GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Mathematical Economics, PG_00072232		
Field of study	Mathematics		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2026/2027
Education level	first-cycle studies	Subject group	Optional subject group Subject group related to scientific research in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	3	Language of instruction	Polish
Semester of study	5	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Divison of Differential Equations and Applications of Mathematics -> Institute of Applied Mathematics -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Krzysztof Świetlik	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	15.0	0.0	0.0	45

E-learning hours included: 0.0

eNauczanie source addresses:

Moodle ID: 9342 Ekonomia matematyczna
https://enauczanie.pg.edu.pl/2025/course/view.php?id=9342

Learning activity and number of study hours

Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
Number of study hours	45	6.0	49.0	100

Subject objectives

Knowledge of theoretical models describing the relationships between economic processes. Ability to derive solutions for these models under specific conditions and to test them against empirical data using software.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_U05	The student is able to select a model and, by applying appropriate mathematical methods, find its solution for specific conditions. They are also able to verify the solution against empirical data using software.	[SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools
K6_U10	The student is able to select an appropriate model and, using suitable computational tools, find a solution for specific conditions. They are also able to verify the solution against empirical data with the help of software.	[SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools
K6_W03	The student is able to identify the relationships between microeconomic and macroeconomic processes and select appropriate theoretical models to describe them.	[SW3] Assessment of knowledge contained in written work and projects

Subject contents

Course content – lecture

1. Mathematical economics versus econometrics. Economic models. Components of a mathematical model.
2. Static equilibrium analysis in economics. Partial market equilibrium – linear and non-linear models. General market equilibrium. Equations in national income analysis. Leontief input-output models.
3. Dynamic analysis in economics. Domar growth model. Market price dynamics. Cobweb model of equilibrium.
4. Samuelson's multiplier-accelerator model.
5. Solow growth model. Balanced growth path. The impact of changes in the savings rate on output and consumption. Savings versus investment.
6. Ramsey-Cass-Koopmans model. Diamond model.
7. Cobb-Douglas production function.
9. Models of research and development (R&D) activity. Modeling knowledge accumulation. Modeling human capital accumulation and physical capital growth.
10. Real business cycle (RBC) modeling. Analysis of output fluctuations: Nelson-Plosser and Campbell-Mankiw tests.
11. Keynesian economic models. IS-LM modeling. The Phillips curve.
12. Modeling consumption. Life-cycle, permanent income, and random walk hypotheses. Models of savings and consumption.
13. Modeling investment. Effects of changes in output, interest rates, and taxes.
14. Modeling inflation. Effects of changes in the money supply and interest rates.
15. Models of unemployment. Performance-based wage model. The Shapiro-Stiglitz model.

Course content – laboratory

1. Dynamic analysis. Domar growth model. Market price dynamics. Cobweb model of equilibrium.
2. Samuelson's multiplier-accelerator model.
3. Solow growth model. Balanced growth path. Assessment of the impact of changes in the savings rate on output and consumption.
4. Ramsey–Cass–Koopmans model. Diamond model.
5. Cobb-Douglas production function.
6. Real business cycle modeling. Analysis of fluctuations: Nelson-Plosser and Campbell-Mankiw tests.
7. IS-LM modeling. Phillips curve.
8. Consumption modeling. Life-cycle, permanent income, and random walk hypotheses. Models of saving and consumption.
9. Investment modeling. Effects of changes in output, interest rates, and taxes.
10. Inflation modeling. Effects of changes in the money supply and interest rates.
11. Unemployment models. Efficiency wage model. Shapiro-Stiglitz model.

Prerequisites and co-requisites

Fundamentals of Economics

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Laboratory project	60.0%	50.0%
Test based on lecture content	60.0%	50.0%

Recommended reading

Basic literature	1. D. Romer, Advanced Macroeconomics, PWN, Warsaw 2011 2. A.C. Chiang, Fundamental Methods of Mathematical Economics, PWE, Warsaw 1994 3. P. Krugman, R. Wells, Macroeconomics, PWN, Warsaw 2020
Supplementary literature	1. P. Krugman, R. Wells, Microeconomics, PWN, Warsaw 2020 2. P. R. Krugman, M. Obstfeld, M. J. Melitz, International Economics: Theory and Policy, Vol. 2, PWN, Warsaw 2018
eResources addresses	

Example issues/ example questions/ tasks being completed

1. For a Cobb-Douglas production function, derive expressions for k*, y*, and c* as functions of the model parameters s, n, delta, g, and alpha. What savings rate is required to generate a capital stock consistent with the Golden Rule?
2. Consider a production model with a Constant Elasticity of Substitution (CES) production function. Show that this production function exhibits constant returns to scale.
3. Assume that the United States permanently reduces its budget deficit from 5% to zero. Suppose that, initially, $s = 0.15$ and that investment increases by the full amount of the reduction in the deficit. Let the capital share be 0.33. By how much will output and consumption ultimately increase?
4. Consider the production function $Y = K^alpha (AL)^beta R^{1-alpha-beta}$, where R is the quantity of land. Assume alpha > 0, beta > 0, and alpha + beta < 1. The factors of production follow these dynamics: dK/dt = sY - delta K, dA/dt = gA, dL/dt = nL, and dR/dt = 0. Does the economy have a unique and stable balanced growth path? If so, what are the growth rates of the factors of production? If not, why?
5. Consider a Ramsey-Cass-Koopmans economy that is on a balanced growth path. Suppose that at a certain point in time — say, at t = 0 — the government introduces a tax on investment income at a rate tau. The real interest rate for households is given by r(t) = (1 - \tau)f'(k(t)). Assume that the change in tax policy is unanticipated and that the government returns the revenue generated by this tax. How will the economy respond to the introduction of the tax at time 0? What is the dynamic behavior of output after time 0?

Practical activites within the subject	Not applicable

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