum - Advantages and Challenges - Unlicensed Spectrum - Examples of Unlicensed Spectrum: o ISM (Industrial, Scientific, and Medical) bands: 2.4 GHz and 5 GHz for Wi-Fi, Bluetooth, etc. o 6 GHz bands for next-generation Wi-Fi (Wi-Fi 6E). - Key Features: o Open for use by multiple users with power limits to minimize interference. o Encourages innovation and cost-effective network deployment. - Applications: o Home and enterprise Wi-Fi, IoT devices, short-range communication.

	- Benefits:
	  o Low cost of deployment.
	  o Rapid adoption of wireless technologies.
	- Challenges:
	  o Congestion in popular bands (e.g., 2.4 GHz).
	  o Interference management in shared environments.
	
	- **Exercise (5 minutes)**
	Divide students into groups and assign the following tasks:
	
	- Group A: List the benefits and challenges of DSA.
	- Group B: List the benefits and challenges of unlicensed spectrum usage.
	- Group C: Propose a new application combining DSA and unlicensed spectrum for smart cities or IoT.
	-

	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/xGZaZTnvR9A 3. Homework Ask students to write a short note on The Role of Dynamic Spectrum Access in the Future of Wireless Communication.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. How does DSA differ from traditional spectrum allocation? 2. Why is unlicensed spectrum critical for IoT and consumer devices? 3. What are the potential risks of relying heavily on DSA? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 38	Course Name: Advanced Mobile Technologies Topic: Large cell usage, LMLC	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Define Large Cell Usage and explain the concept of Low Mobility Large Cells (LMLC). b. Understand the significance of LMLC in the context of cellular networks, especially in 5G and beyond. c. Analyze the benefits and challenges of deploying large cells in low-mobility environments. d. Explore the real-world applications of LMLC in modern communication networks.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Introduce the concept of large cells in wireless networks. Explain how large cells provide broad coverage by using fewer base stations or cell sites. - Define LMLC as a specialized cell designed for areas where the mobility of devices or users is minimal (e.g., rural areas, indoor coverage, or stationary use cases). - Discuss the typical environments where LMLC is used, such as fixed-location devices, smart homes, and IoT applications. - environments would LMLC be most effective? - - **Development (30 minutes)** - Concept of Large Cells in Wireless Networks - Large Cells Overview - What is Low Mobility Large Cell (LMLC)? - Definition and Characteristics - Advantages of Low Mobility Large Cells (LMLC) - Benefits o Cost-Efficiency o Wide Coverage o Low Interference - Challenges of Deploying LMLC - Real-World Applications of LMLC - **Exercise (5 minutes)** - Divide students into groups and assign the following tasks: - **Group A:** List the benefits and challenges of using large cells in a low-mobility environment. - **Group B:** Propose a use case scenario for LMLC in a rural area and discuss how it would benefit from large cell deployment.

	- **Group C:** Identify and explain how LMLC can support smart city applications -
	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/xGZaZTnvR9A 3. Homework Ask students to write a short note on the role of low mobility large cells (LMLC) in expanding network coverage.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What distinguishes Low Mobility Large Cells from traditional small cells in terms of deployment and coverage? 2. Why is LMLC more suited for low-mobility environments? 3. Who benefits most from the deployment of LMLC in communication networks? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 39	Course Name: Advanced Mobile Technologies Topic: Possible solutions for connectivity in rural areas (BharatNet)	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Define BharatNet and understand its significance in bridging the rural-urban digital divide. b. Explain the need for rural connectivity and the role of government initiatives. c. Analyze the challenges faced in providing internet connectivity to rural areas.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Ask students to think about the challenges of providing internet in rural areas. - Why is providing connectivity in rural areas more challenging than in urban areas? - How can connectivity in rural areas improve the quality of life for citizens? - Define BharatNet and its purpose - Overview of BharatNet's goals: - Geographical factors, lack of infrastructure, high costs, and low population density. - Discuss how traditional methods of connectivity (fiber optics, etc.) may not be feasible for remote regions. - - **Development (30 minutes)** - BharatNet: Concept and Implementation - Key features: Optical Fiber Network, Public Data Offices (PDOs), partnerships with private telecom providers. - Stages of rollout and current status. - Benefits of BharatNet - Bridging the digital divide between rural and urban areas. - Enabling services like e-governance, telemedicine, online education, and digital financial services. - Economic empowerment through improved connectivity. - Challenges in BharatNet Implementation - Infrastructure development in difficult terrains (mountains, forests). - Last-mile connectivity issues: Reaching remote villages beyond the fiber backbone. - Sustainability and maintenance challenges.

	- **Exercise (5 minutes)** - Divide students into groups and assign the following tasks: - Group A: Discuss the key benefits of BharatNet in rural areas and how it can transform the economy. - Group B: Identify the challenges of implementing BharatNet and suggest solutions for overcoming them.
	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/xGZaZTnvR9A 3. Homework Ask students to write a short note on the how BharatNet is transforming rural India.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. Why is it crucial for the government to invest in rural broadband initiatives like BharatNet? 2. How do satellite and TVWS technologies differ from traditional broadband, and why are they useful in rural areas? 3. What role can local communities play in the deployment and maintenance of rural internet networks?Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 40	Course Name: Advanced Mobile Technologies Topic: Possible solutions for connectivity in rural areas (TVWS)	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Define TV White Space (TVWS) and understand its role in providing internet connectivity in rural and underserved areas. b. Explain how TVWS works, including its use of unused TV spectrum bands. c. Evaluate the benefits and challenges of using TVWS for wireless communication.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - What makes providing broadband in rural areas difficult? - How do rural areas differ from urban areas in terms of internet needs? - Introduction to TV White Space (TVWS) o Define TVWS: Unused spectrum in the TV broadcasting bands (e.g., 600 MHz to 700 MHz). o TVWS uses the gaps between active TV channels (unused frequencies) for wireless communication. o Explain how TVWS technology can offer long-range connectivity with low power consumption, ideal for rural areas with limited infrastructure. - Highlight how TVWS can help overcome some challenges in rural connectivity, such as lack of fiber infrastructure and difficult terrains. - **Development (30 minutes)** - Concept of Spectrum and TVWS - Technical Explanation of TVWS Usage - Types of Devices Using TVWS - Benefits of TVWS - Challenges of TVWS - Applications of TVWS ▪ Rural Internet Connectivity ▪ Community Networks ▪ Emergency Connectivity - Global Deployment Examples

	- **Exercise (5 minutes)** - Divide students into groups and assign the following tasks: - **Group A:** List the benefits of TVWS technology for rural broadband connectivity. - **Group B:** Identify the challenges of TVWS and propose solutions to overcome these challenges. - **Group C:** Suggest a new application for TVWS technology, possibly in a specific industry like agriculture or education.
	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/xGZaZTnvR9A 3. Homework Ask students to write a short note on the the future of TV White Space Technology in Rural Connectivity"
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. How does TVWS differ from traditional wireless broadband technologies? 2. Why is TVWS considered a good solution for rural connectivity? 3. What are the potential risks of using TVWS technology in densely populated urban areas? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 41	Course Name: Advanced Mobile Technologies **Topic:** Long-range Wi-Fi	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Define long-range Wi-Fi and understand its role in rural connectivity. b. Explain the significance of long-range Wi-Fi in bridging the rural-urban digital divide. c. Analyze the challenges and solutions for implementing long-range Wi-Fi in rural areas.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Ask Students - Why is internet connectivity in rural areas challenging? - How could long-range Wi-Fi help bridge these challenges? - What might be the benefits of affordable, widespread internet in remote regions? - Define long-range Wi-Fi: A wireless communication technology designed to provide internet over large distances, particularly useful in rural or remote regions. - Highlight its importance as a cost-effective alternative to fiber optics or satellite connectivity. - Discuss its ability to bypass geographical constraints like mountains and forests. - - **Development (30 minutes)** - Technology Details: o Uses standard Wi-Fi frequencies with directional antennas to extend coverage. o Capable of reaching distances up to several kilometers. o Provides stable internet access for education, healthcare, and e-governance. - Benefits of Long-Range Wi-Fi - Digital Inclusion - Cost Efficiency - Applications: o Supports rural schools, clinics, and small businesses. o Enables services like telemedicine, online education, and digital banking. - Technical Challenges: o Signal interference due to obstacles like trees and buildings. o Maintaining connection quality over long distances.

	- Solutions:
	  o Use of directional antennas and signal boosters.
	  o Partnerships with local authorities for maintenance.
	
	- **Exercise (5 minutes)**
	
	- Divide students into groups and assign the following tasks:
	- **Group A:** List the benefits of using long-range Wi-Fi in rural areas.
	- **Group B:** Identify the challenges of implementing long-range Wi-Fi and propose solutions.
	-

	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/xGZaZTnvR9A 3. Homework Ask students to write a short note on how long-range Wi-Fi is transforming connectivity in remote regions.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. Why is long-range Wi-Fi a practical solution for rural areas? 2. How does it differ from traditional connectivity methods like fiber optics? 3. What role can local communities play in maintaining long-range Wi-Fi networks? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 42	Course Name: Advanced Mobile Technologies Topic: FSO	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Define Free Space Optics (FSO) and explain its working principle. b. Understand the role of FSO in providing high-speed connectivity in rural and urban areas. c. Analyze the challenges and solutions for implementing FSO technology.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Ask Students - What are the limitations of traditional wired or wireless internet technologies? - How could optical communication systems overcome these limitations? - Briefly introduce Free Space Optics (FSO) - **Development (30 minutes)** - Definition and Principles: Uses laser beams to transfer data between two points in a line-of-sight (LOS) configuration. - Requires no physical medium like cables; data is transmitted through the atmosphere. - Components of an FSO System: - Optical transmitter, receiver, and a line-of-sight link. - Applications - Urban environments - Rural areas - Disaster recovery, military communications, and backhaul for cellular networks. - Benefits of FSO - Cost Efficiency - Speed and Bandwidth - Flexibility - Environment-Friendly - Challenges: - Atmospheric interference - Alignment issues due to vibration or movement. - Limited range compared to fiber optics. - Solutions: - Adaptive optics and multiple-beam systems to mitigate signal loss. - Integration with other technologies (e.g., RF backup) for

	reliability. - **Exercise (5 minutes)** - Divide students into groups and assign the following tasks: - Group A: Discuss the benefits of FSO in urban and rural contexts. - Group B: Identify the challenges in deploying FSO and suggest potential solutions.
	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/xGZaZTnvR9A 3. Homework Ask students to write a short note on how FSO can address connectivity challenges in remote or disaster-prone areas.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What makes FSO a cost-effective solution compared to fiber optics? 2. How does FSO overcome geographical challenges in rural areas? 3. What advancements could further improve the reliability of FSO systems? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 43	Course Name: Advanced Mobile Technologies Topic: Terahertz communication	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Define terahertz communication and explain its fundamental principles. b. Understand the role of terahertz communication in next-generation communication networks.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Ask Students - What limitations do current communication technologies (like 5G) face in terms of speed and capacity? - Why is exploring new frequency ranges important for future communication systems? - Briefly introduce terahertz communication - **Development (30 minutes)** - Terahertz Communication: Concept and Features - Definition and Principles: - Utilizes electromagnetic waves in the terahertz range. - Bridges the gap between microwave and optical communication. - Key Features: - High-frequency waves offer high data rates. - Small wavelengths allow dense data transmission and precise sensing. - Benefits of Terahertz Communication - Enhanced Data Rates - Massive Connectivity - Precision Sensing - - **Exercise (5 minutes)** Ask students to discuss the key benefits of terahertz communication in next-generation networks.
	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/X5G8PWL7U10

	3. Homework Ask students to write a short note on how terahertz communication can transform future wireless networks.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. Why is terahertz communication considered vital for 6G and beyond? 2. How do atmospheric conditions impact terahertz signals? 3. What role does material science play in advancing terahertz technology? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 44	Course Name: Advanced Mobile Technologies Topic: Need for THz Communication, applications	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Explain the need for Terahertz (THz) communication in the context of next-generation networks. b. Discuss key applications of THz communication across industries.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Ask Students - What are the limitations of existing communication technologies like 4G and 5G in handling data-intensive tasks? - Can current networks support future applications like holographic telepresence or ultra-high-definition media? - Define the need for THz communication: - Increasing demand for higher data rates and lower latency. - Expansion of emerging technologies requiring massive bandwidth and dense connectivity. - **Development (30 minutes)** - **Why is THz Communication Needed?** - Current Challenges in Communication Systems: - Spectrum congestion in microwave and millimeter-wave frequencies. - Increasing demand for ultra-high-speed data transfer. - Need for precise and reliable communication for applications like autonomous vehicles and smart cities. - Advantages of THz Communication: - Broadband Spectrum Availability: - Provides much larger bandwidth compared to existing frequency bands. - Ultra-High Data Rates: - Achieves speeds in the terabits-per-second range. - Reduced Latency: - Ensures real-time communication for critical applications. - 2.2 Applications of THz Communication - Wireless Communication: - 6G Networks:

	- Supports data-intensive applications like augmented reality (AR), virtual reality (VR), and holographic displays. - Device-to-Device Communication: - Enables efficient communication in IoT and smart devices. - Medical Imaging and Diagnostics: - High-resolution imaging for non-invasive diagnostics. - Industrial Automation: - High-speed wireless connectivity in smart factories and industrial IoT. - Security and Sensing: - Terahertz imaging for airport security and material characterization. - Environmental Monitoring: - Real-time sensing of gases and pollutants in the atmosphere. - - **Exercise (5 minutes)** Ask students to discuss the key benefits of terahertz communication in next-generation networks.
	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/X5G8PWL7U10 3. Homework Ask students to write a short note on how terahertz communication can transform future wireless networks.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. Why is terahertz communication considered vital for 6G and beyond? 2. How do atmospheric conditions impact terahertz signals? 3. What role does material science play in advancing terahertz technology? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 45	Course Name: Advanced Mobile Technologies Topic: Requirements & Challenges in THz Communication	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Identify the technical and infrastructural requirements for implementing THz communication systems. b. Analyze the challenges faced in deploying THz communication networks. c. Discuss potential solutions to overcome these challenges.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Ask Students - What are the key factors that determine the success of any communication technology? - What challenges do you think ultra-high-frequency communication like THz might face? - Briefly introduce the requirements and challenges for THz communication: - Requirements: Advanced hardware, efficient materials, and optimized network architectures. - Challenges: Signal attenuation, high power consumption, and complex hardware development. - - **Development (30 minutes)** - **Requirements for THz Communication** - High-Performance Hardware: - Development of efficient THz transceivers, antennas, and modulators. - Advanced Materials: - Use of graphene, metamaterials, and other novel materials for efficient wave generation and detection. - Efficient Network Architectures: - Hybrid models integrating THz communication with microwave and optical systems. - Power Management: - Low-power devices and energy-efficient protocols to address power consumption issues. - Spectrum Allocation: - Regulatory frameworks for allocating THz frequency bands. - **Challenges in THz Communication**

	- Signal Attenuation: - THz waves are highly susceptible to atmospheric absorption, especially by water vapor and oxygen. - Limited Range: - Short propagation distances require advanced techniques like beamforming and relay systems. - Penetration Issues: - Poor penetration through obstacles such as walls and buildings. - Hardware Complexity: - Fabrication of efficient THz components is technologically challenging. - Thermal Management: - High-frequency operation leads to significant heat generation. - Cost and Scalability: - High costs of development and deployment hinder widespread adoption. - - **Exercise (5 minutes)** Ask students to Identify major challenges and propose solutions for each challenge.
	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/X5G8PWL7U10 3. Homework Ask students to write a short note on requirements and challenges of THz communication, including proposed solutions.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. Why is hardware development a critical requirement for THz communication? 2. How does signal attenuation impact the feasibility of THz networks? 3. What strategies can be adopted to make THz communication cost-effective and scalable? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 46	Course Name: Advanced Mobile Technologies Topic: Introduction to 6G Technology	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Identify the technical and infrastructural requirements for implementing THz communication systems. b. Analyze the challenges faced in deploying THz communication networks. c. Discuss potential solutions to overcome these challenges.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Ask Students - What comes to mind when you think of 6G technology? - How do you think it differs from 5G in terms of capabilities? - Provide a brief historical context: - Evolution from 1G (voice communication) to 5G (ultra-reliable, low-latency communication). - Define **6G Technology** - **Development (30 minutes)** - **Evolution of 6G** - Drivers for 6G Development: - Demand for higher data rates and expanded connectivity. - Emerging applications like holographic communication, intelligent automation, and real-time AI. - Limitations of 5G in terms of bandwidth, scalability, and coverage in extreme environments. - - **Exercise (5 minutes)** Ask students to identify emerging applications and discuss how 6G could transform industries.
	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/9gXk8hXml2U 3. Homework Ask students to write a short note on potential societal impacts of 6G technology.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. Why is 6G considered a game-changer compared to 5G?

	2. How can 6G help bridge the digital divide? 3. What role does AI play in the development of 6G networks? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 47	Course Name: Advanced Mobile Technologies Topic: Features, Requirements	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Identify the technical and infrastructural requirements for implementing 6G communication systems. b. Discuss the key features that define 6G technology.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Ask Students - What comes to mind when you think of 6G technology? - How do you think it differs from 5G in terms of capabilities? - Explain 6G as the next generation of wireless communication, focusing on ultra-fast speeds, low latency, and AI integration. - **Development (30 minutes)** - **Features of 6G**: o Ultra-High Data Rates o Low Latency o Massive Connectivity o Terahertz (THz) Spectrum Utilization o AI Integration o Energy Efficiency o Holographic and Immersive Communication o Global Coverage - **Requirements for 6G**: o Spectrum Resources o Advanced Infrastructure o AI and Machine Learning o Standardization o Energy-Efficient Technologies o High-Performance Hardware o Cost-Effective Deployment o Enhanced Security - - **Exercise (5 minutes)** Ask students to reflect on how the features and requirements of 6G will influence industries such as healthcare, transportation,

	and education.
	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/9gXk8hXml2U 3. Homework Ask students to write a short note on potential societal impacts of 6G technology.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. Why is 6G considered a game-changer compared to 5G? 2. How can 6G help bridge the digital divide? 3. What role does AI play in the development of 6G networks? Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 48	Course Name: Advanced Mobile Technologies Topic: Emerging applications & Challenges	Course No.: ECE-701(B)

Objectives	At the end of the lesson the student shall be able to: a. Identify emerging applications of 6G technology and their societal impacts. b. Analyze the technical and non-technical challenges in implementing 6G networks.
Teaching Aids (if any)	a. ICT Usage
Teaching Development	- **Introduction (5 minutes)** - Ask Students - What comes to mind when you think of applications enabled by 6G? - What do you think are the main challenges in implementing 6G technology? - Briefly outline how 6G builds on 5G capabilities to enable futuristic applications. - **Development (30 minutes)** - **Emerging Applications of 6G** • Holographic Communication • AI-Driven Systems • Internet of Everything (IoE) • Autonomous Systems • Immersive Technologies • Enhanced Public Safety and Disaster Management - **Challenges in Implementing 6G** • Signal attenuation and propagation issues in Terahertz (THz) bands. • Designing energy-efficient systems to manage power consumption. • Developing cost-effective infrastructure such as reconfigurable intelligent surfaces. • Enhanced risks due to massive connectivity and high-speed data transfer. • Need for robust cybersecurity protocols like quantum encryption. • High costs of infrastructure deployment. • Addressing the digital divide to ensure global accessibility.

	• Lack of unified global standards for 6G technologies. - **Exercise (5 minutes)** Ask students to select one emerging application and discuss how it could transform a specific industry.
	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Video Lecture https://youtu.be/9gXk8hXml2U 3. Homework Ask students to write a short note on how an emerging 6G application could positively impact society, addressing one potential challenge and a possible solution.
Evaluation	Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 1. What industries are likely to benefit the most from 6G applications, and why? 2. What are the primary challenges in using the THz spectrum for 6G communication? 3. How can AI integration help overcome some of the technical challenges in 6G networks? 4. How can 6G address the digital divide in rural and underdeveloped regions? Spend 5 minutes to evaluate student assimilation of the lesson contents