MINISTRY OF HIGHER EDUCATION AND SCIENTIFIC RESEARCH
«SALAHADDIN UNIVERSITY – ERBIL (SUE)»
COLLEGE OF ENGINEERING
AVIATION ENGINEERING DEPARTMENT

# **Subject «**Power Devices of Unmanned Aircraft**»**

**Fall Semester**

**Class:** 4th stage

**Lecturer:** Dr. Heersh S.A.
**B. Sc.** In Aerospace Engineering.
**M. Sc.** In Flight-Type Engines.
**PhD.** In Aviation and Rocket-Space Technology.

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**Erbil 2023 - 2024**

# Syllabus

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| **1. Course name** | Power Devices of Unmanned Aircraft |
| **2. Lecturer in charge** | Dr. Heersh Saleem Ahmed |
| **3. Department/ College** | Aviation Engineering Department / College of Engineering |
| **4. Contact** | e-mail: heersh.ahmed@su.edu.krd<br>Tel: 07504492302 |
| **5. Time (in hours) per week** | Theory: 3<br>Practical: 2 |
| **6. Office hours** | 4 hours |
| **7. Course code** | 9019 |
| **8. Teacher's academic profile** | - B.Sc. In Aerospace Engineering, Russia, 2014.<br>- M.Sc. in Flight-Type Engines, Russia, 2016.<br>- PhD. In Aviation and Rocket-Space Technology from Kazan National Research Technical University named after A.N. Tupolev – KAI, Kazan - Russia, 2021.<br>- Laboratory assistant (Turbojet engine TJ-100A-Z), Kazan National Research Technical University named after A.N. Tupolev – KAI, Russia, 2017 - 2021. |
| **9. Keywords** | UAV Power Systems, Electric Propulsion, Power Electronics for Drones, Unmanned Aerial Vehicle (UAV) Batteries, Energy Storage Systems for UAVs. |

**10. Course overview:**

Explore the vital role of power systems in Unmanned Aircraft (UAV) technology. This course delves into the fundamentals of electric propulsion, power electronics, and energy storage for UAVs. Covering battery technologies, hybrid systems, and emerging alternatives like fuel cells and solar power, students will gain practical insights into designing efficient power devices for unmanned aerial vehicles. The course also addresses power management, distribution, and explores cutting-edge advancements in the field.

**11. Course objective:**

Explore the intricacies of power systems in Unmanned Aircraft (UAVs). Gain insights into electric propulsion, power electronics, and energy storage for UAVs. Learn to design efficient power devices, understand battery technologies, and navigate emerging trends like hybrid systems and alternative power sources. This course prepares you to contribute to the cutting-edge field of UAV technology, focusing on the critical role of power devices in unmanned flight.

**12. Student's obligation**

Engage actively in class, complete assignments and quizzes on time, prepare thoroughly for assessments, contribute to group projects, and maintain professionalism. Attend all sessions, seek clarification when needed, and stay informed about advancements in UAV power technology. Demonstrate respect, ethical conduct, and a commitment to continuous learning, fostering a collaborative and positive learning environment.

**13. Forms of teaching**

Using a whiteboard tool to cover in details all the required explanation and data show. Blend of lectures and group projects. Integrates online resources and student presentations for a comprehensive understanding of UAV power devices.

**14. Assessment scheme**

- 18% Quizzes, Seminar, Report & Activity
- 20% Mid-term exam
- 12% Project
- 50% Final theoretical exam

**15. Student learning outcome:**

Understand the Principles: Grasp the fundamental principles underlying power devices for unmanned aircraft, including electric propulsion, energy storage, and distribution. Design efficient UAV power systems, apply theoretical knowledge practically, and maintain a commitment to lifelong learning in the dynamic field of power devices for unmanned aircraft.

**16. Course Reading List and References:**


- Rouser, Kurt P., Nicholas Lucido, Matthew Durkee, Andrew Bellcock, and Tyler Zimbelman. "Development of turboelectric propulsion and power for small unmanned aircraft." In *2018 Joint Propulsion Conference*, p. 4618. 2018.
- Wu, Maopeng, Lijuan Su, Jianxun Chen, Xiaoli Duan, Donghua Wu, Yan Cheng, and Yu Jiang. "Development and prospect of wireless power transfer technology used to power unmanned aerial vehicle." *Electronics* 11, no. 15 (2022): 2297.
- Zhang, Bowen, Zaixin Song, Fei Zhao, and Chunhua Liu. "Overview of propulsion systems for unmanned aerial vehicles." *Energies* 15, no. 2 (2022): 455.
- Pham, Khac Lam, Jan Leuchter, Radek Bystricky, Milos Andrle, Ngoc Nam Pham, and Van Thuan Pham. "The study of electrical energy power supply system for UAVs based on the energy storage technology." *Aerospace* 9, no. 9 (2022): 500.
- Dantsker, Or D., and Renato Mancuso. "Propulsion System Instrumentation Development and Integration on Small-and Medium-Sized Electric Unmanned Aircraft." In *AIAA SCITECH 2022 Forum*, p. 2156. 2022.


| **17. The Topics:** | **Lecturer's name** |
|---|---|
| **week 1:** Introduction to UAV Power Systems | **Heersh Saleem Ahmed** |
| **week 2:** Electric Propulsion Technologies | |
| **week 3:** Power Electronics in UAVs | |
| **week 4:** Energy Storage Systems for UAVs | |
| **week 5:** Hybrid Power Systems | |
| **week 6:** Fuel Cells in UAVs | |
| **week 7:** Solar Power for Unmanned Aircraft | |
| **week 8:** Power Distribution Architectures | |
| **week 9:** Battery Management Systems (BMS) | |
| **week 10:** Thermal Management in UAV Power Devices | |
| **week 11:** Energy Harvesting Technologies | |
| **week 12:** High-Efficiency UAV Power Solutions | |
| **week 13:** Power Consumption in UAVs | |
| **week 14:** Advancements in UAV Power Devices | |
| **week 15:** Regulatory Considerations for UAV Power Systems | |

| **18. Practical Topics** | |
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| - All lecture material up to the date of the test.<br>- Understanding of application of theoretical Power Devices of Unmanned Aircraft to real world device.<br>- All course content from weeks 1-15 inclusive. | |
| **19. Examinations:**<br>All relative topics in both theory, the student has to finish the entire requirement to meet the syllabus. | |
| **20. Extra notes:**<br>The students should support themselves be able to solve and design project daily by them and not neglect the subject. | |
| **21. Peer review:**<br>Attendance at all theory and laboratory experiments to which you are assigned is compulsory and a register is taken. If you are unable to attend, due to illness, it is important that you inform the head demonstrator as soon as possible so that you may be reassigned to a later experiment. | |