

# **M.Sc., ACTUARIAL SCIENCE SYLLABUS**

(Under Choice Based Credit System)

(For the student admitted in the academic year 2020-21)



**PG DEPARTMENT OF ACTUARIAL SCIENCE  
BISHOP HEBER COLLEGE (AUTONOMOUS)  
Tiruchirappalli– 620017**

Sem.	Course	Course Title	Course Code	Hours / week	Credits	Marks			
						CIA	ESE	Total	
I	Core I	Actuarial Statistics – I	P19AS101	6	5	25	75	100	
	Core II	Actuarial Mathematics – I	P19AS102	6	5	25	75	100	
	Core III	Actuarial Mathematics – II	P19AS103	6	4	25	75	100	
	Core IV	Survival Analysis –I	P19AS104	6	4	25	75	100	
	Elective I	Principles of Insurance	P19AS1:1	6	4	25	75	100	
					<b>Sem I Credits:</b>	<b>22</b>			
II	Core V	Actuarial Statistics – II	P19AS205	5	4	25	75	100	
	Core VI	Actuarial Mathematics – III	P19AS206	5	4	25	75	100	
	Core VII	Actuarial Mathematics – IV	P19AS207	5	4	25	75	100	
	Core VIII	Survival Analysis –II	P19AS208	5	4	25	75	100	
	Core IX	Risk Modelling	P19AS209	5	4	25	75	100	
	Elective II	Programming Using R	P19AS2:P	3	2	40	60	100	
	VLO	RI/MI	P17VL2:1/ P17VL2:2	2	2	25	75	100	
					<b>Sem II Credits:</b>	<b>24</b>			
III	Core X	Business Economics – I	P19AS310	6	4	25	75	100	
	Core XI	Business Finance – I	P19AS311	6	5	25	75	100	
	Core XII	Financial Engineering – I	P19AS312	6	5	25	75	100	
	Elective III	Actuarial Practice	P20AS3:3	6	5	25	75	100	
	Elective IV	Advanced MS-EXCEL	P19AS3:P	6	4	40	60	100	
					<b>Sem III Credits:</b>	<b>23</b>			
IV	Core XIII	Business Economics – II	P19AS413	6	4	25	75	100	
	Core XIV	Business Finance – II	P19AS414	6	4	25	75	100	
	Core XV	Financial Engineering – II	P19AS415	6	4	25	75	100	
	Elective V	Python Programming Language	P19AS4:P	6	4	40	60	100	
	Core Project	Project	P19AS4PJ	6	5	--	--	100	
					<b>Sem IV Credits:</b>	<b>21</b>			
					<b>Total Credits:</b>	<b>90</b>			
Core Theory: 15		Core Project: 1		Elective :5		Value Education: 1		Total: 22	

# **SEMESTER - I**

## ACTUARIAL STATISTICS – I

Core: I

Code: P19AS101

Credits: 5

Hours: 6

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### COURSE OUTCOMES:

**CO1:** Develop problem-solving techniques needed to accurately calculate probabilities.

**CO2:** Will have enough knowledge to use different types of distribution to fitting model.

**CO3:** Apply problem-solving techniques to solving in Actuarial field.

**CO4:** Present the analysis of derived statistics in Actuarial field.

**CO5:** Develop problem solving techniques in testing of hypothesis.

**CO6:** To have application knowledge in actuarial data in the field of estimation theory.

**Unit I: Probability distributions & Generating functions:** Introduction- Important discrete distributions- Important continuous distributions- The Poisson process - Monte Carlo simulation - Generating functions Introduction - Moment generating functions - Cumulant generating functions – Definition- Calculating moments - Linear functions - Further applications of generating functions.

**Unit II: Joint distributions:** Introduction - Joint distributions - Joint probability (density) functions - Conditional probability (density) functions - Independence of random variables - Expectations of functions of two variables – Convolutions - Moments of linear combinations of random variables - Using generating functions to derive distributions of linear combinations of independent random variables - Moment generating functions - Using MGFs to derive relationships among variables

**Unit III: Conditional expectation & The Central Limit Theorem:** The conditional expectation  $E[Y | X = x]$  - The random variable  $E[Y | X]$  - The random variable  $\text{var}[Y | X]$  and the ' $E[V] \square \text{var}[E]$ ' result - The Central Limit Theorem - Normal approximations - The continuity correction - Comparing simulated samples

**Unit IV: Sampling and statistical Inference & Point estimation:** Introduction - Basic definitions - Moments of the sample mean and variance - Sampling distributions for the normal - The t result - The F result for variance ratios - The method of moments - The method of maximum likelihood – Unbiasedness - Mean square error - Asymptotic distribution of MLEs - Comparing the method of moments with MLE - The bootstrap method

**Unit V: Confidence intervals & Hypothesis testing:** Introduction - Confidence intervals in general - Derivation of confidence intervals - Confidence intervals for the normal distribution - Confidence intervals for binomial & Poisson parameters - Confidence intervals for two-sample problems - Paired data - Hypotheses, test statistics, decisions and errors - Hypotheses,

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

**TEXTBOOK:** Actuarial Statistics I (CS I), Institute and Faculty of Actuaries, UK (2019)

**REFERENCE:**

1: Freund, John E f, Mathematical statistics, Pearson Education Limited - Prentice Hall International, ISBN 10: 1-292-02500-X

2: Dr P. Mariappan, “Statistics for Business”, CRC Press, 2019, ISBN: 978-1-138-33617-9

## ACTUARIAL MATHEMATICS – I

Core: II

Code: P19AS102

Credits:5

Hours:6

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### COURSE OUTCOMES:

**CO1:** Ability to understand different types of cash flow models

**CO2:** Ability to handle different situations of compound interest problems in banking and financial sectors.

**CO3:** Ability to understand the different types of interest rates.

**CO4:** Develop various models related to interest rates.

**CO5:** To understand about annuities in financial sector.

**CO6:** Ability to identify and classify the varying annuities on the basis of cash flows.

**Unit I: Data analysis:** Introduction - Aims of a data analysis - The data analysis process - Data sources - Reproducible research - **Principles of actuarial modelling** – Introduction – Models - Modelling – the benefits and limitations - Stochastic and deterministic models - Discrete and continuous state spaces and time sets - Scenario-based and proxy models - Suitability of a model - Short-term and long-term properties of a model - Analyzing the output of a model - Sensitivity testing - Communication of the results - **Cashflow models** - Cashflow process - Examples of cashflow scenarios - Insurance contracts.

**Unit II: The time value of money:** Introduction – Interest - Present values - Discount rates - Effective rates of interest and discount - Equivalent rates - **Interest rates** - Nominal rates of interest and discount - The force of interest - Relationships between effective, nominal and force of interest - Force of interest as a function of time.

**Unit III: Real and money interest rates:** Introduction - Definition of real and money interest rates - Deflationary conditions - Usefulness of real and money interest rates - **Discounting and accumulating** - Present values of cashflows - Valuing cashflows - Interest income.

**Unit IV: Level annuities:** Introduction - Present values – Accumulations - Continuously payable annuities - Annuities payable pthly - Non-integer values of  $n$  – Perpetuities - Deferred annuities.

**Unit V: Increasing annuities:** Introduction - Varying annuities - Annual payments - Continuously payable annuities - Decreasing payments - Special cases - Irregular payments - Compound increasing annuities.

**TEXTBOOK:** Actuarial Mathematics – CM1, Institute and faculty of Actuaries, UK (IFOA),2019

**REFERENCE:**

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

## ACTUARIAL MATHEMATICS – II

**Core: III**

**Code: P19AS103**

**Credits: 4**

**Hours: 6**

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### **COURSE OUTCOMES:**

**CO1:** Ability to handle different situations of policies.

**CO2:** Construct the premium & reserve table.

**CO3:** Develop various types of reserves.

**CO4:** Understand and use the relations between annuities payable in advance and in arrears, and between temporary, deferred and whole life annuities.

**CO5:** Describe and calculate gross premiums and reserves of assurance and annuity contracts.

**CO6:** Understand and use the relations between assurance and annuity factors using equation of value, and their select and continuous equivalents.

**Unit I: The life table & Life assurance contracts:** Introduction - Present values of payments under life insurance and annuity contracts - The life table - Life table functions at non-integer ages - Evaluating probabilities without use of the life table - Select mortality - Whole life assurance contracts - Term assurance contracts - Pure endowment contracts - Endowment assurance contracts - Deferred assurance benefits - Benefits payable immediately on death - Evaluating means and variances using select mortality.

**Unit II: Life annuity contracts & Evaluation of assurances and annuities:** Life annuity contracts - Whole life annuities payable annually in arrears - Whole life annuities payable annually in advance - Temporary annuities payable annually in arrears - Temporary annuities payable annually in advance - Deferred annuities - Deferred annuities-due - Guaranteed annuities payable annually in advance - Guaranteed annuities payable annually in arrears - Continuous annuities - Evaluating means and variances using select mortality - Evaluating assurance benefits - Evaluating annuity benefits - Premium conversion formulae - Expected present values of annuities payable  $m$  times each year - Expected present values under a constant force of mortality.

**Unit III: Variable benefits and conventional with-profits policies:** Variable payments - Payments varying at a constant compound rate - Payments varying by a constant monetary amount - Whole life assurance - Term assurance - Endowment assurance - Decreasing term assurance - Increasing assurances payable immediately on death - Whole life annuity payable annually in arrears - Whole life annuity payable annually in advance - Temporary annuities - Annuities payable continuously - Conventional with-profits contracts - Types of bonus.



**Unit IV: Gross premiums:** Introduction - The gross premium - Gross future loss random variable - Calculating premiums that satisfy probabilities, using the gross future loss random variable - Principle of equivalence – Definition - Determining gross premiums using the equivalence principle - The basis - Premium payment structures - Annual premium contracts - Conventional with-profits contracts - Premiums payable  $m$  times per year - Calculating gross premiums using simple criteria other than the equivalence principle.

**Unit V: Gross premium reserves:** Introduction - Why hold reserves? - Prospective reserves - Retrospective reserves - Equality of prospective and retrospective reserves - Recursive relationship between reserves for annual premium contracts - Net premium reserves for conventional without profit contracts.

**TEXTBOOK:** Actuarial Mathematics – CM2, Institute and faculty of Actuaries, UK (IFOA),2019

**REFERENCE:**

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

## SURVIVAL ANALYSIS – I

**Core: IV**

**Code: P19AS104**

**Credits: 4**

**Hours: 6**

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### **COURSE OUTCOMES:**

**CO1:** Apply the real time application of stochastic process.

**CO2:** Identify the methods stochastic process.

**CO3:** Compute the different applications of stochastic process & Poisson process.

**CO4:** Identify the different kinds of Markov Chains.

**CO5:** Compute the two-state Markov model and the Poisson model.

**CO6:** Compute the Time-homogeneous Markov chains.

**Unit I: Stochastic processes:** Types of stochastic processes - Discrete state space with discrete time changes - Discrete state space with continuous time changes - Continuous state space - Displaying observed data - Processes of mixed type - Counting processes - Defining a stochastic process - Sample paths – Stationarity – Increments - The Markov property – Filtrations - White noise - General random walk - Poisson process - Compound Poisson process - Time series.

**Unit II: Markov chains:** An example of a Markov chain - The Chapman-Kolmogorov equations - Time-homogeneous Markov chains - Time-inhomogeneous Markov chains – Models - A simple model of a No Claims Discount (NCD) policy - Time-inhomogeneous model - Another model of an NCD policy - Time-inhomogeneous model - Simple random walk on  $S = \{\dots - 2, -1, 0, 1, 2, \dots\}$  - Simple random walk on  $\{0, 1, 2, \dots, b\}$  - A model of accident proneness - The long-term distribution of a Markov chain - The stationary probability distribution - The long-term behavior of Markov chains - Modelling using Markov chains - Estimating transition probabilities - Assessing the fit - Triplets test – Simulation.

**Unit III: The two-state Markov model and the Poisson model:** Introduction - The two-state Markov model - Assumptions underlying the model - Comparison with other models - Survival probabilities – Statistics – Definitions - Joint density function - The maximum likelihood estimator - Maximizing the likelihood function - Properties of the maximum likelihood estimator - Alternative method of obtaining the asymptotic distribution - The Poisson model - The Poisson distribution - The Poisson model of mortality - Estimating the underlying force of mortality - Links to the two-state Markov model - Estimating death probabilities - Comment on application.

**Unit IV: Time-homogeneous Markov jump processes:** Notation - The Poisson process - Sums of independent Poisson processes - Thinning of Poisson processes - Inter-event times - Features of time-homogeneous Markov jump processes - The Chapman-Kolmogorov equations - The transition matrix - Transition rates - The time-homogeneous health-sickness-death model - 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 - Solutions of Kolmogorov equation in elementary cases - The maximum likelihood estimator in the general model - Maximum likelihood estimators - Properties of the estimators - Calculating the total waiting time.

**Unit V: Time-inhomogeneous Markov jump processes:** 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:** Actuarial Statistics – CS2, Institute and faculty of Actuaries, UK (IFOA),2019

**REFERENCE:**

R1: 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.

R2: 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](http://www.soa.org/bookstore/naaj_archive.html)

R3: Modeling, analysis, design, and control of stochastic systems. – Kulkarni, Vidyadhar G. Springer, 1999. – xiv, 374 pages. – ISBN: 0 387 98725 8.

R4: Probability and random processes. – Grimmett, Geoffrey; Stirzaker, David. – 3rd ed. – Oxford University Press, 2001. – xii, 596 pages. – ISBN: 0 19 857222 0.

## PRINCIPLES OF INSURANCE

**Elective: I**

**Code: P19AS1:1**

**Credits: 4**

**Hours: 6**

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### **COURSE OUTCOMES:**

**CO1:** Describe the historical development of insurance.

**CO2:** Able to highlight the components of risk.

**CO3:** Able to name the various role players in the insurance market.

**CO4:** Apply the basic insurance knowledge and skills to his/her workplace.

**CO5:** Operate as lower level officers with insurance firms or run an insurance agency.

**CO6:** Acquire technical and practical skills needed in building careers in the insurance industry.

**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.

**UNIT II: Introduction of General Insurance** - The origin of insurance - Indian general insurance market - Historical milestone - The structure of Indian general insurance market - Classification of general insurance companies - Salient features of Indian general insurance market.

**UNIT III: IRDAI functions and Insurance Councils** - Definition of insurance-Insurance Regulatory and Development Authority of India (IRDAI) - Purpose of forming the IRDAI- Duties, powers and functions of the IRDAI - Regulations issued by IRDAI.

**UNIT IV: Protection of Policyholder's Interest** - Introduction - Introduced to stages of insurance policy - Discuss the pre-sale stages of insurance policy - Discuss the post-sale stage of insurance policy - Understand grievance redressal complaint handling and policyholder's servicing procedures - Understand claim procedures and settlement in respect of insurance policies - Life general and health - known about the key feature document.

**UNIT V: Taxation of Insurance** - Details and Income tax act 80C,80CC, 80D and 80DD

### **Textbook:**

- Unit 1: Dr. E. Dharmaraj – “Elements of Insurance” –SIMRES Publications, first edition, 2009 – ISBN 978-81-909568-5-7

- Unit 2 & 3: IC 11 - PRACTICE OF GENERAL INSURANCE, 2006
- Unit 4: IC 14 - REGULATIONS OF INSURANCE BUSINESS, 2006
- Unit 5: IC 24 - LEGAL ASPECTS OF LIFE INSURANCE, 2006

# SEMESTER - II

## ACTUARIAL STATISTICS – II

**Core: V**

**Code: P19AS205**

**Credits: 4**

**Hours: 5**

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### **COURSE OUTCOMES:**

**CO1:** Develop the ability to find the relationship between variables and predicting using model.

**CO2:** Fit multiple regression model

**CO3:** Apply Bayesian Statistics to estimate the posterior distribution

**CO4:** Predict the risk premium for insurance company

**CO5:** Fix the premium rate to the insurance company

**CO6:** Analyze the risk

**Unit I: Data Analysis:** Introduction- Bivariate correlation analysis - Data visualization - Sample correlation coefficients - Spearman's rank correlation coefficient - The Kendall rank correlation coefficient – Inference - Inference under Pearson's correlation - Result 1- Inference under Spearman's rank correlation - Inference under Kendall's rank correlation - Multivariate correlation analysis - Data visualization - Sample correlation coefficient matrix – Inference - Principal component analysis.

**Unit II: Linear regression & Multiple linear regression:** Introduction - The simple bivariate linear model - The full normal model and inference - The multiple linear regression model - The full normal model and inference.

**Unit III: Generalized linear models:** Introduction - Generalized linear models - Exponential family - Linear predictor - Link functions - Model fitting and comparison - Residuals analysis and assessment of model fit.

**Unit IV: Bayesian statistics & Credibility theory:** Introduction - Bayes' theorem - Prior and posterior distributions - The loss function - Some Bayesian posterior distributions - Credibility theory – Introduction - Recap of conditional expectation results – Credibility - Bayesian credibility.

**Unit V: Empirical Bayes Credibility theory:** Introduction - Empirical Bayes Credibility Theory: Model 1 – Introduction -Risk parameter - Conditional claim distribution - Credibility formula - Model 1: specification Assumptions for EBCT Model 1 - Model 1: the credibility premium - Model 1: parameter estimation - Example: Credibility premium using Model 1 - Empirical Bayes Credibility Theory: Model 2 – Introduction - Model 2: specification Assumptions for EBCT Model 2 - Model 2: the credibility premium - Model 2: parameter estimation - Example: Credibility premium using Model 2.

**TEXTBOOK:** Study Material: Core statistics – 1 (CS 1), Institute of faculty of actuaries, UK, 2019.

**REFERENCE:** Freund, John E F, Mathematical statistics, 6th ed. - Prentice Hall International, 1999 ISBN: 0 13 974155 0.



## ACTUARIAL MATHEMATICS – III

Core: VI

Code: P19AS206

Credits: 4

Hours: 5

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### COURSE OUTCOMES:

**CO1:** Ability to understand the concepts relating to functions and annuities.

**CO2:** To know, how to apply the theoretical concept and find the solution for unknown quantity

**CO3:** Develop the skill to know, how to apply the equations of value in loan repayment process.

**CO4:** To develop the skill related to APR

**CO5:** Distinguish the different situations of financial projects

**CO6:** To analyze the investment on the basis of different parameters.

**Unit I: Equations of value:** Introduction - The equation of value and the yield on a transaction - The theory - Solving for an unknown quantity - Security S - Solving for the timing of a payment (n) - Solving for the interest rate (i) - Estimating an unknown interest rate using linear interpolation - Example applications - Uncertain payment or receipt - probability of cashflow - Higher discount rate.

**Unit II: Loan schedules:** Introduction - An example - Calculating the capital outstanding – Introduction - The theory - Prospective loan calculation - Retrospective loan calculation - Calculating the interest and capital elements - The loan schedule - Instalments payable more frequently than annually - Capital and interest elements - Consumer credit: APR.

**Unit III: Project Appraisal:** Introduction - Estimating cashflows - Fixed interest rates - Accumulated value - Net present values - Internal rate of return - The comparison of two investment projects – Different interest rates for lending and borrowing - Payback periods - Other considerations.

**Unit IV: Bonds, equity and property:** Introduction - Fixed-interest securities - Calculating the price and yield - No tax - Income tax - Capital gains tax - Capital gains test - Finding the yield when there is capital gains tax - Optional redemption dates - Uncertain income securities – Equities – Property - Real rates of interest - Inflation-adjusted cashflows - Calculating real yields using an inflation index - Calculating real yields given constant inflation assumptions - Payments related to the rate of inflation - The effects of inflation - Index-linked bonds.

**Unit V: Term structure of interest rates:** Introduction - Discrete-time rates - Discrete-time spot rates - Discrete-time forward rates - Continuous-time rates - Continuous-time spot rates - Continuous-time forward rates - Instantaneous forward rates - Theories of the term structure of interest rates - Why interest rates vary over time - Supply and demand - Base rates - Interest

rates in other countries - Expected future inflation - Tax rates - Risk associated with changes in interest rates - The theories - Expectations theory - Liquidity preference - Market segmentation - Yields to maturity - Par yields - Duration, convexity and immunization - Interest rate risk - Effective duration – Duration – Convexity - Why is it called ‘convexity’? – Immunization - Redington’s conditions.

**TEXTBOOK:** Core Mathematics 1(CM1), Institute and faculty of Actuaries, UK (IFOA),2019

**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.usi
5. The theory of interest. Kellison, Stephen G. 2nd ed. Irwin, 1991. 446 pages. ISBN: 0 256 09150 1. Available from the publications unit.

## ACTUARIAL MATHEMATICS – IV

Core: VII

Code: P19AS207

Credits: 4

Hours: 5

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### **COURSE OUTCOMES:**

**CO1:** Ability to handle different situations of policies.

**CO2:** Construct the premium & reserve table.

**CO3:** Develop various types of reserves.

**CO4:** Understand and use the relations between annuities payable in advance and in arrears, and between temporary, deferred and whole life annuities.

**CO5:** Describe and calculate gross premiums and reserves of assurance and annuity contracts.

**CO6:** Understand and use the relations between assurance and annuity factors using equation of value, and their select and continuous equivalents.

### **Unit I: Joint life and last survivor functions & Contingent and reversionary benefits:**

Random variables to describe joint life functions - Simple probabilities involving two lives - Present values involving two lives - Calculations, premiums, reserves - Contingent probabilities of death - Contingent assurances - Reversionary annuities - Joint life functions dependent on term - Expected present value of annuities payable  $m$  times a year - Further aspects.

**Unit II: Mortality profit & Competing risks:** Mortality profit on a single policy - Mortality profit on a portfolio of policies - Allowing for death benefits payable immediately - Allowing for survival benefits - Allowing for different premium or annuity payment frequencies - Calculation of mortality profit for policies involving two lives - Health insurance contracts - Multiple state models - Multiple decrement models - Multiple decrement tables - Using multiple decrement tables to evaluate expected present values of cashflows.

**Unit III: Unit-linked and accumulating with-profits contracts:** Unit-linked contracts - Unit funds and non-unit funds - Accumulating with-profits contracts – Definition - Unitised (accumulating) with-profits contracts - Charges and benefits under UWP - Comparison between UWP and the simple AWP designs.

**Unit IV: Profit testing:** Introduction - Evaluating expected cashflows for various contract types - Profit tests for annual premium contracts - Profit testing using the present value random variable - Pricing using a profit test.

**Unit V: Reserving aspects of profit testing:** Introduction - Pricing and reserving bases - Calculating reserves for unit-linked contracts - Calculating reserves for conventional contracts using a profit test - Effect of pricing and reserving bases on a profit test - Setting out the calculations.

**TEXTBOOK:** Core Mathematics -1 (CM1), Institute and faculty of Actuaries, UK (IFOA),2019

**REFERENCE:**

**R1:** An introduction to the mathematics of finance. McCutcheon, John J; Scott, William F. London: Heinemann, 1986. 463 pages. ISBN: 0 434 91228 x.

**R2:** Mathematics of compound interest. Butcher, M V; Nesbitt, Cecil J. Ulrich's Books, 1971. 324 pages.

**R3:** Theory of financial decision making. Ingersoll, Jonathan E. Rowman& Littlefield, 1987. 474 pages. ISBN: 0 8476 7359 6.

## SURVIVAL ANALYSIS – II

**Core: VIII**

**Code: P19AS208**

**Credits: 4**

**Hours: 5**

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### **COURSE OUTCOMES:**

**CO1:** Apply the real time application of Survival models.

**CO2:** Identify the methods of Survival models.

**CO3:** Compute the different kinds of lifetime distribution functions.

**CO4:** Analyze the Proportional hazard models.

**CO5:** Compute the Graduation and Methods.

**CO6:** Analyze the Graduation and statistical tests.

**Unit I: Survival models:** simple model of survival - Expected future lifetime - Some important formulae - Simple parametric survival models - The Gompertz and Makeham laws of mortality.

**Unit II: Estimating the lifetime distribution function:** Questions of inference - Censoring mechanisms - The Kaplan-Meier (product-limit) model - Comparing lifetime distributions - The Nelson-Aalen model - Parametric estimation of the survival function.

**Unit III: Proportional hazards models & Exposed to risk:** Covariates and proportional hazards models - Fully parametric models - The Cox proportional hazards model - Estimating the regression parameters - Model fitting - Calculating the exposed to risk – Homogeneity - The principle of correspondence - Exact calculation of the central exposed to risk - Census approximations to the central exposed to risk - Deaths classified using different definitions of age.

**Unit IV: Graduation and statistical tests:** Graduation of observed mortality rates - The underlying assumptions - Comparison with another experience – Graduation - Reasons for graduation - Desirable features of a graduation - Testing the smoothness of a graduation - Statistics refresher - Statistical tests of a mortality experience.

**Unit V: Methods of graduation & Mortality projection:** Graduation by parametric formula - Graduation by reference to a standard table - Graduation using spline functions - Comparison of different methods - Statistical tests of a graduation - The effect of duplicate policies - Methods based on expectation - Methods based on extrapolation - Methods based on explanation - Sources of error in mortality forecasts.

**TEXTBOOK:** Core Statistics – CS2, Institute and faculty of Actuaries, UK (IFOA),2019

## REFERENCE:

**R1:** 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.

**R2:** Actuarial models for disability insurance. – Haberman, Steven; Pitacco, Ermanno.– Chapman & Hall, 1999. – xviii, 280 pages. – ISBN: 0 8493 0389.

**R3:** Analyzing survival data from clinical trials and observational studies. – Marubini, Ettore; Valsecchi, Maria Grazia. – John Wiley, 1995. – xvi, 414 pages. – ISBN: 0 47193987 0.

**R4:** Life contingencies. – Neill, Alistair. – Heinemann, 1977. – vii, 452 pages. – ISBN: 0434 91440 1.

**R5:** Life insurance mathematics. – Gerber, Hans U. – 3rd ed. – Springer. Swiss Association of Actuaries, 1997. – 217 pages. – ISBN: 3 540 62242 X.

## RISK MODELLING

Core: IX

Code: P19AS209

Credits: 4

Hours: 5

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### COURSE OUTCOMES:

- CO1:** Develop the general insurance products.
- CO2:** Fundamental of general insurance contract.
- CO3:** Identifying the non-stationary process to stationary process.
- CO4:** Importance of reinsurance contract.
- CO5:** Apply statistical techniques in general insurance contract.
- CO6:** Forecasting methodology.

**Unit I: Time series 1:** Properties of a univariate time series - Stationary random series - Main linear models of time series.

**Unit II: Time series 2 & Loss distributions :** Compensating for trend and seasonality - Identification of MA(q) and AR(p) models - Fitting a time series model using the Box-Jenkins methodology – Forecasting - Multivariate time series models - Some special non-stationary and non-linear time series models - Simple loss distributions - Other loss distributions – Estimation - Goodness-of-fit tests.

**Unit III: Extreme value theory & Copulas:** Extreme events and extreme value theory - Generalized extreme value (GEV) distribution - Generalized Pareto distribution (GPD) - Measures of tail weight - Marginal and joint distributions - Association, concordance, correlation and tail dependence – Copulas - Fundamental copulas - Explicit copulas (including Archimedean copulas) - Implicit copulas - Choosing and fitting a suitable copula function - Calculating probabilities using copulas.

**Unit IV: Reinsurance:** Proportional reinsurance - Non-proportional reinsurance - Reinsurance arrangements - Normal and lognormal distributions – Inflation – Estimation - Policy excess.

**Unit V: Risk models 1 & Risk models 2:** General features of a product - Models for short-term insurance contracts - The collective risk model - Aggregate claim distributions under proportional and individual excess of loss reinsurance - The individual risk model - Parameter variability / uncertainty.

**TEXTBOOK:** Core Statistics – CS2, Institute and faculty of Actuaries, UK (IFOA),2019

**REFERENCE:**

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.



## PROGRAMMING USING R

**Elective: II**

**Code: P19AS2:P**

**Credits: 2**

**Hours: 3**

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### **COURSE OUTCOMES:**

**CO1:** Use R studio to write and R code.

**CO2:** Write syntactically correct R expressions that involve variables, variable assignment, operators and functions.

**CO3:** Able to Identify basic R data types (character, double, integer and logical)

**CO4:** Able Identify basic R data structures relevant to modern data analysis (atomic vectors and data frames)

**CO5:** Apply the basic verbs of data transformation of actuarial data.

**CO6:** Able to Create statistical graphics with gg plot.

**Unit I:** 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:** 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:** 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 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:** 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).

**TEXT BOOK:**

1. John Verzani, Using R for Introductory statistics, CRC Press, 2014, ISBN: 13:978-1-4665-9073-1

**REFERENCE BOOK:**

Randall E. Schumacher, learning statistics using R Randall E. Schumacher, learning statistics using R, Sage Publications Inc, 2014

# **SEMESTER - III**

## BUSINESS ECONOMICS – I

**Core: X**

**Code: P19AS310**

**Credits: 4**

**Hours: 6**

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### **COURSE OUTCOMES:**

**CO1:** To introduce students to the core economic principles.

**CO2:** It provides grounding in the fundamental concepts of micro and macroeconomics.

**CO3:** To understand the core economic concepts like outputs, inputs, technology location and competition.

**CO4:** To understand the reaction of changes in demand and supply.

**CO5:** To understand the risk and uncertainty about future market movements.

**CO6:** To understand the various pricing strategies the firms can adopt.

**Unit I: Economic concepts and systems:** What economists' study - Different economic systems - Main strands of economic thinking.

**Unit II: Supply and demand (1):** Demand – Supply - Price and output determination - Supply and demand (2) - Price elasticity of demand (PED) - Other elasticities - The time dimension - The control of prices - Indirect taxes and subsidies.

**Unit III : Background to demand:** Marginal utility theory - The timing of costs and benefits - Indifference curve analysis - Demand under conditions of risk and uncertainty - Behavioural economics - Background to supply - The short-run theory of production - Costs in the short run - The long-run theory of production - Costs in the long run – Revenue - Profit maximization.

**Unit IV: Perfect competition and monopoly:** Alternative market structures - Perfect competition – Monopoly - The theory of contestable markets - Monopolistic competition and oligopoly - Monopolistic competition – Oligopoly - Game theory - Pricing strategies - Cost-based pricing and limit pricing - Price discrimination - Multiple product pricing - Pricing and the product life cycle.

**Unit V :** Market Failure and government intervention: Efficiency under perfect competition - The case for government intervention - Forms of government intervention - Government failure and the case for the market - Competition policy - Policies towards research and development (R&D) - The macroeconomic environment - An overview of key macroeconomic issues - The circular flow of income - Measuring national income and output - The AD-AS model - Macroeconomic objectives - The business cycle - Unemployment and the labour market - Inflation and the AD-AS model.

**TEXTBOOK:** Core Business 2 (CB2), Institute and faculty of Actuaries, UK (IFOA),2019

**REFERENCE:**

1. Economics, David Begg, Stanley Fisher and Rudiger Dorn Busch, 5th edition, McGraw Hill Economic 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. - Oxford University Press, 1999. - xvi, 640 pages. - ISBN: 0 19 877588 1.

## BUSINESS FINANCE – I

Core: XI

Code: P19AS311

Credits: 5

Hours: 6

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### COURSE OUTCOMES:

**CO1:** Knowledge to understand the position of each stakeholder.

**CO2:** Develop the knowledge in capital market and analyze about the investments.

**CO3:** Ability to handle the different types of Business entity

**CO4:** To understand the pros and cons about limited companies and to know about the different types of taxation

**CO5:** Skill to understand different types of issue of shares and shareholders.

**CO6:** Knowledge regarding the process for getting quotation

**Unit I : Key principles of finance and corporate governance:** Finance and real resources – Stakeholders - Capital markets and the maximization of shareholder’s wealth - The value of a company - Regulating financial reporting - Corporate governance and organization - Business ownership - Types of business entity - Pros and cons of limited companies – Taxation - Personal taxation - Capital gains tax - Company taxation - Other taxes - Double taxation relief.

**Unit II: Long-term finance:** Loan capital (Debt) - Share capital - Other types of long-term finance - Winding up a company - Issue of shares - Obtaining a stock exchange quotation - Issues made by companies already quoted.

**Unit III: Short-and medium-term finance:** Medium-term company finance - Short-term company finance - Alternative sources of finance - Shadow banking - Project financing – Crowdfunding – Microfinance.

**Unit IV: Uses of derivatives:** Financial futures – Options - Interest rate and currency swaps - Weighted average cost of capital - Cost of equity - Cost of debt - Weighted average cost of capital.

**Unit V: Capital structure and dividend policy:** Capital structure - Dividend – the shareholders’ reward - Capital project appraisal (1) - Introduction to capital project appraisal - Methods of project evaluation - Results of the evaluation - Capital project appraisal (2) - Choice of discount rate - Risk analysis – an overview - Identification of risks - Analysis of risks - Obtaining a distribution of NPVs in practice - Risk mitigation - The investment submission.

**TEXTBOOK:** Core Business 1(CB1), Institute and faculty of Actuaries, UK (IFOA),2019

### REFERENCE:

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. -

9th ed. - 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.

## FINANCIAL ENGINEERING - I

Core: XII

Code: P19AS312

Credits: 5

Hours: 6

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### COURSE OUTCOMES:

**CO1:** Apply utility function in insurance contract.

**CO2:** Modeling of investment returns.

**CO3:** The operation of insurance and other financial systems understood.

**CO4:** Meeting the individuals of the financial institutions and their client's needs.

**CO5:** Analysis the best portfolio-based risk and return.

**CO6:** Predict the risk of the insurance company.

**Unit I: The Efficient Markets Hypothesis:** Rational expectations theory – the three forms of the efficient markets hypothesis-The evidence for or against each form of the Efficient Markets Hypothesis- difficulties with testing the efficient market hypothesis-volatility tests- conclusion

**Utility theory** - The expression of economic characteristics in terms of utility functions - Measuring risk aversion - Some commonly used utility functions - The variation of utility functions with wealth - Construction of utility functions - Maximizing utility through insurance - Limitations of utility theory.

**Unit II: Stochastic dominance and behavioural finance :** Stochastic dominance – background-first order stochastic dominance-second order stochastic dominance- Behavioural finance – introduction-prospect theory critique of expected utility theory-heuristics and behavioural biases-a behavioural approach to the equity premium puzzle **Measures of investment risk** – introduction-variance of return-semi variance of return-short fall probabilities-tail value at risk and expected short fall-Relationship between risk measures and utility functions - Risk and insurance companies-introduction- what to insure-pooling resources-policy holder behavior.

**Unit III: Stochastic models of investment returns-** introduction-simple model- Fixed rate model – Varying rate model-Log normal distribution.

**Unit IV: Portfolio theory:** Introduction – assumptions of mean and variance portfolio theory-specification of the opportunity set-choosing an efficient portfolio-Benefits of diversification.

**Unit V: Models of asset returns:** Multifactor models-definition-macroeconomic factor models-statistical factor models-construction of models-Single index model- definition – results of the single index model-data requirements.

**TEXTBOOK:** Core Mathematics – CM2, Institute and faculty of Actuaries, UK (IFOA),2019



**REFERENCE:**

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.

## ACTUARIAL PRACTICE

**Elective: III**

**Code: P20AS3:3**

**Credits: 5**

**Hours: 6**

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### **COURSE OUTCOMES:**

**CO1:** Able to understand and implement the regulations of Actuarial Clients.

**CO2:** Understand the need & application of actuarial regulations

**CO3:** Preferable to choose the various investments choices available in the market.

**CO4:** Investment portfolio of general insurance business and their terms and conditions can be applied

**CO5:** Understand the concept of various Equity, share markets & investments of insurance

**CO6:** Apply the concept of financial products available and to meet out the customers need.

### **UNIT I: ACTUARIAL ADVICE AND EXTERNAL ENVIRONMENT:**

The clients actuaries advise-other stakeholders affected by actuarial advice given to clients- the interest and functions of the clients-information about the client-attitudes of clients and other stakeholders-advice and decisions-professional and technical standards-legislations and regulations-state benefits-tax-accounting standards-Risk management requirements, capital adequacy and solvency-corporate governance- corporate structure- competitive advantage and commercial requirements-other external issues.

### **UNIT II: REGULATION, FINANCIAL PRODUCTS AND CUSTOMER NEEDS:**

The aims of regulation-the cost of regulation-The need for regulation-The functions of a regulator-areas addressed by regulation-information asymmetry-areas addressed by regulation-maintaining confidence-Regulatory regimes-Role of major financial institutions-types of provisions-social security benefits-financial products and contracts-pension schemes-investment schemes-derivatives-insurance principles-analyzing stakeholder's needs.

### **UNIT III: PROVIDERS OF BENEFITS AND LIFE INSURANCE PRODUCTS:**

An introduction to benefit schemes-benefits providers-the state-employers-individuals-financial institutions and other organizations -an overview of life insurance-life insurance products an overview-pure endowment and endowment assurance-whole life assurance-term assurance-convertible or renewable term assurance-immediate annuity-deferred annuity (including personal pensions)-income drawdown-investment bonds-income protection insurance-critical illness insurance-keyperson cover-long term care insurance-investment types.

### **UNIT IV: GENERAL INSURANCE PRODUCTS, BOND AND MONEY MARKETS:**

An overview of general insurance-an introduction to general insurance products-liability insurance-property damage insurance-financial loss insurance-fixed benefits-cash on deposit-

the money markets-characteristics of cash on deposit and money market instruments-attractions of cash on deposit and money market instruments-bond markets an introduction-fixed interest or conventional bonds-index linked bonds-comparison of fixed interest and index linked bonds.

**UNIT V: EQUITY AND PROPERTY MARKETS, OTHER INVESTMENT CLASSES:**

Characteristics of ordinary shares (Equities)-Equity categorization -property investment-characteristics of direct property investments-freehold and leasehold property investment-indirect property investment-collective investment schemes-Differences between closed ended and open-ended CISs- CISs vs direct investment-Futures and options-Overseas Markets-Indirect overseas investment-Investing in emerging markets.

**TEXT BOOK:** ACTUARIAL PRACTICE-CP1, combined material from IFOA, UK.

## ADVANCED MS-EXCEL

**Elective: IV**

**Code: P19AS3:P**

**Credits: 4**

**Hour: 6**

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### **COURSE OUTCOMES:**

**CO1:** Able to define the statistical terms and its measures.

**CO2:** Able to compute descriptive statistical measure.

**CO3:** Will have capacity to recognize the applications of Statistical measure.

**CO4:** Able to compare using descriptive measures (Statistical Software and Ms-Excel).

**CO5:** Able to analysis the data relationship using correlation.

**CO5:** Able to predict the variation using regression.

**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. (Application – Formatting given data set).

**Unit II:** 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. (Application – Graphical representation of data).

**Unit III:** Work with data - Retrieve Data for external Source - Text to Columns/Remove Duplicates / data validation - Grouping/ Ungrouping. (Application – Working data with syntax).

**Unit IV:** Pivot tables- Macros - Developer Options - Record a Macro – Advance Marco. (Application – creating pivot tables for further calculation, using macro for calculation)

**Unit V:** Problem solving – Using MS-Excel – Core statistics I and Core Mathematics I.

**TEXT BOOK:** Wayne L. Winston, “Microsoft Excel 2010 Data analysis and Business Modeling” Microsoft press, 2011.

### **REFERENCE BOOK:**

John Walkenbach, Microsoft excel 2016 bible: The comprehensive tutorial resource, Wiley Publishers, 2016

# SEMESTER - IV

## BUSINESS ECONOMICS – II

**Core: XIII**

**Code: P19AS413**

**Credits: 4**

**Hours: 6**

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### **COURSE OUTCOMES:**

**CO1:** To introduce students to the core economic principles.

**CO2:** It provides grounding in the fundamental concepts of micro and macroeconomics.

**CO3:** To understand the core economic concepts like out puts, inputs, technology location and competition.

**CO4:** To understood the reaction of changes in demand and supply.

**CO5:** To understood the risk and uncertainty about future market movements.

**CO6:** To understand the various pricing strategies the firms can adopt.

**Unit I: International trade and payments:** Globalization - setting the scene - The advantages of trade - Arguments for restricting trade - The open economy - The financial system and the money supply - The definition, role and evolution of financial systems - The history and consequences of banking crisis - The meaning and functions of money - The supply of money - The money market and monetary policy.

**Unit II: Classical and Keynesian theory:** Classical theory - The Keynesian revolution - Background to Keynesian theory - The determination of national income - The simple Keynesian analysis of unemployment and inflation - The Keynesian analysis of the business cycle - Monetarist and neo classical schools, and Keynesian responses - The monetarist school - The neo classical school - The expectations-augmented Phillips curve and the inflation-unemployment relationship - Inflation and unemployment: the monetarist perspective - The Keynesian response.

**Unit III: Relationship between the goods and money markets:** The effects of monetary changes on national income - The monetary effects of changes in the goods market - The IS-LM model - The IS-MP model - Supply-side policy - Approaches to supply-side policy - Supply-side policies in practice market-oriented policies - Supply-side policies in practice interventionist policies.

**Unit IV: Demand-side policy:** Fiscal policy and the public finances - The use of fiscal policy - The policy-making environment - Exchange rate policy - Alternative exchange rate regimes - Fixed exchange rates – Free-floating exchange rates - Exchange rate systems in practice - The open economy and IS - LM analysis.

**Unit V: Global harmonization and monetary union:** Globalization and the problem of instability - European economic and monetary union (EMU) - Summary of debates on theory and policy - A timeline – revisited - The macroeconomic environment and debates - An emerging consensus up to the crisis of 2008 - The financial crisis and the search for a new consensus.

**TEXTBOOK:** Core Business 2 (CB2), Institute and faculty of Actuaries, UK (IFOA),2019

**REFERENCE:**

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 8775881.

## BUSINESS FINANCE – II

**Core: XIV**

**Code: P19AS414**

**Credits: 4**

**Hours: 6**

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### **COURSE OUTCOMES:**

**CO1:** Ability to understand the reason for preparing accounting statements

**CO2:** Knowledge about the accounting concepts, which followed by the company for preparing the accounting statements.

**CO3:** Understand the purpose for preparing and maintaining the statements.

**CO4:** Ability to handle the depreciation, which is treated in company accounts.

**CO5:** Understand basic construction of accounts of different types and the role and principal features of the accounts of a company.

**CO6:** Learned the structure and content of insurance company accounts.

**Unit I: Introduction to accounts & The main accounts:** The accounting framework - The International Accounting Standards Board (IASB) - Typical contents of an annual report - The auditors' report - Accounting concepts - The statement of financial position - The statement of comprehensive income - The cashflow statement - Statement of changes in equity - Notes to the accounts.

**Unit II: Depreciation and reserves:** Depreciation - Capital and reserves - Constructing accounts - The trial balance - Using the trial balance.

**Unit III: Group accounts and insurance company accounts:** Consolidated financial statements - Insurance companies - Interpretation of accounts - Measuring risk associated with loan capital - Ratios involving share information - Introduction to other accounting ratios - Profitability ratios - Liquidity ratios - Efficiency ratios.

**Unit IV: Limitations of accounts and alternative reporting:** The shortcomings of historical cost accounting - Limitations in the interpretation of accounts - Manipulation of reported figures - Reporting on environmental, social and economic sustainability - Evaluation of working capital - Working capital - Working capital management - Sources of short-term finance - Managing cashflows - Cash, dividends and dividend sustainability.

**Unit V: Constructing management information:** The purpose of forecasts and budgets - Examples of forecasts and budgets - Growth and restructuring of companies - Motives for growth - The relationship between profit and growth - The constraints on growth - Methods of achieving growth - Mergers and acquisitions.

**TEXTBOOK:** Core Business 1(CB1), Institute and faculty of Actuaries, UK (IFOA),2019



## **REFERENCE:**

- 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.

## FINANCIAL ENGINEERING – II

Core: XV

Code: P19AS415

Credits: 4

Hours: 6

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### COURSE OUTCOMES:

**CO1:** Importance of reserve in general insurance contract.

**CO2:** Handling the insolvent position in general insurance contract.

**CO3:** Understand the BornHuetter - Ferguson method for estimating outstanding claim amounts.

**CO4:** Evaluate the basic chain ladder method for completing the delay triangle using development factors.

**CO5:** Reduce upper and lower limits for call and put option prices based on general reasoning.

**CO6:** Understand the Black-Scholes model in valuing options.

**Unit I: Asset pricing models** - The capital asset pricing model (CAPM) –introduction- assumptions-consequences of the extra assumptions-the separation theorem-the capital market line-the security market line- Limitations of CAPM – extension of the basic CAPM-Uses of CAPM - Estimating parameters for asset pricing model.

**Unit II: Characteristics of derivative securities:** Arbitrage - Definition – the principle of no arbitrage-Preliminary concepts – notation – European call options-European put options- American options-other terminology- Factors affecting option prices – introduction- underlying share price- strike price-time to expiry – volatility of the underlying share-interest rates- income received on the underlying security-the Greeks and risk management- introduction- 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- Bounds for option prices –lower bounds on option prices-upper bounds on option prices- Put-call parity.

**Unit III: Credit risk:** introduction-Credit events and recovery rates - Approaches to modelling credit risk – structural models- reduced form models-intensity based models- The Merton model - Two-state models for credit risk – interest rates as hazards rates-incorporating recovery rates- The Jarrow - Lando-Turnbull (JLT) model - Stochastic transition probabilities.

**Unit IV: Ruin theory** – introduction-Basic concepts – notation- the surplus process- the probability of ruin in continuous time- the probability of ruin in discrete time- The Poisson and compound Poisson processes –introduction- the Poisson process-the compound Poisson process- probability of ruin in the short term-premium security loadings- a technicality- The adjustment coefficient and Lundberg's inequality - the Lundberg's inequality –the adjustment coefficient – compound Poisson process-lower bound for R-the adjustment coefficient –

general aggregate claims processes-The effect of changing parameter values on ruin probabilities - introduction – a formula for  $\Psi(U)$  when  $F(x)$  is the exponential distribution-  $\Psi(U, t)$  as a function of  $t$  – ruin probability as a function of initial surplus-ruin probability as a function of premium loading – ruin probability as a function of the Poisson parameter – concluding remarks- Reinsurance and ruin – introduction- proportional reinsurance-XOL reinsurance-maximizing the adjustment coefficient under proportional reinsurance-maximizing the adjustment coefficient under excess of loss reinsurance.

**Unit V:Run-off triangles:** introduction - origins of run-off triangles –types of reserves-presentation of claims data-estimating future claims-other ways of recording data- Projections using development factors – run off patterns-the statistical model for 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-assumption underlying method-Loss ratios - The Bornhuetter-Ferguson method-concept of the bornhuetter ferguson method- description of the method-application of the method-assumption underlying the method- grossing up factor versus development factors.

**TEXTBOOK:** Core Mathematics – CM2, Institute and faculty of Actuaries, UK (IFOA),2019

**REFERENCE:**

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. 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.

## PYTHON PROGRAMMING LANGUAGE

**Elective: V**

**Code: P19AS4:P**

**Credits: 4**

**Hours: 6**

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### **COURSE OUTCOMES:**

**CO1:** Able to build and package Python modules for reusability.

**CO2:** Read and write files in Python.

**CO3:** Design object-oriented programs with Python classes.

**CO4:** Use class inheritance in Python for reusability.

**CO5:** Use exception handling in Python applications for error handling.

**CO6:** Indexing and slicing to access data in Python programs.

**Unit I: Python Basics and Functions** - Variables – Operators – statements – Getting In Puts – Boolean Conditions – Alternative, Chained and Nested Conditions – Catching Expectations – Function Calls – Built-in Functions – Type Conversion Function and Math Function – creating New Functions, Parameters and Arguments – Need for Functions.

**Unit II: Loops - While** Statement – Infinite Loops – Continue Statement – For Loops – Counting and Summing Loops – Maximum and Minimum loops.

**Unit III: Strings** - Traversal through Strings – String Slice – looping and Counting in Strings – The in Operator – String Comparison – String Methods – Parsing Strings – Format Operator.

**Unit IV: Files** - Opening Files – Text Files – Reading Files – Searching Through Files – Selecting Files Names from User – Writing Files.

**Unit V: List - Traversing** List – List Operations – List Slice – List Methods – Deleting elements – Built – in List functions – Objects, Value, Aliasing – List Arguments.

**REFERENCE:** Nischay Kumar Hegde, Python Programming Fundamentals – A beginners Hand book, 2018.