COURSE NAME: Actuarial Mathematics I

COURSE CODE: MATH 2702

LEVEL: II

SEMESTER: II

NUMBER OF CREDITS: 3

PREREQUISITES: MATH2701 and MATH2404

RATIONALE:
The goal of the course is to provide an understanding of the fundamental mathematical techniques required to model and value cashflows dependent on death, survival, or other uncertain events. This syllabus has been revised to reflect changes in theory and practice: increased emphasis on multi-state transition models and discrete cash flow models, and inclusion of interest-sensitive product cash flow models.

CONTENT AND COURSE DESCRIPTION:
This is a compulsory level II course which is an important foundation course in actuarial science. Candidates should master the fundamental concepts of actuarial and financial mathematics and its simple applications as indicated in the "Learning outcomes". This course allows the candidate to begin preparation for the professional examinations (the Society of Actuaries Actuarial Models examination, Exam 3 of the Casualty Actuarial Society, and the Faculty/Institute of Actuaries Contingencies examination). It covers practical applications such as the computational aspects of pricing and prepares the candidate for the follow up courses in reserving and risk measurement of insurance portfolios.

The course contains survival distributions and life tables – applications of probability to problems of life and death, the determination of premiums for insurances and annuities in both the discrete and continuous cases and net Premiums.

LEARNING OUTCOMES:
On completion of this course the student should be able to:

1. Explain how decrements are used in insurance, annuities and investments.
2. Elaborate on how the models used to model decrements used in insurances, annuities and investments; calculate probabilities based on these models.
3. Use non-stochastic interest rate models to calculate present values and accumulated values of cash flows.
4. Use cash flow models of traditional life insurances and annuities to calculate the present values of the cash flows.

5. Illustrate how concepts presented for traditional life insurances and annuities extend to non-interest-sensitive insurances including disability income insurance, product warranty insurance, defined benefit pension plans and health insurance

CONTENT:
A. SURVIVAL MODELS

- Decrements: Common decrements; select, ultimate and aggregate decrements and their applications (general population versus insured population, life insurance versus annuity; individual versus group life insurance; pricing versus valuation; historic versus projected.

- Models used to model decrements in insurance, annuities and investments; probabilities based on these models; time-to-decrement, age-to-decrement, and cause-of-decrement random variables.

- Density, distribution and survival functions: age at death, select and ultimate life tables, fractional ages (include linear, exponential, hyperbolic), mortality laws (uniform, exponential, Makeham, Gompertz); force of decrement.

B. LIFE INSURANCES AND ANNUITIES

- Life insurance: actuarial present value function (apv), moments of apv, basic life insurance contracts, portfolio;
- Life annuities: actuarial accumulation function, moments of apv, basic life annuities.
- Non-interest-sensitive insurances (disability income, product warranty, defined benefit pension plans, health insurance); interest-sensitive insurances (universal life, variable annuities).

C. PREMIUMS

- Net annual premiums: actuarial equivalence principle, loss function, accumulation type benefits.

TEACHING METHODOLOGY:
This course will be delivered by a combination of theoretical classes, practices (tutorials) and laboratories. The lecture mode will be largely interactive. The total estimated 39 contact hours are broken down as follows: 26 hours of lectures and 13 hours of tutorials. The course material (notes, practice problems and assignments) will be posted on ourvle http://ourvle.mona.uwi.edu/

ASSESSMENT:
The course assessment will be divided into two components: a coursework component worth 25% and a final exam worth 75%:

- One 1 hour coursework exam worth 15%
- Two written assignments (problem papers) each worth 5%
- The final theory exam will be two hours in length and consist of compulsory questions worth 75%

PRESCRIBED REFERENCE MATERIALS:

Knowledge and understanding of the actuarial and financial mathematics concepts are significantly enhanced through practice. Candidates are encouraged to work out the textbook exercises.

Dickson, C.M.D., Hardy, M.R., and Waters, H.R. (2009), *Actuarial Mathematics for Life Contingent Risks*, Cambridge: Cambridge University Press. ISBN-10: 9780521118255 [Highly recommended for RBC placement]

RECOMMENDED REFERENCE MATERIALS:

Robin Cunningham, Ph.D, FSA, Thomas N. Herzog, ASA, Ph.D., Richard L. London, FSA, *"Models for Quantifying Risk",* 2008, Actex Publications, Winstead Connecticut. ISBN-10: 1566985234

Online resources:
Supplemental notes to the Dickson et al can be downloaded at no cost from the Cambridge University Press website.

http://www.cambridge.org/gb/knowledge/isbn/item2703201/?site_locale-en_GB&display-genresources&anchor-true