

TRIBHUVAN UNIVERSITY  
INSTITUTE OF SCIENCE AND TECHNOLOGY  
**SCHOOL OF MATHEMATICAL SCIENCES**  
**Bachelor in Mathematical Sciences (B.Math.Sc.)**

**Course of Study**

*Code No.:* MSMT 301

*Full Mark:* 75

*Paper:* **Financial Mathematics I**

*Pass Mark:* 30

*Nature:* Theory

*Credit:* 3

*Course Description:*

This course is a grounding in the principles of modeling as applied to actuarial work focusing particularly on deterministic models which can be used to model and value known cash flows as well as those which are dependent on death, survival, or other uncertain risks.

*Learning Objectives:*

On the successful completion of this subject, the candidate will be able to

1. Describe, interpret and discuss the theories on interest rates.
2. Describe, interpret and discuss mathematical techniques used to model and value cashflows which are contingent on mortality and morbidity risks.

*Mode of Delivery:*

The course will be taught by lecture (48 hrs), and problem solving and class discussion (24 hrs). The use of spreadsheet software for problem solving will be encouraged.

***Contents:***

**Unit 1 Theory of Interest Rate**

**12 hrs**

Interest rates in different time periods, Real and nominal interest rates, Simple interest and discounting, Compound interest and discounting, Present value of a future payment, Present value and accumulated value of cash flow under the combination of scenarios, Compound interest functions in terms  $i$ ,  $v$ ,  $n$ ,  $d$ ,  $\delta$ ,  $i(p)$  and  $d(p)$ ,

**Unit 2 Term Structure of Interest Rates**

**8 hrs**

Term structure of interest rates, factors influencing it, Discrete spot rates, and Forward rates, Continuous rates, Par yield and yield to maturity, Duration, convexity and immunization of cash flows.

**Unit 3 Equation of Value and Its Application**

**8 hrs**

Equation of value, Conditions for the existence of exact solution to an equation of value, Application of the equation of value in solving various practical problems.

**Unit 4 Project Appraisal and Investment Performance****8 hrs**

Discounted cash flow and equation of value techniques in project appraisals, Net cash flows, Net present values and yields, Comparison of two investment projects, Different interest rates for lending and borrowing, Payback periods, Effects of inflation, Measurement of investment fund performance

**Unit 5 Single Decrement Models****12 hrs**

Assurance and annuity contracts, Operations of conventional with-profits contracts, unit-linked contracts and accumulating with-profits contracts, Means and variances of the payments under various assurance and annuity contracts with constant deterministic interest rate, Assurance and annuity factors, Relations between annuities payable in advance and in arrear, Relations between temporary, deferred and whole life annuities, Relations between assurance and annuity factors, Mean and variance of the present value of benefit payments under various contracts in the form of sums/integrals, Expected accumulations in terms of expected values and variances for various contracts and contract structures.

**References**

1. *ActEd Study Material Subject CT1*, Actuarial Education Company, 2016.
2. Kellison *The Theory of Interest*, Irwin Mc-Graw Hill, 2006.
3. Bowers, L. Newton, *Actuarial Mathematics*, Society of Actuaries, 2006.
4. McCutcheon, J. J.; Scott, W. F. Heinemann, *An Introduction to the Mathematics of Finance*, Institute and Faculty of Actuaries' Online Publications Shop, 1986.
5. Mark S. Joshi, *The Concepts and Practice of Mathematical Finance*, Cambridge University Press, 2008.
6. Paul Wilmott, Sam Howison and Jeff Dewynne *The Mathematics of Financial Derivatives*, Cambridge University Press, 1995.
7. S. M Ross, *An introduction to Mathematical Finance*, Cambridge University Press.

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