COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Engineering		
ACADEMIC UNIT	Department of Financial and Management Engineering		
LEVEL OF STUDIES	7		
COURSE CODE	I-5	SEMESTER	1
COURSE TITLE	Financial Mathematics		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures	3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Stream Obligatory
PREREQUISITE COURSES:	-
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://odim.aegean.gr/?q=el/node/29

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The goal of the course is twofold: firstly, to introduce students to the basic principles governing financial modeling and analysis, and secondly, to provide an in-depth understanding of advanced mathematical concepts and techniques for applying them in the solution of both theoretical and practical problems. Additionally, it aims to provide the necessary background either for the comprehension of subsequent courses in the study program or for further study.

Upon successful completion of this course, the student will be able to:

- ✓ Understand and apply concepts from Probability and Statistics for financial data analysis and decision-making
- ✓ Evaluate and manage financial risk
- ✓ Understand the concept of stochastic processes and their application in modeling financial markets
- ✓ Price options in both discrete and continuous time.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- ✓ *Search for, analysis and synthesis of data and information, with the use of the necessary technology*
- ✓ *Adapting to new situations*
- ✓ *Decision-making*
- ✓ *Working independently*
- ✓ *Team work*
- ✓ *Working in an international environment*
- ✓ *Working in an interdisciplinary environment*
- ✓ *Production of new research ideas*

(3) SYLLABUS

1. **Probability Theory:** Random variables, probability distributions, mean and variance. The normal distribution. Conditional probability distribution, joint probability distribution, independence, covariance and correlation.
2. **Statistics:** Sample, sampling distribution. Estimation (point and interval estimation), hypothesis testing.
3. **Introduction and basic concepts:** Financial securities and financial markets, types of financial assets (stocks, bonds, derivative products), interest & interest rate, simple, discount and compound interest, time value of money, present and future value, net present value.
4. **Financial risk & uncertainty I:** Return (arithmetic and logarithmic), the return as a random variable, return on single investment and portfolio, expected return, expected return on portfolio with N assets. The concept of risk & financial risk, major types of financial risk, risk measures, the variance as a risk measure, portfolio risk and covariance structure, systematic and non-systematic risk, risk diversification.
5. **Financial risk & uncertainty II:** Introduction to Value-at-Risk (VaR) and Expected Shortfall, calculation of VaR, Normal VaR, Historical VaR.
6. **Introduction to Derivative Pricing - One-Period Binomial Model:** Pricing Forwards and Futures, pricing of options - one-period binomial model, changing the probability measure, the 'risk-neutral world,' relationships between the prices of different option contracts.
7. **Advanced Probability Concepts – Martingales:** σ-algebra and measure, stochastic independence, conditional mean, properties of conditional mean, stochastic process, martingales.
8. **Valuation of Options in Discrete Time - Multi-Period Binomial Model:** Self-financing investment strategy in discrete time, n-period binomial model, no-arbitrage pricing of derivative financial products using an n-period model.
9. **Brownian Motion:** Brownian Motion, Geometric Brownian Motion.

10. **Valuation of Options in Continuous Time – The Black-Scholes-Merton (BSM) Model:** The Black-Scholes-Merton model, practical issues with the Black-Scholes-Merton formula, Delta Hedging strategy, option pricing by solving the BSM equation in Excel.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance learning
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT in teaching and communication with students
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	<table><tr><th>*Activity*</th><th>*Semester workload*</th></tr><tr><td>Lectures</td><td>30</td></tr><tr><td>Study and analysis of bibliography</td><td>37</td></tr><tr><td>Non-directed study</td><td>80</td></tr><tr><td>Exams</td><td>3</td></tr><tr><td>Course total</td><td>***150***</td></tr></table>
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	***Method of assessment and evaluation:*** • Final exams in Greek (100%) which include open-ended questions, problem solving, written work.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

In Greek

- Στοιχειώδης Εισαγωγή στα Χρηματοοικονομικά Μαθηματικά, 1η εκδ/2007, Ross Cheldom,: ΕΤΑΙΡΙΑ ΑΞΙΟΠΟΙΗΣΗΣ ΚΑΙ ΔΙΑΧΕΙΡΙΣΗΣ ΠΕΡΙΟΥΣΙΑΣ ΤΟΥ ΠΑΝΕΠΙΣΤΗΜΙΟΥ ΜΑΚΕΔΟΝΙΑΣ.
- Σημειώσεις παραδόσεων: Παράγωγα Χρηματοοικονομικά προϊόντα (εισαγωγή στην στοχαστική χρηματοοικονομική ανάλυση), Μπούτσικας Μιχαήλ, Τμήμα Στατιστικής και Αναλογιστικής Επιστήμης, Πανεπιστήμιο Πειραιά.
- Στοχαστικά Χρηματοοικονομικά, Βασιλείου Παναγιώτης – Χρήστος, 1η έκδ./2001, Βασιλείου Παναγιώτης – Χρήστος, Ζήτη Πελαγία & Σια Ι.Κ.Ε.
- Βασικές Αρχές Χρηματοοικονομικών Μαθηματικών, 2η έκδ/2018, Χαλιδιάς Νικόλαος, BROKEN HILL PUBLISHERS LTD.
- Διαχείριση τραπεζικών και χρηματοοικονομικών κινδύνων. Ν. Σχοινιωτάκης και Γ.Συλλιγάρδος. Εκδόσεις Δίσιγμα, 2010.
- Χρηματοοικονομικά Παράγωγα. Θ. Πουφινάς και Χ. Φλώρος. Εκδόσεις Δίσιγμα, 2014
- Εισαγωγή στα Παράγωγα Χρηματοοικονομικά Προϊόντα. Π. Αγγελόπουλος. Εκδόσεις Σταμούλη, 2017
- Βασικές αρχές των αγορών συμβολαίων και δικαιωμάτων, Hull, J., C., Κλειδάριθμος, 2017.
- Διοίκηση Χρηματοπιστωτικών ιδρυμάτων και διαχείριση κινδύνων, Sunders και Cornett, M., M., Broken Hill, 2023.
- Διαχείριση χρηματοοικονομικών κινδύνων με το MATLAB: Μια εφαρμοσμένη προσέγγιση, Α. Ζαπράνης, Κλειδάριθμος, 2009.

In Enlish

- An Elementary Introduction to Mathematical Finance: Options and other Topics, Ross, S., Cambridge University Press; 2nd edition, 2002.
- Options, Futures and Other Derivatives, Hull, J., 5th edition, Prentice Hall, 2003.
- The Mathematics of Financial Derivatives, Willmott, P., Howison, S., Dewynne, J., Cambridge University Press,1997.
- An Introduction to the Mathematics of Financial Derivatives, Neftci, S. N., Academic Press, 2000.
- Value at risk: the new benchmark for controlling market risk, Jorion, P., McGrawHill, 2nd edition, 2001.
- Mathematics for Finance, An introduction to financial engineering, Capinski, M., Zastawniak, T., Springer-Verlag, 2003.
- Basic stochastic processes, Brzezniak, Z., Zastawniak, T., Springer-Verlag, 2006.
- Introduction to mathematical finance, Pliska, S. R, Blackwell, 2006.
- Financial risk manager handbook, second edition, Jorion, P., Wiley, 2003.