UNIVERSITI TEKNOLOGI MARA
ASC553: ADVANCED FINANCIAL MATHEMATICS

Course Name (English)	ADVANCED FINANCIAL MATHEMATICS `APPROVED`
Course Code	ASC553

MQF Credit	4

Course Description	This subject provides more advance fundamental concepts as an extension from Financial Mathematics I course. The topic include the understanding of fixed interest securities, the factors affecting changes in interest rates, capital budgeting techniques, concept of arbitrage, term structure of interest rates and stochastic in interest rates. This course follows the syllabus of Actuarial Mathematics (CM1) from Institute and Faculty of Actuaries (IFoA)

Transferable Skills	Demonstrate ability to identify and articulate self skills, knowledge and understanding confidently and in a variety of contexts. Demonstrateability to apply creative, imaginative and innovative thinking and ideas to problem solving.

Teaching Methodologies	Lectures, Tutorial

CLO	CLO1 Apply concept and methods to solve problems related to financial mathematics. CLO2 Conduct mathematical proving for problem related to financial mathematics. CLO3 Demonstrate lifelong learning skills in assignments related to financial mathematics

Pre-Requisite Courses	No course recommendations

Topics
1. Real and money interest rates 1.1) Demonstrate a knowledge and understanding of real and money interest rates.
2. Project Appraisals 2.1) Calculate the net present value and accumulated profit of the receipts and payments from an investment project at given rates of interest. 2.2) Calculate the internal rate of return implied by the receipts and payments from an investment project. 2.3) Describe payback period and discounted payback period and discuss their suitability for assessing the suitability of an investment project. 2.4) Determine the payback period and discounted payback period implied by the receipts and payments from an investment project. 2.5) Calculate the money-weighted rate of return, the time-weighted rate of return and the linked internal rate of return on an investment or a fund.
3. Investments 3.1) Describe the investment and risk characteristics of the following types of asset available for investment purposes: 3.2) i. fixed interest government borrowings 3.3) ii. fixed interest borrowing by other bodies 3.4) iii. index-linked government borrowings 3.5) iv. shares and other equity-type finance

4. Elementary compound interest
4.1) Calculate the present value of payments from a fixed interest security where the coupon rate is constant and the security is redeemed in one installment.
4.2) Calculate upper and lower bounds for the present value of a fixed interest security that is redeemable on a single date within a given range at the option of the borrower.
4.3) Calculate the running yield and the redemption yield from a fixed interest security (as in a.), given the price.
4.4) Calculate the present value or yield from an ordinary share and a property, given simple (but not necessarily constant) assumptions about the growth of dividends and rents.
4.5) Solve an equation of value for the real rate of interest implied by the equation in the presence of specified inflationary growth.
4.6) Calculate the present value or real yield from an indexlinked bond, given assumptions about the rate of inflation.
4.7) Calculate the price of, or yield from, a fixed interest security where the investor is subject to deduction of income tax on coupon payments and redemption payments are subject to the deduction of capital gains tax.
4.8) Calculate the value of an investment where capital gains tax is payable, in simple situations, where the rate of tax is constant, indexation allowance is taken into account using specified index movements and allowance is made for the case where an investor can offset capital losses against capital gains.

5. The "no arbitrage" assumption and forward contracts
5.1) Define "arbitrage" and explain why arbitrage may be considered impossible in many markets.
5.2) Calculate the price of a forward contract in the absence of arbitrage assuming: no income or expenditure associated with the underlying asset during the term of the contract, a fixed income from the asset during the term, a fixed dividend yield from the asset during the term
5.3) Explain what is meant by "hedging" in the case of a forward contract.
5.4) Calculate the value of a forward contract at any time during the term of the contract in the absence of arbitrage, in the situations listed above.

6. Term structure of interest rates
6.1) Describe the main factors influencing the term structure of interest rates.
6.2) Explain what is meant by the par yield and yield to maturity.
6.3) Explain what is meant by, derive the relationships between and evaluate: discrete spot rates and forward rates, continuous spot rates and forward rates
6.4) Define the duration and convexity of a cashflow sequence, and illustrate how these may be used to estimate the sensitivity of the value of the cashflow sequence to a shift in interest rates.
6.5) Evaluate the duration and convexity of a cashflow sequence.
6.6) Explain how duration and convexity are used in the (Redington) immunisation of a portfolio of liabilities.

Assessment Breakdown	%
Continuous Assessment	30.00%
Final Assessment	70.00%

Details of Continuous Assessment	Assessment Type	Assessment Description	% of Total Mark	CLO
	Assignment	Assignment 1 - CLO1 5%	5%	CLO1
	Group Project	Group project - CLO3 3%	3%	CLO3
	Quiz	Quiz - CLO2 2%	2%	CLO2
	Test	Test2 - CLO2 5%	5%	CLO2
	Test	Test 1 - CLO1 15%	15%	CLO1

Reading List		
	Recommended Text	Kellison 2009, *The Theory of Interest*, McGraw-Hill Higher Education [ISBN: 9780071276276]
	Reference Book Resources	Broverman S. A. 2010, *Mathematics of Investment and Credit.*, Fifth edition Ed., ACTEX Publication
		Rini W. A. 2003, *Mathematics of the Securities Industry*, McGraw Hill
		Goodman V. & Stamplfi J. G. 2009, *The Mathematics of Finance: Modelling and Hedging.*, American Mathematical Society
		Bodie Z. & Merton R. C. 1999, *Finance*
		Mark S. Joshi 2008, *The Concepts and Practice of Mathematical Finance*, Cambridge University Press [ISBN: 9780521514088]
		Wai-Sum Chan,Yiu-Kuen Tse 2017, *Financial Mathematics for Actuaries*, World Scientific Publishing Company [ISBN: 9813224665]
		Marco Corazza,María Durbán,Aurea Grané,Cira Perna,Marilena Sibillo 2018, *Mathematical and Statistical Methods for Actuarial Sciences and Finance*, Springer [ISBN: 9783319898247]
		Richard James Wilders 2020, *Financial Mathematics for Actuarial Science*, 1st Ed., 10, CRC Press [ISBN: 9780367253080]
		Wai-Sum Chan,Yiu-Kuen Tse 2017, *Financial Mathematics for Actuaries*, 2nd Ed., World Scientific Publishing Company [ISBN: 9813224665]
		Joe Francis 2017, *Interest Theory*, 17th Ed., Actuarial Brew [ISBN: 0998160407]
		Yuliya Mishura 2016, *Financial Mathematics*, Iste Press - Elsevier [ISBN: 1785480464]
		Clarence H. Richardson,Leslie Miller Isaiah 2018, *Financial Mathematics*, Franklin Classics Trade Press [ISBN: 0353246921]
		Perry F. 2016, *Financial Mathematics with MATLAB*, Createspace Independent Publishing Platform [ISBN: 154045276X]
Article/Paper List	This Course does not have any article/paper resources	
Other References	This Course does not have any other resources	