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SYLLABUS OF BASIC EDUCATION  
2023  
Financial Mathematics  
Exam 2

The syllabus for this basic education requirement is defined in the form of learning objectives that set forth, usually in broad terms, what the candidate should be able to do in actual practice.

Please check the “*Syllabus Updates*” section of the CAS Web Site for any changes to the *Syllabus*. The options for obtaining credit for this basic education requirement are listed below and in Examination Rules, C. Grades and Accreditation, [Waivers of Examinations](#) section of the *Syllabus*.

The purpose of the syllabus is to develop knowledge of the fundamental concepts of financial mathematics, and how those concepts are applied in calculating present and accumulated values for various streams of cash flows as a basis for future use in: reserving, valuation, pricing, asset/liability management, investment income, capital budgeting, and valuing contingent cash flows. The candidate will also be introduced to financial instruments, including derivatives, and the concept of no-arbitrage as it relates to financial mathematics.

A basic knowledge of calculus and an introductory knowledge of probability is assumed.

*The Learning Objectives and Outcomes to follow have been sourced directly from the Syllabus: Financial Mathematics Exam – August 2023, published by the Society of Actuaries.*



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## LEARNING OBJECTIVES

<b>1. Time Value of Money (5-15%)</b>
<b>Learning Objectives</b>
The Candidate will understand and be able to perform calculations relating to present value, current value, and accumulated value.
<b>Learning Outcomes</b>
The Candidate will be able to: <ul style="list-style-type: none"><li>a) Define and recognize the definitions of the following terms: interest rate (rate of interest), simple interest, compound interest, accumulation function, future value, current value, present value, net present value, discount factor, discount rate (rate of discount), convertible m-thly, nominal rate, effective rate, inflation and real rate of interest, force of interest, equation of value.</li><li>b) Given any three of interest rate, period of time, present value, and future value, calculate the remaining item using simple or compound interest. Solve time value of money equations involving variable force of interest.</li><li>c) Given any one of the effective interest rate, the nominal interest rate convertible m-thly, the effective discount rate, the nominal discount rate convertible m-thly, or the force of interest, calculate any of the other items.</li><li>d) Write the equation of value given a set of cash flows and an interest rate.</li></ul>



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**2. Topic: Annuities/cash flows with non-contingent payments (20-30%)**

**Learning Objectives**

The Candidate will be able to calculate present value, current value, and accumulated value for sequences of non-contingent payments.

**Learning Outcomes**

The Candidate will be able to:

- a) Define and recognize the definitions of the following terms:  
annuity-immediate, annuity due, perpetuity, payable m-thly or payable continuously, level payment annuity, arithmetic increasing/decreasing annuity, geometric increasing/decreasing annuity, term of annuity.
- b) For each of the following types of annuity/cash flows, given sufficient information of immediate or due, present value, future value, current value, interest rate, payment amount, and term of annuity, calculate any remaining item.
  - o Level annuity, finite term.
  - o Level perpetuity.
  - o Non-level annuities/cash flows.
    - Arithmetic progression, finite term and perpetuity.
    - Geometric progression, finite term and perpetuity.
    - Other non-level annuities/cash flows.



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**3. Topic: Loans (15-25%)**

**Learning Objectives**

The Candidate will understand key concepts concerning loans and how to perform related calculations.

**Learning Outcomes**

The Candidate will be able to:

- a) Define and recognize the definitions of the following terms: principal, interest, term of loan, outstanding balance, final payment (drop payment, balloon payment), amortization.
- b) Calculate:
  - The missing item, given any four of: term of loan, interest rate, payment amount, payment period, principal.
  - The outstanding balance at any point in time.
  - The amount of interest and principal repayment in a given payment.
  - Similar calculations to the above when refinancing is involved.



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<b>4. Topic: Bonds (15-25%)</b>
<b>Learning Objectives</b>
The Candidate will understand key concepts concerning bonds, and how to perform related calculations.
<b>Learning Outcomes</b>
The Candidate will be able to:  a) Define and recognize the definitions of the following terms: price, book value, market value, amortization of premium, accumulation of discount, redemption value, par value/face value, yield rate, coupon, coupon rate, term of bond, callable/non-callable, call price, call premium, accumulated value with reinvestment of coupons.  b) Given sufficient partial information about the items listed below, calculate any of the remaining items <ul style="list-style-type: none"><li>• Price, book value, market value, accumulated value with reinvestment of coupons, amortization of premium, accumulation of discount. (Note that valuation of bonds between coupon payment dates will not be covered).</li><li>• Redemption value, face value.</li><li>• Yield rate.</li><li>• Coupon, coupon rate.</li><li>• Term of bond, point in time that a bond has a given book value, amortization of premium, or accumulation of discount.</li></ul> c) Calculate the price of a callable bond to achieve a specified minimum yield



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**5. Topic: General Cash Flows, Portfolios, and Asset Liability Management (20-30%)**

**Learning Objectives**

The Candidate will understand key concepts concerning yield curves, rates of return, measures of duration and convexity, cash flow matching and immunization, and how to perform related calculations.

**Learning Outcomes**

The Candidate will be able to:

- a) Define and recognize the definitions of the following terms: yield rate/rate of return, current value, duration and convexity (Macaulay and modified), portfolio, spot rate, forward rate, yield curve, cash flow and duration matching, and immunization (including full immunization and Redington immunization).
- b) Calculate:
  - The duration and convexity of a set of cash flows.
  - Either Macaulay or modified duration given the other.
  - The approximate change in present value due to a change in interest rate,
    - Using 1<sup>st</sup>-order linear approximation based on modified duration.
    - Using 1<sup>st</sup>-order approximation based on Macaulay duration.
  - The present value of a set of cash flows, using a yield curve developed from forward and spot rates.
- c) Construct an investment portfolio to:
  - Protect the value of an asset-liability portfolio using either Redington or full immunization
  - Exactly match a set of liability cash flows.



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## Options for Obtaining Exam 2 Credit

The CAS will grant credit for Exam 2 to those who have successfully completed one of the following examinations. To obtain credit otherwise, candidates should follow the procedures outlined on the [Waivers of Examination](#) page of the CAS website.

Organization	Examination
Actuarial Society of South Africa	A211, Financial Mathematics
Actuaries Institute (Australia)	CM1, Actuarial Mathematics 1
Canadian Institute of Actuaries (CIA)	University Accreditation Program credit for Financial Mathematics <sup>1</sup>
China Association of Actuaries	CAA, A2 Interest Theory
Institute of Actuaries of India	CM1, Actuarial Mathematics 1
Institute and Faculty of Actuaries (U.K.)	CM1, Actuarial Mathematics 1
Society of Actuaries	Exam FM, Financial Mathematics

1. For credit granted through the CIA's University Accreditation Program, the list of candidates granted waivers by the CIA is provided to the CAS following the end of a semester. The CAS automatically updates its records. No further action is required of candidates.