ECE499/590  
Small Spacecraft Design and Engineering (3:3:0)

**Prerequisite:** Undergraduate students: Junior/Senior standing  
Graduate students: Minimum 9 credits already completed or POI

**Instructor:** Dr. Peter W. Pachowicz  
ECE Dept., Eng. Bldg., Rm.3240  
ppach@gmu.edu

**Course description:**

Comprehensive study of small spacecraft design, operations, communications, computing hardware, software, sensors, power, attitude control, testing, and other topics needed for successful engineering of a spacecraft and its ground station. Review of ultra-small CubeSat already launched into the space; their hardware, software, and missions.

Both fundamental and practical aspects are covered, however, more emphasis is on the development of an infrastructure and a functional ultra-small CubeSat to be launched in the future by ECE students.

**Course outline:**

This course will be very helpful for students interested in taking their senior design project, research project, or MS thesis related to this topic.

- **Week 1:** Kickoff meeting. Introduction to space systems. Spacecraft categories and their missions. Introduction to a CubeSat concept. Evolution and new trends.

- **Week 2:** CubeSat applications.

- **Week 3:** Space environment and its influence on spacecraft systems, electronics, communications, computing, operations, components, and design practice.

- **Week 4:** Satellite orbit. Satellite tracking. Ground communication window and strategies. Discussion and selection of student reports.

- **Week 5:** Introduction to satellite communications. Satellite communications.

- **Week 6:** CubeSat communications.
Discussion and selection of student projects.

Week 7:  Link budget design. Study of practical examples.

Week 8:  Spring break

Week 9:  Student presentations: Review of small CubeSats already launched.


Week 11: Spacecraft power systems. Power bus architectures. Design tradeoffs.


Week 14: Spacecraft development process. Example design and development review.

Week 15: Project presentations. Review for the final.

Grading:

- Design homeworks, reports: 40%
- Small project (design, simulation, or development): 30%
- Final (will cover ~4 topics from the above list): 30%

Textbook:

No formal textbook is required. Each topic will refer to a supporting paper or book chapter available through GMU’s e-library or through Google search.