Department of Statistics,
Shivaji University, Kolhapur
POST-GRADUATE DIPLOMA IN ACTUARIAL SCIENCE (Revised)
(To be implemented from June 2014)

1. **Intake :** 20 (excluding sponsored candidates up to 5)
2. **Eligibility for admission:** Graduate of any recognized University with Statistics/Mathematics as principal subject minimum first class OR Post-graduate of any recognized University in Statistics/Mathematics with minimum 55% marks.
3. **Admission Procedure**: The admission to the course is through entrance test. There shall be 50 question of the multiple choice type on the following topics. Merit cut-off point will be decided by admission committee.
   Limits, derivatives, integration, sequence and series, simple and compound interest, permutation and combination, Ratio and proportions, quadratic equations, matrix and determinant, descriptive statistics.
4. **Duration:** This is a one year course consisting of two semesters.
5. **Fees Structure:** Course fee Rs. 15000/- (Rs. 30000/- for sponsored candidates) plus other fees as per University rule.
6. **Teaching Provision:** Faculty from the Department of Statistics will be involved in the teaching. Faculty from Economics, Commerce & Management etc. will be invited as per need. Eminent persons working in the field of insurance and actuarial related fields will also be invited to share their expertise.
7. **Syllabus:** Structure of the course with the syllabus is enclosed.
8. **Scheme of Examination :** There shall be a total of 8 Theory papers, one practical paper and a project work. Each theory paper is evaluated for 100 marks, out of which 20 marks are assigned to continuous internal evaluation (CIE) while term end examination (TEE) is of 80 marks.
9. **Passing Standard:** A candidate shall be declared to have passed the examination in a paper of study only if he / she has secured not less than 50 % of the total marks of the CIE and TEE marks put together in that paper. A candidate who has been declared as 'Failed' in a particular paper is allowed to reappear for the TEE for the same paper in the succeeding chances and the marks he / she has secured in the CIE in his / her first attempt will however be retained and considered for subsequent attempts. A candidate who successfully completes the course and passes all the prescribed papers / laboratory work / project work of the two semesters shall be declared to qualify for the award of the diploma. A candidate will be awarded the following Grades on the basis of percentage of total marks obtained by the candidate in one or more attempt (s).

Percentage	Grade
50 – below 60	C
60 - below 70	B
70 – below 80	A
80 - 100	A+

10. PGDAS is of 40 credits.
11. Equivalence of the Papers offered in PGDAS:

Sr. No.	PGDAS	M.Sc. Statistics	M.Sc. Applied Statistics and Informatics.	Credits
1	Paper I: Probability and Mathematical Statistics	MST-103: Distribution Theory	MASI-103: Probability Distributions	04
2	Practical I	MST-116: Practical I	MASI-116: Practical I	04
			Total	08

If a student admitted to M.Sc. Statistics/Applied Statistics and Informatics course in Department of Statistics, Shivaji University Kolhapur takes admission to PGDAS, then the credits for Paper I and Practical I will be transferred on the successful completion of the following courses:

For M.Sc. Statistics: MST-103, MST-116,

For M.Sc. Applied Statistics and Informatics: MASI-103, MASI-116.

12. Students admitted to M.Sc. Statistics/Applied Statistics and Informatics/Mathematics can take following papers of PGDAS as add on courses:

Semester	Paper No.	Title of the Paper	Credits	Marks	
				TEE	CIE
I	II	Financial Mathematics	4	80	20
II	V	Contingencies	4	80	20
	VIII	Financial and Statistical Economics	4	80	20

Examination of these courses will be conducted along with that of PGDAS.

Fees for each of these add on courses will be $1/10^{th}$ of that of PGDAS.

13. <u>The PGDAS course will be offered only when at least 10 students are admitted to the course</u>.

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Structure of the course and Syllabus

Semester	Paper No.	Title of the Paper	Credits	Marks	
				TEE	CIE
I	I	Probability and Mathematical Statistics	4	80	20
	II	Financial Mathematics	4	80	20
	III	Finance & Financial Reporting	4	80	20
	IV	Statistical Models and their Applications	4	80	20
	Practical I	Data Analysis using application software like MSEXCEL, R.	4	80	20
II	V	Contingencies	4	80	20
	VI	Statistical Methods	4	80	20
	VII	Economics	4	80	20
	VIII	Financial and Statistical Economics	4	80	20
	Project Work	Project work related to actuarial Science.	4	100	

PAPER –I : PROBABILITY AND MATHEMATICAL STATISTICS

1. Main features of a data set (exploratory data analysis), Concepts of probability. Concepts of random variable, probability distribution, distribution function, expected value, variance and higher moments. Probability generating function, a moment generating function, a cumulant generating function and cumulant.

2. Basic discrete and continuous distributions. Concepts of independence jointly distributed random variables and conditional distributions, and use of generating function.

3. Central limit theorem and its applications. Concepts of random sampling, statistical inference and sampling distribution. Methods of estimation and the main properties of estimators. Confidence intervals for unknown parameters. Testing of hypotheses.

4. Correlation and Regression analysis. Concepts of analysis of variance. Concepts of conditional expectation and compound distribution.

Reference Books :
1. UK Institute of Actuaries core reading forreading for subject CT3 Probability and Mathematical Statistics.
2. Rohatgi V.K & A.K. MD. Ehsanes Saleh: An introduction to probability theory and mathematical statistics, 2nd . John Wiely and Sons, 2001.
3. Wackesly D.D; Mondonhall III, William and Scheffer, R.L Mathematical statistics with applications, Duxbury, 2002.

PAPER –II : FINANCIAL MATHEMATICS

1. Generalised Cash- flow model, Concepts of compound interest and discounting. Interest rates or discount rates in terms of different time periods. Real and Money interest rates.
2. The present value and the accumulated value of a stream of equal or unequal payments using specified rates of interest and the net present value at a real rate of Interest, assuming a constant rate of inflation.
3. Definition of compound interest functions including annuities certain. Definition of an equation of value. Repayment of loan by regular installment of interest and capital. Discounted cash flow techniques. The investment and risk characteristics of the following types of asset available for investment purposes.
4. Elementary compound interest problems. The delivery price and the value of a forward contract using arbitrage free pricing methods, Structure of interest rates. Simple stochastic models for investment returns.

Reference Books:
1. UK Institute of Actuaries core leading for the subject CT1 financial mathematics.
2. Baxter, Robert. Finance Mathematics, Medford, OR : Baxter Instructional Materials 1992. Sixth Edition Revised and Expanded.
3. Hart, W.L. Mathematics of Investment, Lexington, M.A.: D.C. Heath, 1975, Fifth Edition.
4. Karatzas, loannis and Shreve, Steven E., Methods of Mathematical Finance, New York, NY : Springer, 1998.
5. Kellison, Stephen G. The Theory of Interest, Homewood, IL: Richard D. Irwin, 1970, 1090. Second Edition.
6. Martin, Peter G. and Burrow, Michael. Applied Financial Mathematics, New York, NY; Sydney: Prentice Hall, 1991.
7. Roman, Steven. The Mathematics of Finance, Irvine, CA : Innovative Textbooks, 1993.
8. Watsham, Terry J. and Parramore, Keith. Quantitative Methods in Finance, London; Boston, MA: International Thomson Business Press, 1997. First Edition.

PAPER – III : FINANCE & FINANCIAL REPORTING

1. Principal terms in investment and asset management. Key principles of finance. Structure of joint Stock Company and the different methods of financing by which it may be financed.
2. Basic principle of personal and corporate taxation. The characteristics of principal forms of financial instrument used by companies. Factors to be considered by a company when deciding on its capital structure and divided policy.
3. Definition of company's cost of capital & the nature of the investment projects. The basic construction of accounts of different types and principal features of the accounts of a company.

4. Interpretation of the accounts of a company or a group of companies and limitations of such interpretation. Financial techniques used in the assessment of capital investment projects.

Reference Books:
1. UK Institute of Actuaries core reading for subject CT2 Finance and Financial reporting.
2. Brigham, Eugene F and Houston, Joel F., Fundamentals of financial management. 9th ed. Harcourt Brace, 2000 ISBN 0030314615.
3. Holmes, Geoffrey and sugden, Alan, Interpreting company reports and accounts. 7th ed. Prentice hall, 1999 ISBN 027364615X.
4. Samuels, J.M; Wikes, F.M; Bray Shaw, R.E, Management of company finance. 6th ed. International Thomson, 1995 ISBN 1861522290.
5. Brealey, Richard A and Myers, Stewart c., Principles of corporate finance. 6th ed. McGraw-Hill, 1999 ISBN 0077095650.

PAPER – IV : STATISTICAL MODELS AND THEIR APPLICATIONS

1. Principles of Actuarial Modeling. General principles of stochastic processes, and their classification into different types. Markov chain. Markov process.
2. Concept of survival models. Estimation procedures for lifetime distributions.
3. Statistical models of transfer between multiple states Maximum likelihood estimators for the transition intensities between states.
4. Binomial model of mortality, maximum likelihood estimator for the probability of death. Estimation of transition intensities depending on age. Crude estimates for consistency with a standard table or a set of graduated estimates, and the process of graduation.

Reference Books:
1. UK Institute of Actuaries core reading for subject Ct4 Statistical models.
2. Kleinbaum D.G. Survival analysis: A self-learning text, Springer, 1994.
3. Lee E.T. :Statistical methods for survival data analysis,, Wadsworth, Belnout, CA. 1998.
4. Basic stochastic processes: a course through exercises Springer, 1998.
5. Karlin , Samuel and Taylor A : Second course in stochastic processes, Howard M. Academic press 1981.
6. Kulkarni, Vidyadhar: Modeling and analysis of stochastic systems, G. Thomson Science and Professional, 1995.
7. Medhi, Jyotiprasad : Stochastic Processes, Wiley Estern Limited, 2nd ed. 1994.
8. Cox D.R. and Miller H.D.: The theory of stochastic processes, Methuen and co. Ltd. 1964.

PAPER – V: CONTIGENCIES

1. Simple assurance and annuity contracts. Practical methods of evaluating expected values and variances of the simple contracts. Calculation of net premiums and net premium ultimate or select mortality reserves of simple insurance contracts.

2. Calculation of net premiums and net premium reserves for increasing and decreasing benefits and annuities, using ultimate or select mortality.
3. Calculation of gross premiums and reserves of assurance and annuity contracts. Definition of functions involving two lives. Methods used to model cash flows contingent upon competing risks.
4. Technique of discounted emerging costs, pricing, reserving, and assessing profitability. Principal forms of heterogeneity within a population and the ways in which selection can occur.

Reference Books:
1. UK Institute of Actuaries core reading for subject CT5 Contingences.
2. Browers, Newton L et al., Actuarial Mathematics 2nd . Society of Actuaries, 1997.
3. Neill, Alistair, Life contigencies. Heinemann, 1977.
4. Gerber, H.U., Life insurance mathematics 3rd ed. Springer, Swiss Association of Actuaries 1997.
5. Benjamin, Bernard and Pllard, John H., The analysis of mortality and other actuarial statistics. 3rd ed. Institute of Actuaries and Faculty of Actuaries, 1993.
6. Haberman, S. and Pitacco, E., Actuarial models for disability insurance, Chapman & Hall, 1999.
7. Booth, P.M et al., Modern actuarial theory and practice, Chapman & Hall, 1999.

PAPER –VI : STATISTICAL METHODS

1. Concepts of decision theory and their applications. Calculation of probabilities and moments of loss distributions both with and without limits and risk-sharing arrangements.
2. Construction of risk models involving frequency and severity distributions and calculation of the moment generating function and the moments for the risk models with and without simple reinsurance arrangements.
3. Concept of ruin for a risk model. Fundamental concepts of Bayesian statistics, Fundamental concepts of rating. Techniques for analyzing a delay (or run-off) triangle and projecting the ultimate position.
4. Fundamental concepts of a generalized linear model (GLM). Main concepts underlying the analysis of time series models. Monte Carlo simulation using a series of pseudo-random numbers.

Reference Books:
1. UK Institute of Actuaries core reading for subject CT-VI statistical methods.
2. Box G.E.P and Jenkin's : Time series analysis forecasting and control, Holden Day 1970.
3. Degroot M.H. Optimal Statistical decision.
4. Berger J; Statistical Decision theory and Bayesian analysis.
5. Searler S.R Linear Models, John Wiley & sons, 1971.
6. Ross S.M. Introduction to Probability Models-7th Edition Academic Press/Harcourt 2000.
7. Morgan B.J.T. Elements of simulation, Chapman & Hall, 1995.

PAPER – VII : ECONOMICS

1. The interaction between supply and demand in the provision of a product and the way in which equilibrium market prices are determined. Elasticity of demand and supply and the effects on a market of different levels of elasticity. Application of utility theory to economic and financial problems.
2. Profit maximizing firms. Different sorts of competition, or lack of it, and the practical effect on supply and demand. Microeconomic principles to increase their understanding of the markets in which we operate, the regulatory issues and the ramification of strategic decisions. Structure of the public sector finances of an industrialized economy.
3. Definition of GDP, GNP and Net National Product, use these concepts may be useful in describing the economy and in making comparisons between countries, and their limitations. The propensity to save or to consume by the private sector or the corporate sector affects the economy. The impact of fiscal and monetary policy and other forms of government intervention on different aspects of the economy, and in particular on financial markets.
4. Role of exchange rates and international trade in the economy and the meaning of the term balance of payments. The major factors affecting the rate of inflation, the level of interest rates, the exchange rate, the level of unemployment, and the rate of economic growth in the economy of an industrialized country.

Reference Books:

1. Institute of Actuaries core reading for the subject CT7 Economics.
2. Begg David, Stanley Fischer and Rudiger Dornbusch (1997), Economics (5th ed.) and Economics workbook, McGraw Hill.
3. Samuelson Paul and Willian Norhaus (1998), Economics (16th ed.) McGraw Hill.
4. Wonnacott P. and R. Wonnacott (1990), Economics (4th ed.) John Wiley.
5. Gwartney James D. and Richard L. Stroup (1997) Economics: Private and Public choice (8th ed.) HBJ College & School Division.
6. Lipsey Richard G. and Chrystat K. Alec (1999), Principles of economics, Oxford University Press.

Paper – VIII : FINANCIAL AND STATISTICAL ECONOMICS

1. Advantages and disadvantages of different measures of investment risk. The assumptions of mean-variance portfolio theory and its principal results.
2. The properties of single and multifactor models of asset returns. Asset pricing models, discussing the principal results and assumptions and limitations of such models.
3. The various forms of the Efficient Markets Hypothesis and discuss the evidence for and against the hypothesis.

4. Stochastic models of the behaviour of security prices. Concepts of Brownian motion (or Wiener Processes). The properties of option prices, valuation methods and hedging techniques. Models of the term structure of interest rates.

Reference Books:
1. Institute of Actuaries core reading for the subject CT8 Finance Economics.
2. Hall John C. Options, Futures and Other derivatives 3rd . Prentice hall of India Private Ltd. , New Delhi, 1997.
3. Seal H.L. Stochastic Theory of risk business, John Wiley, 1969.
4. Oksendal B. Stochastic Differential Equation, An introduction with applications, Springer, 2003.