

George Mason University

Volgeneau School of Engineering, Telecommunications Program

Tentative Spring 2023 Syllabus for TCOM 652: 5G Service, Technology and Network

Instructor: Narendra Mangra

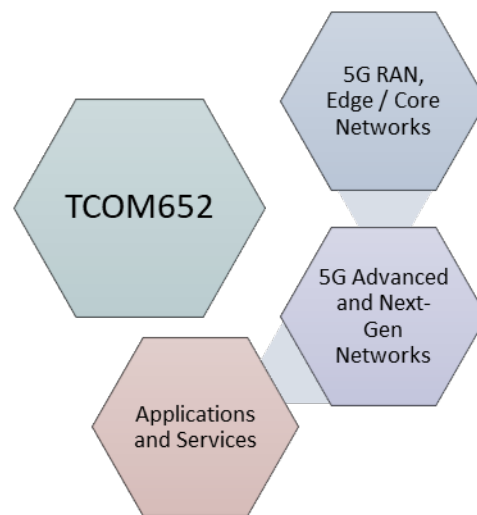
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Class Schedule: Thursdays 7:20 to 10:00pm

Office Hours: By appointment.

Course Overview and Learning Objectives

The wireless telecommunications landscape is rapidly evolving as it extends into traditional industries to create new value propositions. 5G and Future Networks transcend industry boundaries and is positioned to drive innovations in Smart Cities, Smart Grids, Connected Vehicles, Telehealth, Public Safety, Precision Agriculture, etc.



This course introduces 5G from the perspective of four key components, i.e. access, service delivery, customer and network management, and network extensions. These components are the basis for 5G applications and services and next generation networks such as 6G. This structured approach towards understanding 5G, 5G Advanced, and emerging next generation systems.

- 5G and 5G Advanced
 - Access: radio access network (RAN),
 - Service Delivery: edge and core networks,
 - Customer and Network Management: BSS / OSS
 - Network Extensions: network interoperability, roaming
- Applications and Services
 - 5G use categories of enhanced mobile broadband (eMBB), massive machine type communications (mMTC), and ultra-reliable low latency services (URLLC)
- Emerging Networks and Technologies
 - Emerging next generation systems, e.g. 6G

At the end of this course, students should be able to:

1. Describe the fundamentals of the end-to-end 5G network architecture through four key components: access, service delivery, customer and network management, and network extensions.
2. Evaluate technical reports and studies on recent 5G related technical studies from the perspective of the four key components
3. Understand trends in next generation systems and emerging applications and services.

Course Structure

Week	Date	Category	Topic
1	26-Jan-2023	Introduction to Wireless Networks	Introduction to Terrestrial and Non-Terrestrial Wireless Networks, 5G Use Case Categories, and Standards
2	02-Feb-2023	Radio Access Network (RAN)	Spectrum and Devices
3	9-Feb-2023	Radio Access Network (RAN)	Physical Layer, MIMO
4	16-Feb-2023	Radio Access Network (RAN)	Radio Protocol, Logical and Transport Channels
5	23-Feb-2023	Radio Access Network (RAN)	RAN Deployments
6	02-Mar-2023	Transport Networks	xHaul
7	09-Mar-2023	Edge / Core Networks	Service Based and Reference Point Architectures
8	16-Mar-2023	<i>Spring Recess</i>	<i>Spring Recess – n/a</i>
9	23-Mar-2023	Edge / Core Networks	Network Operations Enhancements
10	30-Mar-2023	Customer/User & Network Operations	Operations & Business Support Systems, Network Orchestration Deliverable 1 Due
11	06-Apr-2023	Network Extensions	Network Interoperability and Roaming
12	13-Apr-2023	Applications and Services	Ecosystems, Networks, and Governance
13	20-Apr-2023	5G Advanced / Next Gen	5G-Advanced – Capabilities and Industry Verticals
14	27-Apr-2023	5G Advanced / Next Gen	Next Generation Systems, Emerging Trends
15	04-May-2023	Course Recap, Technical Presentations	Technical Presentation - Technical Studies Deliverable 2 Due

There will be exercises throughout the course that will serve as a basis for class discussions.

Course Materials

This course covers topics from different areas within the 5G ecosystems. There are various accessible sources from the library and other technical sources such as standards development organizations (SDOs), industry groups, and other professional organizations that help to provide to additional perspectives.

There are several books that may be used instead or in conjunction with the course text. Students are responsible for preparing in advance of the classroom discussions.

Course Text

5G Technology: 3GPP New Radio

- Editor(s): Harri Holma, Antti Toskala, Takehiro Nakamura
- Print ISBN: 9781119236313 | Online ISBN: 9781119236306 | DOI: 10.1002/9781119236306
- 2020 John Wiley & Sons Ltd.

Blackboard - <http://courses.gmu.edu/>

Performance Evaluation

Students will earn grades based on demonstrated understanding of 5G services, technologies and network architecture at the end of this course.

The grading details are shown below:

- Class Participation 20%
 - **Active** class participation based on readings and homework.
 - Note – attendance is not the same as class participation.
- Written Deliverable 1 – 5G NR / Network Architecture Foundations 40%
 - Descriptive reports may include link budgets, architecture components (Additional Details in class)
- Written Deliverable 2 and Technical Presentation – Advanced 40%
 - Describe a new 5G or 5G Advanced feature/application from the perspective of the four key components: access, service delivery, customer & network operations, and network extensions.
 - Technical Presentation (10)
 - Written Report (30%)

Class Participation (20%)

This course will address different areas of the 5G ecosystem spanning the 5G NR, edge and core networks, user and network operations, and network extensions. The readings and homework assignments are designed to enhance our understanding of the subject material. Students may be called upon to start off a discussion based on the required readings and assignments. It is expected that students prepare for each session and actively participate in our discussions. Please note that class participation is based on actual class contributions and not simply based on attendance. This is an opportunity to expand our collective knowledge on 5G and related next generation communications systems.

Deliverable 1: - 5G NR / Network Architecture Foundations (40%)

Students will demonstrate their understanding of the 5G system based on existing 3GPP standards and selected releases. Topics may include the 5G NR and network architecture components. This deliverable is intended to demonstrate an understanding of the overall 5G network architecture.

Deliverable 2: 5G / 5G-Advanced Report and Technical Presentation (40%)

Students will describe a new 5G or 5G Advanced feature/application from the perspective of the four key components: access, service delivery, customer & network operations, and network extensions. This deliverable is intended to better understand the implications for new features/applications within the context of our baseline network component structure. The deliverables will include a written report and a class presentation.

Final Grade Determination

Final Grade	Points Accumulated
A+	97.0 to 100
A	94.0 to 96.9
A-	90.0 to 93.9
B+	87.0 to 89.9
B	84.0 to 86.9
B-	80.0 to 83.9
C+	77.0 to 79.9
C	74.0 to 76.9
C-	70.0 to 73.9
F	Less than 70.0

General Information

Academic Integrity

GMU is an Honor Code university (please refer to the University Catalog for a full description of the code and the honor committee process). Academic integrity is taken very seriously, and violations are treated gravely. What does academic integrity mean in this course? Essentially this: when you are responsible for a task, you will perform that task. When you rely on someone else's work in an aspect of the performance of that task, you will give full credit in the proper, accepted form. Another aspect of academic integrity is the free play of ideas. Vigorous discussion and debate are encouraged in this course, with the firm expectation that all aspects of the class will be conducted with civility and respect for differing ideas, perspectives, and traditions. When in doubt (of any kind) please ask for guidance and clarification.

GMU Email Accounts

Students must activate their GMU email accounts to receive important University information, including messages related to this class.

Office of Disability Services

If you are a student with a disability and you need academic accommodations, please see me and contact the Office of Disability Services (ODS) at 993-2474. All academic accommodations must be arranged through the ODS. <http://ods.gmu.edu>

Other Useful Campus Resources:

Writing Center: A114 Robinson Hall; (703) 993-1200; <http://writingcenter.gmu.edu>

University Resources "Ask a Librarian" <http://library.gmu.edu/mudge/IM/IMRef.html>

Counseling and Psychological Services (CAPS): (703) 993-2380; <http://caps.gmu.edu>

University Policies: The University Catalog, <http://catalog.gmu.edu>, is the central resource for university policies affecting student, faculty, and staff conduct in university affairs.