DEPARTMENT OF ACTUARIAL SCIENCE

SCHOOL OF MATHEMATICAL SCIENCES

NORTH MAHARASHTRA UNIVERSITY

JALGAON - 425001, INDIA

SYLLABUS
FOR

T.Y.B.Sc. (Actuarial Science)

Under

the course

B.Sc. (Actuarial Science)

WITH EFFECT FROM ACADEMIC

YEAR 2012-2013

Department of Actuarial Science
School of Mathematical Sciences
North Maharashtra University, Jalgaon

Syllabus Structure for T.Y.B.Sc. (Actuarial Science)

Under

the course
B.Sc. (Actuarial Science)

Semester-I

Course Code	Title of the Course	Contact hours/week			Distribution of Marks for Examination						Credits
					Internal		External		Total		
		Th(L)	Pr	Total	Th	Pr	Th	Pr	Th	Pr	
AS-501	Survival Models	03	--	03	40	--	60	--	100	--	04
AS-502	Mathematical Statistics	03	--	03	40	--	60	--	100	--	04
AS-503	Finance and Financial Reporting	03	--	03	40	--	60	--	100	--	04
AS-504	Life Contingencies-II	03	--	03	40	--	60	--	100	--	04
AS-505	Mathematics of Demography	03	--	03	40	--	60	--	100	--	04
AS-506	Practicals-V	--	04	04	--	40	--	60	--	100	04

Semester-II

Course Code	Title of the Course	Contact hours / week			Distribution of Marks for Examination						Credits
					Internal		External		Total		
		Th(L)	Pr	Total	Th	Pr	Th	Pr	Th	Pr	
AS-601	Stochastic Modeling	03	--	03	40	--	60	--	100	--	04
AS-602	Applied Statistics	03	--	03	40	--	60	--	100	--	04
AS-603	Credibility Theory and Loss Distribution	03	--	03	40	--	60	--	100	--	04
AS-604	Life Contingencies-III	03	--	03	40	--	60	--	100	--	04
AS-605	Financial Economics	03	--	03	40	--	60	--	100	--	04
AS-606	Practicals-VI	--	04	04	--	40	--	60	--	100	04

Note: Syllabus structure of the course B.Sc. (Actuarial Science) is given separately.

Examination and Declaration of result: Internal and External Examinations will be conducted by the Department of Statistics under Academic flexibility and results will be declared by University's Examination section based on CGPA system.

Detailed Syllabi for T.Y.B.Sc.(Actuarial Science)

AS-501: Survival Models

- **Principles of modelling:** Need, benefits and limitations of models.   (5L)
- **Concepts of Survival Models**   (10L)
  The distribution and density functions of the random future lifetime, the survival function, the force of mortality or hazard rate and derive relationships between them, Laws of mortality like Gompertz and Makeham, the distribution and density functions of the curtate future lifetime random variable.
- **Estimating the future lifetime distribution**   (10L)
  Truncation, Right censoring, Left or interval censoring, Likelihood construction for censored and truncated data, Kaplan-Meier model, Nelson Aalen model, Cox proportional hazard model, Breslow's approximations to the partial likelihood estimator.
- **Binomial and Poisson Model**   (10L)
  Maximum likelihood estimator of transitions intensities in Binomial and Poisson model and their mean-variances, advantages and disadvantages of multiple state models and the binomial models, including consistency, efficiency, simplicity of the actuarial estimators and their distributions, application to practical observations and generality.
- **Graduation**   (10L)
  Initial and central exposed to risks, graduation, purpose and methods of graduation, testing goodness of fit and testing smoothness of a set of graduated estimates, statistical test for comparing a set of crude estimates and a standard table or a set of crude estimates and a set of graduated estimates, effect of duplicate policies on estimates.

References

- UK Institute of Actuaries core reading for subject CT4-Models.
- Klein J.P. and Moeschberger, M.L.(2003) Survival Analysis: Techniques for Censored and Truncated Data 2nd Edition, Springer Verlag, New York,.
- Klugman, S.A.(June 2003), "Estimation, Evaluation, and Selection of Actuarial Models".
- Dick London (1997), Survival Models and their Estimation, second edition, ACTEX publications.
- Cox, D.R. and Oakes, D.(1984) Analysis of Survival Data, Chapman and Hall, New York.

AS-502 Mathematical Statistics

- **Review:**   (3L)
  Revision of problems on common univariate distributions; use of CDF, MGF, PDF; variable transformations (Jacobians, graphical domain transformation); distribution of order statistics.

- **Multivariate Normal Distributions:**   (6L)
  Definition, MGF, joint and marginal distributions of linear combinations of MVN random variables. Cochran's theorem on quadratic forms(without proof).

- **Limit Distributions:**   (5L)
  Concept of a degenerate distribution; convergence in distribution (use of the CDF, MGF); Convergence in probability; proof of the CLT; use of Slutsky's theorem.

- **Sufficiency and Completeness:**   (12L)
  Concept of Fisher's Information function, Sufficient statistic, factorization theorem; Minimal sufficient statistic, Rao-Blackwell theorem; Exponential and Pitman family of distributions, Concept of a complete family of distributions; completeness and uniqueness(Lehmann-Scheffe theorem); ancillary statistics; completeness and independence(Basu's theorem); minimum variance unbiased estimation; Cramer-Rao inequality.

- **LR Test:**   (8L)
  Review of likelihood ratio test, Neyman-Pearson lemma; power of a test, Uniformly Most Powerful Test; Monotone likelihood ratio property, unbiased tests.

- **Baysian Estimation:**   (6L)
  Prior distribution, loss function, principle of minimum expected posterior loss, quadratic and other common loss functions, conjugate prior distributions, common examples.

- **Non-Parametric tests:**   (5L)
  Tests of randomness. Sign test, Wilcoxon signed rank test, Kolmogorov-Smirnov test.

References

- John E Freund (2004) Mathematical Statistics with applications. 7th ed. Upper saddle River, NJ: Prentice Hall. ISBN: 0131246461.

- Rohatgi V.K & A.K. MD. Ehsanes Saleh: An Introduction to Probability Theory and Mathematical Statistics, 2nd. John Wiley and Sons, 2001.

- Wackesly D.D; Mondonhall III, William and Scheffer, R.L Mathematical Statistics with applicable Duxbury, 2002.

- Hogg, R.V. and Craig, A.T. Introduction to Mathematical Statistics, (5th Ed. Pearsons Education) 1978.

- Hogg, R.V. and Tanis E. A. Probability and Statistical Inference (6th Ed. Pearsons Education) 2002.

- Dudewicz, E. J. and Mishra, S. N. Modern Mathematical Statistics, (Wiley & Sons) 1988.

- Rao, C.R. (2002). Linear Statistical Inference and Its Applications, (2nd Ed, Wiley Eastern).
- Kale B.K.(2005). A First Course on Parametric Inference, (2nd Narosa Publishing House).

AS-503 Finance and Financial Reporting

- Principal terms in investment and asset management.   (4L)
- Key principles of finance.   (4L)
- Structure of Joint Stock Company and the different methods of financing by which it may be financed.   (4L)
- Basic principle of personal and corporate taxation.   (4L)
- The characteristics of principal forms of financial instrument used by companies.   (4L)
- Factors to be considered by a company when deciding on its capital structure and dividend policy.   (5L)
- Definition of company's cost of capital & the nature of the investment projects.   (5L)
- The basic construction of accounts of different types and principal features of the accounts of a company.   (5L)
- Interpretation of the accounts of a company or a group of companies and limitations of such interpretation.   (5L)
- Financial techniques used in the assessment of capital investment projects.   (5L)

References

- UK Institute of Actuaries core reading for subject CT2-Finance and Financial Reporting.
- Brigham, Eugene F and Houston, Joel F., Fundamentals of financial management. 9th ed. Harcourt Brace, 2000 ISBN 0030314615.
- Holmes, Geoffrey and Sugden, Alan, Interpreting company reports and accounts. 7th ed. Prentice hall, 1999 ISBN 027364615X.
- Samuels, J.M; Wikes, F.M; Bray Shaw, R.E, Management of company finance. 6th ed. International Thomson, 1995 ISBN 1861522290.
- Brealey, Richard A and Myers, Stewart C., Principles of corporate finance. 6th ed. McGraw-Hill, 1999 ISBN 0077095650.
- Brett, How to read the financial pages. M. 2nd ed. Random House Business Books, 2003. ISBN:0712662596

AS-504 Life Contingencies-II

- **Net premiums or Benefit premiums**   (12L)
  The random future loss under an assurance or annuity contract, state the principle of equivalence, Notations and formulae of net premium for common life insurance contracts, Fully Discrete Premiums, True m-thly payment premium, Commutation functions, increasing and decreasing Benefit premiums, Profits contract, Types of bonus, Calculating net premiums for with-profit contracts.

- **Benefit Reserves**   (9L)
  Prospective and Retrospective Reserves , Net future random loss for reserves, Conditions for equality of prospective and retrospective Reserves, Fully Continuous Benefit Reserves, other formulas for fully Continuous Benefit Reserves, Fully Discrete Benefit Reserves, Benefit Reserves on a Semi-continuous basis, Benefit Reserves based on True m-thly Benefit premiums, Net Premium Reserves, Thiele's Differential Equation, Death strain at risk(DSAR), Expected death strain(EDS), Actual death strain (ADS), Mortality profit, Mortality profit on a portfolio of policies, Calculating net Reserves for with-profit contracts.

- **Analysis of Benefit Reserves**   (6L)
  Benefit Reserves for General Insurances, Recursion Relations for Fully Discrete Benefit Reserves, Benefit Reserves at Fractional Durations.

- **Insurance Models Including Expenses**   (8L)
  List the type of expenses incurred in writing a life insurance contract, Describe the influence of inflation on the expenses, Define the gross future loss random variable for the benefits and annuities using equivalence principle.

- **Multiple Life Functions**   (10L)
  Joint distribution of Future Lifetimes, The Joint-Life Status, The Last-Survivor Status, More Probabilities and Expectations, Dependent Lifetime Models: Common Shock, Insurance and Annuity Benefits: Survival Status, Special Two-Life Annuities, Reversionary Annuities, Simple Contingent Functions.

References

1. UK Institute of Actuaries core reading for subject CT5-Contingences.
2. Robin Cunningham, Thomas N. Herzog, Richard L. Models for Quantifying Risk, 4th Edition, ACTEX Publications, 2011.
3. Browers, Newton L et al., Actuarial Mathematics 2nd . Society of Actuaries, 1997.
4. Dickson, David C. M., Hardy, Mary R. and Waters, Howard R., Actuarial Mathematics for life contingent risks, International series on actuarial science, Cambridge 2009.
5. Deshmukh S. R., An Introduction to Actuarial Statistics, University Press, 2009

AS-505 Mathematics of Demography

• Data: Sources and errors	(5L)
• Measures of mortality and fertility	(6L)
• Construction of Life Tables from census data	(7L)
• Stationary population Theory	(7L)
• Stable population Theory	(7L)
• Population Projection	(7L)
• Uses of Census data	(6L)

References
1. R. L. Brown, Introduction to Mathematics of Demography, 3rd edition, 1997

AS-506 Practical-V (On PC Using Software)

A.   Practicals based on AS-501 (Survival Models)   (15 Hrs)

1. Plotting of utility functions.
2. Life table using analytical laws of mortality.
3. Estimation of the empirical survival functions in the absence of censoring.
4. Kaplan-Meier (or product limit) estimate and Nelson-Aalen estimate of the survival function in the presence of censoring.
5. Find the actuarial estimates of Initial and Central Exposed to risk under Binomial and Poisson models of number of deaths observed.
6. Test crude estimates for consistency with a standard table or a set of graduated estimates.
7. Test for smoothness of a set of graduated estimates.

B.   Practicals based on AS-502 (Mathematical Statistics)   (18 Hrs)

1. Demonstrating sampling distributions of Statistics/ Estimators.
2. Plotting of likelihood functions for standard probability distributions.
3. Generating random sample multivariate Normal.
4. Unbiased estimation for the parameters of different probability models.
5. Comparison of more than two estimators through Mean Squared Error.
6. Likelihood ratio test
7. Plotting of a power function for discrete and continuous probability distributions.
8. Most Powerful tests, Uniformly Most Powerful tests for continuous, mixture and truncated Distributions.
9. Estimation of Minimum sample size required to attain given power.
10. Baysian Estimation.
11. Non-Parametric tests.

C.   Practicals based on AS-504 (Life Contingencies-II)   (15 Hrs)

  1. Calculation of Net premiums or Benefit premiums.
  2. Calculation of m-thly payment premium.
  3. Calculation of Benefit Reserves.
  4. Analysis of Benefit Reserves.
  5. Insurance Models Including Expenses.
  6. Multiple Life Functions.

D.   Practicals based on AS-505 (Mathematics of Demography)   (12Hrs)

  1. Census data.
  2. Measures of mortality and fertility.
  3. Construction of Life Tables from census data.
  4. Stationary population.
  5. Stable population.
  6. Population Projection.

AS-601: Stochastic Modelling

- **Principles of stochastic modelling**   (2L)
  Need, benefits and limitations of models, advantages/disadvantages of stochastic and deterministic models, short-run and long-run properties of models, applications of models.

- **Stochastic processes**   (4L)
  Types of Stochastic processes, sample path, white noise, random walk, strictly stationary and weakly stationary processes, increments, Markov property of stochastic processes, Poisson process, Compound Poisson process.

- **Markov chains**   (14L)
  Definitions, finite and countable state space Markov chains, Chapman-Kolmogorov equations, limiting and stationary distribution of Markov chains, classification of states, periodicity, transient and recurrent Markov chain and related results, first passage time, two state Markov model, Time homogenous and time inhomogeneous Markov processes, Long term behaviour of Markov chain, estimation of transition probabilities.

- **Time homogenous Markov jump processes**   (12L)
  Poisson process, Sums of Poisson process, distribution of the number of events in given time interval, inter arrival times, holding times and waiting times distributions, occupancy probabilities, applications of these results, Kolmogorov forward and backward differential equations for a Markov process with time independent transition intensities, maximum likelihood estimator in general model.

- **Time-inhomogeneous Markov jump processes**   (12L)
  Chapman Kolmogorov equations, transition rates, Kolmogorov forward and backward equations for a Markov process with time dependent transition intensities, integrated form of Kolmogorov forward and backward equations, simple

survival models, sickness models and marriage models in terms of Markov processes and other simple applications.

- **Modelling and simulation** (2L)
  Modelling and simulation for time homogenous and time in-homogenous Poisson process models, Markov models

References

- UK Institute of Actuaries core reading for subject CT4-Models.
- Ross, S. (2005) Introduction to Probability Models (6th Ed. Academic Press).
- Medhi, J. (1994). Stochastic Processes, (2nd Ed. New Age Publisher).
- Brzezniak, Zdzislaw and Zastawniak, Tomasz, (1999) Basic stochastic processes: A course through exercises. (Springer)
- Grimmett, Geoffrey and Stirzaker, David (2001) Probability and random processes. (3rd ed. Oxford University Press).
- Grimmett, Geoffrey and Stirzaker, David(2001), One thousand exercises in Probability. (2nd ed. Oxford University Press).
- Norris (1997), Markov Chains. (Cambridge Uni Press).

AS-602: Applied Statistics

- **Decision Theory and Its applications** (2L)
  Optimum strategies under the theory of games, decision function and a risk function, minimax criterion and the Bayes criterion for selecting best decision function.

- **Run-off triangles** (5L)
  The origins of run-off triangles, Presentation of claims data, basic chain ladder method, average cost per claim method and Bornhuetter-Ferguson method for estimating outstanding claim amounts.

- **Linear Models** (7L)
  Gauss-Markov set up, Least square estimation, Normal equations, Consistency of system of normal equations and their solution, Estimability of linear parametric function, necessary and sufficient condition for estimability, Best Linear Unbiased Estimator (BLUE), Gauss-Markov theorem, Variances and covariances of BLUE's. Multiple Linear Regression.

- **Generalised linear model (GLM)** (7L)
  Review of exponential family of distributions, exponential family of distributions, Link functions, Odds ratio, Linear Predictors, Deviance of model fitting, Residuals analysis and assessment of model fit

- **Time Series Analysis** (20L)
  Introduction, Components: Secular trend, seasonal variations, Cyclical variations, Irregular variations, Additive and multiplicative models, stationary random series, filter, autoregressive (AR), moving average (MA), autoregressive moving average (ARMA) and autoregressive integrated moving average (ARIMA) time series,

multivariate autoregressive model, cointegrated time series, univariate time series model as a multivariate Markov model, Residual analysis, non-stationary, non-linear time series models, applications of a time series model, Smoothing techniques.

- **Simulation**   (4L)
  Meaning of simulation, Advantage and disadvantage of simulation, Monte Carlo technique of simulation, Examples and problems

References

- UK Institute of Actuaries core reading for subject CT6-Statistical Methods.
- Montgemory, D.C. Johnson L.A (1977) Forecasting and Time Series Analysis, McGraw Hill.
- Brockwell, P.J. and Davis R.A. Time Series: Theory and Methods (Second Edition) Springer-Verlag.

AS-603: Credibility Theory and Loss Distributions

- **Loss distributions**   (11L)
  Review of Statistical distributions suitable for modelling individual and aggregate losses including the gamma, exponential, Pareto, generalised Pareto, normal, lognormal, Weibull and Burr distributions , concepts of excesses (deductibles), and retention limits, operation of simple forms of proportional and excess of loss reinsurance, Estimation of the parameters of a failure time or loss distribution when the data is complete, or when it is incomplete, using maximum likelihood and the method of moments

- **Risk models**   (11L)
  Short term insurance contracts, compound Poisson distribution, compound binomial, compound negative binomial random variables, simple forms of proportional and excess of loss reinsurance for insurer and reinsurer.

- **Ruin Theory**   (11L)
  Introduction, aggregate claim process and the cash-flow process for a risk, surplus process, probability of ruin in infinite/finite and continuous/discrete time and relationship between them, distribution of arrival, interarrival and waiting time in Poisson process, Compound Poisson process, Lundberg's inequality, Analysis of the effect on the adjustment coefficient and hence on the probability of ruin of simple reinsurance arrangements

- **Credibility theory and Empirical Bayes Credibility theory**   (12L)
  Credibility, Credibility premium formula, credibility factor, Poisson/gamma model, normal/normal model, Bayes' Theorem, prior distribution, a posterior distribution and a conjugate prior distribution, loss function, empirical Bayes approach to credibility theory, Calculation of credibility premium.

References

- UK Institute of Actuaries core reading for subject CT6-Statistical Methods.
- Loss Models: From Data to Decisions, 3rd Edition Stuart A. Klugman (Drake Univ., IA), Harry H. Panjer (Univ. of Waterloo, Canada), Gordon E. Willmot (Univ. of Waterloo, Canada) ISBN: 978-0-470-18781-4

AS-604: Life Contingencies III

- **Multiple Decrement Model**   (12L)
  Two random variables, Random Survivorship Group, Deterministic Survivorship Group, Associated single Decrement tables: Basic Relationship, Uniform Distribution Assumption for multiple decrements, Construction of Multiple decrement table, Relationship between single and multiple decrement tables.

- **Application of multiple decrement theory**   (12L)
  Actuarial present value and their numerical evaluation, benefit premium and reserves, competing risks, multiple state modelling, multiple state Markov model, Kolmogorov forward equations, multiple decrement tables.

- **Profit testing**   (11L)
  Discounted emerging costs, unit-linked contract, Profit test annual premium contracts, the profit vector, the profit signature, the net present value and the profit margin, determining premiums using profit test, Profit criterion, determining reserves using profit testing, Zeroising negative cashflows, Equity-linked insurance, deterministic profit testing for equity linked insurance, Stochastic profit testing, Stochastic pricing, Stochastic reserving.

- **Pension funds**   (10L)
  Multiple decrement service table for pensions calculations, updating a service table, the salary scale function, setting the DC contribution, the service table, funding plans, valuation of benefits: Final salary plans, Career average earnings plans.

References

- UK Institute of Actuaries core reading for subject CT5-Contingencies.
- Robin Cunningham, Thomas N. Herzog, Richard L. Models for Quantifying Risk, 4th Edition, ACTEX Publications.
- Browers, Newton L et.al., Actuarial Mathematics 2nd , Society of Actuaries, 1997.
- Dickson, David C.M., Hardy, Mary R. and Waters, Howard R., Actuarial Mathematics for life contingent risks, International series on actuarial science, Cambridge 2009.
- Deshmukh, S. R., An introduction to Actuarial Statistics, University Press.

AS-605: Financial Economics

- **Utility theory** (2L)

  Applications of utility theory to financial problems, expected utility theorem, risk aversion, risk neutrality and risk seeking, concept of utility maximization and hence explain the traditional theory of consumer choice, conditions for absolute dominance and for first and second-order dominance and their relationship with utility theory

- **Mean-Variance Portfolio theory** (10L)

  Measures of investment risk, Variance of return, downside semi-variance of return, shortfall probabilities, Value at Risk (VaR) / Tail VaR, Diversification and its benefits, Calculation of the expected return and risk of a portfolio of many risky assets, given the expected return, variance and covariance of returns of the individual assets, using mean-variance portfolio theory.

- **Single and multifactor models** (6L)

  Single and multifactor models, types of multifactor models of asset returns, single index model of asset returns, diversifiable and non-diversifiable risk

- **Asset pricing models** (6L)

  Sharpe-Lintner-Mossin Capital Asset Pricing Model (CAPM), Ross Arbitrage Pricing Theory model (APT)

- **Efficient Markets Hypothesis(EMH)** (2L)

  Three forms of the Efficient Markets Hypothesis and their consequences for investment management, evidence for or against each form of the Efficient Markets Hypothesis

- **Stochastic models of the behaviour of security prices** (6L)

  Continuous time log-normal model of security prices and the empirical evidence for or against the model, auto-regressive models of security prices and other economic variables, estimation of parameters for asset pricing models

- **Brownian motion** (2L)

  Basic properties of standard Brownian motion or Wiener process, stochastic differential equations, the Ito integral, diffusion and mean-reverting processes, stochastic differential equation for geometric Brownian motion and Ornstein-Uhlenbeck process.

- **Option prices and hedging techniques** (7L)

  Arbitrage, Complete market, factors that affect option prices, binomial trees and lattices for valuing options, risk-neutral pricing measure for a binomial lattice and describe the risk neutral pricing approach to the pricing of equity options, Black-Scholes derivative-pricing model, Black-Scholes partial differential equation both in its basic and Garman-Kohlhagen forms.

- **Models of the term structure of interest rates** (2L)

  Model for the term-structure of interest rates, the risk-neutral approach to the pricing of zero coupon bonds and interest-rate derivatives for a general one-factor diffusion model for the risk-free rate of interest, Vasicek, Cox-Ingersoll-Ross and Hull-White models

- **Simple models for credit risk** (2L)
  Credit event and recovery rate, Merton model, two-state model for credit ratings with a constant transition intensity, Jarrow-Lando-Turnbull model for credit ratings.

References

- Institute of Actuaries core reading for the subject CT8-Finance Economics.
- Anderson, Sweeney, Williams. Statistics for Business and Economics, Thomson Publication 8th Edition.
- Hall John C. Options, Futures and Other derivatives 5th edition, Prentice hall, 2002
- Oksendal B. Stochastic Differential Equation, An Introduction with applications Springer, 2003.
- Teresa Bradley and Paul Patton. Essential Mathematics for Economics and Business (Second Edition) Wiley India Pvt. Ltd.
- Baxter, Martin and Andrew Rennie, Finanacial calculus: An introduction to derivative pricing, Cambridge University press, 1996. ISBN: 0 521 55289 3
- Panjer, Harry H (ed), Financial economics: with applications to investments, insurance and pensions, The Actuarial Foundation, 1998. ISBN:0 938959 48 4
- Elton, Edwin J, Martin J. Gruber, Stephen J. Brown, and William N Goetzmann, Modern portfolio theory and investment analysis, 6th edition, John Wiley, 2003. ISBn:0 471 23854 6

AS-606 Practical-V (On PC Using Software)

A.   Practicals based on AS-601 (Stochastic Modelling)   (12 Hrs)

1. Calculation of n-step transition probabilities and limiting distribution in Markov chain.
2. Realization of Markov chain.
   Realization of Branching process.
3. Simulation of Poisson process.
4. Simulation of Random Walk.
5. Simulation of Renewal process.
6. Estimation of transition probability of Markov chain using realization.
7. Testing and Estimation of transition probability of Markov chain using realization.

B.   Practicals based on AS-602 (Applied Statistics)   (12 Hrs)

1. Decision theory and Its applications
2. Run-off triangles.
3. Linear estimation.
4. Multiple linear regression.
5. Generalized linear models.
6. Time Series Analysis.

C.   **Practicals based on AS-603(Credibility Theory and Loss Distributions)**(12 Hrs)

1. Loss distributions and fitting of loss distributions.
2. Estimation of parametric functions of loss distributions.
3. Short term insurance contracts.
4. Estimation of proportional and excess of loss reinsurance for insurer and reinsurer.
5. Estimation of probability of ruin in infinite/finite and continuous/discrete time.
6. Computation of posterior probabilities based on simulation.
7. Calculation of credibility premium.

D.   **Practicals based on AS-604 (Life Contingencies-III)**   (12 Hrs)

1. Multiple Decrement Models.
2. Actuarial present value in Multiple Decrement Models.
3. Profit testing.
4. Pension funds.

E.   **Practicals based on AS-605 (Financial Economics)**   (12 Hrs)

1. Estimate the investment risks using variance of return, downside semi-variance of return, shortfall probabilities, Value at Risk (VaR) / Tail VaR.
2. Estimating parameters for Single and Multifactor Models.
3. Estimating parameters for Asset Pricing Models, Capital Asset Pricing Models.
4. Stochastic models of the behavior of security prices.
5. Black-Scholes derivative-pricing model.