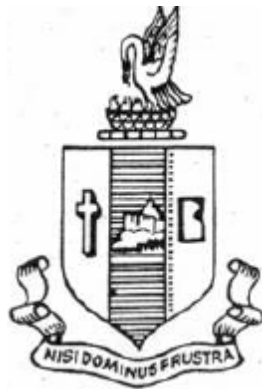# M.Sc. ACTUARIAL SCIENCE
SYLLABUS

(For the students admitted in the academic year 2018-19)

PG DEPARTMENT OF ACTUARIAL SCIENCE
BISHOP HEBER COLLEGE (AUTONOMOUS)
(Nationally Reaccredited with A+ Grade by NAAC)
Tiruchirappalli– 620017

Programme : M.Sc. Actuarial Science

Sem.	Course	Course Title	Course Code	Hours / week	Credits	CIA	ESE	Total
I	Core I	Probability and Mathematical Statistics - I	P18AS101	6	5	25	75	100
	Core II	Financial Mathematics - I	P18AS102	6	5	25	75	100
	Core III	Models - I	P18AS103	6	4	25	75	100
	Elective I	Actuarial Risk Management	P18AS1:1	6	4	25	75	100
	Elective II	Principles of Insurance	P18AS1:2	6	4	25	75	100
II	Core IV	Probability and Mathematical Statistics - II	P18AS204	5	4	25	75	100
	Core V	Financial Mathematics - II	P18AS205	5	4	25	75	100
	Core VI	Life and Health Contingencies - I	P18AS206	5	4	25	75	100
	Core VII	Models - II	P18AS207	5	4	25	75	100
	Core VIII	Programming Using R	P18ASP08	4	4	40	60	100
	NMEC	Actuarial Mathematics	P18AS2E1	4	2	25	75	100
	VLO	RI/MI	P17VL2:1/ P17VL2:2	2	2	25	75	100
III	Core IX	Statistical Methods - I	P18AS309	6	4	25	75	100
	Core X	Business Economics - I	P18AS310	6	5	25	75	100
	Core XI	Finance and Financial Reporting - I	P18AS311	6	5	25	75	100
	Core XII	Life and Health Contingencies - II	P18AS312	6	5	25	75	100
	Elective III	Advanced MS-EXCEL	P18AS3:P	6	4	40	60	100
IV	Core XIII	Statistical Methods - II	P18AS413	6	4	25	75	100
	Core XIV	Business Economics - II	P18AS414	6	4	25	75	100
	Core XV	Finance and Financial Reporting - II	P18AS415	6	4	25	75	100
	Elective IV	Joint Life Annuities and Pension Funds	P18AS4:4	6	4	25	75	100
	Core Project	Project	P18AS4PJ	6	5	--	--	100

Total Credits : 90

Core Theory : 15 Core Project : 1 Elective :4 Value Education : 1	Total	22
NMEC : 1		

NMEC offered by the Department : Actuarial Mathematics - P18AS2E1

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Semester: I	Code: P18AS101
Credits: 5	Hours/week: 6

Objectives: To provide students with a good understanding of the theory of probability, both discrete and continuous, including some combinatory, a variety of useful distributions, Expectation and variance, analysis of sample statistics, and central limit theorems, as Described in the syllabus. To help students develop the ability to solve problems using probability. To introduce students to some of the basic methods of statistics and prepare them for further study in statistic.

Unit I: Basics of Statistics: Grouped Frequency Distribution – Stem and Leaf Diagrams – Line Plots – Cumulative Frequency Tables – Measures of Location – The Mean – The Median – The Mode – Measures of Spread – The Standard Deviation – Moments – The Range – The Interquartile Range – Symmetry and Skewness(Bowley's, Pearson's & moments) – Box Plots – Probability – Definition – Basic properties – Addition rule for probability – Conditional probability definition –Derivation of Bayes' theorem for events – Probabilities for situations involving independence.

Unit II: Random Variables: Discrete Random Variables – Random Variables – Probabilities – Probability Functions – Cumulative Distribution Functions – Continuous Random Variables – Definition – Probability Density Function – Cumulative Distribution Function – Expected Values – Mean – Variance and Standard Deviation – Linear Functions of X – Moments – Important Discrete Distributions – Uniform Distribution – Bernoulli Distribution – Binomial Distribution – Geometric Distribution – Negative Binomial Distribution – Hyper Geometric Distribution – Poisson Distribution – Important Continuous Distributions – Uniform Distribution– Exponential Distribution - Gamma Distribution – Beta Distribution – Normal Distribution – Functions of a Random Variables – Discrete Random Variables – Continuous Random Variables.

Unit III: Generating Functions: Probability Generating Functions – General Formula– Important Examples – Evaluating Moments – Moment Generating Functions – General Formula – Finding Moments – Use of Moment Generating Functions – Important Examples – Cumulate Generating Functions – Linear Functions.

Unit IV: Joint Distributions: Joint Probability (Density) Functions – Discrete Case – Continuous Case – Marginal Probability (Density) Functions – Discrete Case – Continuous Case – Conditional Probability (Density) Functions – Continuous Case – Independence of Random Variables – Discrete Case – Continuous Case – Functions of Random Variables– Expectations of Functions of Two Variables – Expectations – Expectation of a Sum – Expectation of a Product – Covariance and Correlation Coefficient – Useful Results on Handling Covariance – Variance of a Sum – Using Generating Functions to Derive Distributions of Linear Combinations of Independent Random Variables - Probability Generating Functions – Using Probability Generating Functions to Derive Relationships among Variables – Moment Generating Functions – Using Moment Generating Functions to Derive Relationships Among Variables.

Unit V: Conditional Expectation: The Conditional Expectation E [Y|X] – The Random Variable E [Y|X] – The Random Variable V[Y|X] and the "E[V]+ V[E]" Result – Moment Generating Functions – Compound Distributions – Moments

of Compound Distributions – Generating Functions of Compound Distributions – The Central Limit Theorem and its applications – Definitions– Practical Uses – Normal Approximation for Binomial Distribution, Poisson Distribution, Gamma Distribution – The Continuity Correction – Examples.

Textbook: Acted Study Material: Subject -CT3

Reference:

Mathematical statistics. Freund, John E f - 6th ed. - Prentice Hall International, 1999

CORE-II: FINANCIAL MATHEMATICS-I

Semester: I
Code: P18AS102

Credits: 5
Hours/week: 6

Objectives: The aim of the Financial Mathematics subject is to provide grounding in financial mathematics and its simple applications.

Unit I: Cash flow Model: Cash Flow Process – Examples of Cash flow Scenarios – Zero Coupon Bond, Fixed Interest Securities, Index Linked Securities, Cash on Deposit, Equity, Annuity, An Interest Only Loan, and Repayment Loan. The Time Value of Money: Simple Interest, Compound Interest, Present Values, Simple Discount, Investing Over a Period.

Interest Rates: Nominal Rate of Interest – Accumulation Factors – Principles of Consistency, The Force of Interest – Present Values – The Basic Compound Interest Functions – Interest Payable pthly. Real and money rates of interest: Definition of real and money interest rates - Deflationary conditions - Usefulness of real and money interest rates.

Unit II: Discounting and Accumulation: Present Values of Cash flows – Discrete Cash flows, Continuous Cash Flows – Valuing Cash Flows – Constant Interest Rates, Sudden Changes in Interest Rates – Interest Income.

Unit III: Level Annuities: Present Values – Payments Made in Arrear, Payment Made in Advance – Accumulations – Perpetuities – Continuously Payable Annuities – Annuities Payable pthly: Present Values, Accumulations, Perpetuities – Annuities Payable pthly where p is less than 1 – Non Integer Values of n. Deferred and Increasing Annuities: Deferred Annuities – Annual Payments – Continuously Payable Annuities, Annuities Payable pthly, Non Integer Values of n - Varying Annuities – Annual Payments – Continuously Payable Annuities Relationship – Decreasing Annuities – Special Cases – Irregular Payments – Sudden Changes in Interest Rates.

Unit IV: Equation of Value: The Equation of Value and the Yield on the Transaction – The Theory – Solving for an Unknown Quantity – Uncertain Payment or Receipt – Probability of Cash Flows, Higher Discount Rate. Loan Schedules: Calculating the Capital Outstanding – Introduction, the Theory and the Retrospective Loan Calculation – Calculating the Interest and Capital Elements – The Loan Schedule – Installment Payable More Frequently than Annually – Consumer Credit: Flat Rates and APRs.

Unit V: Investments: Introduction – Fixed interest government borrowings – Fixed interest government bonds, cash flows, variations, tax, security, marketability and return – Government bills – Fixed interest borrowings by other bodies – Characteristics of corporate debt, debentures, unsecured loan stocks, Eurobonds, certificates of deposit – Convertibles – Property – Derivatives – Future, range of futures, clearing house, margin, bond futures, short interest futures, stock index futures – Options, swaps – Interest rate swaps, currency swaps.

Textbook: ActEd Study Material: Subject - CT1.

References:

1. An introduction to the mathematics of finance. McCutcheon, John J; Scott, William F. London: Heinemann, 1986. 463 pages. ISBN: 0 434 91228 x.
2. Mathematics of compound interest. Butcher, M V; Nesbitt, Cecil J. Ulrich's Books, 1971. 324 pages.
3. Theory of financial decision making. Ingersoll, Jonathan E. Rowman& Littlefield, 1987. 474 pages. ISBN: 0 8476 7359 6.
4. The theory of interest. Kellison, Stephen G. 2nd ed. Irwin, 1991. 446 pages. ISBN: 0 256 09150 1. Available from the publications unit.

Semester - I	**Code: P18AS103**
Credits: 4	**Hours/Week: 6**

Objectives: The aim of the Models subject is to provide grounding in stochastic processes and survival models and their application

Unit I: Survival Models: A Simple Model Of Survival (Model 1) – Future Lifetime – Probabilities Of Death And Survival The Force Of Mortality   - Survival Probabilities – The Probability Density Function Of Tx– Initial Rates And Central Rates Of Mortality – Complete And Curtate Expectation Of Life – Complete Expectation Of Life – CurtateExpectation Of Life – The Relationship Between   And Ex – Future Lifetime – Variance – Uses Of The Expectation Of Life – Some Important Formulae – A Formula For Tpx Formula For Tpx – Simple Laws Of Mortality – Gompertz' And Makeham's Laws – Calculating The Parameter Values – Survival Probabilities.

Unit II: The Cox Regression Model: Fully Parametric Models – Parametric Models For The Hazard Function – Other Applications – Use Of Parametric Models – Covariates – The Cox Model – Introduction – Time-Dependent Covariates – Hazards Of Different Lives- Other Possible Models – The Utility Of The Cox Model – Estimating The Regression Parameters – The Partial Likelihood – Maximizing The Partial Likelihood – Properties Of The Partial Likelihood – Model Fitting – Assessing The Effect Of The Covariates – Building Models – Using The Results.

Unit III: Binomial And Poisson Models: Binomial-Type Models – The Binomial Model – Estimating Qx From The Data – Generalization Of The Model – Maximizing The Likelihood – The Actuarial Estimate – Finding A Simple Estimate For QxStrengths And Weakness Of The Binomial Model – Poisson Models – The Poisson Distribution – The Poisson Model – Estimating The Underlying Force Of Mortality.

Exposed To Risk: Calculating The Exposed To Risk – The Principle Of Correspondence – Exact Calculation Of   - Working With Complete Data – Working With Incomplete Data – Census Approximations To - The Available Data – The Census Approximation To   - Different Definitions Of Age – Deaths Classified Using Different Definitions Of Age – Consistency Between Census Data And Death Data – Calendar Year Rate Intervals – Deaths Classified By Calendar Year – Consistency Between Census Data And Death Data – Relating Age Definitions To Actual Ages – Policy Year Rate Intervals – Deaths Classified By Policy Year – Consistency Between Census Data And Death Data – Relating Age Definitions To Actual Ages – Distribution Of Policy Anniversaries Over The Year.

Unit IV: Graduation And Statistical Tests: Introduction – Graduation Of Observed Mortality Rates – The Underlying Assumptions – Comparison With Other Tables – Standard Tables – Graduation – The Need For Graduation – Reasons For Graduation – The Theoretical Argument – The Practical Argument – Desirable Features Of A Graduation – Smoothness Versus Adherence To Data – Suitability For Purpose In Hand – Testing The Smoothness Of A Graduation – Smooth Graduation – Statistics Refresher – Statistical Tests – Continuity Correction – Chi-Square Tests – Statistical Tests Of A Mortality Experience – Chi-Square Test – Standardized Deviations Test – Signs Test – Cumulative Deviations

– Grouping Of Sign Test – Serial Corrections Tests – Testing Actual Versus Expected Rates.

Unit V: Methods Of Graduation: Graduation By Parametric Formula – Over View, Choosing And Fitting Parametric Formula – Other Considerations – The Graduation Process – Graphical Graduation – The Graphical Graduation Process – Comparison Of Different Method – Graduation By Parametric Formula - Graduation By Reference To A Standard Table – Statistical Tests Of A Graduation – Comparing One Experience With Other – Testing A Graduation – Chi-Square Test – Cumulative Deviation Test – The Effect Of Duplicate Policies.

Textbook: ActEd Study Material: Subject CT4

References:

1. Actuarial mathematics. - Bowers, Newton L; Gerber, Hans U; Hickman, James C;Jones, Donald A; Nesbitt, Cecil J. - 2nd ed. - Society of Actuaries, 1997. - xxvi, 753pages. - ISBN: 0 938959 46 8.
2. Actuarial models for disability insurance. – Haberman, Steven; Pitacco, Ermanno .–hapman& Hall, 1999. – xviii, 280 pages. – ISBN: 0 8493 0389
3. Analysing survival data from clinical trials and observational studies. – Marubini,Ettore; Valsecchi, Maria Grazia. – John Wiley, 1995. – xvi, 414 pages. – ISBN: 0 47193987 0.
4. Life contingencies. – Neill, Alistair. – Heinemann, 1977. – vii, 452 pages. – ISBN: 0434 91440 1.
5. Life insurance mathematics. – Gerber, Hans U. – 3rd ed. – Springer. Swiss Association of Actuaries, 1997. – 217 pages. – ISBN: 3 540 62242 X.
6. Mortality studies. – Scott, William F. – Department of Mathematical Sciences,University of Aberdeen, 2000. – 147 pages.
7. Survival models and data analysis. – Elandt-Johnson, Regina C; Johnson, Norman L. –assics Library ed. – John Wiley & Sons, 1999. – xvi, 457 pages. – ISBN: 0 47134992 5.

Semester: I   **Code: P18AS1:1**
Credits: 4   **Hours/week: 6**

Objectives: The aim of the Actuarial Risk Management subject is that upon successful completion, the candidate should understand strategic concepts in the management of the business activities of financial institutions and programs, including the processes for management of the various types of risk faced, and be able to analyze the issues and formulate, justify and present plausible and appropriate solutions to business problems.

Unit I: Project management: Participating In A Successful Project (Introduction, Characteristics Of Well Run Projects, Written Strategy Documents, Project Management Team) Choice Of Risk Discount Rate (General Considerations, Systematic Risk And Specific Risk, Choosing The Discount Rate For Projects With A Normal Degree Of Systematic Risk, Choosing The Discount Rate For Projects With A Higher Than Normal Degree Of Systematic Risk, Other Factors To Consider)-Risk Identification-Analysis Of Risks (Distribution Of NPVS, Core Reading Example).

Unit II: Relationship Between Returns On Asset Classes: Expected And Required Returns (Required Returns, Expected Return, Required Vs. Expected Return, Determining Whether An Asset Seems Cheap) Valuation Of Asset Classes And Portfolios:-Analysis Of Expected Returns From Different Assets(Introduction, Two Definitions, The Analysis, Conventional Government Bonds, Corporate Loan Stocks, Equities, Property)-Comparisons Between Investment Sectors (Yield Gap And Reverse Yield Gap, Dividend Yields Vs. Real Yields, Property Vs. Other Sectors, Corporate Bonds Vs. Government Bonds, Overseas Investments)-Other Methods (Yield "Norms", Index Levels And Price Charts, Yield Ratios)-Relationship Between The Assets And Liabilities (Consistency Of Valuation, Consistency Of Method, Consistency Of Bases)-Allowing For The Variability Of The Asset Prices-Notional Portfolios (Method, Choosing The Notional Portfolio)**.**

Unit III: Risks In Benefit Schemes: Risks And Uncertainties(Risks To The Beneficiary ,Risks To The Sponsor, Risks To The State)-Benefit Risks(Benefit Risks In Defined Benefit Schemes, Benefit Risks In Defined Contribution Schemes, Benefit Risks In Both Defined Benefit And Defined Contribution Schemes)-Contribution/Premium Risks (Contribution/Premium Risks In A Defined Contribution Scheme, Contribution/Premium Risks In A Defined Benefit Scheme, Contribution Risks In Both Defined Benefit And Defined Contribution Schemes)-Investment Risks(Income, Capital Proceeds, Reinvestment, Default, Tax And Expenses, Appreciation Of Benefits By Recipients, Opportunity Cost Of The Capital)-Overall Security Risks In Benefit Schemes (Security, Strength Of The Sponsor/Provider Promise).

Unit IV: Reinsurance: Reinsurance Terminology-Reinsurance Contracts (Facultative Reinsurance, Treaty Reinsurance)- Types Of Reinsurance (Proportional Reinsurance, Non-Proportional Reinsurance)- Proportional Reinsurance(Quota Share, Surplus, Reinsurance Premiums Under Proportional Arrangements)-Non- Proportional Reinsurance(Excess Of Loss Reinsurance, Risk Excess Of Loss, Aggregate Excess Of Loss, Catastrophe Excess Of Loss, Stop Loss, Use Of Non- Proportional Reinsurance)-Financial Reinsurance- Reinsurance As A Risk Management Tool

(The Benefits Of Reinsurance, The Cost Of Reinsurance, Cost Vs. Benefit, The Effectiveness Of Reinsurance, Core Reading Example)**.**

Unit V: Risk Diversification: Categories Of Risk-Financial Risks (Market Risks, Credit Risks, Business Risks)-Non-Financial Risks(Operational Risk, External Risk, Core Reading Example)-Risk Classification(Core Reading Example) The Risk Management Process:-Introduction-The Risks Faced (Risks Identification, Risk Measurement, Risk Control, Risk Financing, Risk Monitoring)- Adoption Of Control Measures (Introduction, Reducing The Total Cost Of A Risk, Reducing The Probability Of Catastrophic Loss, Ensuring Survival While Minimizing The Cost Of Risk Management, Core Reading Examples)-Risk As An Opportunity Not A Constraint. **Risk Management Tools**: Introduction-Diversification-Underwriting(What Is Underwriting, Underwriting As A Risk Management Tool, Life Insurance Underwriting, Core Reading Example)-Alternative Risk Transfer(Discounted Covers, Integrated Risk Covers, Securitization, Post Loss Funding, Insurance Derivatives, Swaps, Summary Of Art)-Management Control Systems-Managing The Risk Associated With Options And Guarantees.

Textbook:
Subject CA1 (Actuarial Risk Management) material of institute of actuaries, London.

Reference:
1) Financial Enterprise Risk Management by Paul Sweeting
2) Understanding Actuarial Management: The Actuarial Control Cycle by Clare Bellis, Richard Lyon. Stuart Klugman and John Shepard.

ELECTIVE-II: PRINCIPLES OF INSURANCE

Semester: I   **Code: P18AS1:2**

Credits: 4   **Hours/week: 6**

Objectives: This course intends to provide a basic understanding of the insurance mechanism. It explains the concept of insurance and how it is used to cover risk. How insurance is transacted as a business and how the insurance market operates are also explained. The relationship between insurers and their customers and the importance of insurance contracts are discussed. Some commonly used insurance terms are also listed out.

Unit I:Introduction to Insurance –Definitions of insurance –Origin and History - Significance of insurance – Tax benefits –Factors influencing on insurance products – Features of insurance company – Nature of insurance – Reforms in insurance sector – Recent developments – Fundamental principles of insurance – Comparison of reinsurance and double insurance – Classification of insurance – Coinsurance –Doctrine of reinstatement – Types of life insurance policies- Insurance Documentation –Policy conditions- Difference between nomination and assignment – Policy conditions and Privileges – Non forfeiture options –valuation –Life fund – Method of distributing surplus – Substandard risks – Methods of treating substandard risks.

Unit II: Insurance market – Marketing of LIC – Insurance salesmanship – Sales agents – Selling process – Characteristics and traits of salesman – Marketing channels of insurance products –Effective distribution channels – Banc assurance – Worksite insurance market – Personal selling of insurance –Insurance trends of emerging markets – Insurance market potentials – Use of IT in insurance – Objectives of LIC – Subsidiaries of LIC – Insurance schemes –Insurance term LIC – LIC Pension schemes.

Unit III: Insurance Laws and Regulations – Indian contract Act, 1872 – Insurance Act, 1938 – LIC, Act, 1956 – General Insurance business (Nationalization) Act 1972, Redressal of Public Grievances Rules 1998, IRDA, Consumer protection Act, 1989 – Workmen Compensation.

Unit IV: **Group and Rural insurance** – Features and Types of group insurance schemes – Rural insurance – Schemes implemented by the LIC-Social security schemes – Hut insurance schemes – Comprehensive crop insurance schemes – National agricultural insurance schemes – Micro insurance schemes – Non medical insurance.

Unit V:Risk management in insurance –Meaning of Risk – Types of Risk – Objective risk –Risk management – Risk management Strategies - Risk management process- Risk financing – Bonds insurance – Retirement planning – Employee benefits –Pension plans – PFRDA –OAISS Report – Mandatory provisions – OAISS –New pension system – National senior citizen fund – Micro pension scheme – Taxation – Role of surveyors in non-life insurance – Operational risks –

Disaster risk financing – Non insurance transfers – Risk management matrix – Risk management techniques – Professionals in risk management –Emerging risks –Challenges in risk management.

Textbook:

Dr.E.Dharmaraj – "Elements of Insurance" –SIMRES Publications, first edition, 2009 – ISBN 978-81-909568-5-7
Unit I: Chapter 1, 2, 4
Unit II: Chapter 8, 9(Omitted Group insurance)
Unit III: Chapter 3 (Omitted Marine Insurance Act)
Unit 1V: Chapter 6
Unit V: Chapter 12.

Reference:
Principles of Insurance – IC 01 – Insurance Institute of India

SEMESTER - II

Semester: II   **Code: P18AS204**

Credits: 4   **Hours/week: 5**

Objectives: At the end of this course, the students should be able to use statistical methods to collect and analyze the data. The students should be able to estimate unknown parameters of populations and apply the tests of hypotheses.

Unit I: Sampling and statistical inference: Sample inference – Population inference – Statistical inference – Statistic and its sampling distribution – Mean and variance of sample mean – Use of t-statistic for random samples from a normal distribution – using F distribution for the ratio of two sample variances from normal distributions (definitions and applications only without derivations for F and t distribution)

Unit II: Point estimation: Constructing estimators of population parameters using method of moments - Method of Maximum likelihood – Unbiasedness – Mean square error of an estimator – Asymptotic distribution of maximum likelihood estimators. Confidence Intervals: Deriving confidence intervals – Confidence intervals for mean and variance of normal distribution – For binomial and Poisson – For two-sample distribution – Conf idence interval for a difference between two means from paired data.

Unit III: Hypothesis Testing: Null and alternative hypothesis – Simple and composite hypothesis –Type I error – Type II error -Likelihood ratio – Level of significance – Probability value and power of test – Basic tests for one sample and two sample situations – Chi-squared test – Contingency table.

Unit IV: Correlation and Regression: Scatter plots for bivariate data – Calculation of correlation coefficient of bivariate data – Performing statistical inference – Response and explanatory variable – Simple regression model – Least squares estimate – Statistical inference on slope parameter – Calculation of $R2$ (coefficient of determination – Predict a mean or individual response – Multiple linear regression model.

Unit V: Analysis of Variance: Analysis of Variance – One-way analysis of variance – The model – Estimation of the parameters – Partitioning the variability – Checking the model – Examining the treatment means – Confidence intervals for a single treatment means – Confidence intervals for a pair of treatment means – Analyzing treatment means using a least significant difference approach.

Textbook: Acted Study Material: Subject -CT3.

Reference: Mathematical statistics**.** Freund, John E f - 6th ed. - Prentice Hall International, 1999.xii, 624 pages. ISBN: 0 13 974155 0.

CORE-V: FINANCIAL MATHEMATICS – II

Semester: II   **Code: P18AS205**
Credits: 4   **Hours/week: 5**

Objectives: The aim of the Financial Mathematics subject is to provide grounding in financial mathematics and its simple applications

Unit I: Project Appraisal: Introduction – Estimating Cash Flows – Fixed Interest Rates – Accumulated Value, Net Present Value, Internal Rate Of Return, The Comparison Of Two Investment Projects – Different Interest Rates For Lending And Borrowing – Payback Period – Other Considerations – Measurement Of Investment Performance – Money Weighted Rate Of Return, Time Weighted Rate Of Return, Linked Internal Rate Of Return.

Unit II: Simple Compound Interest Problems: Fixed Interest Securities – Calculating The Price, Allowing For Income Tax, Perpetuities, Calculating Yields – The Effect Of The Term To Redemption On The Yield – Part Loan Purchases – Optional Redemption Dates – Deferred Income Tax – Uncertain Income Securities – Equities – Property – Real Rate Of Interest – Inflation Adjusted Cash Flows – Calculating Real Yield Using An Inflation Index – Calculating Real Yields Given Constant Inflation Assumption – Payments Related To The Rate Of Inflation – The Effects Of Inflation – Index Linked Bonds – Capital Gains Tax – Valuing A Loan With Allowance For Capital Gains Tax – Finding The Yield When There Is Capital Gains Tax – Optional Redemption Dates – Offsetting Capital Losses Against Capital Gains – The Indexation Of Capital Gains.

Unit III: 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 – Fixed Cash Income.

Unit IV: Term Structure Of Interest Rates: Discrete Time – Discrete Time Spot Rates – Discrete Time Forward Rates – Continuous Time Rates – Continuous Time Spot Rates – Continuous Time Forward Rates – Instantaneous Forward Rates – Theories Of Time - Term Structure Of Interest Rates – Why Interest Rates Vary Over Time – The Theories – Yield Curve – Yields To Maturity – Par Yields – Duration – Convexity And Immunization – Interest Rate Risk – Effective Duration – Duration – Convexity – Immunization.

Unit V: Stochastic Interest Rate Models: Simple Models – Preliminary Remarks – Fixed Interest Rate Model – Varying Interest Rate Model – Moment Of Sn– Moments Of An – Log Normal Distribution.

Textbook: ActEd Study Material: Subject - CT1

Reference:

1. Actuarial mathematics. Bowers, Newton L et al. – 2nd ed. – Society of Actuaries, 1997. xxvi, 753 pages. ISBN: 0 938959 46 8.
2. An introduction to the mathematics of finance. McCutcheon, John J; Scott, William F. London: Heinemann, 1986. 463 pages. ISBN: 0 434 91228 x.
3. Mathematics of compound interest. Butcher, M V; Nesbitt, Cecil J. Ulrich's Books, 1971. 324 pages.
4. Theory of financial decision making. Ingersoll, Jonathan E. Rowman& Littlefield, 1987. 474 pages. ISBN: 0 8476 7359 6.
5. The theory of interest. Kellison, Stephen G. 2nd ed. Irwin, 1991. 446 pages. ISBN: 0 256 09150 1. Available from the publications unit.

Semester: II	**Code: P18AS206**
Credits: 4	**Hours/week: 5**

Objectives: This course is to provide students with an understanding of the mathematical concepts and techniques that are used to model and value cash flows contingent on survival, death and other uncertain events.

Unit I: The Life Table: Constructing A Life Table – Using The Life Table - The Pattern Of Human Mortality - Life Table Functions At Non-Integer Ages - Method 1 – Uniform Distribution Of Deaths (UDD) - Method 2 – Constant Force Of Mortality (CFM) - The General Pattern Of Mortality - Mortality Characteristics - The Shape Of Qx, Lx, Dx - Using The Life Table To Evaluate Means And Variances - Evaluating Means And Variances Without Use Of The Life Table - Select Mortality - Displaying Select Rates - Constructing Select And Ultimate Life Tables - Using Tabulated Select Life Table Functions - Evaluating Means And Variances Using Select Mortality.

Unit III: Life Assurance Contracts: Pricing Of Life Insurance Contracts - Equations of Value - Allowance For Investment Income - Present Value Random Variable - Expected Present Value - Variance Of The Present Value Random Variable For Life Assurance Contracts – Life Assurance Benefits Payable Immediately On Death - Claim Acceleration Approximation.

Unit III: Life Annuity Contracts: Immediate Annuity - Present Value Random Variable - Expected Present Value - Variance Of The Present Value Random Variable - Annuity-Due - Temporary Annuity - Temporary Annuity-Due - Deferred Annuities - Deferred Annuities-Due - Continuous Annuities.

Unit IV: Evaluation Of Assurance And Annuities: Introduction-Evaluating Assurance Benefits-Premium Conversion Equations-Expected Present Values of Annuities Payable M Times Each Year

Unit V: Net Premiums And Provisions: Premiums - Frequency Of Payment - The Net Premium – Definition – Notation - The Insurer's Loss Random Variable – Provisions - Prospective Provision - Retrospective Provisions - Conditions For Equality Of Prospective And Retrospective Provisions - Provision Conventions - Net Premium Provisions – Definition - Some Notation And Results For Net Premium Provisions - Whole Life Policies - Continuous Functions - Non-Annual Premiums - Term Assurances - Other Contracts - Recursive Calculation Of Provisions - Conditions For Recursive Calculations - Net Premium Provisions At Successive Durations. The Equation Of Equilibrium For A Whole Life Assurance - General Reasoning - Mortality Profit - Death Strain At Risk (DSAR) - Expected Death Strain (EDS) - Actual Death Strain (ADS) - Mortality Profit - Mortality Profit On A Portfolio Of Policies - Allowing For Survival Benefits – Annuities - Thiele's Differential Equation.

Textbook: ActEd Study Material: Subject CT5.

References:

1. Actuarial mathematics. Bowers, Newton L et al. – 2nd ed. – Society of Actuaries,1997. xxvi, 753 pages. ISBN: 0 938959 46 8.
2. Life contingencies. Neill, Alistair. – Heinemann, 1977. vii, 452 pages. ISBN 0 43491440 1.
3. Life insurance mathematics. Gerber, Hans U. – 3rd ed. – Springer. Swiss Association of Actuaries, 1997. 217 pages. ISBN 3 540 62242 X.

CORE-VII: MODELS – II

Semester: II   **Code: P18AS207**

Credits: 4   **Hours/week: 5**

Objectives: The aim of the Models subject is to provide grounding in stochastic processes and survival models and their application

Unit I: Estimating the Life Time Distribution Function Fx(t): the Kaplan-Meier and Nelson-Aalen models – Questions of inference – Estimating the lifetime distribution – Censoring mechanisms – The Kaplan-Meier (product-limit) estimator – Assumptions and notations – Maximum likelihood estimators – Extending the force of mortality to discrete distributions – The Kaplan-Meier estimate – A graphical approach – Comparing lifetime distributions – The Nelson-Aalen estimate – The integrated hazard function – Calculating Nelson-Aalen estimates – Relationship between the Kaplan-Meier and Nelson-Aalen estimates.

Unit II: Markov Chains: An example of an Markov chain – The Chapman-Kolmogorov equations – Time-homogeneous Markov chains – Time-inhomogeneous Markov chains – Models – A model of a no claims discount policy – Another model of NCD – Simple random walk on Z={…-2, -1,0,1,2…} – Simple random walk on {0,1,2…b} – A model of accident proneness – The long-term distribution of a Markov chain – The stationary probability distribution – The long-term behavior of Markov chains – Modeling using Markov chains – Estimating transition probabilities – Assessing the fit .

Unit III: The two-state Markov Model : Assumption – Comparison with models – Probabilities – Statistics – Joint density function – The maximum likelihood estimator – Maximizing the likelihood function – Properties of the maximum likelihood estimator – The distribution of $\tilde{\mu}$ - Alternative derivation – Application of μ_x – The central exposed to risk.

Unit IV: Time-homogeneous Markov jump processes: The Poisson process-Features of time-homogeneous Markov jump processes-Kolmogorov's forward differential equations-Kolmogorov's backward differential equations -The Poisson process revisited -Holding times and occupancy probabilities-Expected time to reach state k starting from state i-The jump chain-Application: a simple two-decrement model-The maximum likelihood estimator in the general model.

Unit V: Time-inhomogeneous Markov jump processes: Introduction-Features of time-inhomogeneous Markov jump processes- Kolmogorov's forward differential equations- Occupancy probabilities- Kolmogorov's backward differential equations- Example – a two-state model- Residual holding times-Integrated form of the Kolmogorov backward equations-Integrated form of the Kolmogorov forward equations-Applications-Modelling and simulation

Textbook: ActEd Study Material: Subject CT4.

References:

1. Basic stochastic processes; A course through exercises. – Brzezniak, Zdzislaw; Zastawniak, Tomasz. – Springer, 1998. – x, 225 pages. – ISBN: 3 540 76175 6. Available from the Publications Unit.
2. Introduction to actuarial modeling. – Hickman, James C. North American Actuarial Journal (1997) 1(3) 1-5.URL: http://www.soa.org/bookstore/naaj_archive.html.
3. Modeling, analysis, design, and control of stochastic systems. – Kulkarni, Vidyadhar G. Springer, 1999. – xiv, 374 pages. – ISBN: 0 387 98725 8.
   Probability and random processes. – Grimmett, Geoffrey; Stirzaker, David. – 3rd ed.
   –Oxford University Press, 2001. – xii, 596 pages. – ISBN: 0 19 857222 0.

CORE VIII- PROGRAMMING USING R

Semester: II   **Course Code: P18ASP08**

Credits: 4   **Hours/Week: 4**

UNIT I: Introduction   (6 Hours)

Introduction to R – Introduction to R studio – Overview of R environment – R editor – Workspace – Data structures: vectors – matrices – lists and data frames – getting help and loading packages – Importing and exporting data – Accessing data – Manipulating data frames –Basic computational   ideas–Merges in R.

UNIT II: Navigating the Software   (6 Hours)

Matrix determinants – Inverse – Transpose – Trace – Eigen values and Eigen Vectors (Application – Arrangements of data for calculation) - Graphics: Construction of Bar, Pie, Histogram, Stem-and-leaf, line chart, Box plot, Scatter plot (Application – Diagrams and graphical representation of data).

UNIT III: Data Structures   (6 Hours)

Grouping, loops and conditional execution - writing your own functions – Univariate data analysis – Bivariate data analysis – Outliers detection – Binomial and Normal distributions (Application – calculating average, dispersion and Model fitting of data).

UNIT IV: Parametric and Non parametric tests   (6 Hours)
Parametric and non-parametric testing of statistical hypothesis – One sample t test – Two group t test – Paired t test – One-way ANOVA – Two-way ANOVA – Post Hoc tests Sign test – Wilcoxon - Mann Whitney – Kruskal Wallis (Application – Testing of significance of data).

UNIT V: Linear Regression   (6 Hours)

Correlation – Pearson, Spearman, and other correlation techniques – Linear regression – Multiple linear regression- Testing for overall significance – of model coefficients – Testing for individual regression coefficients (Application – Finding the relations between data and predicting future).

Textbook:

John Verzani, Using R for Introductory statistics, CRC Press, 2014, ISBN: 13:978-1- 466

9073-1

Reference:
The Art of R Programming A Tour of Statistical Software Design By Norman Matloff,
Norman S. Matloff · 2011

NMEC- ACTUARIAL MATHEMATICS

Semester: II   **Code: P18AS2E1**

Credits:2   **Hours/Week: 4**

Objectives: The aim of the Actuarial Mathematics subject is to provide grounding in Actuarial mathematics and its simple applications

Unit I: Actuary in Financial Services Industry: - Role of Actuaries – Skills required for the Actuary Acquiring Knowledge about the Aspects of the Company where Actuary is employed.

Unit II: Types of insurance contract: Assurance & Annuity: Whole life – Term contract –

Pure Endowment Contract – Endowment Contract – Deferred Contract

Unit III: Interest valuations: Simple Interest, Compound Interest, Simple Discount Rate,

Compound Discount, Rate, P_{thly} Interest Rate.

Unit IV: Time Value of Money: Accumulated Value and Present value of money

Unit V: Annuities: Level Annuities Definition – present value equation Arrear and Advance – Accumulated value Arrear and Advance

Textbook:

IC 28 Foundation of Actuarial science – Published by Insurance Institute of India.

Reference:

Actuarial Mathematics – 2nd Edition by Bowers, N.L; Gerber, H.U,; Hickman, J.C. et al.

SEMESTER-III

Semester: III   **Code: P18AS309**
Credits: 4   **Hours/Week: 6**

Objectives: The aim of the Statistical Methods subject is to provide a further grounding in mathematical and statistical techniques of particular relevance to financial work.

Unit I: Decision Theory: Introduction –Zero-Sum Two Player Games-Domination-The Minimum Criterion-Saddle Points- Randomized Strategies – Statistical-The Bayes Criterion Bayesian Statistics: Bayesian Theorem Prior And Posterior Distribution: Notation- Determination The Posterior Density-Continuous Prior Distribution –Conjugate Priors-Improper Prior Distribution. The Loss Function: Quadratic Loss Absolute Error Loss-All-Or-Nothing Loss.

Credibility Theory: Introduction – Credibility; the Credibility Premium Formula the Credibility Factor. Bayesian Credibility: Introduction-The Process/Gamma Model-Numerical Illustrations ofthePoisson/Gamma Model-The Normal/Normal Model-Discussion of The Bayesian Approach To Credibility.

Unit II: Loss Distributions: The Exponential Distribution-The Gamma Distribution-Normal Distribution-Pareto and Generalized Pareto Distribution-Lognormal Distribution-The Weibull Distribution the Burr Distribution. Estimation- The Method of Moment-MLE for Gamma, Exponential Distribution.

Unit III: Reinsurance: Introduction- Proportional Reinsurance Arrangements- Excess Of Loss Reinsurance For Insurer And Reinsurer-Proportional Reinsurance Lognormal Distribution And Examples-Normal Distribution And Example – Inflation – Estimation-Policy Excess.

Unit IV: Risk Model (1): The Basic Model-Discussion Of The Simplification In The Basic Model-Notation And Assumption. **The Collective Risk Model**:The Collective Risk Model-Distribution Function And Convolution-Moments Of Compound Distribution-The Compound Poisson distribution-The Compound Binomial Distribution-The Compound Negative Binomial Distribution. **Risk Model (2)**: Aggregate Claim Distribution Under Proportional And Excess Of Loss Reinsurance: Proportional Reinsurance-Excess Of Loss Reinsurance. The Individual Risk Model Parameter **Variability/Uncertainty**:Introduction- Variability In Heterogeneous Portfolio- Variability In Homogeneous Portfolio-Variability In Claim Numbers And Claim Amounts And Parameter Uncertainty.

Unit V: Monte Carlo Simulation : Introduction- Generation Of Pseudo-Random Numbers Using A Computer- Generation Of Random Variates From A Specified Distribution- Disadvantages Of Using Truly Random, As Opposed To Pseudo-Random, Numbers- Common Sets Of Random Numbers Vs Independent Sets Of Random Numbers-How Many Simulations To Carry Out In Order To Estimate A Quantity Of Interest?

Textbook: ActEd Study Material: Subject CT6.

References:

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1. An introduction to statistical modelling. - Dobson, Annette J. - Chapman & Hall, 1983.viii, 125 pages. - ISBN: 0 412 24860 3.
2. Introductory statistics with applications in general insurance. - Hossack, Ian B;Pollard, John H; Zehnwirth, Benjamin. - 2nd ed. - Cambridge University Press, 1999.xi, 282 pages. - ISBN: 0 521 65534 X.
3. Loss models: from data to decisions. - Klugman, Stuart A; Panjer, Harry H; Willmot,Gordon E; Venter, Gary G. - John Wiley & Sons, 1998. - xiii, 644 pages. - ISBN: 0471 23884 8.
4. Practical risk theory for actuaries. - Daykin, Chris D; Pentikainen, Teivo; Pesonen,Martti. - Chapman & Hall, 1994. - 545 pages. - ISBN: 0 412 42850 4.

CORE-X: BUSINESS ECONOMICS-I

Semester: III   **Code: P18AS310**

Credits: 5   **Hours/Week: 6**

Objectives: The aim of the Business Economics subject is to introduce students to the core economic principles and how these can be used in a business environment to help decision making and behavior. It provides grounding in the fundamental concepts of micro and macroeconomics 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 individual and institutional clients' needs.

Unit I: Economic concepts: What economists study- Business economics- The macroeconomic environment- Business economics- Microeconomics choices-Demand and supply: Demand-supply-price and output determination-business in a competitive market

Unit II: Elasticity and uncertainty: Price elasticity of demand- The importance of PED to business decision making- Other elasticity- The time dimension of market adjustment- Dealing with uncertainty.

Consumer demand and uncertainty: Marginal utility theory- Demand under condition of risk and uncertainty – Utility and insurance.

Unit III: Production and costs: The meaning of cost-production in the short run- Cost in the short run- Production in the long run - Cost in the long run-Revenue and profit: Revenue-Profit maximization.

Unit IV: Perfect competition and monopoly: Alternative market structures- Perfect competition – Monopoly- Comparing monopoly with perfect competition-Imperfect competition: Monopolistic competition- Comparing monopolistic competition with other market structures – Oligopoly- Collusive oligopoly – Non-collusive oligopoly – Game theory.

Unit V: Products, marketing and advertising: Product differentiation – Marketing – Advertising - Pricing strategies: Pricing and market structure – Alternative pricing strategies – Price discrimination – Multiple product pricing-transfer pricing.

Textbook: ActEd Study Material: Subject CT7

References:
1. Economics, David Begg, Stanley Fisher and Rudiger Dorn Busch, 5th edition, McGraw HillEconomic Analysis by Dr. S. Sankaran
2. Economics. - Samuelson, Paul A; Nordhaus, William D. - 17th ed. - McGraw-Hill,2001. - xxiv, 792 pages. - ISBN: 0 07 118064 8.
3. Economics. - Wonnacott, Paul; Wonnacott, Ronald J. - 4th ed. - John Wiley, 1990. -xxix, 804 pages. - ISBN: 0 471 51737 2.
4. Principles of economics. - Lipsey, Richard G; Chrystal, K Alec. - 9th ed. – OxfordUniversity Press, 1999. - xvi, 640 pages. - ISBN: 0 19 877588 1.

Semester: III   Code: P18AS311

Credits: 5   Hours/Week: 6

Objectives: The aim of the Finance and Financial Reporting 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 and to provide the ability to interpret the accounts and financial statements of companies and financial institutions.

Unit I :Key Principles Of Finance: Introduction To Finance – Finance And Real Resources Of An Organization – Finance And The Organizations Objectives – Responsibilities For Financial Decisions – The Importance Of Capital Budgeting – Financial Analysis – Business Objectives – The Stakeholders – Conflicting Objectives – Providers Of Finance – Ways Of Managing Conflicts – Business Objectives – A Re–Statement – The Maximization Of Shareholders Wealth – The Goal Of The Financial Managers – The Opportunity Cost Of Capital – The Capital Markets. Company Ownership: Types Of Business Entity – Sole Trader – Partnership – Limited Companies – Limited Liability Partnerships – Private &Public Limited Companies – Pros & Cons Of Limited Companies – Medium Term Finance – Hire Purchase – Credit Sale – Leasing – Bank Loans – Short Term Finance – Bank Overdrafts – Trade Credit – Factoring – Bills Of Exchange – Commercial Paper.

Unit II: Financial Instruments: Loan Capital – Introduction – Debenture Stock – Unsecured Loan Stock – Subordinate Debt – Eurobond Loan Capital – Floating Rate Notes – Share Capital – Ordinary Shares – Preference Capital – Convertibles – Warrants – Options Issued By Companies – Winding Up Of A Company. Issue Of Shares: Obtaining Stock Exchange Quotation – Reasons For Quotation – Methods To Obtain Quotation – Offer For Sale At Fixed Price – Offer For Sale By Tender – Concessionary Methods – Offer For Subscription – Placing – Introduction – Role Of Underwriting – Issue Made By Companies Already Quoted – Right Issue – Purpose – Impact – Theoretical Price – Scrip Issue – Purpose – Impact – Scrip Dividend.

Unit III: Taxation: Introduction – Personal Taxation – Considerations – Taxable Income – Tax Rates – Corporation Tax – Accounting Profits & Taxable Profits – Rates Of Tax – Uses Of Corporation Tax System – Capital Gain Tax – Chargeable Gains – Indexation Allowance– Taper Relief – Capital Losses – Rates Of Tax – Other Taxes – Stamp Duty – Inheritance Taxes – Property Taxes – Sales Tax – Custom And Excise Duties – Double Taxation Relief. Use Of Derivatives: Introduction – Financial Futures – Bond Futures – Short Interest Rate Future – Stock Index Futures – Options – Meaning – Margins & Premium – Types– Put Option – Call Option – Uses Of Option – Interest & Currency Swaps – Pricing– Risk – Uses Of Swaps.

Unit IV: Capital Structure And Dividend Policy: Introduction – Capital Structure – Components Of Capital Structure – Asset Structure And Business – Degree Of Acceptable Gearing – The Market And Capital Structure – High Growth Company That Is Highly Geared – Cyclical Industry – An Industry Facing Decline – "People" Businesses – Companies In High Growth But High Risk Industries – Taxation And Capital Structure – Dividends – Share Holder's Reward – Fundamentals Of Dividend Policy –Factors Influencing

Dividend Policy – Other Methods Of Reward – Scrip And Stock Dividends – Effects On Companies And Share Holders – Share Buyback – The Market And Dividends. Weighted Average Cost Of Capital: Introduction – The Importance Of The Discount Rate – Defining The Weighted Average Cost Of Capital – Modigliani And Miller – Their View – CAPM – Cost Of Equity – CAPM And Risk – Systematic Risk – Beta As A Measure Of Systematic Risk – Measuring Beta – Market Derived Real Discount Rate –Cost Of Debt – Marginal Or Average Cost – Determinants – Calculation Of WACC.

Unit V: Capital Project Appraisal: Definition Of A Capital Project – Definition Of Project –Evaluation Of Cash Flows – Methods Of Project Evaluation – Net Present Value – Internal Rate Of Return – Annual Capital Charge – Other Methods – Payback Period – Nominal Returns – Strategic Fit – Opportunity Cost – Hurdle Rates – Evaluation Of Risky Projects –Simulation –Sensitivity Analysis – Scenario Testing – Monte Carlo Simulation – Probability Trees – Certainty Equivalents – Results Of The Evaluation –Allowing For Systematic Risk – Calculation Of Required Rate Of Return For A Project – WACC – CAPM Based Approach – Factors Influencing Beta Practice – Practical Experience – Other Factors – Risk Analysis And Dealing With Risks – Identification Of Risk – Risk Matrices – Causes Of Risk – Analysis Of Risk – Financial Consequences Of Risks – Obtaining A Distribution Of Npvs – Scenario Analysis – Stochastic Modelling – Relative Merits Of The Two Approaches – Unfavorable Npvs – Risk Mitigation – Ways Of Mitigating Risk – Financial Consequences Of Risk Mitigation –The Investment Submission.

Textbook: ActEd Study Material - CT2.

References:
1. Financial statement analysis in Europe. - Samuels, J M; Brayshaw, R E; Craner, J M. -Chapman & Hall, 1995. 454 pages. - ISBN: 0 412 54450 4.
2. Fundamentals of financial management. - Brigham, Eugene F; Houston, Joel F. - 9thed. - Harcourt Brace, 2000. 959 pages. - ISBN: 0 03 031461 5.
3. How to read the financial pages. - Brett, M. 2nd ed. Random House Business Books,2003. 430 pages. ISBN: 0712662596.
4. Interpreting company reports and accounts. - Holmes, Geoffrey; Sugden, Alan;Gee, Paul. - 8th ed. - Pearson Education, 2002. 298 pages. - ISBN: 0 273 65592 2.
5. Principles of corporate finance. - Brealey, Richard A; Myers, Stewart C. - 7th ed. -McGraw-Hill, 2003. 1004 + appendices pages. - ISBN: 0 07 115144 3.

Objectives: This course is to provide students with an understanding of the mathematical concepts and techniques that are used to model and value cash flows contingent on variable benefits and profit testing

Unit I: Variable benefits and with-profit policies: Variable payments - Payments varying at a constant compound rate - Payments changing by a constant monetary amount - Whole life assurance - Term assurance - Whole life annuity payable annually in arrears - Whole life annuity payable annually in advance - Temporary annuities - With-profit contracts - Types of bonus - Calculating net premiums and net premium provisions for with-profit contracts - Net future loss random variable - Net premiums - Net premium provisions.

Unit II: Gross premiums and provisions for fixed and variable benefit contracts: Types of expenses incurred in writing a life insurance Contract - Measuring and allocating costs - Charging for expenses - The influence of inflation on expenses - Gross future loss random variable for standard Contracts - Determining gross premiums using the equivalence principle - Annual premium contracts - With-profit contracts - Premiums payable m times per year - Gross premium using simple criteria other than the equivalence principle - Gross premium prospective and retrospective provision - Equality of gross premium prospective and retrospective provisions - Recursive relationship between provisions for annual premium contracts.

Unit III: Profit testing: Unit–linked contracts – Evaluating expected cash flows – Multiple decrement tables – Evaluating expected cash flows for Conventional whole life assurance, Disability insurance with waiver of premium, Unit–linked endowment assurance – Profit tests for annual premium contracts – Summary measures of profit – Choosing the risk discount rate – Determining premiums using a profit test– Profit criterion.

Unit IV: Determining provisions using profit testing: Pricing and provisioning bases – Determining provisions for a unit–linked policy using cash flow techniques – Zeroising negative cash flows – Determining provisions for a conventional policy using cash flow techniques – Effect of pricing and provisioning bases on a profit test

Unit V: Mortality, selection and standardization: Principal factors contributing to variation in mortality and morbidity – Occupation – Nutrition – Housing – Climate and geographical location – Education – Genetics – Selection – Temporary initial selection – Class selection – Time selection – Adverse selection – Spurious selection – Selection in life assurance and pensions business – Life assurance – Pension funds – Why it is necessary to have different mortality tables for different classes of lives – How decrements can have a selective effect – Risk classification in life insurance – Impact of genetic information on risk classification in life insurance – Single figure indices – Crude mortality rate – Directly standardized mortality rate – Indirectly standardized mortality rate – Standardized mortality ratio.

Textbook: ActEd Study Material: Subject CT5

References:
1. Actuarial mathematics. Bowers, Newton L et al. – 2nd ed. – Society of Actuaries,1997. xxvi, 753 pages. ISBN: 0 938959 46 8.
2. Life insurance mathematics. Gerber, Hans U. – 3rd ed. – Springer. Swiss Association of Actuaries, 1997. 217 pages. ISBN 3 540 62242 X.

ELECTIVE-III: ADVANCED MS-EXCEL

Semester: III   **Code: P18AS3:P**
Credits: 4   **Hours/Week: 6**

Objectives: (I)To train the students in using Advanced MS-Excel for solving a variety of Statistical and Actuarial problems.(II)To find NPV, IRR and loan schedule problems using MS-Excel

Unit I: Introduction to MS-Excel - Using Excel list – Creating a list – Sorting - Filtering Data – Totals and Sub totals – Splitting Windows – Freezing panes.

Basis Functions - Uses of normal s/s – (Open/Create/Save s/s) - Cut/Copy/Paste /Delete/Sort/Find/Insert - Formatting/Merge and wrap – Conditional Formatting/Auto Fill

Unit II: Lookup functions: Working with Graphs - Formulas - Arithmetic functions - Logical functions - Lookup & Reference functions - Date & Time functions - How to Evaluate Formulas - Use of Name manager in the Formulas.

Unit III: Data Validation: Work with data - Retrieve Data for external Source - Text to Columns/Remove Duplicates / data validation - Grouping/ Ungrouping.

Unit IV: Pivot Tables: Pivot tables- Macros - Developer Options - Record a Macro – Advance Marco.

Unit V: Application of Actuarial Science using MS-Excel: Problem solving – Using MS-Excel – CT1, CT3, CT4, CT5 and CT6.

Textbook:

MS-Excel: "Microsoft Excel 2010 Data analysis and Business Modeling" By Wayne L. Winston

Reference:
Microsoft Excel 2016 bible: The comprehensive tutorial resource by John, Walken Bach.

SEMESTER-IV

<h1 style="text-align:center">CORE-XIII: STATISTICAL METHODS-II</h1>

Semester: III   **Code: P18AS413**

Credits: 4   **Hours/week: 6**

Objectives: The aim of the Statistical Methods subject is to provide a further grounding in mathematical and statistical techniques of relevance to financial work.

Unit I: Empirical Bayes Credibility Theory: Model – I – Empirical Bayes Credibility Theory Model II.

Unit II: Ruin Theory: Introduction – Basic Concepts – The Poisson And Compound Poisson Processes – The Adjustment Coefficient And Lundberg's Inequality – The Effect Of Changing Parameter Values On Finite And Infinite Time Ruin Probabilities – Reinsurance And Ruin.

Unit III: Run-Off Triangles: Introduction- The Origins Of Run-Off Triangles- Types Of Reserves- Presentation Of Claims Data – Estimating Feature Claims. Projections Using Development Factors: Run-Off Triangles – The Chain Ladder Method – Model Checking - Other Methods of Deriving Development Factors Assumptions Underlying the Method. Adjusting For Inflation: The Inflation Adjusted Chain Ladder Method. The Average Cost per Claim Method Description of Method Application of the Method- Assumptions Underlying in the Method. Loss Ratios the Bornhuetter Ferguson Method: Concept of Bornhuetter Ferguson Method – Description of the Method – Application of the Method – Assumptions Underlying the Method – Grossing Up Factors versus Development Factors.

Unit IV: Generalized Linear Models: Introductions - Exponential Families: Normal Distribution-Poisson Distribution – Binomial Distribution – Gamma Distribution. Link Functions And Linear Predictor Link Functions- Linear Predictor. Deviance of Model Fitting Residuals Analysis and Assessment of Model Fit.

Unit V: Time Series (1): Introduction- Properties Of A Univariate Time Series- Stationary Random Series Main Linear Model Of Time Series: Introduction-Backwards Shift Operator, B And Difference Operator-The First-Order Autoregressive Model AR (1)-The Autoregressive Model AR (P)-The First-Order Moving Average Model MA (1)-The Moving Average MA(Q)-The Autoregressive Moving Average Process ARMA(P,Q)-Modeling Non-Stationary Processes: The ARIMA Model.

Time Series(2) : Introduction- Compensating For Trend And Seasonality- Defecting Non-Stationary Series- Least Squares Trend Removal – Differencing – Method Of Moving Average –Method Of Seasonal Means – Transformation Of The Data Identification Of MA(Q) And AR(P) Models:- Estimation Of The ACF And PACF- Identification Of White Noise- Identification Of MA(Q) – Identification Of AR(P) Fitting The Time Series Model Using The BOX-Jenkins Methodology - The BOX-Jenkins Methodology- Differencing – Fitting An ARMA(P,Q) Model- Parameter Estimation- Diagnostic Checking -Forecasting - BOX-Jenkins Approach To Forecasting ARIMA Process – Exponential Smoothing – Linear Fitting. Multivariate Time Series Models:- Vector Auto Regressions- Co Integrated Time Series Some Special Non-Stationary And Non-Linear Time Series Models - Bilinear Models- Random Threshold Autoregressive Models- Random Coefficient

Autoregressive Models- Autoregressive Models With Conditional Hetroscedasticity.

Textbook: ActEd StudyMaterial: Subject CT6

References:
1. An introduction to statistical modelling. - Dobson, Annette J. - Chapman & Hall, 1983.viii, 125 pages. - ISBN: 0 412 24860 3.
2. Introductory statistics with applications in general insurance. - Hossack, Ian B;Pollard, John H; Zehnwirth, Benjamin. - 2nd ed. - Cambridge University Press, 1999.xi, 282 pages. - ISBN: 0 521 65534 X.
3. Loss models: from data to decisions. - Klugman, Stuart A; Panjer, Harry H; Willmot,Gordon E; Venter, Gary G. - John Wiley & Sons, 1998. - xiii, 644 pages. - ISBN: 0471 23884 8.Practical risk theory for actuaries. - Daykin, Chris D; Pentikainen, Teivo; Pesonen,Martti. - Chapman & Hall, 1994. - 545 pages. - ISBN: 0 412 42850 4.

Semester: IV   **Code: P18AS414**

Credits: 4   **Hours/Week: 6**

Objectives: The aim of the Business Economics subject is to introduce students to the core economic principles and how these can be used in a business environment to help decision making and behavior. It provides grounding in the fundamental concepts of micro and macroeconomics 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 individual and institutional clients' needs.

Unit I: Growth strategy and globalization: Growth and profitability- Constraints on growth- Alternative growth strategies- Internal growth- External growth through merger- External growth through strategic alliance-Explaining external firm growth – a transactions cost approach- Globalization

Government intervention in markets: The objectives of government intervention- Types of market failure- Types of government intervention- The case for less government intervention

Unit II: Government and the firm: Competition policy- Policies towards research and development (R&D).

Supply-side policy: The supply-side problem- Market-orientated supply-side policies- Industrial policy.

Unit III: International trade: Trading patterns- The advantages of trade-Arguments for restricting trade- The world trading system and the WTO.

Balance of payments and exchange rates: The balance of payments account- The exchange rate- Exchange rates and the balance of payments- Fixed versus floating exchange rates

Unit IV: The macroeconomic environment: Macroeconomic objectives- The circular flow of income- The measurement of national income- The determination of national income- Economic growth- Unemployment- Inflation.

Money and interest rates: The functions and meaning of money- The financial system- The supply of money- The demand for money- Equilibrium in the money market- The effect of a change in the money supply.

Unit V: Business activity, unemployment and inflation : Unemployment and inflation- The "disappearance" of the Phillips curve- Business cycles.

Demand-side macroeconomic policy: Fiscal policy-Monetary policy-Demand-management in general Current demand-side policy in the UK- The supply-side problem.

Textbook: ActEd Study Material: Subject CT7

References:

1. Economics, David Begg, Stanley Fisher and Rudiger Dorn Busch, 5th edition, McGraw Hill
2. Economic Analysis by Dr. S. Sankaran
3. Economics. - Samuelson, Paul A; Nordhaus, William D. - 17th ed. - McGraw-Hill,2001. - xxiv, 792 pages. - ISBN: 0 07 118064 8.
4. Economics. - Wonnacott, Paul; Wonnacott, Ronald J. - 4th ed. - John Wiley, 1990. -xxix, 804 pages. - ISBN: 0 471 51737 2.
5. Principles of economics. - Lipsey, Richard G; Chrystal, K Alec. - 9th ed. – OxfordUniversity Press, 1999. - xvi, 640 pages. - ISBN: 0 19 877588*1*.

Semester: IV   **Code: P18AS415**
Credits: 4   **Hours/Week: 6**

Objectives: The aim of the Finance and Financial Reporting 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 and to provide the ability to interpret the accounts and financial statements of companies and financial institutions

Unit I: Introduction To Accounts- The Accounting Framework- Users- Sources Of Regulation- Statutory Requirements- Directors Report – Accounting Standards- Contents Of Annual Report- Auditors Report- Accounting Concepts- Cost Concepts- Money Measurement Concepts- Business Entity Concept – Realization Concept – Accrual Concept – Dual Aspect Concept – Materiality – Prudence – Going On Concept – Consistency – Bringing The Concepts Together.

Unit II: The Main Accounts – The Balance Sheet – Format – Fixed Assets – Tangible Assets And Intangible Assets – Revaluation – Current Assets- Liabilities – Long-Term Liabilities – Current Liabilities – Provisions And Charges – Provision For Taxation And Dividends – Pensions – Contingent Liability – Capital – Profit And Loss Account – Format – Cost Of Sales – Expenses – Categories Of Profit – Taxation – Dividends And Retained Profits – Earnings Per Share – Cash Flow Statement – Format – Purpose Of Cash Flow Statement – Notes To Accounts

Depreciation And Reserves – Introduction – Purpose – Methods – Straight-Line Methods – Reducing Balance Method – Capital And Reserves – Share Capital And Share Premium – Revaluation Reserve – Profit And Loss Account.

Unit III: Generating Accounts – The Trial Balance – Construction And Preparation Of Financial Statement – Profit And Loss Account And Balance Sheet – Awkward Items In The Trial Balance – Depreciation – Profit And Loss Reserve – Stock – Adjustment In The Accrual Concept – Preparation Of Cash Flow Statement – Limitations Of Accounts – Shortcomings Of Historical Cost Accounting – Valuation Of Stock – Depreciation – Interest Payments – Consistency Over Time – Limitations In The Interpretation Of Accounts – Subjectivity – Appropriateness – Comparison Between Firms – Some Limitations Of Ratio Analysis – Accuracy Of Figures

.**Unit IV:** Group Accounts And Insurance Company Accounts – Introduction – Consolidated Financial Statements – Subsidiary Companies – Consolidated Balance Sheet – Goodwill On Consolidation – Minority Interest – Associated Companies – Interpretation Of Consolidated Financial Statements – Insurance Companies – Introduction – Estimation Of Liabilities And Timing Of Profit – Profit And Loss Account – Technical Accounts – Non-Technical Accounts – Balance Sheet – Assets – Liabilities – Shareholders Fund. (Accounts And Simple Problems Related With Insurance)

Unit V: Interpretations Of Accounts – Security Of Loan Capital – Introduction – Measuring Risk Associated With Loan Capital – Loan Capital – Income Cover And Income Priority Percentages – Asset Cover And Asset

Priority Percentages – Asset Gearing – Income Gearing – Shareholder Analysis – Earnings Per Share – Basic And Diluted – Earnings And Dividend Ratios – Price Earnings Ratio – Dividend Yield – Dividend Cover – Payout Ratio – EBITDA – Net Asset Value Per Share – Other Accounting Ratios – Profitability Ratios – Return On Capital Employed – Profit Margin – Liquidity Ratios – Current Ratio – Quick Ratio – Efficiency Ratios – Stock Turn Over Ratio – Debtors Turnover Ratio – Creditors Turnover Ratio.

Textbook: ActEd Study Material - CT2.

References:
1. Financial statement analysis in Europe. - Samuels, J M; Brayshaw, R E; Craner, J M. -Chapman & Hall, 1995. 454 pages. - ISBN: 0 412 54450 4.
2. Fundamentals of financial management. - Brigham, Eugene F; Houston, Joel F. - 9thed. - Harcourt Brace, 2000. 959 pages. - ISBN: 0 03 031461 5.
3. How to read the financial pages. - Brett, M. 2nd ed. Random House Business Books,2003. 430 pages. ISBN: 0712662596.
4. Interpreting company reports and accounts. - Holmes, Geoffrey; Sugden, Alan;Gee, Paul. - 8th ed. - Pearson Education, 2002. 298 pages. - ISBN: 0 273 65592 2.
5. Principles of corporate finance. - Brealey, Richard A; Myers, Stewart C. - 7th ed. -McGraw-Hill, 2003. 1004 + appendices pages. - ISBN: 0 07 115144 3.

Semester: IV   **Code: P14AS4:4**

Credits: 4   **Hours/Week: 6**

Objectives: At the end of the course students should be able to:

1. Apply survival models to the pricing and valuation of life insurance and pension contracts

2. Apply multiple state models to the pricing and valuation of life insurance and pension contracts.
3. Understands the main forms of insurance and pension contract and their actuarial aspects.

Unit I: Simple annuities and assurances involving two lives: Random variables to describe joint life functions – Joint lifetime random variables and joint life table functions – Last survivor lifetime random variables – Determining simple probabilities involving two lives – Evaluating probabilities of death or survival of either or both of two lives – Evaluating last survivor functions – Determining present values involving two lives – Present values of joint life and last survivor assurances – Present values of joint life and last survivor annuities.

Unit II: 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 values of last survivor assurances and annuities that also depend upon term – Expected present values of reversionary annuities that depend upon term – Expected present values of contingent assurances that depend upon term – Expected present value of annuities payable m times a year– Premium conversion relationships

Unit III: Competing risks: Multiple state modeling – Notation – Kolmogorov forward equations – Valuing benefits that are contingent upon competing risks – Multiple state approach – Multiple decrement tables– Deriving dependent probabilities from transition intensities – Deriving the independent probabilities from the dependent probabilities.

Unit IV: Competing Risks (Cont.): Decrement table – Associated single decrement tables – Relationships between single and multiple decrement tables – Obtaining the underlying single decrement tables from the multiple decrement table – Construction of multiple decrement tables from underlying single decrement tables– How to obtain multiple decrement table rates – Alternative method for determining underlying single decrement rates – Consistency with the multiple state approach.

Unit V: Pension Funds : Salary scales - Salary related pensions benefits and contributions, Age retirement benefits, Ill health retirement benefits,Death in service benefits, Scheme contributions, Expected cash flows generated by pensions and contributions - Classifications of benefits, Determining expected cash flows- Expected amount payable - Probability of payments -Expected cash flows using commutation functions to value salary related benefits and contributions-Death benefits – Members contributions – Benefits and options available to an individual leaving a pension scheme-return of contribution - A deferred pension - Immediate

pension - Transfer of cash equivalent

Textbook: ActEd Study Material : Subject CT5.

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2. Life contingencies. Neill, Alistair. – Heinemann, 1977. VII, 452 pages. ISBN 0 43491440 1.Life insurance mathematics. Gerber, Hans U. – 3rd ed. – Springer. Swiss Association of Actuaries, 1997. 217 pages. ISBN 3 540 62242 X.
3. Modern actuarial theory and practice. Booth, Philip M et al. – Chapman &Hall, 1999.xiii, 716 pages. ISBN 0 8493 0388 5.