COURSE NAME: ACTUARIAL MATHEMATICS II

COURSE CODE: MATH3804

LEVEL: III

SEMESTER: I

NUMBER OF CREDITS: 3

PREREQUISITES:

Mathematics of Finance (MATH2210), Introduction to Actuarial Mathematics (MATH2220)

RATIONALE

This course is an extension and expansion of that for Introduction to Actuarial Mathematics. The goal of the syllabus is to provide an understanding of fundamental mathematical techniques required to value and model cash flows dependent on death, survival, disability, termination, sickness and other uncertain events. It also covers multiple life and other types of status.

COURSE DESCRIPTION:

This is a compulsory level III 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).

LEARNING OUTCOMES

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

- Calculate the reserves for life insurance and annuity contracts based on single and multiple decrement tables using the Prospective and Retrospective Methods.
- Calculate premiums for all types of policies based on the multiple decrement tables and single life table (SDT)
- Construct a Multiple Decrement Table (MDT) and its Associated Single Decrement Tables (ASDT).
- Apply the SDT and the MDT to calculations involving life insurance and pensions problem.
- Explain joint life and last survivor statuses and evaluate the cash flows associated with life insurances and annuities based on these statuses.
- Explain the concept of Reversionary Annuities and evaluate the cash flows associated with life insurances and annuities based on these statuses.

- Explain the concept of Reversionary Annuities and evaluate the cash flows associated with these annuities
- Apply the Common Shock Model to calculations involving multiple dependent lives.
- Apply the continuous –time and discrete approximation of continuous-time Markov chain models to problems involving life insurance and pensions.

CONTENT

Reserves: Based on Single Decrement (Life) Table: Calculation of Reserves using Prospective and Retrospective methods, Recursive Formula, Policy Alteration

Joint Life Functions: Study of T(*x)* and T (*y),* the complete future lifetimes of two lives (*x*) and (*y*), Joint Cumulative Function, Joint Density Function, Joint survival function, Covariance of T*(x)* and T *(y),* Correlation coefficient of T(*x)* and T(*y),* Marginal distributions of T*(x)* and T(*y)*

Study of the Joint Status (xy) and Last Survivor: Definition of joint status (*x y)* and Last Status Survivor $(\overline{xy})$, Full study of T *(x y)* including and T $(\overline{xy})$, Cumulative Distribution Function, Probability Density Function, Expectation, Variance, Survival Function, Probabilities associated with T(*xy*) and T $(\overline{xy})$, Force of failure of the status (*xy)* and status $(\overline{xy})$

Insurances and Annuities: Problems on Insurances and Annuities based on Joint Life status and Last survivor status, Problems on Reversionary Annuities

The Common Shock Model: Definitions, Modelling Dependence, Applications to all types of Insurance and Annuity Problems

MDT and ASDT: Definitions, Complete study of MDT, Complete study of ASDT, Construction of MDT from ASDT and vice versa, Incorporating continuous and discrete decrements, Problems involving MDT and ASDT, Applications to Pensions Annuities and Insurances.

Markov Chain Models: Calculate the probability of being in a particular state and transitioning between states based on continuous-time Markov chain models, discrete approximations of continuous-time Markov chain models and discrete-time Markov chain models. Calculate present values of cash flows by redefining the present-value-of-benefits and present-value-of-premium random variables to Markov chain models. Calculate the benefit reserves and premium using a Markov chain model with specific cash flows.

TEACHING METHODOLOGY:

This course will be delivered by a combination of theoretical classes, practices (tutorials) and other group activities. The delivery mode will be largely interactive. The total estimated 39 contact hours are broken down as follows: 28 hours of lectures and 11 hours of tutorials. The

course material (complimentary 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 coursework exam worth 15% of the final grade
- Two written assignments each worth 5% of the final grade
- The final exam will be two hours in length and consist of compulsory questions.

REFERENCE MATERIAL

Prescribed Text:
Bowers, N.L. et al, *Actuarial Mathematics* (Second Edition), 1997, Society of Actuaries

Highly Recommended Text:
Cunningham, R. Herzog, T., *Moels for Quantifying Risk* (Thir Edition), 2009, Actex Publications

Online resources:
The following are free online lectures which the student may access for revision purposes:
http://www.soa.org/files/pdf/edu-2008-spring-mlc-24-2nd.pdf
http://www.actuarialseminars.com/Misc/SNorderform.html