Semester 5 Modules: Specialization Financial Engineering (Ingénierie pour la Finance - IF-)

code	Title	type	Coeffi-cients	ECTS	Total work-load	Contact hours	Private study
FIN.5.1	International Finance	compulsory	2	2	50	30	20
MAT.5.3	Numerical Optimization	compulsory	2	2	50	30	20
FIN.5.2	The Risk Modelling and Dynamic Financial Risk Management	compulsory	2	2	50	30	20
FIN.5.3	Bank Management	compulsory	2	2	50	30	20
ISA.5.1	Big Data	compulsory	2	2	50	30	20
FIN.5.4	Monte carlo methods and financial model simulation	compulsory	2	2	50	30	20
MAT.5.5	Data analysis	compulsory	2	2	50	30	20
MAT.5.4	Statistical Inference	optional	2	2	50	30	20
ISA.5.4	Business intelligence	optional	2	2	50	30	20
AI.5.1	Multi agent systems	optional	2	2	50	30	20
FIN.5.6	Valuation and financing of companies	compulsory	2	2	50	30	20
AI.5.12	Introduction to Deep Learning	compulsory	1	1	25	15	10
FIN.5.5	Quantitative Finance	compulsory	1	1	25	15	10
DOS.5.2	Blockchain	compulsory	1	1	25	15	10
SE.5.3	Mobile Development	optional	1	1	25	15	10
ISA.5.7	Distributed data Bases	optional	1	1	25	15	10
DOS.5.3	IoT	optional	1	1	25	15	10
	Module complémentaire 1		2	2	50	30	20
	Module complémentaire 2		2	2	50	30	20
	Module complémentaire 3		2	2	50	30	20
	Module complémentaire 4		1	1	25	15	10
	Module complémentaire 5		1	1	25	15	10
	Module complémentaire 6		1	1	25	15	10

FIN.5.1 International Finance

Module designation	FIN.5.1 International Finance
Semester(s) in which the module is taught	S5
Person responsible for the module (coordinator)	Snoussi Imen
Teaching team	Snoussi Imen
Language	French
Relation to curriculum	Compulsory
Teaching methods	lesson
Workload (incl. contact hours, self-study hours)	Total workload: 50h Contact hours : 30h (15h lessons, 15h exercises) Private study: 20h.
Credit points	2 ECTS
Required and recommended prerequisites for joining the module	Financial markets concepts
Module objectives/intended learning outcomes	To acquire a good knowledge of the functioning of the international monetary system, to understand the functioning of the spot and forward foreign exchange market, to understand the functioning of the operations on the various compartments of the foreign exchange market, to make known the various types of foreign exchange risks and the instruments which allow to cover them. Competencies: C11, C12, C13
Content	I. INTRODUCTION TO THE FOREIGN EXCHANGE MARKET : 1) History of the international monetary system 2) The exchange rate regime in Tunisia 3) Organisation of the international foreign exchange market 4) Participants in the foreign exchange market 5) The media used 6) Foreign exchange transactions II. THE FOREIGN EXCHANGE MARKET IN THE SPOT MARKET : 1) Definition and characteristics 2) Exchange rate quotation methods 3) The transition from rating with uncertainty to rating with certainty 4) The calculation of cross rates 5) Geographical arbitrage 6) Triangular arbitration (for the bank's own account and for the customer's account) III. THE FORWARD FOREIGN EXCHANGE MARKET 1) Definition and characteristics 2) Notions of carry forward and backwardation

	3) Forward foreign exchange market quotations 4) The mechanism for forming forward rates: forward outright exchange 5) Calculation of the forward price 6) The calculation of the forward price 7) Foreign exchange swaps IV. HEDGING CURRENCY RISK THROUGH CURRENCY OPTIONS 1) Origin and development of options markets 2) Over-the-counter markets 3) Organised markets 4) Calls/currencies 5) Puts/contracts 6) Determinants of currency options 7) The principle of hedging currency risk through currency options
Examination forms	35% continuous eval+65% written exam
Study and examination requirements	10/20
Reading list	Bourguinat, Teïletche, Dupuy. (2007). Finance internationale. Dunod. Krugman, P., & Obstfeld, M. (2012). International Economics (9th edition). Pearson.

MAT.5.3 Numerical Optimization

Module designation	MAT.5.3 Numerical Optimization
Semester(s) in which the module is taught	S:5
Person responsible for the module	Fethi Kadhi
Language	English
Relation to curriculum	Compulsory
Teaching methods	Lessons, Lab, Projects.
Workload (incl. contact hours, self-study hours)	Total workload:50h Contact hours :30h Private study:20h
Credit points	2 ECTS
Required and recommended prerequisites for joining the module	MAT.3.1Linear and nonlinear programming MAT.2.2 Numerical methods
Module objectives/intended learning outcomes	Mathematical optimization or mathematical programming is the selection of a best element, with regard to some criterion, from some set of available alternatives. Optimization problems of sorts arise in all quantitative disciplines from computer science and engineeringto operations research and finance. the development of solution methods has been of interest in mathematics for centuries. R tool is a free open-source computing environment which works on several platforms such as Windows, Linux, and macOS. In recent years, there has been an increasing interest in using R software to perform the data analysis. Competencies: C1, C9, C13
Content	Ch:1 Basics of R 1.1 Data structures in R 1.2 Funtios in R 1.3 Decision-Making and Loop Statements 1.4 Graphics Ch:2 Optimality Conditions 2.1 First-Order Necessary Condition 2.2 Second-Order Necessary Condition 2.3 Second-Order Sufficient Condition Ch: 3 One-Dimensional Optimization Methods 3.1 Introduction 3.2 Golden Section Search Method 3.3 Newton–Raphson Method 3.4 Secant Method . Ch:4 Steepest Descent Method 4.1 Introduction 4.2 Basics of Steepest Descent Method 4.3 Steepest Descent Method for Quadratic Functions 4.4 Convergence Analysis of Steepest Descent Algorithm . Ch:5 Conjugate Gradient Methods

	5.1 Introduction 5.2 Basics of Conjugate Direction 5.3 Convergence Analysis of Conjugate Direction Method 5.4 Method of Conjugate Gradient Ch: 6 Newton's Method 6.1 Introduction 6.2 Newton's Method for Multiple Unknowns 6.3 Convergence Analysis of Newton's Method
Examination forms	35%Mid-term quiz + 65% Written final exam
Study and examination requirements	10/20;
Reading list	Mishra, S. K., & Ram, B. (2019). Introduction to Unconstrained Optimization with R. Springer. Gilli, M., Maringer, D., & Schumann, E. (2019). Numerical Methods and Optimization in Finance. Academic Press.

FIN.5.2 The Risk Modelling and Dynamic Financial Risk Management

Module designation	FIN.5.2 The Risk Modelling and Dynamic Financial Risk Management
Semester(s) in which the module is taught	S5
Person responsible for the module (coordinator)	Mouna Ben Salah
Teaching team	Mouna Ben Salah
Language	French
Relation to curriculum	Compulsory
Teaching methods	Lesson
Workload (incl. contact hours, self-study hours)	Total workload: 50h Contact hours : 30h (21h lessons, 9 h exercises) Private study: 20h.
Credit points	2 ECTS
Required and recommended prerequisites for joining the module	Portfolio management, financial market
Module objectives/intended learning outcomes	The Risk Modeling and Dynamic Financial Risk Management course aims to understand the concept of financial risk, and to provide information on the methods of measuring and managing this risk. This course will focus on market risk (equity market risk and interest rate risk related to movements in the term structure of interest rates). The classical methods of measuring this type of risk (standard deviation) as well as modern methods (Value at Risk or VaR) are studied. Next, this course will present the instruments used to hedge against market risk, namely: forwards, futures, options and swaps. At the end of this course, the student will acquire the necessary tools to identify measure and hedge financial risks. Competencies: C11, C12, C13

Content	Chapter 1: Financial Risk Assessment I: Measures of Financial Asset Risk II. Value at Risk 1. Definition of VaR 2. Historical VaR 3 Parametric VaR 3.1 Calculation of the VaR of a stock position or a stock portfolio 3.2 Calculation of the VaR of a currency position 3.3 Calculation of the VaR of a bond position 3.4 Aggregate VaR 3.5 portfolio VaR a. Marginal VaR b. Incremental VaR c. Individual VaR d. The VaR component 4. VaR by Monte Carlo simulation 5.The VaR of an option position 5.1 The VaR of a "Delta Normal" Option Position 5.2 VaR of a "Delta Gamma" Option Position 6. The expected short fall (ES) 7. Stressed VaR Chapter 2: Portfolio Insurance I. Definition of Options 1. The Call Option 2. The Put Option II. Uncovered Positions III. Portfolio Insurance 1. Stop-Loss Strategy 2. Option-based portfolio insurance 2.1 Put-based portfolio insurance 2.2 Call-based portfolio insurance 2.3 Cushion Method Insurance
	Chapter 4: Interest Rate Risk Management I. Definition II. Risk measurement: Gap analysis methods III. Hedging of interest rate risk and firm OTC instruments. 1. FRAs (Forward Rate Agreements) or rate guarantees 1.1 Definition 1.2 Mechanism 1.3 Calculation of the interest rate differential 2. The Forward Rate Agreement 1.1 Definition 1.2 Mechanism 1.3 Borrower forward 1.4 Lender forward 3. Interest rate swap IV. Hedging interest rate risk and conventional OTC instruments 1. The cap 2. The Floor 3. The Collar 3.1 The Borrowing Collar 3.2 The Lending Collar
Examination forms	35% continuous+65% written exam
Study and examination requirements	10/20

Reading list	Bellalah, M., & Simon, Y. (2000). Options, contrats à terme et gestion des risques: Analyse, évaluation et stratégies. Economica. Bellalah, M. (2003). Gestion des risques et produits dérivés classiques et exotiques. Gestion Sup, Dunod. Esch, L., Kieffer, R., & Lopez, T. (2003). Asset and Risk Management: La finance orientée « risques ». De Boeck et Larcier. Hull, J. (1997). Options, futures and other derivatives (3rd ed.). Prentice Hall. Roncalli, T. (2004). La Gestion des Risque Financiers. Economica. Simon, Y. (1995). Marchés dérivés de Matières Premières et Gestion du Risque de Prix. Economica. Simon, Y., & Bellalah, M. (2003). Options, contrats à terme et gestion des risques (2nd ed.). Economica. Simon, Y., Lautier, D., & Morel, C. (2009). Finance internationale (10th ed.). Economica. Vernimmen, P. (2002). Finance d'Entreprise. Dalloz.

FIN.5.3 Bank Management

Module designation	FIN.5.3 Bank Management
Semester(s) in which the module is taught	S5
Person responsible for the module (co-ordinator)	Mouna Ben Salah
Teaching team	Mouna Ben Salah
Language	French
Relation to curriculum	Compulsory
Teaching methods	Lesson
Workload (incl. contact hours, self-study hours)	Total workload: 50h Contact hours : 30h (20h lessons, 10h exercises) Private study: 20h.
Credit points	2 ECTS
Required and recommended prerequi-sites for joining the module	Financial analysis
Module objectives/intended learning outcomes	The Banking Management course aims to introduce students to the different types of banks and their respective businesses and to identify the risks they face through their activity (interest rate risk, market risk, credit risk, operational risk) and the mechanisms of credit risk management under the effect of tightening regulations and capital allocation requirements through the Basel I, Basel II and Basel III agreements ... Competencies: C11, C12, C13
Content	Chapter 1: Organization and functioning of the credit institution: the Tunisian banking system 1. Definition and mission of the credit institution 2. Rules of constitution 3. The three main areas of banking activity 4. Architecture of the Tunisian banking sector Chapter 2: Banking risks, definition and typology I. Typologies of banking risks 1. The credit risk 2. Market risk 3. Operational risk 4. Liquidity risk 5. Global Interest Rate Risk Chapter 3: The Regulatory Framework 1. History of the Basel Committee 2. Role of the Basel Committee 3. The Basel I agreement 4. The three pillars of the Basel II agreement 4.1 Minimum capital requirement 4.2 Prudential supervision process 4.3 Market discipline 5. The contributions of the Basel III agreement Chapter 4 : Credit risk management

	Section 1: Credit risk assessment I. The traditional approach to assessing credit risk: financial analysis II. The new approach to credit risk assessment 1. The credit scoring method 2. the Rating 3. RAROC: Risk Adjusted Return On Capital 4. Credit VaR 5. Measuring the credit risk of a bond portfolio
	Section 2. Credit risk management I. Traditional credit risk management instruments 1. Regulatory management 2. Guarantees 3. Provisioning II. New techniques 1. Securitization 2. Credit derivatives 2.1 Definition of credit derivatives 2.2 Credit Default Swaps (CDS) 2.3 Credits Linked Notes: "CLN 2.4 Total Return Swap: "TRS
Examination forms	35% continuous+65% written exam
Study and examination requirements	10/20
Reading list	Dumontier, P., & Dupré, D. (2005). Pilotage bancaire: Les normes IAS et la réglementation Bâle II. Revue Banque Editeur. Van Greuning, H., & Bratanovic, S. (2004). Analyse et Gestion du Risque Bancaire: Un cadre de référence pour l'évaluation de la gouvernance d'entreprise et du risque financier. ESKA. Coussergues, S., & Bourdeaux, G. (2013). Gestion de la banque du diagnostic à la stratégie. Dunod. Banque des règlements internationaux. (2017). Bâle III: Finalisation des réformes de l'après-crise.

ISA.5.1 Big Data

Module designation	ISA.5.1 Big Data
Semester(s) in which the module is taught	S5
Person responsible for the module (coordinator)	Raoudha Chebil
Language	French
Relation to curriculum	Compulsory
Teaching methods	lesson, lab works, presentations.
Workload (incl. contact hours, self-study hours)	Total workload: 50h Contact hours: 30h (20h lessons + 10h lab works) Private study]: 20 h
Credit points	2 ECTS
Required and recommended prerequisites for joining the module	DAT.1.1 Database and DBMS
Module objectives/intended learning outcomes	Knowledge: Students: -Master the basic building blocks of the Hadoop platform, namely HDFS and MapReduce, and have an idea of the components of its ecosystem; -Master the MapReduce approach for problem solving; -Understand the limits of the relational model and know the different models of NOSQL databases. Competencies: C4, C7, C8

Content	Chapter I – Introduction to Big Data 1. Motivations 2. Definition 3. The 3Vs and the additional Vs 4. Benefits and challenges 5. Application examples 6. Stages of a Big Data project 7. New professions 8. Related fields Chapter II – Hadoop: Building Blocks 1. Hadoop presentation 2. Hadoop history 3. Hadoop ecosystem 4. HDFS 5. MapReduce V1 6. MapReduce V2 7. Design Patterns MapReduce Chapter III - Advanced Processing Tools 1. Data processing types 2. MapReduce review 3. Abstraction languages a. Pig b. Hive 4. Apache Spark Chapter IV – NOSQL Databases 1. DBMS strengths 2. DBMS limits 3. BD NOSQL 4. BDR vs BD NOSQL 5. Study of BD NOSQL instances a. Cassandra b. MongoDB Chapter V – Big Data Architectures 1. Motivations 2. Lambda architecture 3. Kappa architecture 4. Other architectures 5. Case study Practical Works 1. Installation and testing of the working environment 2. HDFS 3. MapReduce 4. Pig and Hive 5. Spark 6. HBase
Examination forms	35% continuous evaluation (Lab works, presentations) ; 65% written exam
Study and examination require-ments	10/20

Reading list	Mooc − "Fundamentals for Big Data", Télécom Paris-Tech − "Introduction to Hadoop and MapReduce", University Nice Sophia Antipolis Books Bruchez, R. (2015). NoSQL databases and BigData: Understanding and implementing. Editions Eyrolles. Marr, B. (2015). Big Data: Using SMART big data, analytics and metrics to make better decisions and improve performance. John Wiley & Sons. Zikopoulos, P., Eaton, C., et al. (2011). Understanding big data: Analytics for enterprise class Hadoop and streaming data. McGraw-Hill Osborne Media. Classes Nerzic, P. (2016). Hadoop tools for Big Data. Rennes1 University, France.

FIN.5.4 Monte carlo methods and financial model simulation

Module designation	FIN.5.4 Monte Carlo Methods & Simulation of Financial Models
Semester(s) in which the module is taught	S5
Person responsible for the module (coordinator)	Amor Oueslati
Teaching team	
Language	French
Relation to curriculum	Compulsory
Teaching methods	lecture, lab works
Workload (incl. contact hours, self-study hours)	Total workload: 50h Contact hours: 30h (20h lessons, 10h lab works) Private study:20h
Credit points	2 ECTS
Required and recommended prerequisites for joining the module	Probability, inferential statistics, Bayesian statistics, stochastic calculus, stochastic process, Financial Mathematics
Module objectives/intended learning outcomes	Competencies: C1, C9, C13
Content	1. Introduction to Monte Carlo Simulation 2. Simulation of random variables 3. Simulation of Diffusion Processes & Time Discrete Methods 4. Variance reduction techniques: - antithetic variable, control

	variable and pairing of moments - Strategic sampling, Stratified sampling, and Latin hypercube 5. Option pricing and value-at-risk estimation 6. Model estimation and calibration 7.MCMC
Examination forms	35% continuous evaluation (Lab works, presentations) ;65% written exam
Study and examination requirements	Requirements for successfully passing the module
Reading list	Glasserman, P. (2003). Monte Carlo Methods in Financial Engineering (Stochastic Modelling and Applied Probability) (v. 53). Springer-Verlag New York, LLC. Lamberton, D., & Lapeyre, P. (1999). Introduction au calcul stochastique appliqué à la finance. Ellipses. Rennie, A. (1996). Financial Calculus: An Introduction to Derivative Pricing. Cambridge University Press. Steele, J. M. (2003). Stochastic Calculus and Financial Applications. Springer-Verlag New York, LLC. Duffie, D. (1992). Dynamic Asset Pricing Theory. Princeton University Press. Karatzas, I., & Shreve, S. E. (1988). Brownian Motion and Stochastic Calculus. Springer.

MAT.5.5 Data analysis

Module designation	MAT.5.5 Data Analysis
Semester(s) in which the module is taught	Sem:5
Person responsible for the module	Fethi Kadhi
Language	French
Relation to curriculum	Compulsory
Teaching methods	Lessons, Lab, Projects.
Workload (incl. contact hours, self-study hours)	Total workload:50h Contact hours :30h Private study:20h
Credit points	2 ECTS
Required and recommended prerequisites for joining the module	MAT.1.1 Probabilty and statstics
Module objectives/intended learning outcomes	The emphasis in this course is on financial data and how to model and analyze it. Understanding financial data may increase one's success in the markets Competencies:C1, C9
Content	1. The Nature of Financial Data 1.1 Financial Assets and Markets 1.2 Frequency Distributions of Returns 1.3 Volatility 2. Exploratory Financial Data Analysis 2.1. Data Reduction 2.2. The Empirical Cumulative Distribution Function 2.3. Graphical Methods in Exploratory Analysis 3. Statistical Models and Methods of Inference 3.1. Models 3.2. Optimization in statistics 3.3. Properties of estimators 4. Regression Models 4.1. Linear regression model 4.2. Nonlinear models 4.3. ARMA and ARIMA Models
Examination forms	100% final exam
Study and examination requirements	10/20

Reading list	Collard, J.-F. Hands-On Data Analysis in R for Finance. CRC Press (Taylor & Francis Group, LLC). DOI: 10.1201/9781003320555.

MAT.5.4 Statistical Inference

Module designation	MAT.5.4 Statistical inference
Semester(s) in which the module is taught	Sem:5
Person responsible for the module	Fethi Kadhi
Language	French
Relation to curriculum	Optional
Teaching methods	Lessons, Lab, Projects.
Workload (incl. contact hours, self-study hours)	Total workload:50h Contact hours :30h Private study:20h
Credit points	2 ECTS
Required and recommended prerequisites for joining the module	MAT.1.1 Probabilty and statstics
Module objectives/intended learning outcomes	In a statistical investigation, it is known that for reasons of time or cost, one may not be able to study each individual element of the population. In such a situation, a random sample should be taken from the population, and the inference can be drawn about the population on the basis of the sample. Hence, statistics deals with the collection of data and their analysis and interpretation. In this book, the problem of data collection is not considered. We shall take the data as given, and we study what they have to tell us. The main objective is to draw a conclusion about the unknown population characteristics on the basis of information on the same characteristics of a suitably selected sample. Competencies:C1, C9
Content	1. Basics of R 1.1 Types of R 1.2 Data structures of R 1.3 Functions in R 2. Theory of Sampling 2.1. Samples 2.2. Weak law of great numbers 2.3. Limit central theorem 2.4. Gamma, Student, Fisher Distributions 3. Point estimates 3.1. Moments method 3.2. Likelihood method 3.3. Properties of estimators 4. Confidence intervals 4.1. Confidence interval of a proportion 4.2. Confidence interval of a mean 4.3. Confidence interval of a variance 5. Hypothesis tests 5.1. Tests of conformity 5.2. Tests of comparison 5.3. One-Way Analysis of Variance (ANOVA)

	6. Regression: Fitting a Straight Line 6.1. Least Squares Regression 6.2. Properties of the Least Squares Estimators 6.3 Estimating the Error Variance r
Examination forms	100% final exam
Study and examination requirements	10/20
Reading list	Bartoszynski, R., & Niewiadomska-Bugaj, M. (2020). Probability and Statistical Inference, Third Edition. Wiley-Interscience. Deshmukh, S., & Kulkarni, M. (2021). Asymptotic Statistical Inference: A Basic Course Using R. Springer.

ISA.5.4 Business intelligence

Module designation	ISA.5.4 Business intelligence
Semester(s) in which the module is taught	S5
Person responsible for the module (coordinator)	Manel BenSassi
Language	French
Relation to curriculum	Optional
Teaching methods	lesson, lab works.
Workload (incl. contact hours, self-study hours)	Total workload: 50H Contact hours:30h (21H lesson, 09H Lab works). Self study: 20h
Credit points	2 ECTS
Required and recommended prerequisites for joining the module	DAT.1.1 Database and DBMS
Module objectives/intended learning outcomes	This course refers to technologies, applications and practices of heterogeneous data integration, storage, multidimensional analysis, and visualization to support business decision making. Thus, the student will be able to propose concrete conceptual and technological architecture for the integration od heterogenous data in the professional environment as he will acquire many competencies such as: - Become able to evaluate the technologies that make up BI (data Warehousing, OLAP) - Become able to plan the implementation of a BI architecture. Learning outcomes: C1, C2, C3, C4, C8, C9
Content	Chapter 1 : Understanding Business intelligence - The challenge of decision making - What is business intelligence - The BI value chain and value Chapter 2: Data Integration - Data integration motivation - ETL Process - ETL techniques Chapter 3: Data Storage: Data Warehousing - What is data warehousing? - Data Marts and analytical Data - Organization of DataWarehouse - Data access Chapter 4: Multi dimensional Analysis with OLAP - Definitions - OLAP vs OLTP - Operational data stores - Multi-Dimensions techniques - OLAP architecture Chapter 5 : MDX Language - Problem presentation - MDX Syntax and Request
Examination forms	35% Continues evaluation + 75% Written exam
Study and examination requirements	10/20

Reading list	**Fernandez, A. (2013). Les nouveaux tableaux de bord des managers: Le projet Business intelligence clés en main (6th ed.). Eyrolles.** **Fernandez, A. (2013). L'essentiel du tableau de bord: Concevoir le tableau de bord de pilotage avec Microsoft Excel (4th ed.). Eyrolles.** **Galzy, C., Girona, P., Martin, B., Nicoloso, C., & Vandermoere, J. (May 2010). La Business Intelligence, Livre Blanc.**

AI.5.1 Multi agent systems

Module designation	AI.5.1 MultiAgent Systems
Semester(s) in which the module is taught	S5
Person responsible for the module (coordinator)	Narjès Bellamine Ben Saoud
Language	French/English
Relation to curriculum	Compulsory
Teaching methods	lesson, lab works, project, seminar.
Workload (incl. contact hours, self-study hours)	Total workload:50h Contact hours :30h Private study:20h
Credit points	2 ECTS
Required and recommended pre-requisites for joining the module	SE.3.1 Software Engineering AI.3.1
Module objectives/intended learning outcomes	- Master the concepts of agent and multi-agent systems - Study and apply a design methodology for a multi-agent system. - Learn the development of a multi-agent system - Explore complementary research questions Competencies: C1, C7
Content	Chapter 1: Introduction to MAS Chapter 2: Intelligent Agents Chapter 3: Agents architectures Chapter 4: Methodologies for developing multi-agent systems Chapter 4: MAS Development environments & case study
Examination forms	35% Continues evaluation + 65% Written exam
Study and examination requirements	10/20
Reading list	Ferber, J. (1995). Les systèmes multi-agents. InterEditions. Wooldridge, M. (2002). An Introduction to MultiAgent Systems. Wiley. Russell, S., & Norvig, P. (2006). Intelligence Artificielle (2nd ed., 2ème Chapitre). Pearson Education France. Russell, S., & Norvig, P. (2020). Artificial Intelligence: A Modern Approach (4th ed.). Pearson.

FIN.5.6 Valuation and financing of companies

Module designation	FIN.5.6 Valuation and financing of companies
Semester(s) in which the module is taught	S5
Person responsible for the module (coordinator)	Snoussi Imen
Teaching team	Snoussi Imen
Language	French
Relation to curriculum	Compulsory
Teaching methods	lesson
Workload (incl. contact hours, self-study hours)	Total workload:25h Contact hours :15h Private study:10h
Credit points	1 ECTS
Required and recommended prerequisites for joining the module	
Module objectives/intended learning outcomes	This course aims to present mathematical methods adapted to the interests of engineering students in the constantly evolving fields of analysis, processing, filtering and estimation of data as a support for information. • In the first part, it aims to introduce, on a mathematical level, the concepts of measurement theory, distributions, convolution and Fourier analysis of signals. • Secondly, a series of practical work sessions using Matlab constitutes a first contact for our engineering students with this programming language which allows them to better understand certain theoretical aspects related to the processing of speech, images and digital transmission. Competencies: C11, C12, C13
Content	I. Investment decision in a context of certainty : 1) The criteria for evaluating the profitability of a project (Van, IRR, DR...) 2) Calculation of investment parameters 3) Calculation of cash flows 4) Study of conflicting NPV and IRR cases (NPV replicated to infinity, equivalent annuity) II. Investment decision in a context of risk and uncertainty : 1) Projects that are independent of the company's activity (Use of cash flow distribution, Use of NPV distribution: Decision tree technique) 2) Projects that are integrated into the company's activities III. Financing choices :

	1) Definition of the Weighted Average Cost of Capital 2) The cost of the various sources of financing (common shares, preferred shares, bank loans, bonds...) 3) Formal expression of the Weighted Average Cost of Capital (choice of weights...) 4) The impact of debt on the risk and return on common equity (financial leverage, optimal capital structure....)
Examination forms	35% continuous eval+65% written exam
Study and examination requirements	10/20
Reading list	Vernimmen, P. (2020). Finance d'entreprise (19th ed.). Dalloz books. Pilverdier, J., Gillet, P., Guidici, S., & Vinhas Pereira, C. (2016). Finance d'entreprise (9th ed.). Economica. Le Gros, G. (2018). Finance d'entreprise (3rd ed.). Dunod.

AI.5.12 Introduction to Deep Learning

Module designation	AI.5.12 Introduction to Deep Learning
Semester(s) in which the module is taught	S5
Person responsible for the module (coordinator)	Rym Besrour
Teaching team	Rym Besrour
Language	French
Relation to curriculum	Compulsory
Teaching methods	Lesson and project
Workload (incl. contact hours, self-study hours)	Total workload:25h Contact hours :15h Private study:10h
Credit points	1 ECTS
Required and recommended pre-requisites for joining the module	MAT.1.1: Probability and Statistics AI .3.1.: IA & Machine Learning Students must be competent in python.
Module objectives/intended learning outcomes	Knowledge: ● Understand generic machine learning terminology ● Understand motivation and functioning of the most common types of deep neural networks ● Understand the choices and limitations of a model for a given setting ● Apply deep learning techniques to practical problems ● Critically evaluate model performance and interpret results Competencies: C1, C9

Content	Introduction Chapter1:Applied Math and Machine Learning Basics ● Linear Algebra ● Probability and Information Theory ● Numerical Computation ● Machine Learning Basics Chapter2:Modern Practical Deep Networks ● Deep Feedforward Networks ● Regularization for Deep Learning ● Optimization for Training Deep Models ● Convolutional Networks ● Sequence Modeling: Recurrent and Recursive Nets ● Practical Methodology ● Applications Chapter3 :Deep Learning Research ● Autoencoders ● Deep Generative Models Projects ideas : ● Smart routing ● Smart home security ● Smart energy managment
Examination forms	100% project evaluation
Study and examination requirements	10/20
Reading list	Géron, A. (2020). Deep Learning avec Keras et TensorFlow (2e édition). Dunod. Charniak, E. (2021). Introduction au Deep Learning. Dunod.

FIN.5.5 Quantitative Finance

Module designation	FIN.5.5 Quantitative Finance
Semester(s) in which the module is taught	S5
Person responsible for the module (coordinator)	Mouna Ben Salah
Teaching team	Mouna Ben Salah
Language	French
Relation to curriculum	Compulsory
Teaching methods	Lesson
Workload (incl. contact hours, self-study hours)	Total workload: 25h Contact hours : 15h (10h lessons, 5h exercises) Private study: 10h.
Credit points	2 ECTS
Required and recommended prerequisites for joining the module	Stochastic calculus, differential equations. Portfolio Management.
Module objectives/intended learning outcomes	The objective of the Numerical Optimization Methods in Finance course is to introduce students to the most commonly used numerical methods in finance and mainly to the numerical methods used in the valuation of derivative products. Competencies:C11, C12, C13
Content	Chapter 1: The Discrete-Time Option Pricing Model: the Cox Ross and Robinstein model (1985) I. The one Period Binomial Model 1. Call options 2. Put options II. Extension of the model to two periods III. Generalization of the binomial formula to n periods IV. Dynamic hedging V. Taking dividends into account 1. Case of a known proportional dividend 2. Case of a known dividend amount Chapter 2: Option Pricing in Continuous Time: The Black-Scholes Model I. Black-Scholes partial derivative equation 1. Assumptions 2. Itô's lemma 4. The Black-Scholes valuation formula II. The Greek letters 1. The delta 2. The gamma 3. Theta 4. The Vega 5. The Rho III. The dynamic hedging 1. The delta hedging 2. The delta gamma hedging

	3. Delta vega hedging 4. The delta gamma vega hedging
Examination forms	100% written exam
Study and examination requirements	10/20
Reading list	Bellalah, M. (2003). Gestion des risques et produits dérivés classiques et exotiques. Collection: Gestion Sup. Dunod. François, P. (2005). Les produits dérivés financiers: Méthodes d'évaluation. Dunod. Hull, J. (1997). Options, futures and other derivatives (3rd ed.). Prentice Hall. Huu Tue, H., Van Son L., Issouf S. (2006). Simulation Stochastiques et application en finance avec programmation Matlab. Economica. Khoury, N., Laroche, P., & François, P. (2010). Introduction aux instruments financiers dérivés. Les presses de l'université Laval, Québec. Racicot, F., & Théoret, R. (2006). Finance computationnelle et gestion des risques: Ingénierie financière avec applications Excel et Matlab. Les presses de l'université Laval, Québec.

DOS.5.2 Blockchain

Module designation	DOS.5.2 Blockchain
Semester(s) in which the module is taught	S5
Person responsible for the module	Mohamed Houcine Hdhili, Hanen Idoudi
Teachers team	Hanen Idoudi
Language	French
Relation to curriculum	Optional
Teaching methods	Lesson, Lab works
Workload (incl. contact hours, self-study hours)	Total workload:25h Contact hours): 15h (9h lesson, 6h lab works) Private study:in hours: 10h
Credit points	1 ECTS
Required and recommended prereq-uisites for joining the module	SEC.4.1 Cybersecurity and Cryptography
Module objectives/intended learning outcomes	Knowledge: After completing this course, students should be able to: • Explain blockchain and how it is applied across industries. • Describe key principles of blockchain technology and the bene-fits and value that they bring to enterprises. • Explain the role of a shared ledger. • Explain fundamental concepts in Hyperledger Fabric. • Describe the elements of a business network, the role of chan-nels, and how the world state is maintained. • Develop, test, debug, and deploy chaincode with IBM Block-chain Platform Extension for Visual Studio Code • Apply concepts of blockchain security, identity and access con-trol, and data privacy to blockchain solutions. • Write applications that interact with a blockchain network. • Describe patterns, best practices, and reference architectures for integration from enterprise applications to blockchain networks. Competencies: C6, C13
Content	Unit 1. Blockchain overview Unit 2. Introduction to chaincode development Unit 3. Chaincode query methods Unit 4. Best practices for writing, testing, and debugging chaincode Unit 5. Identity and access control Unit 6. Data privacy Unit 7. Basics of application development Unit 8. Blockchain integration and advanced application develop-ment
Examination forms	100% written exam

Study and examination requirements	10/20
Reading list	IBM Blockchain Developer – Official course material

SE.5.3 Mobile Development

Module designation	SE.5.3 Mobile Development
Semester(s) in which the module is taught	S5
Person responsible for the module (coordinator)	Sabri ALLANI
Teaching team	Sabri ALLANI
Language	French
Relation to curriculum	Compulsory
Teaching methods	lab works and project.
Workload (incl. contact hours, self-study hours)	Total workload: 25h Contact hours : 15h Private study : 10h
Credit points	1 ECTS
Required and recommended pre-requisites for joining the module	AP.2.1, AP.2.2 and DAT.2.1
Module objectives/intended learning outcomes	Key question: what learning outcomes should students attain in the module? Knowledge: · have a good understanding of the mobile app's context · have a basic knowledge of mobile dev frameworks · have good knowledge of which standards apply to mobile application and related constraints. Competencies: C2, C3

Content	Introduction to mobile mobile app development Learn the basic principles of mobile app development using a cross-platform solution. Project · Project Proposal: Conceptualize and design your project in the abstract and write a short proposal that includes the project description, expected data needs, timeline, and how you expect to complete it. · Analysis and Planning: The application concept begins to develop at this point, after which it becomes a real mission. Definition of use cases and capture of comprehensive functional codes are the first steps in the assessment and planning strategy. · UI / UX Design: A user-friendly interface is included in the UI/UX layout. The goal of the application product is to create a wholly mobile experience that is intuitive and straightforward to employ · App Development: Concurrently with the prototype, the foundation stages of building an app are still essential. Before you begin writing your codes, make sure you've done this: o Specify the product backlog o Select a technology package o Set application's building goals A standard mobile application project consists of three major components: o Back-end/server technology o API(s) o The mobile app front-end
Examination forms	100% project eval
Study and examination requirements	10/20
Reading list	Alessandria, S. (2018). Flutter Projects: A practical, project-based guide to building real-world cross-platform mobile applications and games (Vol. 53). Packt Publishing. Nagy, R. (2022). Simplifying Application Development with Kotlin Multiplatform Mobile (Vol. 61). Packt Publishing.

ISA.5.7 Distributed databases

Module designation	ISA.5.7 Distributed Databases
Semester(s) in which the module is taught	S5
Person responsible for the module (coordinator)	Raoudha KHCHERIF
Language	French
Relation to curriculum	Compulsory
Teaching methods	lecture, lesson, assignment, labs
Workload (incl. contact hours, self-study hours)	Total workload: 25h Contact hours: 15h Private study: 10h
Credit points	1 ECTS
Required and recommended prerequisites for joining the module	DAT.2.1 , DAT.2.2, NET3.1, NET3.2, NET4.1
Module objectives/intended learning outcomes	This course will deal with the fundamental issues in large distributed database systems which are motivated by the computer networking and distribution of processors, and control. The theory, design, specification, implementation, and performance of large systems will be discussed. Competencies: C1, C2, C8, C13
Content	I INTRODUCTION II. BDR DESIGN AND IMPLEMENTATION II. TRANSACTION AND COMPETITOR ACCESS IV. OPTIMIZATION OF DISTRIBUTED QUERIES
Examination forms	100% written Exam
Study and examination requirements	10/20
Reading list	Özsu, M. T., & Valduriez, P. (2011). Principles of Distributed Database Systems. Springer. Rahimi, S. K. (2010). Distributed Database Management Systems. John Wiley & Sons Inc.

DOS.5.3 IoT

Module designation	DOS.5.3 IoT
Semester(s) in which the module is taught	S5
Person responsible for the module (coordinator)	Hanen Idoudi
Language	French
Relation to curriculum	Compulsory
Teaching methods	lecture, project
Workload (incl. contact hours, self-study hours)	Total workload: 25h Contact hours: 15h Private study: 10h
Credit points	1 ECTS
Required and recommended pre-requisites for joining the module	Existing competences in networking
Module objectives/intended learning outcomes	The purpose of this course is to study the fundamental concepts of Internet of Things. At the end of the course, the students will be able: 1. Understand the basic concepts of Internet of Things (IoT) 2. Identify the main components of the IoT ecosystem 3. Explore the major applications in IoT 4. Understand the architecture and protocol stack proposed for IoT 5. Set up the specific requirements to design the logic and network architectures of an IoT application Competencies: C2, C3, C9

Content	Chapter I – Introduction to the Internet of Things - - The inception of IoT - - Basic concepts : smart objects, global connectivity, sensors, etc. - - IoT Ecosystem - - IoT challenges Chapter II – IoT Applications and architectures - - IoT Applications - - IoT architecture layers - - Connectivity models in IoT Chapter III – Networks technologies in IoT - IoT networks technologies classification - Long range communication networks overview - Short range communication networks overview Chapter IV – Middelwares and Application protocols for IoT - Web of Things: concepts and communication's models - WoT : Data Standards - IoT middelwares - Publish/subscribe model - WoT : Data exchange protocols - MQTT - CoAP Practical Work (personal project) : Design of a simple IoT application
Examination forms	Oral presentation of the personal project.
Study and examination requirements	To acquires at least 10/20 in the oral of the personal project
Reading list	Al-Fuqaha, A., Guizani, M., Mohammadi, M., Aledhari, M., & Ayyash, M. (January 2015). Internet of Things: A Survey on Enabling Technologies, Protocols and Applications. IEEE Communications Surveys & Tutorials.