# RTU Course "Aerodynamics of Aircrafts"

**15E03 Lidaparātu teorijas un konstrukcijas katedra**

*General data*

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| Code | TAL425 |
| Course title | Aerodynamics of Aircrafts |
| Course status in the programme | Compulsory/Courses of Limited Choice |
| Course level | Undergraduate Studies |
| Course type | Professional |
| Field of study | Transport |
| Responsible instructor | Pavelko Igors |
| Academic staff | Pavelko Vitālijs |
| Volume of the course: parts and credits points | 1 part, 2.0 Credit Points, 3.0 ECTS credits |
| Language of instruction | LV, EN, RU |
| Possibility of distance learning | Not planned |
| Abstract | Aerodynamics of aviation airfoil: drag, lift forces and moments. Geometrical and aerodynamic characteristics of airfoils. Centre of pressure and aerodynamic centre. Calculation methods of airfoils. Polar. Aerodynamics of finite span wing. Influence of geometrical characteristic of wing on it's aerodynamically characteristics. Wing mechanisation. Aerodynamics of aircraft. Aerodynamics of propellers. Basics of supersonic aerodynamics. (JAR CPL Course: 08000- Principles of Flight, 08100-Subsonic Aerodynamics). |
| Goals and objectives of the course in terms of competences and skills | Acquire theoretical knowledge of principal regularities and research methods of aircraft aerodynamics. Understand the approaches of aircraft aerodynamic calculations. Get acquainted with the experimental techniques in aerodynamics. |
| Structure and tasks of independent studies | Preparation of reports of practical works:<br>•experimental determination of the airplane airfoil lift coefficient (1 h);<br>•experimental determination of aerodynamic characteristics of the air prop (1h).<br>Preparation of reports of calculation-graphic works:<br>•analysis of airfoil in the ideal incompressible two-dimensional parallel flow (2 h);<br>•aircraft polar calculation (2 h).<br>Work with the literature (10 h). |
| Recommended literature | 1.V.Pavelko. Gaisa kuģu aerodinamika // Mācību līdzeklis.- Rīga: RTU, 2009.- 258 lpp.<br>2.JAR CPL Course: 08000- Principles of Flight, 08100- Subsonic Aerodynamics). 1998.- 250 pp.<br>3.Lešinskis A. Aerodinamika, Mācību līdzeklis, Rīga, RAU, 1997. - 120 lpp.<br>4.I. Pavelko, V. Pavelko. Metodiskie norādījumi laboratorijas un aprēķinu-grafiskajiem darbiem „Aerohidromehānika". – Rīga, RTU Izdevniecība, 2006 – 31 lpp.<br>5.Мхитарян А.М. и др. Аэродинамика. 1976.- 448 с.<br>6.Airframe and Powerplant Mechanics Handbook: US Department of Transportation. FAA, 1991. - 500 pp.<br>7.Anderson, J.D. 1991. Fundamentals of Aerodynamics, 2nd ed. McGraw-Hill, New York<br>8.Л.Ф.Николаев. Аэродинамика и динамика полета транспортных самолетов// - Москва: Транспорт, 1990. -256 с.<br>9.Гаухман Я.Н. и др. Аэродинамика и динамика полета летательных аппаратов. Часть 1. Аэродинамика. – Рига: РКИИГА, 1976<br>10.Aerodynamics, Aeronautics, and Flight Mechanics, 2/e Barnes W. McCormick// John Wiley & Sons, Inc., 1995 ISBN 0-471-57506-2 672 pages |
| Course prerequisites | Aerodynamic forces, moments and their coefficients. Liquid and gas vortices movement. Potential flow theory basics. Similarities and dimension theory. Theory of boundary layer. Supersonic flow regularities and pressure jumps. |

*Course outline*

| Theme | Hours |
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| Airfoil and wing geometrical characteristics. Zhukovskii theorem. Kutta postulate. | 2 |
| Applications of a potential flow theory for determination of the airfoil lift force. Thin airfoil theory. | 2 |
| Vortex theory of the wing of finite span. General equations of vortex theory. Lift line theory of Prandtl. | 2 |
| Downward deflection of airflow and induced drag. Adverse drag. Aerodynamic coefficients of wing of finite span. | 2 |
| The pressure centre and focus. Pressure coefficient and its correlation to aerodynamic coefficients. | 1 |
| Aerodynamic parameters versus angle of attack, geometric parameters and Reynolds number. | 1 |
| Analysis of airfoil in the ideal incompressible two-dimensional parallel flow. | 2 |
| Experimental determination of the airplane airfoil lift coefficient. | 2 |
| Influence of compressibility on the airfoil and wing characteristics. Regularities of compressible subsonic flow. | 2 |
| Airfoil and wing in the transonic and supersonic flow. Wave drag. | 2 |
| Aerodynamic characteristics of fuselage and gondola of engine. A symmetrical solid aerodynamic forces and moments. | 2 |
| High lift devices of wing. Aerodynamic characteristics of the empennage, elevator and rudder. Hinge moment compensation. | 2 |
| Aircraft aerodynamic characteristics. Aircraft polar. | 2 |

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| Aircraft polar calculation. | 2 |
| Geometric, kinematical and aerodynamic characteristics of the air prop. | 2 |
| Experimental determination of aerodynamic characteristics of the air prop. | 2 |
| Introduction to flight dynamics. | 2 |

*Learning outcomes and assessment*

| Learning outcomes | Assessment methods |
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| Able to use analytical methods of aerodynamics to determine aerodynamic characteristics of the profile and the wing. | Calculation-graphic work: Analysis of airfoil in the ideal incompressible two-dimensional parallel flow. |
| Able to orientate in the methods of experimental aerodynamics used in the experiment and the results obtained in the wing aerodynamic characteristics of the profile. | Practical work: Experimental determination of airplane airfoil lift coefficient. |
| Able to calculate the polar of specific airplane and to evaluate its aerodynamics. | Calculation-graphic work: Aircraft polar calculation. |
| Able to make the optimal choice of operating mode of the airprop on the basis of the results of aerodynamic experiment. | Practical work: Experimental determination of aerodynamic characteristics of the airprop. |
| Able to deal with aerodynamics standard tasks. Able to show theoretical knowledge of main regularities and research methods of aerodynamics. | Exam. |

*Study subject structure*

| Part | CP | ECTS | Hours per Week | | | Tests | | |
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| | | | Lectures | Practical | Lab. | Test | Exam | Work |
| 1. | 2.0 | 3.0 | 1.0 | 1.0 | 0.0 | | * | |