MENG574 – SPACE SYSTEMS ENGINEERING

Department:
Mechanical Engineering

Program Name: Mechanical Engineering	**Program Code:** 23	
Course Number: MENG574	**Credits:** 3 (3,0)	**Year/Semester:** 2022-2023 Fall

☐ Required Course ☒ Elective Course ☐ Service Course

Prerequisite(s): None

Catalog Description:
Space Systems Engineering combines multidisciplinary engineering fields to realize high-performance space systems and system components. The course uses an integrated approach to the complete design of a total space system and adopt a systems engineering approach to understand how the various component subsystems function and interface with each other. This course aims to provide an understanding of the processes and methods used in industry to design spacecraft, by adopting a systems engineering approach, and a detailed look at spacecraft systems and subsystems, whilst emphasizing the concurrent and iterative nature of spacecraft design, beginning from the definition of a space mission and the identification of a suitable payload to the final assembly, integration and verification. The topics covered include: introduction to systems engineering & spacecraft subsystems, space environment and its effect on design, orbital mechanics, dynamics of spacecraft, mission analysis, launch systems, spacecraft design & sizing, spacecraft subsystems, space propulsion systems, spacecraft structures & mechanisms, attitude control system, power systems, thermal system, telecommunications, telemetry, command, data handling and processing, ground system design & sizing, space manufacturing, assembly, integration and verification, reliability & cost, space law & regulations.

Course Web Page: http://staff.emu.edu.tr/qasimzeeshan/en

Textbook(s):

a. Fortescue and J. Stark, **Spacecraft Systems Engineering**, John Wiley and Sons, 3rd Ed., 2003.
b. Wertz, J. R., and Larson, W. J., eds., **Space Mission Analysis and Design**, 3rd ed., Microcosm Press, El Segundo, CA,1999.

Indicative Basic Reading List :

a. James R. Wertz & Wiley J. Larson, **Orbit & Constellation Design & Management**, 2001/1999
b. Ashish Tewari, **Atmospheric/Space Flight Dynamics,** Springer, 2007
c. Walter, Ulrich, **Astronautics - The Physics of Space Flight**, Springer, 2019
d. C.D. Brown, **Spacecraft Mission Design**, AIAA Education Series, 1998.
e. M. D. Griffin and J. R. French, **Space Vehicle Design**, AIAA, 2nd Ed., 2004
f. NASA **Systems Engineering Handbook**, NASA SP-2016-6105 Rev2, 2016
g. NASA Space Systems Engineering - Online source: https://spacese.spacegrant.org/

Topics Covered and Class Schedule:
(3 hours of lectures per week)

Week 1: Introduction to Systems Engineering
Week 2: Space Environment and Its Effect On Design
Week 3: Orbital Mechanics
Week 4: Dynamics of Spacecraft
Week 5: Mission Analysis
Week 6: Launch Systems
Week 7: Spacecraft Design & Sizing
Week 8 & 9: Mid Term Exam Week
Week 10: Spacecraft Subsystems, Space Propulsion Systems

Week 11: Spacecraft Structures & Mechanisms, Thermal System

Week 12: Attitude Control System

Week 13: Power Systems, Telecommunications, Telemetry, Command, Data Handling and Processing

Week 14: Space Manufacturing, Manufacture, Assembly, Integration and Verification, Reliability & Cost

Week 15: Space Law & Regulations

Week 16: Final Exam & Project Presentations

Term Assignment:
Each student is expected to choose a term project and produce a paper at the end of the semester. Students are also required to make presentations for their project. Completion of the term assignment and presentation is a requirement to pass the course.

Course Learning Outcomes:
The focus of Space Systems Engineering is to enable the students to gain knowledge about the fundamentals of design, analysis and operation of space systems. The course is intended to provide with the following benefits to the students:

1. An understanding of the overall aspects of Space Systems and Sub-Systems.
2. An understanding of the practical tools and methods for Design and Analysis of Space Systems.
3. An awareness of the recent related research on Space Systems.
4. Demonstrate proficiency in applying the fundamental principles of systems engineering to the design, analysis and definition of space systems.
5. Demonstrate knowledge and technical proficiency to analyze and create a concept for a space mission and an integrated design of the spacecraft that executes that mission.
6. Practice oral and written communication skills through the design project report and project presentation.

	Method	**No**	**Percentage**
Assessment	Midterm Exam(s)	1	20 %
	Design Project Report *	1	30 %
	Design Project Presentation **	1	10 %
	Final Examination	1	40 %

Relationship of Course to Program Outcomes
The course has been designed to contribute to the following program outcomes:
1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Prepared by: Assoc. Prof. Dr. Qasim Zeeshan	**Date Prepared:** August 2021

* Submission of the report on the selected topic in the format of a paper.
** Short presention on the selected topic (30 mins)
NG Policy: Students who do not attend any of the above assessment activities (such as mid-term exam, project report, presentation etc.) will be given NG (Nil Grade).