



## UAV PROPULSION Courses, DVD Packages, Laboratory Tutorials

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**Description:** Marques Aviation offers different training methods for UAV Propulsion. This include 3-day and 6-day executive courses, UAV Propulsion Course on DVD, lectures and class exercises in PPT, and dedicated UAV propulsion laboratory tutorials (4 days). Courses provided by Dr Abdul-Retha who is a recognised World-class authority in UAV Propulsion. Course available online.

**Instructor:** Dr. Emaid A. Abdul-Retha

Dr. Emaid A. Abdul-Retha holds the BSc, MSc, PhD and DSc degrees in aeronautical engineering. His research areas include jet engine automatic control systems and modeling of gas turbine engines. He has over 34 years of aviation experience including 20 years' experience with unmanned aircraft vehicles and their propulsions. Dr Emaid offers a UAV propulsion package that can be divided into educational material, laboratory workshops, practical tutorials and other related materials. The courses and workshops introduce the various issues in fundamental engineering related to UAV propulsion and are designed to meet the needs of UAV propulsion engineers, UAV operators, UAV technical staff, managers, educators, and research and development employees.

### UAV Propulsion 6-Day Technical Course

This 6-day (36 hours) 'instructor led' course consists of a series of lectures related to fundamental principles of UAV propulsion. It requires a basic knowledge of mathematics, numerical modelling, physics of thermodynamics, and heat transfers. It is intended as a first course that provides and in-depth understanding of the state-of-art propulsion aspects for UAVs, including propulsion types, cycles analysis, principles of different aero-engines operation, systems, components, and engine performances and efficiency calculations. Theories of aero-engines and their related background in aerodynamics, thermodynamics and stress analysis are presented. System as well as component engineering aspects of engine aero-thermo-mechanical design are examined. Unique and alternative power plants for unmanned aircraft systems will be discussed. Graduates will receive a diploma that lists all course topics.

### Textbooks

1. J. D. Mattingly, Elements of Propulsion Gas Turbines and Rockets, AIAA, 2006
2. J. B. Heywood, Internal Combustion Engines Fundamentals, 1988 by McGraw-Hill, Inc.

## **Objectives**

The purpose of this course is to provide the student with a foundation in UAV propulsion design. The student shall have a good appreciation of why UAV power plants evolved to their current form. Further students shall be more aware of the multitude of opportunities that are available in the revolutionary growing UAV industry, by which they can contribute to the further development of these systems. After completing the course the student will be able to:

1. Understand the choices and tradeoffs of different types of aero-engines, and the primary parameters on which their performance depends.
2. Understand the aerodynamic and thermodynamic characteristics of major engine components.
3. Assess the different options of propulsion types for UAV applications.
4. Analyse the operational behavior of the major components of UAV engines.
5. Know the factors that bound the performance of UAV engine components.
6. Be familiar with the performance limitations of various types of UAV propulsion based on engine cycle.
7. Know factors that determine the transient response of different kinds of UAV engines.
8. Explain the fundamentals of UAV propulsion theories.
9. Select engines for UAV, and understand their compatibility and matching.
10. Analyse the interrelation between the systems of the UAV engine UAV.
11. Identify sources to obtain UAV propulsion.
12. Apply management maintenance repairs and overall repairs (MRO).
13. Select alternative Unmanned Aircraft Systems power.
14. Take advantage of computer programs to design and simulate UAV propulsion.

## **A. Course schedule**

Day 1: Fundamentals of UAV propulsion, analysis and design of UAV propulsion.

Day 2: Tutorials 1 - UAV Gas turbine engines; jet engines.

Day 3: Tutorials 2 - UAV gas turbine engines (turbofan, turboprop, turboshaft).

Day 4: UAV internal combustion propulsion; UAV propellers.

Day 5: Tutorials 3 - UAV electric propulsion.

Day 6: Tutorials 4 – Perception for UAV propulsion; course conclusions.

## **B. Assignments**

Assignment 1: Gas turbine engine theory.

Assignment 2: UAV IC engines.

Assignment 3: UAV engines structures.

Assignment 4: Blade Element Momentum Theory (BEMT) relative to electric motors.

## **C. Teaching Method**

One week visit to the Marques Aviation Training Centre or lectures conducted over the internet using web conferencing, at least one day each week for 3 hours (12 weeks). Lecture notes are provided on PPT slides.

## UAV Propulsion 3-Day Technical Course

### ***At a Glimpse***

This 3-day technical course has been designed to provide an introduction to the fundamental principles of Unmanned Aerial Vehicle (UAV) propulsion design. The course is intended as a first course that provides in-depth understanding of state-of-the-art propulsion issues for UAVs, including propulsion options, cycle analysis, and principles of operation, systems, components, and performance and efficiency calculations. Also, the Theories of aero-engines and their related background in aerodynamics, thermodynamics and stress analysis are presented. System as well as component engineering aspects of engine aero-thermo-mechanical design is examined. Unmanned Aircraft Systems alternative power and propulsion power management is discussed.

### **What will be gained & learnt**

- Fundamentals of UAV propulsion.
- Classify UAV engines by types and missions.
- Understand UAV propulsion operation.
- Types of UAV propulsion, applications & design.
- UAV propulsion selection and matching.
- UAV propulsion assist devices.
- Propeller types and requirements.
- Principles of UAV engine control & regulation.
- UAV power resources & alternatives.
- UAV engine selection by efficiency.
- Trade studies and costs.
- Maintenance, repair and overhaul (MRO).

**Day 1:** Welcome and Introductions: Fundamentals of UAV propulsion; Analysis and design of UAV propulsion; UAV gas turbine engines; Jet engines.

**Day 2:** UAV gas turbine engines (turbofan, turboprop, turboshaft); UAV internal combustion; UAV propellers.

**Day 3:** UAV electric propulsion; Perception for UAV propulsion.

### **Teaching Method**

Lectures with notes provided on PPT slides. Online lectures available on request.

## **UAV Propulsion Course on DVD - Published by Marques Aviation**

### **Introduction**

This audio eBook is designed to teach an introduction to the fundamental principles of Unmanned Aircraft Vehicle (UAV) propulsion design. The course is intended as a first course that provides in-depth understanding state-of-the-art propulsion issues for UAVs, including propulsion options, cycle analysis, and principles of operation, systems, components, and performance and efficiency calculations. The theories of aero-engines and their related background in aerodynamics, thermodynamics and stress analysis are presented. System and component engineering aspects of engine aero-thermo-mechanical design are examined. Unmanned Aircraft Systems alternative power and propulsion power management is also discussed. You will learn the following topics: Fundamentals of UAV Propulsion, How to Classify UAV Engines by Types and Missions, Understand UAV Propulsion Operation, Types of UAV Propulsion, Applications & Design, UAV Propulsion Selection and Matching, UAV Propulsion Assist Devices, Explain Propeller Types and Requirements, Principles of UAV Engine Control & Regulation, UAV Power Resources & Alternatives, UAV Engine Selection by Efficiency, Trade Studies and Costs, Maintenance, Repair and Overhaul (MRO).

**Number of DVDs:** Package of 4 DVDs. 22 hours of lectures.

### **UAV Propulsion Laboratory Workshops (4 Days)**

The purpose of these tutorials is to increase the perception of the UAV propulsion theoretical lectures, and provide hands-on practical experience with a large range of types of UAV engine and motors. The instruction is invaluable for UAV pilots, operators, engineers, technicians and support staff, who are involved in UAV flight, preparation for flight, maintenance and repairs of UAV propulsion systems. The workshops involve working on functional prototypes of different types of UAV engines, which are installed on suitable test stands equipped with all necessary measurement and calibration devices.

**Day 1:** Components unpacking, control content and damage and specifications.

**Day 2:** Safety measures, installing on test stands, connecting the necessary materials for operation (fuel, oil, etc.) and linking measurement devices.

**Day 3:** Starting, operation, tuning/calibration and records of measured parameters.

**Day 4:** Analyses, faults identification, and participants' practice.

### **Laboratory components and equipment**

Operational UAV engines (small gas turbine, IC engine, electric motors and spare parts). Fuel, oil and batteries. Test stands, checking devices and rigs. Equipment and measuring devices. Safety equipment and firefighting. Recording equipment.