

## RTU Course "Supplementary Mathematics (Aviation Transport)"

## 31000 Faculty of Civil and Mechanical Engineering

General	doto
JUILLIAI	uaia

Course status in the programme Computery/Courses of Limited Choice Responsible instructor Emma Sidlowska Academic staff Volume of the course: parts and credits points Ly, EN Annotation  The study course provides knowledge of ordinary and partial differential equations of mathematical methods, Fourier analysis, vector analysis and field theory, probability theory and mathematical statistics as well as application of mathematical models of damage and failure accumulation in aircraft operation modeling and aircraft safety analysis and aerosal analysis for successful mastering of aerohydromechanics.  Goals and objectives of the course in terms of competences and skills  The aim of the study course is to promote the in-depth acquisition of knowledge in solving the problems of aircraft aerodynamics, aerohydromechanics and safety analysis by applying mathematical knowledge.  The tasks of the study course is to promote the in-depth acquisition of knowledge in solving the problems of aircraft aerodynamics, aerohydromechanics and safety analysis by applying mathematical knowledge.  The tasks of the study course is to promote the in-depth acquisition of knowledge in solving the problems of aircraft aerodynamics, aerohydromechanics and safety analysis by applying mathematical and possesses and the study of mechanical and electrical systems;  sealar field gradient and vector field divergence and rotor calculation;  - the Fourier method in solving partial differential equations;  - the fourier method in solving partial differential equations;  - probability theory, damage and refusal to calculate probability.  Structure and tasks of independent studies  Recommended literature  Obligation Sollisatory:  - Pavelko 1. Aerohidromechanika/la.ekciju konspekts. Riga: RTU, 2009 - 94 lpp.  2. Pavelko 2. Casaskugu aerodinamika/Macfbu fizeksiis. Riga: RTU, 2009 - 358 lpp.  3. Paramonov Yu, M. Aeroplane structure and strength analysis. Riga: RTU, 2009 - 12 kpp.  6. Koliškina A. Rugsika matematika, 3. dala, Varbütübu teorija un matematisk	General data	
Course status in the programme         Compulsory/Courses of Limited Choice           Responsible instructor         Emma Sidlovska           Academic staff         Vitalijs Pavelko           Volume of the course; parts and credits points         I.V. FN           Annotation         I.V. EN           In Estudy course provides knowledge of ordinary and partial differential equations of mathematical methods, Fourier analysis, vector analysis and field theory, probability theory and mathematical asstatistics as well as application of mathematical models of damage and failure accumulation in aircraft operation modeling and aircraft safety analysis and aerosol analysis for successful matering of aerobydromechanics.           Goals and objectives of the course in terms of competences and skills         The aim of the study course is to promote the in-depth acquisition of knowledge in solving the problems of aircraft acrodynamics, aerohydromechanics and safety analysis by applying mathematical knowledge.  The tasks of the study course are to teach:  - the application of calculations of differential equations for the study of mechanical and electrical systems;  - scalar field gradient and vector field divergence and rotor calculation; - the Fourier method in solving partial differential equations; - mathematical models of dramage and retrial to calculate probability.           Structure and tasks of independent studies         Work with literature and the Internet. Independent solving of mathematical problems (homework obligation): - probability theory, damage and retrial to calculate probability.           Structure and tasks of independent studies         Work with literature and the Internet. Independent solving of ma	Code	BM0549
Responsible instructor  Academic staff  Viālijs Pavelko Volume of the course; parts and credits points  Language of instruction  Annotation  The study course provides knowledge of ordinary and partial differential equations of mathematical and methods, Fourier analysis, vector analysis and field theory, probability theory and mathematical statistics as well as application of mathematical models of damage and failure accumulation in an increaft operation modeling and arterial staty-analysis and acrosol analysis for successful mastering of acrohydromechanics.  Goals and objectives of the course in terms of competences and skills  The aim of the study course is to promote the in-depth acquisition of knowledge in solving the problems of aircraft acrodynamics, acrohydromechanics and safety analysis by applying mathematical knowledge.  The tasks of the study course are to teach:  The tasks of the study course are to teach:  Structure and tasks of independent studies  Recommended literature  Obligation and partial differential equations;  - mathematical and vector field divergence and rotor calculation; - the Fourier method in solving partial differential equations; - mathematics and physics tasks in modelling aircraft operation; - mathematics and physics tasks in modelling aircraft operation; - mathematics and physics tasks in modelling aircraft operation; - mathematics and physics tasks in modelling aircraft operation; - probability theory, damage and refusal to calculate probability.  Structure and tasks of independent studies  Recommended literature  Obligation Obligatory; - Paveloo V Gaisakulgu aerodinamika/Michib Infazelis, Riga: RTU, 2009 - 94 Ipp Paveloo V Gaisakulgu aerodinamika/Michib Infazelis, Riga: RTU, 2009 - 958 Ipp Paveloo V V an Aeroplame structure and teatrength malysis; RTU, 2009 - 958 Ipp Paveloo V V and Aeroplame structure and strength malysis; RTU, 2009 - 958 Ipp Paveloo V V and Aeroplame structure and strength malysis; RTU, 2009 - 958 Ipp Paveloo V V and Aeroplame structure and st	Course title	Supplementary Mathematics (Aviation Transport)
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Volume of the course: parts and credits points         1 part, 6.0 credits           Language of instruction         LV, EN           Annotation         The study course provides knowledge of ordinary and partial differential equations of mathematical methods, Fourier analysis, vector analysis and field theory, probability theory and mathematical statistics as well as application of mathematical methods of damage and failure accumulation in aircraft operation modeling and aircraft safety analysis and aerosol analysis for successful mastering of aerohydromechanics and safety analysis and aerosol analysis for successful mastering of aerohydromechanics and safety analysis by applying mathematical knowledge.  The tasks of the study course are to teach:  - The tasks of the study course are to teach: - The tasks of the study course are to teach: - The policitation of calculations of differential equations for the study of mechanical and electrical sections: - mathematical models of damage accumulation; - probability theory, damage and refusal to calculate probability.  Structure and tasks of independent studies  Recommended literature  Structure and tasks of independent studies  Obligitation/bligatory: - Pavelko I. Aerohidromehänika/Lekciju konspekts, Rīga: RTU, 2009 - 94 lpp Pavelko I. Aerohidromehänika/Lekciju konspekts, Rīga: RTU, 2009 - 958 lpp Pavelko I. Aerohidromehänika/Lekciju konspekts, Rīga: RTU, 2009 - 958 lpp Pavelko I. Augstākā matemātika, 2. daļa. Rīga: Zvaigzne ABC, 2009 - 396 lpp Koliškins A. Augstākā matemātika, 2. daļa. Rīga: Zvaigzne ABC, 2009 - 396 lpp Koliškins A. Augstākā matemātika, 2. daļa. Narbūtību teorija un matemātiskā statistika: lekciju konspekts. Rīga: RTU, 2011 RTU, Pavelnko O., Sadurskis K. Varbūtību teorija un matemātiskā statistika: Pavelngrue ABC, 2004 RTU,	Responsible instructor	Emma Šidlovska
Language of instruction   LV, EN	Academic staff	Vitālijs Pavelko
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1. Pavelko I. Āerohidromehānika/Lekciju konspekts. Rīga: RTU, 2009 94 lpp. 2. Pavelko V. Gaisakuģu aerodinamika/Mācību līdzeklis. Rīga: RTU, 2009 258 lpp. 3. Paramonov Yu. M. Aeroplane structure and strength analysis. Riga: RTU, 2009. 4. Paramonovs Ju.M., Paramonova A. Ju. Transporta līdzekļu slodzes, resurss un drošums. Rīga: RTU, 2002 108 lpp. 5. Volodko I. Augstākā matemātika, 2. daļa. Rīga: Zvaigzne ABC, 2009 396 lpp. 6. Koliškins A. Augstākā matemātika, 3. daļa. Varbūtību teorija un matemātiskā statistika. Rīga: Zvaigzne ABC, 2011 88 lpp. 7. Pavļenko O., Šadurskis K. Varbūtību teorija un matemātiskā statistika: lekciju konspekts. Rīga RTU, 2011. 8. Pavļenko O., Šadurskis K. Varbūtību teorija un matemātiskā statistika: praktiskie darbi. Rīga: RTU, 2011. 9. Šteiners K. Augstākā matemātika, Lekciju konspekts inženierzinātīņu un dabaszinātīņu studentiem, IV, V un VI daļa. Rīga: Zvaigzne ABC, 1999 - 2001. 10. Salenieks N. Mehānisko un tehnoloģisko sistēmu drošums. Rīga: RTU MKI, 1994 33 lpp. Papildu/Additional: 11. Urbaha A., Carjova K., Urbaha M., Stelpa I. Gaisa kuģu konstrukciju nesagraujošā kontrole. Rīga: RTU, 2017 310 lpp. 12. Tikhonov A.N., Samarskii A.A. Equations of mathematical physics. Dover Publications, 2013. Smotrovs J. Varbūtību teorija un matemātiskā statistika. Rīga: Zvaigzne, 1985. 15. Андронов А.М., Копытов Е.А., Гринглаз Л.Я. Теория вероятностей и математическая статистика [Учебинк для вузов]. Москва [и дл.]. I Intrep, 2004 460 с. 16. Филиппов А.Ф. Сборник задач по дифференциальным уравнениям. Москва: Интеграл-Пресс, 1998 208 с. 17. Тихонов А.Н., Самарский А.А. Уравнения математической физики. Москва: Интеграл-Пресс, 1998 208 с. 17. Тихонов А.Н., Самарский А.А. Уравнения математической физики. Москва: Интеграл-Преос, 1908 208 с. 17. Тихонов А.Н., Самарский А.А. Уравнения математической физики. Восква: Интеграл-Преос, 1908 208 с.	Structure and tasks of independent studies	Work with literature and the Internet. Independent solving of mathematical problems (homework).
Course prerequisites Higher mathematics, physics, technical mechanics.		1. Pavelko I. Āerohidromehānika/Lekciju konspekts. Rīga: RTU, 2009 94 lpp. 2. Pavelko V. Gaisakuģu aerodinamika/Mācību līdzeklis. Rīga: RTU, 2009 258 lpp. 3. Paramonov Yu. M. Aeroplane structure and strength analysis. Riga: RTU, 2009. 4. Paramonovs Ju.M., Paramonova A. Ju. Transporta līdzekļu slodzes, resurss un drošums. Rīga: RTU, 2002 108 lpp. 5. Volodko I. Augstākā matemātika, 2. daļa. Rīga: Zvaigzne ABC, 2009 396 lpp. 6. Koliškins A. Augstākā matemātika, 3. daļa. Varbūtību teorija un matemātiskā statistika. Rīga: Zvaigzne ABC, 2011 88 lpp. 7. Pavļenko O., Šadurskis K. Varbūtību teorija un matemātiskā statistika: lekciju konspekts. Rīga: RTU, 2011. 8. Pavļenko O., Šadurskis K. Varbūtību teorija un matemātiskā statistika: praktiskie darbi. Rīga: RTU, 2011. 9. Šteiners K. Augstākā matemātika, Lekciju konspekts inženierzinātņu un dabaszinātņu studentiem, IV, V un VI daļa. Rīga: Zvaigzne ABC, 1999 - 2001. 10. Salenieks N. Mehānisko un tehnoloģisko sistēmu drošums. Rīga: RTU MKI, 1994 33 lpp. Papildu/Additional: 11. Urbahs A., Carjova K., Urbaha M., Stelpa I. Gaisa kuģu konstrukciju nesagraujošā kontrole. Rīga: RTU, 2017 310 lpp. 12. Tikhonov A.N., Samarskii A.A. Equations of mathematical physics. Dover Publications, 2013. 13. Smotrovs J. Varbūtību teorija un matemātiskā statistika. Rīga: Zvaigzne ABC, 2004. 14. Krastiņš O. Varbūtību teorija un matemātiskā statistika. Rīga: Zvaigzne, 1985. 15. Андронов А.М., Копытов Е.А., Гринглаз Л.Я. Теория вероятностей и математическая статистика [Учебник для вузов]. Москва [и др.]: Питер, 2004 460 с. 16. Филиппов А.Ф. Сборник задач по дифференциальным уравнениям. Москва: Интеграл-Пресс, 1998 208 с. 17. Тихонов А.Н., Самарский А.А. Уравнения математической физики. Москва: Изд-во МГУ, 1999. 18. Gertsbakh I.B. Reliability theory with application to preventive maintenance. Berlin, NY, London, Tokio: Springer, 2000 218 p. 19. Swift T. Damage tolerance Technology.

## Course contents

Course contents				
Content	Full- and part-time intramural studies		Part time extramural studies	
	Contact Hours	Indep. work	Contact Hours	Indep. work
Research of periodic processes. Fourier protrusion in real and complex form. Fourier transform. Signal spectral projection.	8	6	0	0
Process research with first order differential equations. Reactive motion, Tsiolkovsky formula. Transition processes in electrical circuits.	4	4	0	0

Investigation of processes using second and higher order linear differential equations with constant coefficients. Special oscillations in mechanical and electrical systems. Forced oscillations. Reson	6	4	0	0
Scalar and vector fields in physics, aerodynamics and hydrodynamics. Gradients, divergence, rotor. Continuity equation.	4	4	0	0
Modeling of aerodynamic and hydrodynamic processes. Modeling of aviation engine thermal and thermodynamic processes. Corresponding equations and problems of mathematical physics. Variable Separation.	8	4	0	0
Probabilities of damage and refusal. Classical definition of probability. Basic concepts of probability theory.	4	4	0	0
Sum and multiplication of events. Sum of incompatible events. Multiplication of independent events.	4	4	0	0
Conditional probability. Multiplication of events and sum probabilities in the general case. Full probability formula.	4	4	0	0
Beiesa formula. Application of full probability and Beies formulas in damage and rejection analysis. Bernoulli rehearsal scheme. Binomial distribution. Poisson distribution. Poisson's flow of events.	4	4	0	0
Bernoulli rehearsal scheme. Binomial distribution. Poisson distribution. Poisson's flow of events.	4	4	0	0
Discrete and continuous random variables. Statistical definition of probability. Probability density.	4	4	0	0
Mathematical hope and variance. Average distance and average time to failure.	4	4	0	0
Distribution functions. Moda. Median. Central moments. Asymmetry factor. Excess.	4	4	0	0
Even distribution. Exponential distribution. Normal distribution. Weibull distribution.	4	4	0	0
Mathematical models of damage and failure accumulation. Durability distribution functions. Basics of reliability theory.	4	4	0	0
Numerical solution of first order differential equations and study of solution stability. Laboratory work. Mathcad (Matlab).	2	4	0	0
Investigation of the equation of oscillations in the modes of special oscillations and forced oscillations. Laboratory work. Mathcad (Matlab).	4	4	0	0
Working with discrete distributions. Laboratory work. MS Excel.	2	5	0	0
Verification of the compliance of the continuous random variable with the normal and exponential distributions. Laboratory work. MS Excel.	2	5	0	0
Total:	80	80	0	0

Learning outcomes and assessment

Learning outcomes and assessment		
Learning outcomes	Assessment methods	
Is able to study the transition processes in mechanical and electrical systems, as well as to analyze the special oscillations and forced oscillations of the systems using 1st order differential equations and higher order linear differential equations with constant coefficients.	Laboratory works. Homework.	
Able to solve simple mathematical physics problems with partial differential equations, which arise in modeling aircraft operation.	Homework. Tests. Testing.	
Able to calculate the probabilities of events using the classical definition of probability, theorems on the sum and multiplication of events, full probability formula, Beies formula.	Homework. Tests. Testing.	
Can work with discrete and continuous distributions and can calculate mode, median, mathematical expectation, variance, standard deviation, asymmetry factor and excess.	Laboratory works. Homework.	
Able to apply mathematical methods in aircraft operation modeling and aircraft safety analysis.	Exam.	

Evaluation criteria of study results

Criterion		%
Laboratory works		15
Tests		20
Calculations (homework)		30
Testing		5
Exam		30
	Total:	100

Study subject structure

Part	СР	Hours				Tests	
		Lectures	Practical	Lab.	Test	Exam	Work
1.	6.0	30.0	40.0	10.0		*	