SYLLABUS

M.Sc Actuarial Science

2020 onwards

DEPARTMENT OF ACTUARIAL SCIENCE

BISHOP HEBER COLLEGE (AUTONOMOUS)

(Nationally Reaccredited with A+ Grade by NAAC)

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
			Sem I Credits :		22			
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
			Sem II Credits :		24			
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	Advanced Management Science	P19AS3:1	6	5	25	75	100
	Elective IV	Advanced MS-EXCEL	P19AS3:P	6	4	40	60	100
			Sem III Credits :		23			
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
			Sem IV Credits :		21			
				Total Credits :	90			

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**

Course objectives:

1. To learn basic univariate distributions like dictate probability distributions and continuous probability distributions
2. To learn key characteristics of discrete and continuous
3. To evaluate probabilities and quantiles associated with distributions (by calculation or using statistical software as appropriate)
4. Learn to identify the applications for which generating functions and why they are used
5. To learn about basic and advanced level of probability and its distribution and its situations.
6. To know about the central limit theorem and its applications
7. To learn about sampling theory and its applications and statistical inference and to compare the sampling distribution with the normal
8. To learn about estimation in point and interval and apply in different situations.

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 $E[Y \mid X = x]$ - The random variable $E[Y \mid X]$ - The random variable var$[Y \mid X]$ and the '$E[V]$□ 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

Course Outcomes:

1. Develop problem-solving techniques needed to accurately calculate probabilities.
2. Will have enough knowledge to use different types of distribution to fitting model.
3. Apply problem-solving techniques to solving in Actuarial field.
4. Present the analysis of derived statistics in Actuarial field.
5. Develop problem solving techniques in testing of hypothesis.
6. To have application knowledge in actuarial data in the field of estimation theory.
7. Apply simulated data from the given distributions and compare with normal distribution.
8. Deal with survey data and apply statistical techniques using statistical software.

ACTUARIAL MATHEMATICS – I

Core: II **Code: P19AS102** **Credits:5** **Hours:6**

Course Objectives:

1. The aim of the Financial Mathematics subject is to provide grounding in financial mathematics and its simple applications.
2. To understand the types of cash flows.
3. To learn about the different types of interest rates.
4. To learn about the annuities concept with present value and accumulated value.
5. To learn about concept of varying annuities.
6. To learn about loan Schedules.
7. To learn about Financial Derivatives and Investments.
8. To learn about the features of financial derivatives.

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 - Analysing 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 publications unit.

Course Outcomes:

1. Ability to understand different types of cash flow models
2. Ability to handle different situations of compound interest problems in banking and financial sectors.
3. Ability to understand the different types of interest rates.
4. Develop various models related to interest rates.
5. To understand about annuities in financial sector.
6. Ability to identify and classify the varying annuities on the basis of cash flows.
7. Develop to analyze different types of annuities and to know, how to handle that.
8. Ability to create a model on the basis of the structure of the cash flows and types of interest rates.

ACTUARIAL MATHEMATICS – II

Core: III **Code: P19AS103** **Credits: 4** **Hours: 6**

Course Objectives:

1. The aim of the Actuarial Mathematics subject is to provide grounding in Life contingencies and its simple applications.
2. To understand the types of assurances & annuities.
3. To learn about evaluation of types of assurances & annuities
4. To learn about types of reserves.
5. To calculate premiums for life insurance contracts
6. To define the assurance factors and their select and continuous equivalents.
7. To develop formulae for the means and variances of the payments under various assurance and annuity contracts, assuming a constant deterministic interest rate.
8. To define the assurance and annuity factors and their select and continuous equivalents.
9. Extend the annuity factors to allow for the possibility that payments are more frequent than annual but less frequent than continuous.

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.*

Course Outcomes:

1. Ability to handle different situations of policies.
2. Construct the premium & reserve table.
3. Develop various types of reserves.
4. Understand and use the relations between annuities payable in advance and in arrears, and between temporary, deferred and whole life annuities.
5. Describe and calculate gross premiums and reserves of assurance and annuity contracts.

6. Understand and use the relations between assurance and annuity factors using equation of value, and their select and continuous equivalents.
7. Develop formulae for the means and variances of the payments under various assurance and annuity contracts, assuming a constant deterministic interest rate.
8. Understand the concept of gross random future loss under an insurance contract.

SURVIVAL ANALYSIS – I

Core: IV	**Code: P19AS104**	**Credits: 4**	**Hours: 6**

Course Objectives:

1. To study Stochastic process.
2. To compute different methods Stochastic process.
3. To know real time applications of Stochastic process.
4. To know the Markov Chains.
5. To know the two-state Markov model and the Poisson model.
6. To study the Time-homogeneous Markov jump processes.
7. To know the Chapman- Kolmogorov equations.
8. To study the Time-inhomogeneous Markov jump processes.

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 $S = \{... - 2, -1, 0,1, 2, ...\}$ - 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 behaviour 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 - Maximising 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

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

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

Course Outcomes:

1. Apply the real time application of stochastic process.
2. Identify the methods stochastic process.

3. Compute the different applications of stochastic process & Poisson process.
4. Identify the different kinds of Markov Chains.
5. Compute the two-state Markov model and the Poisson model.
6. Compute the Time-homogeneous Markov chains.
7. Analyze the Chapman- Kolmogorov equations.
8. Compute the Time-inhomogeneous Markov jump processes.

PRINCIPLES OF INSURANCE

Elective: I	**Code: P19AS1:2**	**Credits: 4**	**Hours: 4**

Course Objectives:

1. This course intends to provide a basic understanding of the insurance mechanism.
2. It explains the concept of General Insurance and how it is used to cover risk.
3. Identify the relationship between Insurers and their insured's, the importance of Insurance Contracts.
4. Give an overview of major Life Insurance and General Insurance Products.
5. How insurance is transacted as a business.
6. To understand the functions of IRDAI & Insurance councils.
7. To understand about the protection of policyholder's interest.
8. To Study about the taxation of insurance.

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 past-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

Course Outcomes:

1. Describe the historical development of insurance.
2. Able to highlight the components of risk.
3. Able to name the various role players in the insurance market.
4. Apply the basic insurance knowledge and skills to his/her workplace.
5. Operate as lower level officers with insurance firms or run an insurance agency.
6. Acquire technical and practical skills needed in building careers in the insurance industry.
7. Acquire knowledge in selling, investigating and underwriting insurance business functions in the workplace.
8. Gain the necessary business ethics with special reference to the insurance industry.

SEMESTER - II

ACTUARIAL STATISTICS – II

Core: V **Code: P19AS205** **Credits: 4** **Hours: 5**

Course Objectives :

1. To learn Analysis of variance
2. To construct model using simple linear regression
3. To learn the multiple linear regression model
4. To learn about Bayesian statistics and its applications.
5. To know about the Credibility theory
6. To learn about the GLM application
7. To predict the risk premium using EBCT model 1.
8. To estimate the risk premium using EBCT model 2.

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: Generalised linear models: Introduction - Generalised 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.

Course Outcomes:

1. Develop the ability to find the relationship between variables and predicting using model.
2. Fit multiple regression model
3. Apply Bayesian Statistics to estimate the posterior distribution
4. Predict the risk premium for insurance company
5. Fix the premium rate to the insurance company
6. Analyse the risk
7. Forecast the future claim amount using regression model
8. Model fit to the collection of data.

ACTUARIAL MATHEMATICS – III

Core: VI **Code: P19AS206** **Credits: 4** **Hours: 5**

Course Objectives :

1. To learn the concept about the equation of value
2. To learn about loan Schedules
3. Learn to calculate the capital outstanding by using prospective and retrospective methods.
4. To analyze the project with various criteria and predict the solution on the basis of return.
5. To measures the project returns by using various strategies.
6. To learn about the features of different types of financial instruments and Investments.
7. To learn about the uses of bonds and derivatives.
8: To learn about the investment and its return on the basis of various term structures.

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'? – Immunisation - 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.

Course Outcomes:

1. Ability to understand the concepts relating to functions and annuities.
2. To know, how to apply the theoretical concept and find the solution for unknown quantity
3. Develop the skill to know, how to apply the equations of value in loan repayment process.
4. To develop the skill related to APR
5. Distinguish the different situations of financial projects
6. Students can play a role as a fund manager in financial institutions.
7. Analyze the different types of term structure of interest rates.

8. To analyze the investment on the basis of different parameters.

ACTUARIAL MATHEMATICS – IV

Core: VII **Code: P19AS207** **Credits: 4** **Hours: 5**

Course Objectives:

1. The aim of the Actuarial Mathematics subject is to provide grounding in Life contingencies and its simple applications.
2. To understand the types of assurances & annuities.
3. To learn about evaluation of types of assurances & annuities
4. To learn about types of reserves.
5. To calculate premiums for life insurance contracts
6. To define the assurance factors and their select and continuous equivalents.
7. To develop formulae for the means and variances of the payments under various assurance and annuity contracts, assuming a constant deterministic interest rate.
8. To define the assurance and annuity factors 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.

Course Outcomes:

1. Ability to handle different situations of policies.
2. Construct the premium & reserve table.
3. Develop various types of reserves.
4. Understand and use the relations between annuities payable in advance and in arrears, and between temporary, deferred and whole life annuities.
5. Describe and calculate gross premiums and reserves of assurance and annuity contracts.
6. Understand and use the relations between assurance and annuity factors using equation of value, and their select and continuous equivalents.
7. Develop formulae for the means and variances of the payments under various assurance and annuity contracts, assuming a constant deterministic interest rate.
8. Understand the concept of gross random future loss under an insurance contract.

SURVIVAL ANANLYSIS – II

Core: VIII **Code: P19AS208** **Credits: 4** **Hours: 5**

Course Objectives:

1. To study Survival models.
2. To compute different methods of Survival models.
3. To know real time applications of Survival models.
4. To know the Estimating the lifetime distribution function.
5. To know the Proportional hazards models.
6. To study the Graduation and statistical tests.
7. To know the Methods of graduation.
8. To study the Mortality projection.

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 .–hapman& Hall, 1999. – xviii, 280 pages. – ISBN: 0 8493 0389.

R3: Analysing 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.

Course Outcomes:

1. Apply the real time application of Survival models.
2. Identify the methods of Survival models.
3. Compute the different kinds of lifetime distribution functions.
4. Analyze the Proportional hazard models.
5. Compute the Graduation and Methods.
6. Analyze the Graduation and statistical tests.
7. Compute the Methods of Graduation.
8. Analyze the Mortality projection.

RISK MODELLING

Core: IX **Code: P19AS209** **Credits: 4** **Hours: 5**

Course Objectives:

1. To understand univariate time series and forecast method.
2. To identify the bivariate in time series and forecast method.
3. To understand extreme value theory and copulas.
4. To understand the reinsurance contract and its importance.
5. To know the collective risk application in general insurance contract.
6. To apply individual risk model in general insurance contract.
7. To know the distribution application in insurance contract.
8. To know the non-stationary process to stationary process.

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 - Generalised extreme value (GEV) distribution - Generalised 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.

Course Outcomes:

1. Develop the general insurance products.
2. Fundamental of general insurance contract.
3. Identifying the non-stationary process to stationary process.
4. Importance of reinsurance contract.
5. Apply statistical techniques in general insurance contract.
6. Forecasting methodology.
7. Stochastic application in financial contract.
8. Application of compound distribution in general insurance contract.

PROGRAMMING USING R

Elective:II **Code: P19AS2:P** **Credits: 4** **Hours: 4**

Course Outcomes:

1. Learn to work with R-Studio and R – Code
2. Understand and getting familiarity with R language
3. Learn to perform basic analysis and visualization with R
4. Learn to applying R to their own domain-specific problems
5. Learn to compute descriptive analysis
6. Learn to compute basic statistical inference
7. Learn debugging, and organizing and commenting R code
8. To learn over all atmosphere about R programming

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 Whiteny – 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 Books:

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

Reference Book:

Randall E. Schumacker, Learning statistics using R Randall E. Schumacker, Learning statistics using R, Sage Publications Inc, 2014

Course Outcomes:

1. Use R studio to write and R code.
2. Write syntactically correct R expressions that involve variables, variable assignment, operators and functions.
3. Able to Identify basic R data types (character, double, integer and logical)
4. Able Identify basic R data structures relevant to modern data analysis (atomic vectors and data frames)
5. Apply the basic verbs of data transformation of actuarial data.
6. Able to Create statistical graphics with ggplot.
7. Apply descriptive analysis tools in actuarial application.
8. Able to solve actuarial case studies and simulated projects to sharpen your skill sets.

SEMESTER - III

BUSINESS ECONOMICS – I

Core: X **Code: P19AS310** **Credits: 4** **Hours: 6**

Course Objectives :

1. To introduce students to the core economic principles.
2. It provides grounding in the fundamental concepts of micro and macroeconomics.
3. Ability to provide products that meet individual and institutional clients' needs.
4. Relevance of Economic to the world of Business.
5. To discuss consumer demand and behavior.
6. To gain knowledge of the production function, cost of production, revenue and profit.
7. To know profit maximization under imperfect competition.
8. To understand the role of a firms growth strategy on its profitability and survival.

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 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.

Course Outcomes:

1. To understand the core economic concepts like out puts, inputs, technology location and competition.
2. To understood the reaction of changes in demand and supply.
3. To understood the risk and uncertainty about future market movements.
4. To understand the various pricing strategies the firms can adopt.

BUSINESS FINANCE – I

Core: XI **Code: P19AS311** **Credits: 5** **Hours:**

Course Objectives :

1. To learn the basic understanding of corporate finance.

2. To learn about the different types of taxation and its slab rates.
3. To learn about the financial instruments and to know how it's used by companies to raise finance
4. To learn about the different structure of the financial instruments.
5. to understand about long term finance.
6. To understand about short term finance and its characteristics.
7. To learn about the derivatives and its uses.
8. To learn about the capital structure and dividend policy.

Unit I : Key principles of finance and corporate governance: Finance and real resources – Stakeholders - Capital markets and the maximisation 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. - 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.

Course Outcomes:

1. Knowledge to understand the position of each stakeholder.
2. Develop the knowledge in capital market and analyze about the investments.
3. Ability to handle the different types of Business entity
4. To understand the pros and cons about limited companies and to know about the different types of taxation
5. Skill to understand different types of issue of shares and shareholders.
6. Knowledge regarding the process for getting quotation
7. Evaluate the project with different stages by using probability trees.
8. Understand the debt and capital structure

FINANCIAL ENGINEERING - I

Core: XII **Code: P19AS312** **Credits: 5** **Hours: 6**

Course Objectives :

1. To introduce Economic Principles to the students
2. To understand the utility functions
3. To know the capital assets pricing model
4. To identify the risk of insurance company.
5. To solve asset pricing models
6. To find out the risk and return of the portfolio.
7. To discuss the important ideas of specific risk – risk that can be diversified away – and systematic risk .
8. Describe the concept of a stochastic investment return model and the fundamental distinction between this and a deterministic model.
9. State conditions for absolute dominance and for first- and second-order dominance.
10. To demonstrate a basic understanding of stochastic differential equations.

Unit I: The Efficient Markets Hypothesis: Rational expectations theory - The evidence for or against each form of the Efficient Markets Hypothesis - 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 - Maximising utility through insurance - Limitations of utility theory.

Unit II: Stochastic dominance and behavioural finance & Measures of investment risk: Stochastic dominance - Behavioural finance - Measures of risk - Relationship between risk measures and utility functions - Risk and insurance companies.

Unit III: Stochastic models of investment returns & Portfolio theory: Simple models - lognormal distribution - Benefits of diversification.

Unit IV: Models of asset returns: Multifactor models - The single-index model - Asset pricing models - The capital asset pricing model (CAPM) - Limitations of CAPM - Uses of CAPM - Estimating parameters for asset pricing models - Brownian motion and martingales - Introduction to Brownian motion – Martingales.

Unit V: Stochastic calculus and Its processes: Stochastic calculus - Stochastic calculus - Stochastic models of security prices - Are stochastic processes good models for asset prices? - The continuous-time lognormal model.

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.

Course Outcome:

1. Apply utility function in insurance contract.
2. Modeling of investment returns.
3. The operation of insurance and other financial systems understood.
4. Meeting the individuals of the financial institutions and their clients needs.
5. Analysis the best portfolio based risk and return.
6. Predict the risk of the insurance company.
7. Find out the expected return from the portfolio.
8. Recall that the expected utility theorem suggests that a rational investor will aim to maximise their expected utility.
9. Use of a shortfall risk measure corresponds to a utility function that has a discontinuity at the minimum required return.

ADVANCED MANAGEMENT SCIENCE

Elective: III **Code: P19AS3:1** **Credits: 5** **Hours: 6**

Course Objectives :

1. To formulate mathematical model for Decision and Game Theory.
2. To apply the concept of Graphical method in Game Theory.
3. To understand the basic concepts of Integer Programming Problem and its applications.
4. To Solve Integer programming problem by using Branch and Bound Methods.
5. To introduce the concept of sequencing and solve it by using Johnson's Method and Graphical Method.
6. To understand the basic concepts of Queuing theory and Dynamic Programming Problem.
7. To Solve Dynamic Programming Problem by using calculus and tabular method.
8. To introduce the field of operations research this has many applications in management techniques.

Unit I: Decision Theory and Games: Introduction - Decisions Under Risk – Decision Trees – Decisions Under Uncertainty – Game Theory - Graphical Method –LPP Application.

Unit II: Integer Programming : Introduction - Mathematical Formulation of Pure and Mixed Integer Programming and Zero-One Programming Problem – Solving IPPs using Branch and Bound Method [Exactly Two Variables model only].

Unit III: Sequencing : Introduction – Johnson's Method – Graphical Method.

Unit IV: Queuing Theory: Introduction – some queuing terminologies – Queuing Model 1 – Queuing Model 3 – Example Problems.

Unit V: Dynamic Programming: Introduction – Calculus Method to solve a DPP – Tabular Method to Solve a DPP – DPP application to solve an LPP.

Textbook:

1. Unit-1 and Unit-2: Hamdy A. Taha, Operations Research An Introduction [1982] ––- Third Edition – Maacmillon Publishing - ISBN:0-02-418860-3.
2. Unit-3, Unit-4 and Unit-5: - P. Mariappan, Operations Research An Introduction– Pearson-First Edition-ISBN: 978-81-317-9934-5

Reference:

R1: "Operations Research - An Introduction [1982]", Hamdy A. Taha - Third Edition, Maac millon Publishing, ISBN: 0-02-418860-3.
R2: "Operations Research - An Introduction", P. Mariappan, Pearson, First Edition, ISBN: 978-81-317-9934-5

Course Outcomes:

1. Understand the meaning of Operations Research and how to use it.
2. Write integer programming program in the event of minimum cost or maximum profit.
3. Solve Integer programming problem using Branch & Bound Method.
4. Explain the mathematical formulation of Pure and Mixed integer programming problem.
5. Understand the characteristics of different types of decision-making environments and the appropriate decision making approaches and tools to be used in each type.
6. Build and solve Sequencing Problems.
7. Explain queuing theory and its applications.
8. Discuss the Mathematical Formulation and solving techniques for Dynamic Programming Problem.

ADVANCED MS-EXCEL

Elective : IV **Code: P19AS3:P** **Credits: 4** **Hour: 6**

Course Objectives:

1. To understand basic to advance level of functions using Ms-excel
2. To equip students with the knowledge on debug and audit the advanced formulae
3. To Explore the magic of analyzing data using advanced excel
4. To train the students in using Advanced MS-Excel for solving a variety of Statistical and Actuarial problems
5. To train students to calculate NPV, IRR and loan schedule problems using Ms- Excel
6. Learn to integrate information and build models
7. Learn to choose charts to successfully highlight their research result and interpret charts
8. To be comfortable using Ms- excel as a data analysis tool (Advanced).

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

Course Outcomes:
1. Able to define the statistical terms and its measures.
2. Able to compute descriptive statistical measure.
3. Will have capacity to recognize the applications of Statistical measure.
4. Able to compare using descriptive measures (Statistical Software and Ms-Excel).
5. Able to analysis the data relationship using correlation.
6. Able to predict the variation using regression.
7. Able to Demonstrate the procedure to compute statistical measure using statistical software tool.
8. Able to apply basic functions using MS-Excel.

SEMESTER - IV

BUSINESS ECONOMICS – II

Core: XIII **Code: P19AS413** **Credits: 4** **Hours: 6**

Course Objectives:

1. To introduce students to the core economic principles.
2. It provides grounding in the fundamental concepts of micro and macroeconomics.
3. Ability to provide products that meet individual and institutional clients' needs.
4. Relevance of Economic to the world of Business.
5. To discuss consumer demand and behavior.
6. To gain knowledge of the production function, cost of production, revenue and profit.
7. To know profit maximization under imperfect competition.
8. To understand the role of a firms growth strategy on its profitability and survival.

Unit I: International trade and payments: Globalisation: 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 harmonisation and monetary union: Globalisation 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.

Course Outcomes:

1. To understand the core economic concepts like out puts, inputs, technology location and competition.
2. To understood the reaction of changes in demand and supply.
3. To understood the risk and uncertainty about future market movements.
4. To understand the various pricing strategies the firms can adopt.

BUSINESS FINANCE – II

Core: XIV **Code:P18AS414** **Credits: 4** **Hours: 6**

Course Objectives :

1. To learn about the accounting standards and to know about the accounting concepts and to interpret the accounts and financial statements of companies and financial institutions.
2. To learn about the depreciation and reserves for preparing the accounting Statements.
3. To learn about the group accounts and insurance company accounts.
4. To know about the limitation of accounts.
5. To know about the forecasting and budgeting.
6. To Manage financial risk and to provide the ability to interpret the accounts and financial statements of companies and financial institutions.
7. To analyze the credit risks.
8. To learn about working capital and to know about working capital management.

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.

Course Outcomes:

1. Ability to understand the reason for preparing accounting statements
2. Knowledge about the accounting concepts, which followed by the company for preparing the accounting statements.
3. Understand the purpose for preparing and maintaining the statements.
4. Ability to handle the depreciation, which is treated in company accounts.
5. Understand basic construction of accounts of different types and the role and principal features of the accounts of a company.
6. Learned the structure and content of insurance company accounts
7. Learned to evaluate policies for working capital management, including its individual elements.
8. Understand the function forecasts and budgets and prepare budgets.

FINANCIAL ENGINEERING – II

Core: XV **Code: P19AS415** **Credits: 4** **Hours: 6**

Course Objectives :

1. To understand the characteristics of derivatives and securities and black Sholes model
2. How to estimate the reserve in general insurance contract
3. To understand the ruin probability in insurance contract
4. To introduce Economic Principles to the students
5. To focuses on the mathematics underlying the valuation of derivatives.
6. Consider the argument we used to derive the lower bounds for European call and put options on a non-dividend-paying stock.
7. To develop simple models that can be used to value derivatives.
8. To identify the underlying asset in a single portfolio allow us to modify our exposure to risk.

Unit I: Characteristics of derivative securities: Arbitrage - Preliminary concepts - Factors affecting option prices - Pricing forward contracts - Bounds for option prices - Put-call parity - The Greeks - Portfolio risk management.

Unit II: The binomial model: Background - The one-period model - Two-period binomial tree - n-period binomial tree - Recombining binomial trees - Calibrating binomial models - The state price deflator approach - The Black-Scholes option pricing formula - The assumptions underlying the Black-Scholes model - The Black-Scholes model - The Black-Scholes model for dividend-paying shares - Implied volatility.

Unit III: The 5-step method in discrete time: Preliminary concepts - The martingale representation theorem - Another look at the binomial model - The 5-step method in continuous time - The state price deflator approach - The 5-step approach with dividends

Unit IV: The term structure of interest rates: Notation and preliminaries - Desirable characteristics of a term structure model - Models for the term structure of interest rates - Summary of short-rate modeling - State-price deflator approach to pricing.

Unit V: Credit risk: Credit events and recovery rates - Approaches to modelling credit risk - The Merton model - Two-state models for credit risk - The Jarrow-Lando-Turnbull (JLT) model - Stochastic transition probabilities - **Ruin theory** - Basic concepts - The Poisson and compound Poisson processes - The adjustment coefficient and Lundberg's inequality - The effect of changing parameter values on ruin probabilities - Reinsurance and ruin - **Run-off triangles** - The origins of run-off triangles - Projections using development factors - Adjusting for inflation - The average cost per claim method - Loss ratios - The Bornhuetter-Ferguson method.

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.

Course Outcomes:

1. Importance of reserve in general insurance contract.
2. Handling the insolvent position in general insurance contract.
3. Understand the Bornhuetter-Ferguson method for estimating outstanding claim amounts.
4. Evaluate the basic chain ladder method for completing the delay triangle using development factors.
5. Reduce upper and lower limits for call and put option prices based on general reasoning.
6. Understand the Black-Scholes model in valuing options.
7. Modeling of investment returns.
8. Analysis the best portfolio based risk and return.

PYTHON PROGRAMMING LANGUAGE

Elective: V **Code: P19AS4:P** **Credits: 4** **Hours: 6**

Course Objectives:

1. To understand why Python is a useful scripting language for developers.
2. To learn how to design and program Python applications.
3. To learn how to use lists, tuples, and dictionaries in Python programs.
4. To learn how to identify Python object types.
5. To learn how to use indexing and slicing to access data in Python programs.
6. To define the structure and components of a Python program.
7. To learn how to write loops and decision statements in Python.
8. To learn how to write functions and pass arguments in Python.

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.

Course Outcomes:

1. Able to build and package Python modules for reusability.
2. Read and write files in Python.
3. Design object-oriented programs with Python classes.
4. Use class inheritance in Python for reusability.
5. Use exception handling in Python applications for error handling.
6. Indexing and slicing to access data in Python programs.
7. Lists, tuples, and dictionaries in Python programs.
8. Identify Python object types.