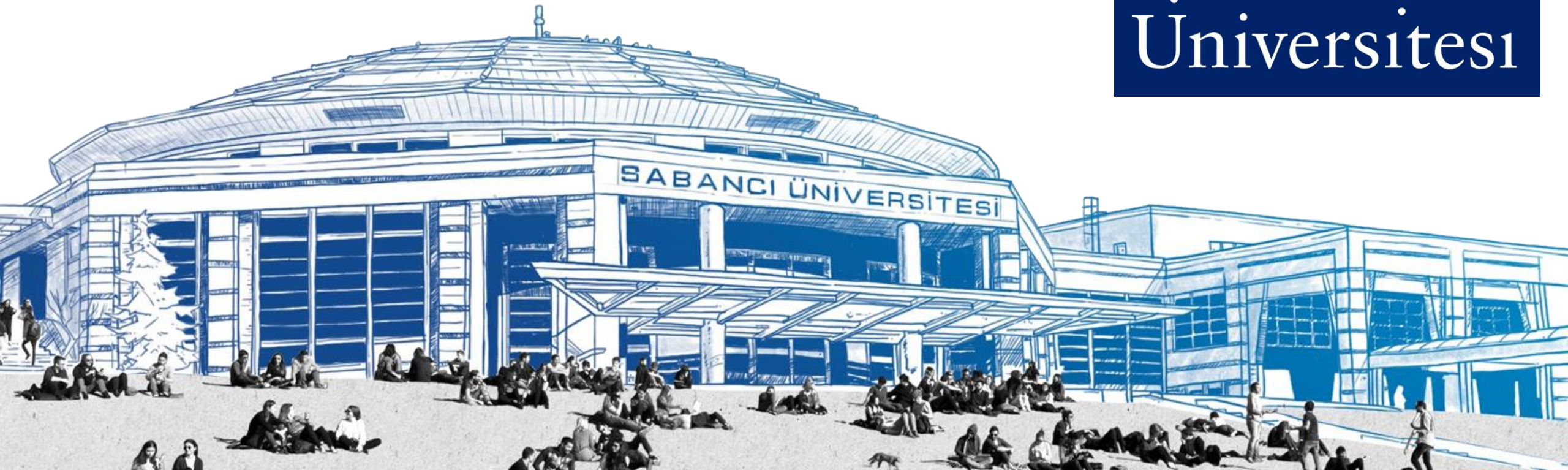
EE5807 Special Topics Course Syllabus:
Millimeter-Wave & Terahertz CMOS

Sabancı Üniversitesi



Office Hours

Sabancı Üniversitesi

- Online – any time our schedule match for short meetings
- Office: FENS1064

Grading Policy

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- Final 20%
- Midterm Project 25%
  - Deadline near the end of April
- Final Project 35%
- Final Presentation 20%

Lectures & Discussions

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Lectures:

- Wednesdays 14:40-17:30 FENS L061

Discussion/Optional Sessions:

- Fridays 12:40-14:30 FENS L061

General Outline

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1. Fundamentals of Wireless Communications & Link Budget Calculations
2. Millimeter-Wave & Terahertz Transceivers
    1. Ultra-broadband high speed wireless communications
    2. Phased-arrays for wireless communications
3. Active & Passive Devices for millimeter-wave and terahertz circuit design
4. Design of millimeter-wave and terahertz circuits

1. Fundamentals of Wireless Communications & Link Budget Calculations

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- Free space path loss
- Atmospheric radio-frequency windows
- Friis Transmission Equation
- Antenna & Distance Considerations
- Shannon's Channel Capacity
  - Maximum data-rate calculations
  - Incorporating with Friis Transmission Equation
  - Modulations and SNR requirements
  - Shannon's Channel Capacity for MIMO (optional at the moment)
- Signal to Noise and Distortion Ratio
  - Distortion due to non-linearity
  - 1dB gain compression, IM3 and IIP3
  - SNDR Calculation

2. Millimeter-Wave & Terahertz Transceivers

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- Ultra-broadband high speed wireless communications
  - 60-GHz Transceiver example and considerations
  - D-Band Transceiver example and considerations
  - Sub-Terahertz 300-GHz Transceivers and considerations
- Phased-arrays for wireless communications
  - Phased-arrays for 5G base stations

- This part includes considerations such as the noise figure concept, linearity, output-backoff, ACLR and etc.

3. Active and Passive Devices for mm-Wave and THz Circuits and Systems

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- Process Design Kit, Importance of Device Modeling, Scattering Parameters
- De-embedding, T-Parameters, Pad Modeling
- Other Passive Components used in mm-Wave and THz circuits
- Transistor Modeling, Some amplifier examples and Revised L-2L De-embedding
- Differential De-embedding and Device Characterizations, mixed-mode S-parameters
- Multi-port device characterizations based on two-port Network Analyzer Measurements

4. Design of mm-Wave and THz circuits

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- (Quarter-Wavelength based SPDT switches, theoretical approach and design) PA+LNA SPDT-less antenna switching amplifier design
- Distributed common-source amplifier for ultra-wideband amplification
  - Staggered amplifier design
- Differential millimeter-wave amplifiers with distributed components
- Positive-feedback amplifiers for terahertz region
- Frequency multipliers for millimeter-wave and terahertz
- Millimeter-wave and THz Mixers