Programme Specification

1	**Awarding body**	University of London
2	**Teaching Institution**	**Birkbeck College**
3	**Programme Title(s)**	MSc Financial Engineering
4	**Programme Code(s)**	TMSFIEGG
5	**UCAS code (if applicable)**	N/A
6	**Home Department**	Economics, Mathematics and Statistics.
7	**Exit Award(s)**	PG Cert; PG Diploma
8	**Duration of Study (number of years)**	1 year FT or 2 years PT
9	**Mode of Study (FT/PT/DL)**	FT/PT
10	**Level of Award (FHEQ)**	7

11	**Other teaching depts or institution (if applicable)**	N/A
12	**Professional, Statutory Regulatory Body(PSRB) details (if applicable)**	(include URL to PSRB) N/A
13	**QAA Benchmark Group (if applicable)**	N/A

14	***Programme Rationale & Aims***
	The aim of MSc Financial Engineering is to train students in the mathematical, statistical and financial disciplines required for work as a specialist quantitative analyst in a financial institution, or to complete a doctorate in the field of mathematical finance. The programme includes instruction in relevant material on stochastic processes, statistics, numerical mathematics and computational methods, and advanced study of the applications of these analytical tools to financial markets. Students develop a good knowledge of techniques and a facility for problem solving in the areas of option pricing, risk management, econometrics and commodities, grounded on a solid foundation of mathematical and numerical methods. There is a special emphasis on developing knowledge of computer programming, in both Matlab and C++, and numerical analysis. Distinctive features of this programme are part-time, evening study. It is one of the very few taught Mathematical Finance MSc programmes that can be taken by working students.

15	**Entry Criteria**
	The normal requirement will be a second class degree from a UK university (or an overseas qualification of an equivalent standard obtained from a university, or educational institution of university rank, following a programme of study extending over a period of no less than three years) in a quantitative subject such as mathematics, physics, statistics, economics or engineering. Alternatively, a merit or higher in the Graduate Diploma in Finance or Mathematics or Statistics would be suitable for entry. Work experience will be taken into account in assessing applicants. Graduates from other disciplines such as computer science will be accepted if their degree contains a major quantitative element. In some circumstances students are admitted with a first

	degree that is less than the 2.1 standard, provided that their subsequent work experience and/or education and training is deemed to have brought them to an equivalent standard.

16	**Prospectus Entry**
	This Master's degree in financial engineering offers advanced training in quantitative skills used in modern financial institutions, including most notably valuation of securities, and measurement and management of portfolio risks. Training is provided in programming, numerical methods and statistics, and you will be given grounding in pricing and risk management techniques. A key feature is the emphasis on computational methods and implementation of the pricing and risk management techniques learnt. You will complete modules in programming, numerical methods and financial statistics, and all the modules are illustrated by computer examples. Economics and finance at Birkbeck have acquired an excellent reputation, not only for the quality of research but also for the quality of training. Employers recognise the quality of Birkbeck graduates in economics and finance. We take students who are determined to succeed and are prepared to undergo the rigours of a first-class training, whether they are studying full-time or part-time. We aim to produce world-class graduates who have a proven record of success in a tough learning environment. **Why study this course at Birkbeck?** • Equips you to work as a specialist quantitative analyst in financial institutions or to complete doctoral study in financial engineering. • Excellent reputation for the quality of our teaching, providing training for employers such as the Treasury and the Bank of England. • Birkbeck's Department of Economics, Mathematics and Statistics enjoys an international reputation and its Economics and Finance Research Group stands among the foremost research groups in the country. **Further study opportunities** • If you are interested in further research, we offer an MPhil/PhD in Economics/Finance. **Careers information** • Graduates go on to careers in banking and finance, the public sector, in industry, or in research and analysis.

17	**Learning Outcomes**
	In general, at the end of the programme students should have a comprehensive overview of the fields of mathematical finance and financial engineering. They should understand and be able to apply quantitative tools to solve problems in this field and conduct independent applied research, as witnessed by the completion of a dissertation. Specific learning outcomes: **Subject specific**

	• L01: The application of calculus, probability and the theory of stochastic processes, notably stochastic integration and stochastic differential equations to financial valuation problems. • L02: The use of numerical methods for pricing securities and commodities. • L03: The analysis of financial data using statistics. • L04: Techniques for measuring risk and estimating suitable levels of capital for financial institutions. • L05: The appropriate structuring and implementation of computer programmes for financial applications. **Intellectual:** • L06: The ability to understand advanced material on the behaviour of prices in financial markets in the absence of arbitrage. • L07: The ability to formulate valuation problems. • L08: The ability to formulate and devise tests for statistical hypotheses in a financial context.. • L09: The ability to conceive, write and understand complex computer programmes for use in a financial context. **Practical** • L10: How to solve valuation problems, both theoretically and numerically, given appropriate hypotheses about the stochastic nature of the underlying financial assets, as well as their practical implementation on a computer. • L11: How to analyse and quantify financial risks by means of statistical techniques. • L12: Demonstrate and awareness of different sources of credit risk. **Personal and Social** • L13: The ability to develop knowledge independently by study of a range of sources, including learned journals. • L14: The ability to plan, execute and complete an in-depth study of a particular topic within a specified period of time, and to write a polished and convincing summary of the results obtained.

18	**Learning, teaching and assessment methods**
	The majority of teaching is delivered in the form of the traditional chalk-and-talk lectures. Given the formal content of the courses, this method gives the lecturers the opportunity to clarify each step of a complex derivation, react instantly to clarification queries and vary the pace of the lecture where appropriate. While lecturing is the primary method of delivery, it is by no means the only one. An important aspect of learning involves solving problems and, to this end, many of the lectures will be augmented by supporting classes to discuss solutions to problem sets. Most courses make use of substantial handouts designed to help students digest the material developed in lectures. Specific directions to textbooks, academic papers or extensive lecture notes help the students obtain a clear idea of the material. Lectures also specify precise objectives

at the outset and this knowledge is particularly helpful in calibrating oneself with the state of the course especially if work commitments force absence.

An important ingredient of learning is private study. Apart from the reading lists the programme requires students to produce independent project work, aiding development of analytic, quantitative as well as written communication skills.

Learning is further assisted by review sessions; these are important as they also provide guidance on examination technique.

The following methods of assessment are used:

- Unseen 3 hour examination
- Assessed coursework
- Dissertation

For each module the bulk (generally around 80%) of the assessment comes from unseen examinations. These are typically held in June, thus giving as much time as possible for assimilation of the material, promoting an overall understanding and engagement with the curriculum. The contribution (around 20%) from the coursework ensures that, throughout the year, students get practice, and are given feedback, in tackling and solving problems independently without time pressure of examinations.

The modules are assessed on a scale on which 50% represents a pass mark, 60-69% a merit and 70% or above yields a distinction. The dissertation is assessed similarly as Fail, Pass, Merit or Distinction.

The range of questions and problems set within examinations and coursework are structured to balance theory and practice, to address the individual learning outcomes and to discriminate between different levels of achievement. Our assessment strategy also takes into consideration that students can exhibit a wide range of aptitudes and abilities in different aspects of the course. Thus the assessment is designed to ensure a good coverage of the curriculum so that all students have the opportunity to demonstrate their strengths.

Examination papers and dissertations are marked independently by two markers who then compare marks and produce agreed final marks. All marks are moderated by an external examiner who is also asked to comment on the suitability of the assessment.

19 **Programme Structure**

Detailed list of modules taken:

Title	Status	Schedule
Quantitative Techniques	Compulsory	Sept
Mathematical and Numerical Methods	Compulsory	Autumn and Spring
Financial Econometrics	Compulsory	Autumn and Spring
Credit Risk Management	Option	Spring
Pricing	Compulsory	Autumn and Spring

Market Risk	Option	Autumn
Commodities and Commodity Derivatives	Option	Autumn and Spring
Dissertation MSc Financial Engineering	Compulsory	Summer

Optional Modules:

Students must choose whether to take **either** Commodities **or** the two Risk Management modules. They are also recommended to take part in the Matlab and C++ programming tutorials held in our computer laboratory.

ADDITIONAL DETAIL

Note: FT = Full Time (students), PTY1 (part time students in their 1st year) and PTY2 (part time students in their 2nd year).

BUEM027S6 Quantitative techniques.

FT and PTY1: September (pre-sessional).

Aim: To review the necessary mathematical and statistical background for the courses of the MSc.

Topics:. Calculus, applied linear algebra, optimization theory (method of Lagrange multipliers) and probability theory.

EMMS011S7 Mathematical and Numerical Methods

FT and PTY1: Autumn and Spring terms.

Aim: To teach the principal mathematical and numerical techniques used in present day quantitative finance, and to become acquainted with some of the programming languages and computer packages for financial applications, notably C++ and Matlab. All topics will be illustrated via Matlab where appropriate.

Topics: Stochastic calculus; Brownian motion; stochastic integration; Ito calculus; stochastic differential equations (SDEs) and martingales; the relationship between probability and parabolic equations (Feynman-Kac); Monte Carlo simulation for solving SDEs; finite difference algorithms for solving parabolic partial differential equations; binomial option pricing methods; stability of numerical algorithms; nonlinear equation solving and optimization techniques; the language fundamentals of Matlab and C++, including allocation, dynamic memory allocation, data input/output, the construction of classes and the use of numerical libraries.

BUEM053H7 Market Risk Management

FT and PTY2: Autumn term. *Students choose **either** Commodities **or** Credit Risk Management and Market Risk Management.*

Aim: To provide an introduction to modern market risk management theory and practice, developing problem solving skills in risk management applications and becoming conversant with up-to-date techniques used by financial institutions.

Topics: measuring financial losses, Value at Risk (VaR) and Tail Value at Risk (TVaR) – definitions, theoretical properties and calculations, time series analysis for risk managers, stylized facts of asset returns, risk models featuring jumps and stochastic volatility, GARCH family of risk models, VaR for derivatives, extreme value theory applied to VaR, simulation methods and back-testing.

BUEM051H7 Credit Risk Management

FT and PTY2: Spring term. Students choose **either** Commodities **or** Credit Risk and Market Risk**.**

Aim: Same as those for 'Market Risk Management'

Topics: essential mathematics for credit risk, credit risk modelling using (i) structural models (as illustrated by Merton's model and its extensions) (ii) industry standard models (as illustrated by CreditMetrics and/or KMV) (iii) the reduced form models (as illustrated by Jarrow and Turnbull), credit derivatives and valuation of credit value adjustments CVA.

EMMS012S7 Financial Econometrics

FT and PTY2: Autumn and Spring terms.

Aim: To provide an introduction to modern econometric techniques in the analysis of financial time series, emphasizing the interaction between theory and practice

Topics: Classical least-squares theory; maximum-likelihood estimation; hypothesis testing and model evaluation; generalized least-squares theory; endogeneity; instrumental variables and generalized method of moments; linear stochastic processes; nonlinear stochastic processes; switching models; ruptures and cycles.

EMMS014S7 Pricing

FT and PTY2: Autumn and Spring terms.

Aim: To understand and be able to implement contingent claim pricing by a variety of methodologies: the binomial, PDE and martingale pricing methods.

Topics: Contingent claim asset pricing using PDEs; applications to vanilla put and call options; American options; exotic options; stochastic volatility models; jump diffusion models; Girsanov's theorem and the Brownian representation of martingales; pricing via the equivalent martingale measure; applications to option pricing; multiple asset markets and complete versus incomplete markets; term structure models for interest rate products, notably HJM and BGM; change of numeraire; continuous time credit risk modelling; intensity based models

EMEC054S7 Commodities and Commodity Derivatives

FT and PTY2: Autumn and Spring terms. Students choose **either** Commodities **or** Credit Risk and

Market Risk**.**

Aim: To provide a thorough analysis of commodity markets, their specificities and how they differ from bond and stock markets.

Topics: Students will gain familiarity with the various Exchanges, the instruments and hedging and trading strategies; the different sub- classes of commodities and their analysis, including metals, agriculturals, and shipping. The energy class (crude oil, coal and natural gas, electricity) will be analysed in detail. The course provides a thorough overview of recent developments in energy and commodities modelling, along with the necessary computational methods. Students will be equipped with a critical understanding of current scientific research output. A particular attention will be brought to the economic fundamentals, including inventory, reserves and forward curve).

BUEM029S7 Dissertation MSc Financial Engineering

FT and PTY2: Summer term.

Students will complete a dissertation of maximum length of 6000 words on a subject agreed with the teaching staff and related to material covered in taught classes. The dissertation should provide an in depth analysis of a specific financial risk management issue, The summer project provides students with the opportunity to apply the techniques and knowledge they have acquired in the rest of the programme. Students either perform a statistical or numerical investigation or, less commonly, examine a question using a theoretical model.

OPTIONAL MODULES

Students choose **either** Commodities **or** Credit Risk and Market Risk**.**

Students are encouraged to take part in the Matlab and C++ programming tutorials in the EMS computer laboratory.

PROGRAMME STRUCTURE

1 year programme FULL TIME

Level	Module Code	Module Title	Credits	Status
6	BUEM027S6	Quantitative techniques	30	Compulsory
7	EMMS011S7	Mathematical and Numerical Methods	30	Compulsory
7	EMMS012S7	Financial Econometrics	30	Compulsory
7	EMMS014S7	Pricing	30	Compulsory
7	EMEC054S7	Commodities and Commodity Derivatives **OR**	30	Compulsory
7	BUEM053H7	Market Risk Management **AND**	15	Compulsory
7	BUEM051H7	Credit Risk Management	15	
7	BUEM029S7	Dissertation MSc Financial Engineering	30	Compulsory

2 year programme PART TIME

Year 1

Level	Module Code	Module Title	Credits	Status
6	BUEM027S6	Quantitative techniques	30	Compulsory
7	EMMS011S7	Mathematical and Numerical Methods	30	Compulsory
7	EMMS012S7	Financial Econometrics	30	Compulsory

Year 2

Level	Module Code	Module Title	Credits	Status
7	EMMS014S7	Pricing	30	Compulsory
7	EMEC054S7	Commodities and Commodity Derivatives **OR**	30	Option
7	BUEM053H7	Market Risk Management **AND** Credit Risk Management	15	Compulsory
7	BUEM051H7		15	
7	BUEM029S7	Dissertation MSc Financial Engineering	30	Compulsory

20	**Regulations**
	Admissions This programme adheres to the College Admissions Policy http://www.bbk.ac.uk/mybirkbeck/services/rules/Admissions%20Policy.pdf/view ***N/A*** ***Credit Transfer*** Accredited Prior Learning will be considered in line with the College Policy on Accredited Prior Learning http://www.bbk.ac.uk/mybirkbeck/services/rules/AccreditedPriorLearning.pdf ***Programme Regulations*** This programme adheres to the College Common Awards Scheme http://www.bbk.ac.uk/mybirkbeck/services/rules/casregs.pdf ***Programme Specific Regulations (if applicable)*** ***N/A***

21	**Student Support and Guidance**
	All Birkbeck students have access to a range of student support services, details can be found on our website here: http://www.bbk.ac.uk/mybirkbeck/services/facilities More specifically we make note of the following: • There is a pre-session induction evening where information is given on services provided by the library, ITS and the student's union. An informal welcome follows the formal proceedings. • The programme is supported by a handbook giving details of the programme structure, course outcomes, assessment procedures, progression paths and support mechanisms. • Each student has access to the Programme Director and a personal tutor. Personal tutors are available for consultation and advice on all academic matters and they monitor progress. They also advise on personal matters and may refer students for further advice from the College's central support services. All academic staff encourage contact by email for arranging meetings and some post office hours.

	• The 'disability statement' is a student friendly handbook which provides detailed information on the provision for students with disabilities at the college. • Birkbeck Evening Nursery is available between 5.30pm and 9.00pm (Monday to Friday) during Term Time for students and current members of staff and accepts children aged 2 years - 10 years. In exceptional circumstances, children up to 12 will be accepted (see:http://www.bbk.ac.uk/mybirkbeck/services/facilities/nursery). • Financial support is available for those on low incomes who would otherwise be prevented from entering, or continuing in, higher education. A summary of the types of financial support available can be found on the College web site at: http://www.bbk.ac.uk/reg/

22	**Methods of Enhancing Quality and Standards**
	The College has rigorous procedures in place for the monitoring and enhancing its educational provision. This includes: • The external examiner's report, comments on individual examinations and contributions at the examiners meeting. • Double marking and the independent moderation of all examination elements. • Analysis of entry and exit qualifications, progression and completion rates. • Scrutiny of standards by the college Quality Assurance Committee via programme reports and required responses to external examiners reports. • Close associations between taught courses and research frontiers, facilitated by the fact that all members of the teaching staff actively undertake research. • Student feedback from questionnaires, comment forms, class representatives and staff/student exchange meetings. • In addition, departments are reviewed every four to five years through the internal review process and this includes external input. For more information please see the Academic Standards and Quality website www.bbk.ac.uk.asq

23	**Programme Director**	Dr Brad Baxter
24	**Start Date** ***(term/year)***	Autumn 2002
25	**Date approved by TQEC**	Spring 2002
26	**Date approved by Academic Board**	Summer 2002
27	**Date(s) updated/amended**	October 2014