DEPT OF MATHEMATICS & ACTUARIAL SCIENCE

M.SC ACTUARIAL SCIENCE

Department vision mission statement

VISION

> To be a leader in providing quality education and to carryout research in the field of Mathematics and its application in Science, Engineering and Technology

MISSION

- To provide quality education in higher mathematics through well designed programs
- To provide quality mathematical foundation for all science and engineering programs
- To offer programs in specialized areas such as Actuarial Science to meet the needs of Insurance and other Industries
- To undertake fundamental, applied and interdisciplinary research

PEO and PO of the program

PROGRAMME EDUCATIONAL OBJECTIVES:

- To provide opportunities of higher studies in the professional area of Actuarial Science.
- To impart knowledge on various theoretical and practical aspects of Actuarial Science.
- To enable the students to apply their newly gained knowledge and skills in their workplace.
- To develop independent learning skills and transferable skills among the students.
- To help the students extend and develop their career plan and pursue their own professional development.
- To provide the students with a structured programme of study covering all Core Actuarial Science subject contents.
- To contribute to the education of academics, allowing the University to play an active role in the production of advanced studies in the areas of the Master in Actuarial Science.

PROGRAMME OUTCOMES

On Completion of the Programme, the students will be able to

- understand the fundamental probability tools for quantitatively assessing risk and demonstrate an ability to apply these tools to problems encountered in Actuarial Science.

- use the fundamental concepts of Financial Mathematics and demonstrate an ability to use those concepts to calculate present and accumulated values for various streams of cash flows as a basis for future use.

- demonstrate an understanding of the financial instruments, including derivatives, and the concept of no–arbitrage as it relates to financial mathematics.

- understand the theoretical bases of certain Actuarial Models and Life Contingent models and can apply those models to insurance and other financial risks.

- understand the frequency and severity models and an ability to carry out the steps involved in the modeling process in solving Actuarial Science problems.

- demonstrate the ability to summarize and communicate, orally and in writing, Actuarial problems and the ability to communicate solutions to Actuarial problems to specialized and non-specialized audiences, and,

- demonstrate highest standards of Actuarial ethical conduct and Professional Actuarial behavior, critical, interpersonal and communication skills as well as a commitment to lifelong learning.

CURRICULUM & SYLLABI FOR M.SC. (ACTUARIAL SCIENCE) (FOUR SEMESTERS / FULL TIME)
CURRICULUM

Semester 1					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
MAC 6101	Fundamentals of Financial Mathematics	3	1	0	4
MAC 6102	Probability and Distributions	3	1	0	4
MAC 6103	Business Economics	2	1	0	3
MAC 6104	Financial reporting and Accounting	2	1	0	3
MAC 6105	Principles of Insurance	2	0	0	2
MAC 6106	R Programming	0	0	4	2
Total		12	4	4	18

Semester 2					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
MAC 6201	Applications of Financial Mathematics	3	1	0	4
MAC 6202	Fundamentals of Life Contingencies	3	1	0	4
MAC 6203	Descriptive Statistical Methods in Actuarial Science	3	1	0	4
MAC 6204	Stochastic Models	2	1	0	3
MAC 6205	Mathematical Statistics	3	1	0	4
ENC 6281	Communication Skills	1	0	2	2
MAC 6206	Actuarial Computational Laboratory (MS-EXCEL)	0	0	4	2
Total		15	5	6	23

Semester 3					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
MAC 7101	Applications of Life Contingencies	3	1	0	4
MAC 7102	Financial Economics	3	1	0	4
MAC 7103	Applied Statistical Methods in Actuarial Science	3	1	0	4
MAC 7104	Survival Models	2	1	0	3
MAC 7105	Actuarial Computational Laboratory (SPSS)	0	0	4	2
	Elective – I	3	0	0	3
	Elective- II	3	0	0	3
MAC7201	Project Phase-I	0	0	8	4*
	Total	17	4	12	23

Semester 4					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
MAC 7201	Project Phase –II	0	0	24	12*
Total		0	0	24	16

 * Credits for Project Work Phase I to be accounted along with Project Work Phase II in IV Semester

LIST OF ELECTIVES

Elective – I					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
MACY 01	Financial Management of Life Office	3	0	0	3
MACY 02	Islamic Investments	3	0	0	3
MACY 03	Corporate Finance	3	0	0	3

Elective – II					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
MACY 04	Financial Markets	3	0	0	3

| MACY 05 | Islamic Asset and Fund Management | 3 | 0 | 0 | 3 |
| MACY 06 | Portfolio and Credit Risk Management | 3 | 0 | 0 | 3 |

Total Credit (18+23+23+16) = 80

MAC 6101 - FUNDAMENTALS OF FINANCIAL

             MATHEMATICS

L	T	P	C
3	1	0	4

OBJECTIVE:

- The aim of this course is to provide basic grounding in basic financial mathematics like simple interest, compound interest and their simple applications to calculate accumulate value, present value and loan calculation.

MODULE-I   **Cash flow model**   **(7+2)**
Cash flow model: Cash flow process, outflows-Cash flow model for a zero coupon bond – Time value of money – Simple and Compound interest problems-Present value and Simple discount-Investing over a period.

MODULE-II   **Interest rates**   **(7+2)**

Interest rates: Nominal and effective rate of interest. Accumulation factors- Principle of consistency- The force of interest- Present values- The basic compound interest functions-Interest payable monthly.

MODULE-III   **Real and money interest rates**   **(7+2)**

Real and money interest rates: Definition- Deflationary conditions- Usefulness. Discounting and accumulating: Present value of continuous cash flows- Valuing cashflows- Interest income.

MODULE-IV   **Level annuities**   **(8+3)**

Level annuities: Present values and Accumulations -Payments made in arrear- Payments made in advance- Continuously payable annuities- Annuities payable monthly- Non-integer values-Perpetuities.

MODULE-V   **Deferred and increasing annuities**   **(8+3)**

Deferred and increasing annuities: Deferred annuities- Varying annuities- Decreasing payments- Irregular payments- Sudden changes in interest rates- Simple and Compound increasing annuities.

MODULE-VI   **Loan schedules**   **(8+3)**

Equations of value: Uncertain payment or receipt- Loan schedules- Calculation of capital outstanding- Calculation of interest and capital elements- Installments payable more frequently than annually- Consumer credit: flat rates and APRs.

L – 45; T – 15; TOTAL – 60

References:

1. Mark S. Joshi, "The concepts and practice of Mathematical Finance", Cambridge University Press, 2nd Edition (2008).
2. Paul Wilmott, Sam Howison, and Jeff Dewynne "The Mathematics of Financial derivatives" Cambridge University press, 1995.
3. S.M. Ross "An Introduction to Mathematical finance" Cambridge University Press.
4. J J McCutcheon and Dr W F Scott, "An Introduction to the Mathematics of Finance" Heinemann, 1986.
5. Bowers, Newton L et al. "Actuarial mathematics" – 2nd ed. – Society of Actuaries, 1997.
6. Butcher, M V; Nesbitt, Cecil J. "Mathematics of compound interest". Ulrich's Books, 1971.
7. Ingersoll, Jonathan E. Rowman & Littlefield, "Theory of financial decision making" 1987.
8. Kellison, Stephen G. "The theory of interest".2nd ed. Irwin, 1991.

OUTCOME:

On completion of the course the students will be able to

- describe how to use a generalised cash-flow model to describe financial transactions
- describe how to take into account the time value of money using the concepts of compound interest and discounting.
- show how interest rates or discount rates may be expressed in terms of different time periods.
- demonstrate a knowledge and understanding of real and money interest rates.
- calculate the present value and the accumulated value of a stream of equal or unequal payments using specified rates of interest and the net present value at a real rate of interest, assuming a constant rate of inflation.
- define and use the more important compound interest functions, including annuities certain.
- describe how a loan may be repaid by regular installments of interest and capital.

MAC 6102 - PROBABILITY AND DISTRIBUTIONS

L	T	P	C
3	1	0	4

OBJECTIVE:

- The aim of this subject is to provide grounding in the aspects of Basic probability, Random variables, probability distributions, joint distribution that are of relevance to actuarial work.

MODULE-I   Basic Probability   (9+3)

Types of data- Frequency distributions-Bar chart- Histogram- Stem and leaf diagram- Dotplot /Lineplot- Cumulative frequency curves- Boxplot- Location- Spread. Set theory, Venn diagrams, Basics of probability- The addition and multiplication rule – Conditional Probability- and Total probability – Baye's Theorem.

MODULE-II   Random variables   (6+2)

Random Variables and Expectation of a random variable – Moment inequalities (Tchebyshev, Markov, Jensen)- Continuous random variables Functions of a random variable

MODULE-III   Probability distributions   (9+3)

Discrete distributions- Uniform, Bernoulli, Binomial, Geometric, Negative binomial, Hypergeometric and Poisson distribution. Continuous distributions- Uniform, Gamma, exponential, chi-square, Beta, Normal distribution, Lognormal distribution, t-distribution, F-distribution. Deriving the Poisson process, Random number simulation.

MODULE-IV   Generating functions   (6+2)

Probability generating functions, Moment generating functions, Cumulant generating functions, Linear functions

MODULE-V   Joint distributions   (7+2)

Joint distributions- Expectations of functions of two variables- Convolutions- Using generating functions to derive distributions of linear combinations of independent random variables.

MODULE-VI   Conditional expectation and Law of large numbers   (8+3)

Conditional expectation and Conditional variance - Compound distributions- Functions of vector random variables. Weak and strong law of large numbers - Central Limit Theorems - Normal approximations. The continuity correction,

L – 45; T – 15; TOTAL – 60

References:

1. Miller, I.; Miller, M.; [Freund, J. E.], "Mathematical statistics", 7th ed. Prentice Hall International, 1999
2. S.C Gupta,V.K Kapoor, "Fundamentals of mathematical statistics ", Sultan chand and sons , New Delhi.
3. S.C Gupta,V.K Kapoor, "Fundamentals of Applied statistics ", Sultan chand and sons , New Delhi.
4. **Dekking**, F.M., **Kraaikamp**, C., **Lopuhaä,** H.P., **Meester**, L.E. "A Modern Introduction to Probability and Statistics" Springer text series, 2nd Edition
5. **Chin Long chiang " Statistical Methods of Analysis " World Scientific Books, 2003**

OUTCOME:

On completion of the course the students will be able to

- summarize the main features of a data set (exploratory data analysis).

- explain the concepts of probability.

- explain the concepts of random variable, probability distribution, distribution function, expected value, variance and higher moments, and calculate expected values and probabilities associated with the distributions of random variables.

- define a probability generating function, a moment generating function, a cumulant generating function and cumulants, derive them in simple cases, and use them to evaluate moments.

- explain the concepts of independence, jointly distributed random variables and conditional distributions, and use generating functions to establish the distribution of linear combinations of independent random variables.

- state the central limit theorem, and apply it.

MAC 6103 - BUSINESS ECONOMICS

L	T	P	C
2	1	0	3

OBJECTIVE:

- The aim of the Business Economics subject is to provide a grounding in the fundamental concepts of economics as they affect the operation of insurance and other financial systems, both from the point of view of individuals and their requirements for financial security, and from the point of view of financial institutions and their ability to provide products that meet customer needs.

MODULE-I   Economic concepts   (5+3)

Economic concepts- the macroeconomic Environment- microeconomics choices-Demand and supply- Price and output determination- Business in a competitive market Elasticity and uncertainty- Price elasticity of demand- The time dimension of market adjustment-Consumer demand and uncertainty- Marginal utility theory- Demand under conditions of risk and uncertainty- utility and insurance.

MODULE-II   Production and costs   (5+2)

Production and costs- Costs in the short run and long run- Revenue and profit maximization- Perfect competition and monopoly- Comparing monopoly with perfect competition- contestable markets-Imperfect competition- Monopolistic competition- Oligopoly- Collusive oligopoly- Non-collusive oligopoly.

MODULE-III   Products, marketing and advertising   (5+3)

Products, marketing and advertising- Growth strategy and globalization- Growth and profitability- Constraints on growth- Alternative growth strategies- Internal and External growth- Globalization-Pricing strategies- Pricing and market structure- Price discrimination- Multiple product pricing.

MODULE-IV   Government intervention in markets   (5+2)

Government intervention in markets- objectives- Types of market failure- Types of government intervention- Government and the firm- Competition policy- Policies towards R&D- Supply-side policy- Market-orientation- Industrial policy.

MODULE-V   International trade   (5+3)

International trade- Trading patterns- advantages- The world trading system and the WTO- Balance of payments and exchange rates- The balance of payments account- Fixed versus floating exchange rates- Business activity, unemployment and Inflation- Keynesian model- The "disappearance" of the Phillips curve- Business cycles.

MODULE-VI   **The macroeconomic environment**   **(5+2)**

The macroeconomic environment- objectives- The circular flow of income- The measurement and determination of national income- Economic growth- The AD-AS model Money and interest rates- The financial system- The supply and demand of money- Equilibrium in the money market- The effect of a change in the money supply- Demand-side macroeconomic policy- Fiscal policy- Monetary policy- The supply-side problem.

L – 30; T – 15; TOTAL – 45

References:

1. Sloman, John; Hinde, Kevin. "Economics for business"- 4th ed.- Prentice Hall, 2007. ISBN: 9780273709084. [No: 38420]

2. Frederik Mishkin " Economics of Money banking and Financial Markets ", Prentice Hall, July , 2009

OUTCOME:

On completion of the course the students will be able to

- discuss the interaction between supply and demand in the provision of a product and the way in which equilibrium market prices are determined, define elasticity of demand and supply and discuss the effects on a market of different levels of elasticity.
- describe how profit maximizing firms make short run and long run production choices. Describe what is meant by different sorts of competition, or lack of it, and discuss the practical effect on supply and demand.
- define what is meant by GDP, GNP and net national product, show how these concepts may be useful in describing the economy and in making comparisons between countries, and discuss their limitations.
- describe how the propensity to save or to consume by the private sector or the corporate sector affects the economy. describe and discuss the impact of fiscal and monetary policy and other forms of government intervention on different aspects of the economy, and in particular on financial markets.
- discuss the role of exchange rates and international trade in the economy and the meaning of the term balance of payments.
- describe the major factors affecting the rate of inflation, the level of interest rates, the exchange rate, the level of unemployment, and the rate of economic growth in the economy of an industrialized country.

MAC 6104- FINANCIAL REPORTING AND ACCOUNTING

L	T	P	C
2	1	0	3

OBJECTIVE:

- The aim of this subject is to provide a basic understanding of corporate finance including knowledge of the instruments used by companies to raise finance and manage financial risk.
- To provide the ability to interpret the accounts and financial statements of companies and financial institutions.

MODULE-I   THE KEY PRINCIPLES OF FINANCE   (5+3)

The key principles of finance- Finance and the real resources of an organisation-Business objectives- The maximisation of shareholder wealth- Company ownership- Types of business entity - Types of medium-term company finance- Types of short-term company finance- Taxation- Personal taxation- Corporation tax- Capital gains Tax- Double taxation relief.

MODULE-II   FINANCIAL INSTRUMENTS   (5+3)

Financial instruments- Debenture - Unsecured loan stocks- Subordinated debt- Eurobond loan capital- Share capital-Convertible- Warrants- Use of derivatives- Financial futures- Options- Interest rates and currency swaps- Issue of shares- Obtaining stock exchange quotation- Rights issues- Scrip issues.

MODULE-III   INTRODUCTION TO ACCOUNTS   (5+2)

Introduction to accounts- Users- regulation- requirements- Accounting Standards Board- The auditors' report- Accounting concepts- The main accounts- balance sheet- income statement- cash flow statement- Statement of changes in equity- Notes to the accounts.

MODULE-IV   GENERATING ACCOUNTS   (5+2)

Depreciation- purpose of depreciation- straight line basis -reducing balance method- Generating accounts -The trial balance- Constructing financial statements.

MODULE-V   GROUP ACCOUNTS   (5+2)

Group accounts and insurance company accounts- Subsidiary companies- Consolidated balance sheets- Goodwill on consolidation- Minority interests- Associated companies.

MODULE-VI   INTERPRETATION OF ACCOUNTS   (5+3)

Interpretation of accounts- security of loan capital - Income cover and income priority percentages- Asset cover and asset priority percentages- Gearing-shareholder analysis- Ratios involving share information- Profitability ratios- Liquidity ratios- Efficiency ratios- Limitations in the interpretation of accounts.

L – 30; T – 15; TOTAL – 45

REFERENCES:

1. Anne Britton, Chris waterston " Financial Accounting", Pearson Education,2009
2. Barry Elliott, Jamie Elliott "Financial Accounting and reporting", Trans-Atlantic publications, 2005.
3. Lawrence Revsine "Financial Reporting and Analysis", Mc Graw Hill, 2008.
4. Samuels, J M; Brayshaw, R E; Craner, J M. "Financial statement analysis in Europe" -Chapman & Hall, 1995.
5. Brigham, Eugene F; Houston, Joel F. "Fundamentals of financial management" 9th Edition - Harcourt Brace, 2000.
6. Brett, M. "How to read the financial pages", 2nd Edition-Random House Business Books, 2003.
7. Holmes, Geoffrey; Sugden, Alan; Gee, Paul. – "Interpreting company reports and accounts"- 8th Edition - Pearson Education, 2002.
8. Brealey, Richard A; Myers, Stewart C. – "Principles of corporate finance" - 7th Edition -McGraw-Hill, 2003.

OUTCOMES:

On completion of the course the students will be able to

- demonstrate a knowledge and understanding of the principal terms which is used in investment and asset management.
- demonstrate an awareness of the key principles of finance and basic principles of personal and corporate taxation.
- describe the structure of a joint stock company and the different methods by which it may be financed.
- demonstrate a knowledge and understanding of the characteristics of the principal forms of financial instrument issued or used by companies and the ways in which they may be issued.
- describe the basic construction of accounts of different types and the role and principal features of the accounts of a company.
- interpret the accounts of a company or a group of companies and discuss the limitations of such interpretation and show how financial techniques can be used in the assessment of capital investment projects.

MAC 6105 - PRINCIPLES OF INSURANCE

L	T	P	C
2	0	0	2

OBJECTIVE:

- The objective of the paper Principles of Insurance is to give introduction about the various types of insurable risk, principle of insurance, insurance products and markets with a brief history of Insurance.

MODULE-I   The concept of risk   (5)

The concept of risk- kinds and classification of risk – assessment – transfer- risk appraisal-risk selection- underwriting risk appraisal – Mortality tables- physical and moral hazards-representations- warranties- conditions.

MODULE-II   The business of insurance   (5)

The business of insurance-risk managed by individuals- risk managed by insurers-premium fixing- reinsurance and its important-role of insurance in economic development-the insurance market-role of-intermediaries-specialists-regulator.

MODULE-III   Insurance customers   (5)

Insurance customers-types of customers-customer mindset and customer satisfaction-importance of ethical behavior-History of insurance- History of insurance in India.

MODULE-IV   Basic principles of Insurance   (5)

Basic principles of Insurance – Utmost good faith- Insurable Interest- Material facts- Economic principles of Insurance- Sharing – Subrogation – contribution –Legal principles of Insurance – Actuarial principles.

MODULE-V   Insurance terminology, life insurance   (5)

Insurance terminology-terms that are specific to life insurance-traditional product offered by life insurance companies-features of MODULE linked policies-features of annuities and group policies.

MODULE-VI   Insurance terminology, General insurance   (5)

Insurance terminology-terms that are specific to general insurance- product offered by non-life insurance companies-fire insurance-marine insurance-various product under miscellaneous category.

L – 30; T – 0; TOTAL – 30

References:

1. Neelam C Gulati "Principles of Insurance Management", Excel Books, New Delhi.

2. Harriett E Jones "Principles of Insurance "FLMI Insurance Education Program. Life Management Institute LOMA, (Dec 1995).

3. Robert I Mehr "Principles of Insurance" Richar D Irwin edition,(8th edition, 1985).

4. Ben G Baldwin "The New Life Insurance Investment Advisor" 2nd Edition. Mc Graw Hill.

OUTCOME:

On completion of the course students will be able to

- describe the basic principle of insurance.
- identify different kind of insurable risk.
- demonstrate the insurance terminology.
- describe the history of insurance.
- plan new products based market need.

MAC 6106 - R PROGRAMMING

L	T	P	C
0	0	4	2

R: A Language and Environment for Statistical Computing

OBJECTIVE:

- The objective of the R-Programming is to give the basic knowledge of a system for statistical computation and graphics.

PROBLEMS FROM THE FOLLOWING TOPICS

1. Introduction and preliminaries
2. Simple manipulations; numbers and vectors
3. Objects, their modes and attributes
4. Ordered and unordered factors
5. Arrays and matrices
6. Lists and data frames
7. Reading data from files
8. Probability distributions
9. Grouping, loops and conditional execution
10. Writing own functions
11. Statistical models in R

OUTCOME:

On completion of the course the students will be able to use the statistical procedures. Among these are:

- linear and generalized linear models.
- nonlinear regression models.
- time series analysis.
- classical parametric and nonparametric tests.
- clustering and smoothing.

MAC 6201- APPLICATIONS OF FINANCIAL MATHEMATICS

L	T	P	C
3	1	0	4

OBJECTIVE:

- The aim of this course is to provide advance knowledge on financial mathematics like project evaluation, calculation of bond price in tax environment, Investment decision, and calculation of forward price and idea of stochastic interest rate model.

MODULE-I   Project appraisal   (8+2)

Project appraisal- Accumulated value- Net present values-Internal rate of return-Comparison of two investment projects-Different interest rates for lending and borrowing-payback periods-Measurement of investment performance-Money-weighted rate of return-Time-weighted rate of return-Linked internal rate of return.

MODULE-II   Investments   (7+2)

Investments-Fixed interest borrowings- government bonds-Government bills-Characteristics of corporate debt-Debentures-Unsecured loan stocks-Eurobonds-Certificates of deposit-Shares and other equity-type borrowing-Property-Derivatives-Futures-Options-Swaps.

MODULE-III   Elementary compound interest problems   (8+3)

Elementary compound interest problems-Fixed interest securities-Calculating the price-Calculating yields-The effect of the term to redemption on the yield-Optional redemption dates-Deferred income tax-Uncertain income securities-Equities-Property-Real rates of interest-Inflation adjusted cash flows-Calculating real yields using an inflation index-Index-linked bonds-Capital gains tax.

MODULE-IV   Arbitrage and forward contracts   (7+2)

Arbitrage and forward contracts-The "No Arbitrage" assumption-Why do we assume "No Arbitrage"?-Forward contracts-Calculating the forward price for a security with no income-Calculating the forward price for a security with fixed cash income-Calculating the forward price for a security with known dividend yield-Hedging-The value of a forward contract.

MODULE-V   Term structure of interest rates   (8+3)

Term structure of interest rates-Discrete time-spot rates-forward rates-Continuous time-spot rates-forward rates-Instantaneous forward rates-Theories of the term structure of interest rates-Yields to maturity-Pay yields-Duration, convexity and immunization.

MODULE-VI   Stochastic interest rate models   (7+3)

Stochastic interest rate models-Simple models-Preliminary remarks-Fixed interest rate model-Varying interest rate model-Log-normal distribution

L – 45; T – 15; TOTAL – 60

References:

1. Mark S. Joshi, "The concepts and practice of Mathematical Finance", Cambridge University Press, 2nd Edition (2008).
2. Paul Wilmott, Sam Howison, and Jeff Dewynne "The Mathematics of Financial derivatives" Cambridge University press, 1995.
3. S.M. Ross "An Introduction to Mathematical finance" Cambridge University Press..
4. J J McCutcheon and Dr W F Scott, "An Introduction to the Mathematics of Finance Heinemann",1986.
5. Bowers, Newton L et al. "Actuarial mathematics" – 2nd ed. – Society of Actuaries, 1997.
6. Butcher, M V; Nesbitt, Cecil J. "Mathematics of compound interest". Ulrich's Books, 1971.
7. Ingersoll, Jonathan E. Rowman & Littlefield, "Theory of financial decision making" 1987.
8. Kellison, Stephen G. "The theory of interest".2nd ed. Irwin, 1991.

OUTCOME:

On completion of the course the students will be able to

- show how discounted cash flow techniques can be used in investment project appraisal.
- describe the investment and risk characteristics of the following types of asset available for investment purposes.
- calculate the delivery price and the value of a forward contract using arbitrage free pricing methods.
- show an understanding of the term structure of interest rates.
- show an understanding of simple stochastic interest models for investment returns.

MAC 6202- FUNDAMENTALS OF LIFE CONTINGENCIES

L	T	P	C
3	1	0	4

OBJECTIVE:

The aim of the Life Contingencies subject is to provide grounding in the mathematical techniques which can be used to model and value cash flows dependent on death, survival, or other uncertain risks and also help to calculate premium and reserve for the insurance company.

MODULE-I   THE LIFE TABLE   (7+2)

The life table-Constructing a life table-Using the life table-The pattern of human mortality-Life table functions at non-integer ages-uniform distribution of deaths (UDD)- constant force of mortality (CFM)-The general pattern of mortality-Select mortality-Constructing select and ultimate life tables-Evaluation of assurances and annuities-Premium conversion equations-Variance of benefits-Expected present values of annuities payable m times each year.

MODULE-II   LIFE ASSURANCE CONTRACTS   (8+3)

Life assurance contracts: Pricing of life insurance contracts, Whole life assurance contracts, Term assurance contracts, Pure endowment contracts, Endowment assurance contracts, Critical illness assurance contracts, Deferred assurance benefits, Mean and Variance of the present value random variable Claim acceleration approximation.

MODULE-III   LIFE ANNUITY CONTRACTS   (8+3)

Life annuity contracts: Whole life annuities payable annually in arrears, Whole life annuities payable annually in advance, Temporary annuities payable annually in arrear, Temporary annuities payable annually in advance, Deferred annuities, Deferred annuities-due, Continuous annuities, Immediate annuity, Mean and Variance of the present value random variable approximations.

MODULE-IV   NET PREMIUMS AND RESERVES   (8+3)

Net premiums and reserves-The basis-The net premium-The insurer's loss random variable-Reserves- Prospective reserve-Retrospective reserves-Conditions for equality of prospective and retrospective reserves-Net premium reserves-Recursive calculation of reserves-Mortality profit-Death strain at risk (DSAR)-Expected death strain (EDS) for a single policy-Actual death strain (ADS) for a single policy-Mortality profit.

MODULE-V   WITH-PROFIT POLICIES   (7+2)

Variable benefits and with-profit policies-Variable payments-Payments varying at a constant compound rate-Payments changing by a constant monetary amount-With-profit contracts-Types of bonus-Calculating net premiums and net premium reserves for with-profit contracts-Accumulating with-profits contracts.

MODULE-VI   GROSS PREMIUMS AND RESERVES   (7+2)

Gross premiums and reserves for fixed and variable benefit contracts-Types of expenses incurred in writing a life insurance contract-The influence of inflation on expenses-Gross future loss random variable for standard contracts- Determining gross premiums using the equivalence principle-Gross premium reserves-Equality of gross premium prospective and retrospective reserves.

L – 45; T – 15; TOTAL – 60

REFERENCES:
1. B H Smith "Contingencies of Value", Harvard University Press, 1988.
2. Alistair Neil "Life Contingencies", Butterworth-Heinemann Ltd; illustrated edition (1977).
3. Griffith Davis "Table of Life Contingencies", Longman & Co, 1825: University of California Library.
4. Micheal M Parmenter, "Theory of Interest and Life contingencies with Pension", 3rd Edition.
5. Bowers, Newton L et al. – "Actuarial mathematics". 2nd Edition – Society of Actuaries, 1997.
6. Benjamin, Bernard; Pollard, John H. – "The analysis of mortality and other actuarial statistics" 3rd Edition – Faculty and Institute of Actuaries, 1993.
7. Gerber, Hans U. – "Life insurance mathematics" 3rd Edition– Springer. Swiss Association of Actuaries, 1997.
8. Booth, Philip Metal. "Modern actuarial theory and practice"– Chapman & Hall,1999.

OUTCOME:

On completion of the course the students will be able to

- define simple assurance and annuity contracts, and develop formulae for the means and variances of the present values of the payments under thesecontracts, assuming constant deterministic interest.
- describe practical methods of evaluating expected values and variances of the simple contracts defined in objective.
- describe and calculate, using ultimate or select mortality, net premiums and net premium reserves of simple insurance contracts.
- describe the calculation, using ultimate or select mortality, of net premiums and net premium reserves for increasing and decreasing benefits and annuities.
- describe the calculation of gross premiums and reserves of assurance and annuity contracts.

	L	T	P	C
MAC 6203 - DESCRIPTIVE STATISTICAL METHODS IN	3	1	0	4
ACTUARIAL SCIENCE				

OBJECTIVE:

- The objective of this subject is to provide grounding in Decision theory, Bayesian statistics, Loss distributions, Reinsurance, and Credibility theory which have particular relevance to General Insurance.

MODULE-I   Decision theory   (6+2)

Decision theory-Zero-sum two-player games-Domination- the Minimax criterion-Randomised Strategies-Statistical games-Decision criteria-The Bayes criterion.

MODULE-II   Bayesian statistics   (6+2)

Bayesian statistics-Bayes' Theorem- Prior and posterior distributions- Conjugate priors-Improper prior distributions-The loss function-Quadratic loss-Absolute error loss-All-or-nothing loss.

MODULE-III   Loss distributions   (7+2)

Loss distributions- MGFs and basic loss distributions- exponential-gamma-normal-Pareto and generalised Pareto distributions- lognormal distribution-Weibull distribution- The Burr distribution-Estimation-The method of moments-Maximum Likelihood Estimation-Goodness-of-fit-tests-Mixture distributions.

MODULE-IV   Reinsurance   (8+3)

Reinsurance- Reinsurance arrangements- Excess of loss reinsurance – the insurer-Excess of loss reinsurance – the reinsurer-Proportional reinsurance-Particular distributions-Lognormal distribution-Normal distribution-Inflation-Estimation-Policy excess.

MODULE-V   Credibility theory   (9+3)

Credibility theory-Credibility-The credibility premium formula-The credibility factor-Bayesian credibility-The Poisson/gamma model-The normal/normal model-Bayesian approach to credibility. Empirical Bayes credibility theory - EBCT Model to estimate risk premium - EBCT Model to estimate claim frequency

MODULE-VI   Risk Models   (9+3)

Risk models-General features of a product -Insurable interest- Insurable risk- types of cover and types of product-Products liability-Property damage-Financial loss-Fixed benefits-Models for

short term insurance contracts-The collective risk model- Aggregate claim distributions under proportional and excess of loss reinsurance-The individual risk model-Parameter variability/uncertainty.

L – 45; T – 15; TOTAL – 60

References:

1. Dobson, Annette J. – "An introduction to statistical modeling"- Chapman & Hall, 1983.
2. Hossack, Ian B; Pollard, John H; Zehnwirth, Benjamin. "Introductory statistics with applications in general insurance"- 2nd ed. - Cambridge University Press, 1999.
3. Klugman, Stuart A; Panjer, Harry H; Willmot, Gordon E; Venter, Gary G. "Loss models: from data to decisions"- John Wiley & Sons, 1998.
4. Daykin, Chris D; Pentikainen, Teivo; Pesonen, Martti. "Practical risk theory for actuaries" - Chapman & Hall, 1994.
5. Critian P Robert "Monte Carlo Statistical Methods", 2nd Edition, Springer- Verlag.
6. George W Snedecor "Statistical Methods", 8th Edition, Iowa State University Press.
7. G.S. Maddala C.R Rao" Statistical methods in Finance", Jan 1996, Elsevier Science and technology.
8. Philip J Boland "Statistical and Probabilistic Methods in Actuary Science", Chapman & Hall Press, 2007.

OUTCOME:

On completion of the course the students will be able to

- explain the concepts of decision theory and apply them.
- calculate probabilities and moments of loss distributions both with and without limits and risk-sharing arrangements.
- construct risk models involving frequency and severity distributions and calculate the moment generating function and the moments for the risk models both with and without simple reinsurance arrangements.
- explain the fundamental concepts of bayesian statistics and use these concepts to calculate bayesian estimators.
- describe the fundamental concepts of rating and apply them to simple experience rating systems.
- Construct risk models involving frequency and severity distributions and calculate the moment generating function and the moments for the risk models both with and without simple reinsurance arrangements.

MAC 6204 - STOCHASTIC MODELS

OBJECTIVE:

L	T	P	C
2	1	0	3

- The objective of this subject is to provide grounding in actuarial modeling, stochastic processes, Markov chains and its application in framing NCD, HSD models.

MODULE-I   Principles of actuarial modeling   (5+2)

Principles of actuarial modelling-Models-Modelling - the benefits and limitations-Stochastic and deterministic models-Discrete and continuous state spaces and time sets-Suitability of a model-Short-term and long-term properties of a model-Analysing the output of a model-Sensitivity testing-Communication of the results.

MODULE-II   Stochastic processes   (5+2)

Stochastic processes-Types of stochastic processes-Defining a stochastic process-Sample paths-Stationarity-Increments-The Markov property-Filtrations-White noise-General random walk-Poisson process-Compound Poisson process.

MODULE-III   Markov chains   (5+3)

Markov chains-The Chapman-Kolmogorov equations-Time-homogeneous Markov chains-No Claims Discount policy-Simple random walk on $Z = \{... - 2, - 1, 0, 1, 2, ...\}$ and $\{0, 1, 2, ... , b\}$-A model of accident proneness-The long-term distribution of a Markov chain-The stationary probability distribution-Estimating transition probabilities-Assessing the fit-Simulation.

MODULE-IV   Two-state Markov model   (5+2)

The two-state Markov model-Assumptions underlying the model-Comparison with other models-Probabilities-Statistics-Joint density function-The maximum likelihood estimators-The distribution of $\bar{\mu}$.

MODULE-V   Time-homogeneous Markov jump processes   (5+3)

Time-homogeneous Markov jump processes: Poisson process- Chapman-Kolmogorov equations- transition matrix- Transition rates- health-sickness-death model- Kolmogorov's forward and backward differential equations- Holding times and occupancy probabilities-Expected time to reach state k starting from state i- Jump chain- Two-decrement model- MLE.

MODULE-VI   Time-inhomogeneous Markov jump processes   (5+3)

Time-inhomogeneous Markov jump processes: Chapman-Kolmogorov equations- Transition rates- Kolmogorov's forward and backward differential equations- Occupancy probabilities-Residual holding times- Integrated form of the Kolmogorov forward and backward equations-Applications.

References:

1. Brzezniak, Zdzislaw; Zastawniak, Tomasz. "Basic stochastic processes; A course through exercises"- Springer, 1998.
2. Hickman, James C. "Introduction to actuarial modeling" – North American Actuarial Journal (1997) 1(3) 1-5.
3. Kulkarni, Vidyadhar G. "Modeling, analysis, design, and control of stochastic systems" – Springer, 1999.
4. Grimmett, Geoffrey; Stirzaker, David. – "Probability and random processes" – 3rd ed. – Oxford University Press, 2001.
5. Bowers, Newton L; Gerber, Hans U; Hickman, James C; Jones, Donald A; Nesbitt, Cecil J. – "Actuarial mathematics"-2nd ed. - Society of Actuaries, 1997.
6. Haberman, Steven; Pitacco, Ermanno." Actuarial models for disability insurance"– Chapman & Hall, 1999.
7. Vlamidir I Rotar "Actuarial Models" Chapman & Hall, 2006.
8. A.C. Davison "Statistical models "Cambridge University Press, 2008.

OUTCOME:

On completion of the course the students will be able to

- describe the principles of actuarial modeling.
- describe the general principles of stochastic processes, and their classification into different types.
- define and apply markov chain.
- define and apply markov process.
- Solve insurance related problem based on markov chain.

MAC 6205 - MATHEMATICAL STATISTICS	L	T	P	C
	3	1	0	4

OBJECTIVE:

- The aim of the Mathematical Statistics subject is to provide grounding in Advance Probability and in particular sampling, Hypothesis testing, correlation-regression and Analysis of variance that are of relevance to actuarial work.

MODULE-I   Sampling   (7+2)

Types of Sampling - Moments of the sample mean and variance, Sampling distributions for the normal, t-test, F-test.

MODULE-II   Point estimation   (7+2)

Point estimation - method of moments- method of maximum likelihood- one and two parameter cases-Incomplete samples, Unbiasedness- Mean square error- Asymptotic distribution of MLEs.

MODULE-III   Confidence intervals   (8+3)

Confidence intervals in general, Derivation of confidence intervals, Confidence intervals for the normal distribution, Confidence intervals for binomial & Poisson, Confidence intervals for two-sample problems, Paired data

MODULE-IV   Hypothesis testing   (8+3)

Hypothesis testing- Hypotheses, test statistics, decisions and errors- Classical testing, significance and p-values- Basic tests — single samples- two independent samples- paired data- Tests and confidence intervals- Chi square test.

MODULE-V   Correlation and regression   (8+3)

Correlation and regression- Scatter plots- Correlation- linear correlation- Regression-Regression line- deriving the least squares estimates- Bivariate data- Correlation analysis-Regression analysis- The multiple linear regression model-

MODULE-VI   Analysis of variance   (7+2)

Analysis of variance- One-way analysis of variances- Estimation of the parameters- Partitioning the variability-Examining the treatment means- Confidence intervals for a single treatment mean and pair of treatment means.

L – 45; T – 15; TOTAL – 60

References:

1. Mathematical statistics. Miller, I.; Miller, M.; [Freund, J. E.] 7th ed. Prentice Hall International, 1999.
2. **Dekking,** F.M., **Kraaikamp**, C., **Lopuhaä,** H.P., **Meester**, L.E. "A Modern Introduction to Probability and Statistics" Springer, 2nd Edition.
3. **Chin Long chiang "Statistical Methods of Analysis "World Scientific Books, 2003.**

OUTCOME:

On completion of the course the students will be able to

- explain the concepts of random sampling, statistical inference and sampling distribution, and state and use basic sampling distributions.
- Describe the main methods of estimation and the main properties of estimators, and apply them.
- Construct confidence intervals for unknown parameters and Test hypotheses.
- Investigate linear relationships between variables using correlation analysis and regression analysis.
- Explain the concepts of analysis of variance and use them.

ENC 6281 - COMMUNICATION SKILLS

L	T	P	C
1	0	2	2

OBJECTIVE:

- To orient students in communication skills.
- To train students making effective presentations and discussion various topics.
- To develop active listening skills among students.
- To encourage them to read important documents by using the sub – skills of reading.
- To train them to write project reports with confidence.

MODULE – I   Introduction to language skills   (2)

Orientation to communication skills - Introduction to business vocabulary - Integration of grammatical elements in business English

MODULE – II Speaking in formal and informal scenario   (2)

Orientation to presentation skills – Introducing one-self - Presentation skills -Talking on a familiar topic.(JAM) - Making presentations - Getting into conversations- Role play

MODULE - III   Active listening   (2)

Listening to basic conversations - Listening for specific information - Note-taking and developing points

MODULE – IV   Reading comprehension   (2)

Introduction to reading skills & sub – skills - Developing comprehension skills - Reading circulars and important notices - Reading advertisement and responding

MODULE – V Writing Skills   (2)

Writing a letter of application & resume - Writing a brochure - Writing a report to a periodical - eg.newspaper.

MODULE – VI   Integration of Skills   (2)

Implications of communication skills in work life - Discussion on current topics- newspaper items, current issues - Reading a newspaper article - Report writing - Project proposal and report.

L – 12; P – 18; TOTAL – 30

References:

1. Byrne, D "Teaching Oral Skill", London: Longman. (1975).

2. Byrne, D. Teaching Writing,, London: Longman. (1975).

3. Grellet, F "Developing Reading Skills", Cambridge University Skills.UK. (1981).

4. Ur,P. "Teaching Listening Comprehension", Cambridge University Press.UK. (1984).

5. Anderson, K., Maclean, J. & Lynch, T "Study speaking", A Course in Spoken English for Academic Purposes. Cambridge University Press, UK. (2004).

6. Withrow, J., Brookes, G.& Cummings, M.C. "Inspired to write. Reading and Tasks to Develop Writing Skills", Cambridge University Press, U.K (2004).

OUTCOME:

On completion of the course the students will be able to

- communicate effectively.
- present their ideas with confidence.
- listen and respond effectively.
- read all types of documents effectively.
- write project reports.

MAC 6206- ACTUARIAL COMPUTATIONAL LABORATORY
(MS-EXCEL)

L	T	P	C
0	0	4	2

OBJECTIVE:

- The objective of this laboratory is to provide grounding in Microsoft Excel so that they can perform the actuarial calculation in an effective way.

Review: Custom Toolbar/Custom Menu Bar-Paste Options/Paste List/Paste Special-Managing Comments/Protect Worksheet-Create Lists/Data Form-Custom Sort/Auto Filters/Subtotals-Labels in Formulas-IF/AND/OR Conditions-Pivot Table-V Lookup-H Lookup.

PROBLEMS FROM THE FOLLOWING TOPICS

- Presenting data in tables and charts
- Numerical descriptive measures
- Basic probability
- Some important discrete probability distributions
- The normal distribution and other continuous distributions
- Sampling and sampling distributions
- Confidence interval estimation
- Fundamentals of hypothesis testing
- Simple linear regression
- Introduction to multiple regression

References:

D.M. Levine, D.F.Stephan, T.C. Krehbiel, M.L. Berenson. "Statistics for Managers Using

Microsoft Excel" 5th Edition, Pearson Education Ltd., 2008.

OUTCOME:

On completion of the course the students will be able to

- entering data.
- calculating a set of data.
- displaying the data in a meaningful way.
- Sharing data so that other can understand.
- formatting cells for the need.
- using functions and formulae and inserting charts and graphs.

MAC 7101- APPLICATIONS OF LIFE CONTINGENCIES

L	T	P	C
3	1	0	4

OBJECTIVE:

- The objective of the subject is to give the basic knowledge of different types of insurance contract involving two life's, Idea of Pension Scheme and ULIP policies.

MODULE-I   Simple annuities and assurances involving two lives   (8+3)

Simple annuities and assurances involving two lives-Random variables to describe joint life functions-Determining simple probabilities involving two lives-Determining present values involving two lives-Contingent and reversionary benefits-Contingent probabilities of death-Present values of contingent assurances-Present values of reversionary annuities-Present values of functions with specified terms- Expected present value of annuities payable m times a year-Premium conversion relationships.

MODULE-II   Profit testing   (7+2)

Profit testing-Unit-linked contracts-Evaluating expected cashflows for various contract types-profit tests for annual premium contracts-Determining premiums using a profit test.

MODULE-III   Determining reserves using profit testing   (7+2)

Determining reserves using profit testing-Pricing and reserving bases-Determining reserves for a unit-linked policy using cashflow techniques-Determining reserves for a conventional policy using cashflow techniques-Effect of pricing and reserving bases on a profit test.

MODULE-IV   Competing risks   (8+3)

Competing risks-Multiple state modelling-Valuing benefits that are contingent upon competing risks-Multiple decrement tables-Multiple decrement service table for pensions calculations-Updating a service table-How to obtain multiple decrement table rates under the assumption of uniformity in the single decrement tables-Consistency with the multiple state approach.

MODULE-V   Pension funds   (8+3)

Pension funds-Salary scales-Salary-related pensions benefits and contributions-Expected cashflows generated by pensions benefits and contributions-Using commutation functions to value salary related benefits and contributions-Valuing health and care insurance benefits using multiple decrement tables-Non-life contingencies.

MODULE-VI   Mortality, selection and standardization   (7+2)

Mortality, selection and standardization-Principal factors contributing to variation in mortality and morbidity-Selection-Selection in life assurance and pensions business- different mortality tables for different classes of lives-Crude mortality rate-Directly standardised mortality rate-Indirectly standardised mortality rate-Standardised mortality ratio.

References:

1. B H Smith "Contingencies of Value "Harvard University Press, 1988.
2. Alistair Neil "Life Contingencies", Butterworth-Heinemann Ltd; illustrated edition (1977).
3. Griffith Davis "Table of Life Contingencies", Longman &Co, 1825: University of California Library.
4. Micheal M Parmenter, 'theory of Interest and Life contingencies with Pension", 3rd edition.
5. Bowers, Newton L *et al.* – "Actuarial mathematics". 2nd ed. – Society of Actuaries, 1997.
6. Benjamin, Bernard; Pollard, John H. – "The analysis of mortality and other actuarial statistics" 3rd ed. – Faculty and Institute of Actuaries, 1993.
7. Gerber, Hans U. – "Life insurance mathematics"3rd ed. – Springer. Swiss Association of Actuaries, 1997.
8. Booth, Philip M *et al.* "Modern actuarial theory and practice"– Chapman & Hall, 1999.

OUTCOME:

On completion of the course the students will be able to

- define and use straightforward functions involving two lives.
- describe methods which can be used to model cash flows contingent upon competing risks.
- describe the technique of discounted emerging costs, for use in pricing, reserving, and assessing profitability.
- describe the principal forms of heterogeneity within a population and the ways in which selection can occur.

MAC 7102-FINANCIAL ECONOMICS

L	T	P	C
3	1	0	4

OBJECTIVE:

- The objective of the Financial Economics subject is to provide basic grounding in Financial Economics such as efficient market hypothesis, Measures of investment risk, Utility theory and portfolio theory with Brownian motion- Martingales which help them to understand the economic environment and value the security price in different situation.

MODULE-I   Introduction to financial economics   (7+2)

Introduction to financial economics- Economic models- Mathematical models- Efficient market hypothesis- The three forms of the efficient markets hypothesis- The evidence for or against each form of the efficient markets hypothesis- Informational efficiency- Volatility tests.

MODULE-II   Consumer choice theory   (8+3)

Consumer choice theory- Utility theory- The expression of economic characteristics in terms of utility functions- Measuring risk aversion-Construction of utility functions-Stochastic dominance-Relationship between dominance concepts and utility theory.

MODULE-III   Measures of investment risk   (7+2)

Measures of investment risk- Measures of risk-Variance of return-Semi-variance of return-Shortfall probabilities-Value at risk-Tail value at risk (TailVar) and expected shortfall-Relationship between risk measures and utility functions.

MODULE-IV   Portfolio theory   (8+3)

Portfolio theory-Lagrangian function-Benefits of diversification-Models of asset returns-Multifactor models- Macroeconomic factor models-Fundamental factor models-Statistical factor models-Construction of models- The single-index model- The capital asset pricing model (CAPM)-Limitations of CAPM-Arbitrage pricing theory.

MODULE-V   Brownian motion and Martingales   (8+3)

Introduction to Brownian motion- standard Brownian motion- Properties of Brownian motion-Geometric Brownian motion- Martingales- Martingales in discrete time- Martingales in continuous time.

MODULE-VI   Stochastic calculus   (7+2)

Stochastic calculus- The Ito Integral- Ito's lemma- Stochastic differential equations- Diffusion and Ito process models- The Ornstein-Uhlenbeck process.

References:

1. Baxter, Martin & Andrew Rennie, Financial calculus; "An introduction to derivative pricing" Cambridge University Press, 1996.
2. Panjer, Harry H (ed), "Financial economics: with applications to investments, insurance and pensions", The Actuarial Foundation, 1998.
3. Elton, Edwin J, Martin J Gruber, Stephen J Brown, & William N Goetzmann, "Modern portfolio theory and investment analysis" (6th edition), John Wiley, 2003.
4. Hull, John C, "Options, futures and other derivatives" (5th edition), Prentice Hall, 2002.

OUTCOME:

On completion of the course the students will be able to

- discuss the various forms of the efficient markets hypothesis and discuss the evidence for and against the hypothesis.
- discuss the advantages and disadvantages of different measures of investment risk.
- describe and discuss the assumptions of mean-variance portfolio theory and its principal results.
- describe and discuss the properties of single and multifactor models of asset returns.
- describe asset pricing models, discussing the principal results and assumptions and limitations of such models.
- define and apply the main concepts of Brownian motion, Martingales, and Ito integral.

MAC 7103- APPLIED STATISTICAL METHODS IN

ACTUARIAL SCIENCE

L	T	P	C
3	1	0	4

OBJECTIVE:

- The objective of this subject is to provide grounding in Risk models, Ruin theory, Run-off triangles and Time series which have particular relevance to fix the premium and calculation of reserve in General Insurance.

MODULE-I   Ruin theory   (7+2)

Ruin theory-Basic concepts-The surplus process-The probability of ruin in continuous time-The probability of ruin in discrete time-Probability of ruin in the short term-Premium security loadings-Reinsurance.

MODULE-II   Generalised linear models   (7+2)

Generalised linear models-Exponential families-Normal distribution-Poisson distribution-Binomial distribution-Gamma distribution-Link functions and linear predictors-Deviance of model fitting-Residuals analysis and assessment of model fit.

MODULE-III   Run-off triangles   (8+3)

Run-off triangles-Projections using development factors-Run-off patterns-The chain ladder method-Model checking-Other methods of deriving development factors-Adjusting for inflation-The inflation adjusted chain ladder method-The average cost per claim method-Loss ratios-The Bornhuetter-Ferguson method.

MODULE-IV   Time series I   (8+3)

Time series-Properties of a univariate time series-Stationary random series-Main linear models of time series- Autoregressive process (AR)- Moving average process (MA)- Autoregressive moving average process (ARMA)- ARIMA Model

MODULE-V   Time series II   (8+3)

Compensating for trend and seasonality-Identification of MA(q) and AR(p) models- Box-Jenkins method-Forecasting-Multivariate time series models- Bilinear models-Threshold autoregressive models-Random coefficient autoregressive models-Autoregressive models with conditional heteroscedasticity.

MODULE-VI   Monte Carlo simulation   (7+2)

Monte Carlo simulation-Generation of pseudo-random numbers using a computer-Inverse transform method-Inverse transform method for discrete variates-Acceptance-rejection method-Generating normal variates-Numerical evaluation of derivatives-Comparative simulations, performance evaluation.

L – 45; T – 15; TOTAL – 60

References:

1. Dobson, Annette J. – "An introduction to statistical modeling"- Chapman & Hall, 1983.
2. Hossack, Ian B; Pollard, John H; Zehnwirth, Benjamin. "Introductory statistics with applications in general insurance"- 2nd ed. - Cambridge University Press, 1999.
3. Klugman, Stuart A; Panjer, Harry H; Willmot, Gordon E; Venter, Gary G. "Loss models: from data to decisions"- John Wiley & Sons, 1998.
4. Daykin, Chris D; Pentikainen, Teivo; Pesonen, Martti. "Practical risk theory for actuaries" - Chapman & Hall, 1994.
5. Critian P Robert "Monte Carlo Statistical Methods", 2nd Edition, Springer- Verlag.
6. George W Snedecor " Statistical Methods", 8th Edition, Iowa State University Press,
7. G.S. Maddala C.R Rao" Statistical methods in Finance", Jan 1996, Elsevier Science and technology.
8. Philip J Boland "Statistical and Probabilistic Methods in Actuary Science", Chapman & Hall Press, 2007.

OUTCOME:

On completion of the course the students will be able to

*   Explain the concept of ruin for a risk model.
*   describe and apply techniques for analyzing a delay (or run-off) triangle and projecting the ultimate position.
*   explain the fundamental concepts of a generalized linear model (glm), and describe how a glm may apply.
*   define and apply the main concepts underlying the analysis of time series models.
*   explain the concepts of "monte carlo" simulation using a series of pseudorandom numbers.

MAC 7104- SURVIVAL MODELS

L	T	P	C
2	1	0	3

OBJECTIVE:

- The objective of the Survival Models subject is to provide grounding in survival models such as Estimating the lifetime distribution function, calculating crude mortality rate and testing for best feet which will help the Insurance companies to model the premium rates.

MODULE-I   Survival models and the life table   (5+2)

Survival models and the life table-Future Lifetime-Probabilities of death and survival The force of mortality μ_x -Survival probabilities-The probability density function of T_x Initial rates and central rates of mortality-Complete and curtate expectation of life-Gompertz' and Makeham's laws-Calculating the parameter values-Survival probabilities.

MODULE-II   Estimating the lifetime distribution function   (5+3)

Estimating the lifetime distribution function – the Kaplan-Meier and Nelson-Aalen models-Statistical Inference-Censoring mechanisms-The Kaplan-Meier (product-limit) estimator-Comparing lifetime distributions-The Nelson-Aalen estimate-Relationship between the Kaplan-Meier and Nelson-Aalen estimates.

MODULE-III   The Cox regression model   (5+2)

The Cox regression model-Fully parametric models-Parametric models for the hazard function-Covariates-The Cox model-Estimating the regression parameters-The partial likelihood-Model fitting.

MODULE-IV   Binomial-type models   (5+3)

Binomial-type models-The actuarial estimate-Central exposed to risk-Strengths and weakness of the binomial model-Poisson models- Estimating the underlying force of mortality- Comparison of multiple-state, binomial and Poisson models- Exposed to risk-Homogeneity-The principle of correspondence-Exact calculation of E_x^c -Census approximations to E_x^c -Different definitions of age.

MODULE-V   Graduation and statistical tests   (5+3)

Graduation and statistical tests-The need for graduation-Reasons for graduation-Desirable features of a graduation-Testing the smoothness of a graduation- Statistical tests of a mortality experience-Chi square (χ^2) test-Standardised deviations test-Signs test-Cumulative deviations-Grouping of signs test-Serial correlations test-Testing actual versus expected rates.

MODULE-VI   Methods of graduation   (5+2)

Methods of graduation-Graduation by parametric formula-Graduation by reference to a standard table-Graphical graduation-Comparison of different methods- Statistical tests of a graduation- The effect of duplicate policies.

L – 30; T – 15; TOTAL – 45

References:

1. Vlamidir I Rotar "Actuarial Models" Chapman & Hall, 2006.
2. Elke Korn, Ralf Korn "Monte Carlo Simulation of financial and Actuarial model" Chapman & Hall, (Feb 2010).
3. Dick London "Survival models and their estimation "ACTEX Publication. 1998.
4. A.C. Davison "Statistical models "Cambridge University Press, 2008.
5. Regina C Elandt Johnson "Survival models and data Analysis", Wiley, Inter science, 1999.

OUTCOME:

On completion of the course the students will be able to

- explain the concept of survival models and estimation for lifetime distributions.
- derive maximum likelihood estimators for the transition intensities in models of transfers between states with piecewise constant transition intensities.
- describe the binomial model of mortality, derive a maximum likelihood estimator for the probability of death and compare the binomial model with the multiple state models.
- describe how to estimate transition intensities depending on age, exactly or using the census approximation and test crude estimates for consistency with a standard table or a set of graduated estimates, and describe the process of graduation.

**MAC 7105- ACTUARIAL COMPUTATIONAL LABORATORY
       (SPSS)**

L	T	P	C
0	0	4	2

OBJECTIVE:

The aim of the SPSS lab is to provide the practical knowledge of the various Actuarial aspects

[S P S S (STATISTICAL PACKAGE FOR SOCIAL SCIENCES)]

- Data Analysis
- Basic Data Analysis and graphs
- Regression Analysis
- Sampling (Normal, F, Students- t, chi-square distributions)
- Analysis of Variance (One way, Two Way, Latin square, factorial Methods)
- Contingency tables
- Risk Analysis Using Monte-Carlo Method
- Insurance Claims Severity and frequency

References:

George A. Morgan, Nancy L. Leech, Gene W. Gloeckner, Karen C. Barrett: SPSS *for Introductory Statistics: Use and Interpretation,* (Second Edition), Lawrence Erlbaum Associates Publishers, New Jersey, 2004.

OUTCOME:

- Will have the thorough knowledge SPSS and they can use this idea to calculate premium and reserve using similar software which is widely used in actuarial evaluation process in industries.

ELECTIVES

MACY 01　　　FINANCIAL MANAGEMENT OF LIFE OFFICE

L	T	P	C
3	0	0	3

OBJECTIVE:
- The objective of the subject is to provide the basic idea about the financial management of companies in particular Life insurance companies.

MODULE- I　　　　　Ethic of financial Management　　　　　　(7)

Financial Management development - scientific management - Management Vs Administration, Ethics in management – Social responsibilities of managers-roles & responsibilities – duties.

MODULE –II　　　　　Role of Actuary　　　　　　　　(8)

Role of Actuary : Investment policy – Product pricing and design Control cycle Profit testing-Model office and uses – Analysis of surplus - marketing- underwriting and reinsurance policies- reserving – profit distribution – sales policy – Surrender and transfer policy.

MODULE – III　　　　　Liability and fiscal responsibility　　　　　(8)

Liability and fiscal responsibility – Budgeting - Financial ledgers – Accounts expenditure requests – Petty cash - Limited purchase orders (LPO) - Direct pay/cheque request – Journal vouchers – funding opportunities – Resources and services.

MODULE – IV　　　　　Asset types of life companies　　　　　(7)

Reversionary and terminal bonuses- Solvency for a life insurance company – Mechanical and model based solvency margins – fair values of life insurance liabilities.

MODULE – V　　　　　Reversionary and terminal bonuses　　　(8)

Asset types of life companies - Insurer's liabilities - surplus on portfolio of insurance -Nonprofit premiums- owner ship of surplus and types of bonus system – Asset shares and uses.

MODULE – VI　　　　　Reserving　　　　　　　　　(7)
Mismatching reserves- capital requirements for life office – lognormal and Willkie models of equity returns - asset/liability investigation.

L – 45; T – 0; TOTAL – 45

References :

1. Peter J Booth " Modern actuary theory and practice " 2nd Edition (2004)CRC Press.
2. http://www.ma.hw.ac.uk/~niall/lopcourse/
3. J David Cummins "Financial management of Life Insurance Companies", June 1993, Huebner International.

OUTCOME:

On completion of the course the students will be able to

- explain the role of actuary and their work.
- explain what are the asset and liabilities of an insurance companies.
- differentiate the different type of bonuses.
- explain why insurance companies need to keep reserve.

MACY 02   ISLAMIC INVESTMENTS

L	T	P	C
3	0	0	3

OBJECTIVE:

- The objective of the subject is to provide the basic idea about Islamic investment in insurance sector and how it differs from other investment.

MODULE- I   Islamic investment and global trends   (8)
Innovation, globalization and diversification- strengths and resilience of the Islamic banking sector- Growth and development of Islamic capital market.

MODULE- II   Islamic law   (7)
Objectives and Sources of Islamic law – principle of business contracts in Islamic law- Islamic banking Models.

MODULE – III   Islamic derivatives   (8)
Hedging and Islamic derivatives – Islamic Bonds (Sukuk) – Islamic Fund Management – Islamic Structured products- risk management for Islamic funds, derivatives, structured products.

MODULE-IV   Islamic Insurance   (8)
Islamic Insurance (Takaful): Introduction–Takaful models and Mechanism – Reinsurance (Re takaful) – Concerns in the provision of Takaful – Business models – retailing.

MODULE-V   Jurisprudence and Arbitrage   (7)
Jurisprudence and Arbitrage – Sale based Islamic Finance – Derivatives like sales – Partnership and Equity Investment.

MODULE- VI Islamic Asset management   (7)
Islamic Asset management: Screening criteria for Islamic Equity funds- Islamic Indexes- Equities- Sukuk – Private equity investment – Investing in real estate and leasing funds.

L – 45; T – 0; TOTAL – 45

References

1. Munawar Iqbal "A Guide to Islamic Finance "Risk Books ,UK, 2007.
2. Mahmoud A El-Gamal "Inslamic Finance: Law, Economics and Practice" Cambridge university Press, 2008.
3. Sohail Jaffar "Islamic Asset management" Euromoney books, London, 2006.
4. Michael Mahlknecht "Islamic capital markets and risk management" Risk Books UK 2007.
5. Aly Khorshid "Islamic Insurance" Routledge Curzon, London, 2004.
6. Sohail Jaffar "Islamic Insurance" Euromoney books, London, 2006.

OUTCOME:

On completion of the course the students will be able to

- describe the fundamental concept of islamic law
- use islamic derivatives to reduce the risk in investment
- demonstrate the concept of islamic asset management

MACY 03- CORPORATE FINANCE

L	T	P	C
3	0	0	3

OBJECTIVE:

The objective of the subject is to provide the basic idea about corporate finance and Capital project appraisal.

MODULE-I   FINANCIAL INSTITUTIONS   (8)

Government agencies- The Stock Exchange- The roles of the Stock Exchange- Derivatives exchanges- Institutional investors- Investment banks- Clearing banks- Building societies- Investment trusts- Unit trusts- Open-ended investment companies (OEICs)- Investment management companies- Self-administered pension schemes- Life insurance companies- General insurance companies.

MODULE-II   USE OF DERIVATIVES   (7)

Financial futures- Types of futures- Uses of financial futures- Forwards- Options- Types of options- Uses of options- Interest rate and currency swaps- Types of swaps- Uses of swaps.

MODULE-III   WEIGHTED AVERAGE COST OF CAPITAL   (8)

Importance and definetion of WACC- Theoretical background- The traditional view- Modigliani and Miller- Cost of equity- The capital asset pricing model (CAPM) and risk- Specific risk- Systematic risk- Beta as a measure of systematic risk- Adjusting beta for gearing- Measuring beta- Cost of debt- calculation of WACC.

MODULE-IV   CAPITAL STRUCTURE AND DIVIDEND POLICY   (7)

Components of capital structure- aims of the financial manager- Theoretical background to the gearing decision- Factors affecting the gearing decision- Fundamentals of dividend policy- Factors influencing the decision on dividend policy- Other methods of reward- Scrip or stock dividends- Share buybacks.

MODULE-V   CAPITAL PROJECT APPRAISAL I   (8)

capital project- Initial appraisal- Evaluation of cashflows- Methods of project evaluation- Net present value (NPV)- Internal rate of return (IRR)- Annual capital charge- Shareholder value approach- Payback period- Nominal returns- Strategic fit- Opportunity cost- Hurdle rates- Receipts/costs ratio- Results of the evaluation- Simulations.

MODULE-VI   CAPITAL PROJECT APPRAISAL II   (7)

Choice of discount rate- Risk analysis – an overview- Identification of risks- Analysis of risks- Obtaining a distribution of NPVs in practice- Risk mitigation- investment submission.

L – 45; T – 0; TOTAL – 45

REFERENCES:

- S A Ross, Wester Field, Jaffe "Corporate Finance" 8th Edition , Mc Graw Hill, 2008.
- Interpreting company reports and accounts. Holmes, G.; Sugden, A.; Gee, P. 10th ed. 336 pages. FT Prentice Hall, 2008. ISBN: 978-0273711414.
- S.R Vishwanath "Corporate Finance Theory and Practice", Sage Publications (ca), 2007.
- Principles of corporate finance (Global edition). Brealey, R. A.; Myers, S. C.; Allen, F. 10th ed. McGraw-Hill, 2010. ISBN: 978-0071314176.
- IIBF "International Corporate Finance", Macmillan (I) Publishing , Delhi,2007.

OUTCOME:

On completion of the course the students will be able to
- explain the basic concepts of corporate finance.
- explain the various financial institutions and its purpose.
- identify the components and factors of capital structure.
- identify the factors and important of didivent policies.
- interpret the accounts of a company or a group of companies and discuss the limitations of such interpretation and show how financial techniques can be used in the assessment of capital investment projects.

L	T	P	C
3	0	0	3

MACY 04   FINANCIAL MARKETS

OBJECTIVE:

The objective of the subject is to provide the basic idea about the production, investment, risk process and market treading in financial market.

MODULE – I   Facts of financial markets   (7)

Facts of financial markets – time variation and business cycle – equity premiums – consumption models

MODULE – II   Interest rate model   (8)

The rate of interest - liquidity preference theory- structure of interest rates- Market segmentation theory- Forward interest rates and yield curve.

MODULE – III   Production, investment and general equilibrium   (8)

Production, investment and general equilibrium – labour income - Idiosyncratic risk – challenges for the future.

MODULE – IV   Financial risk processes   (7)

Financial risk processes- risk measurement – team structure dynamics – financial risk management.

MODULE – V   Science of Market trading   (7)

Science of Market trading: Signals and indicators – trending, oscillator, vertex indicators – various time frames- wavelet analysis – trading systems.

MODULE –VI   Islamic finance   (8)

Islamic banking and finance: Socio economic responses – resilience and stability – current developments – Islamic structured products – Islamic capital markets- trust and wealth managements.

L – 45; T – 0; TOTAL – 45

References:

1. John H Cochrane " Financial markets and the real economy ", Now Publishers, Oct 2005
2. Don K Mak " The science of financial market trading ", World Scientific, 2003
3. Keith Pilbeam "Finance and Financial Markets" 2nd Edition, Palgrave Macmillan
4. Lloyd B Thomas " Money banking and Financial Markets ", 1997, Student Gd edition, Mc Graw hill

5. Stepeh G Cecchetti "Money banking and Financial Markets ", 1st edition, 2005, Mc Graw hill
6. Natalie Schoon "Islamic banking and Finance" Spiramus Press Ltd., Jan, 2009.

OUTCOME:

On completion of the course the students will be able to

- explain the basic concept of financial market.
- demonstrate the concept of financial risk management.
- explain the treading procedure in financial market.
- explain the importance of Islamic finance.

MACY 05   ISLAMIC ASSET AND FUND MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVE:

- The objective of the subject is to provide the basic idea about the Islamic asset and fund management.

MODULE-I   The Capital Market   (7)

The Capital Market: Functions and Objective – Risk return principle in Islam: Cost of Capital – Shariah Principles for Capital Market.

MODULE-II   Islamic Stocks and Wealth Management   (8)

Islamic Stocks and Wealth Management- Equity shares and funds- Business and Structure of Islamic enterprise: Indebtedness- Earnings from impermissible activities.

MODULE-III   Shariah screening in Islam   (7)

Norms for Shariah screening in Islam- Dow Jones Islamic investment criteria – Norms used in India, Pakistan and Middle East.

MODULE-IV   Islamic Screening norms   (7)

Critical assessment of Islamic Screening norms- Suitability of Market cap – Purification and Zakah.

MODULE-V   Real Estate and Project financing   (8)

Islamic Real Estate and Project financing – Characteristics of Real Estate – Islamic REITS & REMFs – Islamic MODULE Trusts and Mudaraba Certificates.

MODULE- VI Islamic Banking   (8)

Islamic Banking – Introduction: Riba – Modern Islamic Banking – Largest Islamic banks- Principles of Islamic Banking.

L – 45; T – 0; TOTAL – 45

References

1. Munawar Iqbal "A Guide to Islamic Finance "Risk Books ,UK, 2007.
2. Mahmoud A El-Gamal "Inslamic Finance: Law, Economics and Practice" Cambridge university Press, 2008.
3. Sohail Jaffar "Islamic Asset management" Euromoney books, London, 2006.
4. Michael Mahlknecht "Islamic capital markets and risk management" Risk Books UK 2007.
5. Aly Khorshid "Islamic Insurance" Routledge Curzon, London, 2004.
6. Sohail Jaffar "Islamic Insurance" Euromoney books, London, 2006.

OUTCOME:

On completion of the course the students will be able to

- explain the concept of capital market.
- demonstrate the concept of Islamic stocks and wealth management.
- explain the concept of real estate and project financing.
- explain the idea of Islamic banking .

MACY 06   PORTFOLIO AND CREDIT RISK MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVE:

- The objective of the subject is to provide the basic idea about portfolio theory and credit risk management.

MODULE – I   Valuation of derivative securities   (8)
Arbitrage-European options-American options-Factors affecting option price-Pricing forward contracts-Bounds for option prices-Put-call parity.

MODULE – II   The Binomial model   (8)

The one-period model-Two-period binomial tree-n-period binomial tree-Recombining binomial trees-Calibrating binomial models-state price deflator approach

MODULE – III   Black-Scholes option pricing formula   (7)
Assumptions of Black-Scholes model-The Black-Scholes model- Black-Scholes model for dividend-paying shares

MODULE – IV   The 5-step method in discrete & continuous time   (8)
Tradeable assets-Self-financing strategies-Replicating strategies and complete markets-Cameron-Martin-Girsanov theorem-martingale representation theorem-Diffusion models-The martingale approach (the 5-step method)- The 5-step approach with dividends

MODULE – V   The term structure of interest rates   (7)

Relationships between interest rates and bond prices-The risk-neutral approach to pricing-The state price deflator approach to pricing-Models for the term structure of interest rates

MODULE – VI   Credit risk   (7)

Credit events and recovery rates- Structural models- Reduced-form models- Intensity-based models- The Merton model- Two-state models for credit ratings- The Jarrow-Lando-Turnbull (JLT) model

L – 45; T – 0; TOTAL – 45

References:

1. Andrew Kimble "Credit Risk: From Transaction of Portfolio Management", Nov, 2003, Butterworth Heinemann.
2. Andrew Fight "Credit riskManagement", 2007, Elsevier India Private Limited.
3. Ludwig B chincarini "Quantitative Equity Portfolio Management ", 2006, Mc Graw Hill.
4. Greg N Gregoriou, Critisian Hoppe "The Handbook of Credit Portfoilo .Management", 2008, Mc Graw Hill.

OUTCOME

On completion of the course the students will be able to

- Demonstrate a knowledge and understanding of the properties of option prices, valuation methods and hedging techniques.
- Show how to use binomial trees and lattices in valuing options and solve simple examples.
- Show how to use the Black-Scholes model in valuing options and solve simple examples.
- Demonstrate a knowledge and understanding of models of the term structure of interest rates.
- Demonstrate a knowledge and understanding of simple models for credit risk.

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