# SYLLABUS (NEP)

# MASTER OF SCIENCE
# IN
# MATHEMATICS AND STATISTICS
# UNDER DEPARTMENT OF APPLIED MATHEMATICS AND STATISTICS

**(TWO YEARS PG)**

**(CHOICE BASED CREDIT SYSTEM)**

## MIZORAM UNIVERSITY
## AIZAWL-796004
## MIZORAM, INDIA
## (2022)

**DEPARTMENT OF APPLIED MATHEMATICS AND STATISTICS**
**PACHHUNGA UNIVERSITY COLLEGE, MIZORAM UNIVERSITY**
**Syllabus for M.Sc. (NEP)**
**(Two Year PG)**

**Note : First semester and second semester syllabus is common for students who are admitted for Msc Mathematics (Specialization in Applied Mathematics) and Statistics Under Department of Applied Mathematics and Statistics**

**I SEMESTER**

| Sl. No | Paper/Course No. | Name of Paper | Marks Scale | | | Credit | | | | Exam (hrs) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | C/A | End Sem. | Tot | L | T | P | Tot | Th | Pr |
| 1 | AMS/MJ/500 | Numerical Methods | 40 | 60 | 100 | 3 | 0 | 0 | **3** | 3 | - |
| 2 | AMS/MJ/501 | Complex Analysis | 40 | 60 | 100 | 3 | 0 | 0 | **3** | 3 | - |
| 3 | AMS/MJ/502 | Stochastic Processes | 40 | 60 | 100 | 2 | 0 | 1 | **3** | 2 | 1 |
| 4 | Interdisciplinary Major | **To be chosen from an MJ course offered by other disciplines** | 40 | 60 | 100 | 3 | 0 | 0 | **3** | 3 | - |
| 5 | AMS/MN/503 (a-c) - *any one* | (a) Statistical Computing with R<br>(b) Research Methodology<br>(c) Discrete Data Analysis | 40 | 60 | 100 | 2 | 0 | 0 | **2** | 2 | - |
| 6 | Interdisciplinary Minor | **To be chosen from an MN course offered by other disciplines** | 40 | 60 | 100 | 2 | 0 | 0 | **2** | 2 | - |
| 7 | AMS/FP/504 | Proramming in MATLAB | 40 | 60 | 100 | 0 | 0 | 4 | **4** | 0 | 4 |

**II SEMESTER**

| Sl. No | Paper/Course No. | Name of Paper | Marks Scale | | | Credit | | | | Exam (hrs) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | C/A | End Sem. | Tot | L | T | P | Tot | Th | Pr |
| 1 | AMS/MJ/550 | Mathematical Modelling | 40 | 60 | 100 | 3 | 0 | 0 | **3** | 3 | - |
| 2 | AMS/MJ/551 | Operations Research | 40 | 60 | 100 | 2 | 0 | 1 | **3** | 2 | 1 |
| 3 | AMS/MJ/552 | Multivariate Analysis | 40 | 60 | 100 | 2 | 0 | 1 | **3** | 2 | 1 |
| 4 | Interdisciplinary Major | **To be chosen from an MJ course offered by other disciplines** | 40 | 60 | 100 | 3 | 0 | 0 | **3** | 3 | - |
| 5 | AMS/MN/553 (a-c) - any one | (a) Graph Theory<br>(b) Classical Mechanics<br>(c) Dynamical System | 40 | 60 | 100 | 2 | 0 | 0 | **2** | 2 | - |
| 6 | Interdisciplinary Minor | **To be chosen from an MN course offered by other disciplines** | 40 | 60 | 100 | 2 | 0 | 0 | **2** | 2 | - |
| 7 | AMS/FP/554 | Data Analysis using SPSS | 40 | 60 | 100 | 0 | 0 | 4 | **4** | 0 | 4 |

**DEPARTMENT OF APPLIED MATHEMATICS AND STATISTICS**
**PACHHUNGA UNIVERSITY COLLEGE, MIZORAM UNIVERSITY**
**M.Sc MATHEMATICS (Specialization in Applied Mathematics)**

**Note: Students can choose either Applied Mathematics or Statistics from third semester. Students who opt Applied Mathematics have a degree of Msc Mathematics (Specialization in Applied Mathematics) and who opt statistics have a degree of Msc Statistics**

**III SEMESTER**

| Sl. No | Paper/Course No. | Name of Paper | Marks Scale | | | Credit | | | | Exam | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | C/A | End Sem. | Tot | L | T | P | Tot | Th | Pr |
| 1 | AMS/MJ/600-A | Integral Transforms and Fourier Analysis | 40 | 60 | 100 | 3 | 0 | 0 | **3** | *3* | - |
| 2 | AMS/MJ/601-A | Differential Geometry | 40 | 60 | 100 | 3 | 0 | 0 | **3** | *3* | - |
| 3 | AMS/MN/602-A | (a) Topology<br>(b) Ecological Modelling<br>(c) Fluid Dynamics | 40 | 60 | 100 | 2 | 0 | 0 | **2** | 2 | - |
| 4 | Interdisciplinary minor | **[To be chosen from an MN course offered by other disciplines]** | 40 | 60 | 100 | 2 | 0 | 0 | **2** | 2 | - |
| 5 | AMS/FP/603-A | Type setting in LATEX | 40 | 60 | 100 | 0 | 0 | 4 | **4** | 0 | 4 |
| 6 | AMS/MJ/649 | Dissertation | | | | | | 6 | **6** | | - |
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| | | | | | | | | | | | |

**Note: Students can choose either Applied Mathematics or Statistics from third semester. Students who opt Applied Mathematics have a degree of Msc Mathematics (Specialization in Applied Mathematics) and who opt statistics have a degree of Msc Statistics**

**IV SEMESTER**

| Sl. No | Paper/Course No. | Name of Paper | Marks Scale | | | Credit | | | | Exam | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | C/A | End Sem. | Tot | L | T | P | Tot | Th | Pr |
| 1 | AMS/MJ/650-A | Elasticity | 40 | 60 | 100 | 4 | 0 | 0 | **4** | *4* | - |
| 2 | LSC/FP/651-A | Practice Teaching | 40 | 60 | 100 | 0 | 0 | 4 | **4** | 0 | |
| 3 | AMS/MJ/699 | Dissertation | | | | | | 0 | **12** | 0 | - |

**DEPARTMENT OF APPLIED MATHEMATICS AND STATISTICS**
**PACHHUNGA UNIVERSITY COLLEGE, MIZORAM UNIVERSITY**

**M.Sc STATISTICS**

**Note: Students can choose either Applied Mathematics or Statistics from third semester. Students who opt Applied Mathematics have a degree of Msc Mathematics (Specialization in Applied Mathematics) and who opt statistics have a degree of Msc Statistics**

**III SEMESTER**

| Sl. No | Paper/Course No. | Name of Paper | Marks Scale | | | Credit | | | | Exam | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | C/A | End Sem. | Tot | L | T | P | Tot | Th | Pr |
| 1 | AMS/MJ/600-B | Demography | 40 | 60 | 100 | 3 | 0 | 0 | **3** | 3 | - |
| 2 | AMS/MJ/601-B | Econometrics | 40 | 60 | 100 | 3 | 0 | 0 | **3** | 3 | - |
| 3 | AMS/MN/602-B | (a) Health Statistics & Epidemiology<br>(b) Advanced Design of Experiments<br>(c ) Introduction to Acturial Statistics | 40 | 60 | 100 | 2 | 0 | 0 | **2** | 2 | - |
| 4 | Interdisciplinary Minor | [To be chosen from an MN course offered by other disciplines] | 40 | 60 | 100 | 2 | 0 | 0 | **2** | 2 | - |
| 5 | AMS/FP/603-B | Practical | 40 | 60 | 100 | 0 | 0 | 4 | **4** | 0 | |
| 6 | AMS/MJ/649 | Dissertation | | | | | | | **6** | - | - |

**IV SEMESTER**

| Sl. No | Paper/Course No. | Name of Paper | Marks Scale | | | Credit | | | | Exam | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | C/A | End Sem. | Tot | L | T | P | Tot | Th | Pr |
| 1 | AMS/MJ/650-B | Survival Analysis | 40 | 60 | 100 | 4 | 0 | 0 | **4** | *4* | - |
| 2 | LSC/FP/651-B | Practical | 40 | 60 | 100 | 0 | 0 | 4 | **4** | 0 | |
| 3 | AMS/MJ/699 | Dissertation | | | | | | 0 | **12** | 0 | - |

## *DISCIPLINARY MAJOR*

# AMJ/MJ/500: NUMERICAL METHODS

*Full Marks: 100 (3 Credits)*

**Unit-I: Numerical Methods for Solving Algebraic and Transcendental Equations**

Round-off error and computer arithmetic, Local and global truncation errors, Algorithms and convergence; Bisection method, false position method, fixed point iteration method, Newton's method and secant method for solving equations.

**Unit-II: Numerical Methods for Solving Linear Systems**

Eigen values and Eigen vectors: Eigen values, Eigen vectors, Cayley Hamilton theorem, Power method for finding largest Eigen value. Curve fitting: Least square curve fit- Straight line fitting, parabolic curve fitting, fitting of exponential curve, fitting of other curves.

**Unit-III: Numerical Differentiation and Integration**

First order and higher order approximation for first derivative, Approximation for second derivative; Numerical integration: Trapezoidal rule, Simpson's rule, Weddle rule and its error analysis, Bulirsch-Stoer extrapolation methods, Richardson extrapolation.

**Unit-IV: Initial and Boundary Value Problems of Differential Equations**

Euler's method, Runge-Kutta methods, Higher order one step method, Multi-step methods; Finite difference method, Shooting method.

**References:**

1. Brian Bradie (2006), *A Friendly Introduction to Numerical Analysis.* Pearson.
2. C. F. Gerald & P. O. Wheatley (2008). *Applied Numerical Analysis* (7th edition), Pearson Education, India.
3. M.K. Jain, S. R. K. Iyengar & R. K. Jain (2012). *Numerical Methods for Scientific and Engineering Computation* (6th edition). New Age International Publishers.
4. Robert J. Schilling & Sandra L. Harris (1999). *Applied Numerical Methods for Engineers Using* MATLAB *and C*. Thomson-Brooks/Cole.
5. Atkinson, K. E. An Introduction to Numerical Analysis. John Wiley & Sons, 1989.
6. Conte, S. D. and Boor, C. D. Elementary Numerical Analysis. An Algorithmic Approach, Tata McGraw Hill, New Delhi, 1981.
7. Isacson, E. and Keller, H. B. Analysis of Numerical Methods. John Wiley & Sons, 1994.
8. Thangaraj, P. Computer Oriented Numerical Methods. PHI Learning Pvt. Ltd, 2013.

*FIRST SEMESTER*

## *DISCIPLINARY MAJOR*
## AMS/MJ/501: Complex Analysis

*Full Marks: 100 (3 Credits)*

**UNIT I** :

Zeros of an analytic function, Singularities of a function, removable singularities, pole and essential singularities, Fundamental theorem of algebra, Residue theorem and its applications to the evaluation of definite integrals, Contour Integration.

**UNIT II** :

Bilinear transformations, their properties and classifications. Definitions and examples of Conformal mappings, Necessary and Sufficient condition of conformal maping, Cross-retio, Linear transformation , Bilinear transformation and its normal form, Elliptic, Hyperbolic, and Parabolic transformations, The transformation of $w = z^n$ , $z = \sqrt{w}$ , $w = e^z$ , $w = \log z$ , transformation of trigonometric function.

**UNIT III** :

Maximum modulus and Minimum modulus principle, Meromorphic functions. The argument principal Schwarz lemma, Rouche's theorem. Inverse function theorem, Analytic Countinuation. Uniqueness of direct analytic continuation.

**UNIT IV** :

Uniqueness of analytic continuation along a curve. Power series method of analytic continuation, Schwarz Reflection principle, Weierstrass' factorization theorem. Gamma function and its properties. Riemann Zeta function. Reimann's functional equation. Runge's theorem. Mittag-Leffler's theorem.

***References*** :


1. Priestly H. A. (1990): Introduction to Complex Analysis, Clarendon Press, Oxford.
2. Titchmarsh E.C. (1939): The Theory of Functions, Oxford University Press, London.
3. Ahlfors L.V. (1979): Complex Analysis, MC Graw Hill.
4. Ponnusamy S. (1997): Foundations of Complex Analysis, Narosa Publishing House.
5. Walter Rudin, Real and Complex Analysis, McGraw Hill Book Co., 1968.
6. Hille E. (1994) : Analytic Function Theory, Hindustan Book Agency, Delhi.

## *DISCIPLINARY MAJOR*

# AMS/MJ/502: STOCHASTIC PROCESSES

*Full Marks: 100 (3 Credits)*

**Unit – 1:**

Definition and examples of stochastic process: classification of general stochastic processes into discrete/continuous time, discrete/continuous state spaces, types of stochastic processes elementary problems, random walk, gambler's ruin problem.

**Unit – II:**

Markov chains: Definition and examples of Markov chain, transition probability matrix, classification of states, recurrence, simple problems, basic limit theorem of Markov Chain (statement only), stationary probability distribution.

**Unit – III:**

Continuous time Markov Chain: Poisson process and related inter-arrival time distribution, pure birth process, pure death process, birth and death process, Wiener process

**Unit – IV:**

Branching process: Definition and examples of discrete time branching process, probability generating function, mean and variance, probability of extinction problems.

**References:**

1. Karlin S. and Taylor H.M. (1995): A First Course in Stochastic Process, Academic Press
2. Hoel P.G., Port S.C. and Stone C.J. (1991): Introduction to Stochastic Process, Universal Book Stall.
3. Parzen E. (1962): Stochastic Process, Holden-Day
4. Cinlar E. (1975) : Introduction to Stochastic Processes, Prentice Hall.
5. Adke S.R. and Manjunath S.M. (1984) : An Introduction to Finite Markov Processes, Wiley Eastern.
6. Medhi J. (1996) : Stochastic Processes, new Age International (P) Ltd.
7. Ross S.M. (1983) : Stochastic Process, John Wiley. Taylor H.M. and Karlin S. (1999) : Stochastic Modeling, Academic Press.

## *FIRST SEMESTER*

## *INTER-DISCIPLINARY MAJOR*

To be chosen from an MJ course offered by other disciplines

*FIRST SEMESTER*

*DISCIPLINARY MINOR*

## AMS/MJ/503 (a): STATISTICAL COMPUTING USING R

*Full Marks: 100 (2 Credits)*

**Unit-I:**

Statistical Computing: Introduction to statistics as applied to the social sciences. Basic meth odological and statistical issues in managing and analyzing data using *R* software like -History of R, introduction and some preliminaries concepts to R, Getting help and loading packages, R as a calculator. Object types in R: numeric, logical, character, integer and complex. Various data types in R: Vectors and matrices, lists and data frames. Manipulation with numbers and vectors. Data Input, reading data from files, export data.

**Unit-II:**

Basic introduction to Graphics, Basic Statistical Methods: Descriptive Statistics, Linear Regression and Correlation using R function, Analysis of Variance. Parametric and Non para metric statistical test using R.

**References:**

1. Crawley, M.J. : Statistics: An Introduction Using R (English)
2. Dalgaard, P. :Introductory Statistics with R. New York: Springer-Verlag.
3. Fox, J. : An R and S-Plus Companion to Applied Regression. Thousand Oaks, CA: Sage.
4. Hothorm Torsten and Everitt Brain S.: A Handbook of Statistical Analyses using R,CRC press

*FIRST SEMESTER*

*DISCIPLINARY MINOR*

# AMS/MJ/503 (b): RESEARCH METHODOLOGY

*Full Marks: 100 (2 Credits)*

**Unit-I:**

Research Methodology: Concept and definitions, variables and hypotheses, theory and facts, formulation of research problems, development of research methodology, developments of knowledge-approaches, rationalistic mode, scientific mode. Identification of problem, formulation of hypotheses, imagination in the formulation of scientific law, recognition of a problem area and identifying the relative questions.

**Unit-II:**

Measurement of Scaling Concepts: Scales of measurements, nominal, ordinal, internal and ratio scales, Errors in measurements. Validity and Reliability in measurement, Scale Construc tion Techniques. Data Collection and Analysis: Primary & secondary data, Validity and Reli ability of data collection procedures, data preparation, exploratory data analysis, parametric and nonparametric tests, correlation and regression analysis, ANOVA, Multivariate Techniques.

**References :**

1. Kothari, C.R. (1985): Research Methodology: Methods and Techniques, Wiley Eastern.
2. Dominowski, R.L. (1980): Research Methods, Prentice Hall Inc., New Jersey.
3.Royce A. Singleton and Bruce C. Straits, (1999): Approaches to Social Research, Oxford, Oxford University Press.

*FIRST SEMESTER*

*DISCIPLINARY MINOR*

# AMS/MJ/503 (c): DISCRETE DATA ANALYSIS

*Full Marks: 100 (2 Credits)*

**Unit-I:**

$2\times 2$ contingency table and its probability structures (joint, marginal, and conditional prob abilities). comparing proportions in two-by-two contingency tables using proportions, Odds ratio and relative risk approaches. Analysis of $I \times J$ contingency tables: analysis of Chi-square tests of independence, Likelihood-ratio statistic, testing for independence for ordinal data. Analysis of three-way and multi-way contingency tables.

**Unit-II:**

The logistic regression model and its inference. Building and checking model adequacy in logistic regression. Logit models for nominal responses and cumulative logit models for ordinal responses. Poisson regression model and its inference.

**References**

1. Christensen, R. (1997). Log-linear models and logistic regression, second edition, Springer, New York.
2. Agresti A. (2002). Categorical Data Analysis. (2nd ed.), Wiley, New York.
3. Chap, T. L. (1998). Applied Categorical Data Analysis. John Wiley and Sons, New York.
4. Collett, D. (2003). Modelling Binary data , 2nd ed, Chapman -Hall, London.
5. Hosmer, D. W and Lemeshow S. (2000). Applied Logistic Regression ( 2nd Edition)., Wiley, New York.
6. Lloyd, C. J. (1999). Statisticall Analysis of Categorical Data. Wiley, New York.
7. Simonoff, J. S. (2003). Analyzing Categorical Data. Springer, New York. 8. Allisson, P. (1999). Logistic Regression Using the SAS System. Cary, NC, SAS Institute. 9. Cramer, J. S. (2003) . Logit Models from Economics and Other Fields. Cambridge University Press, Cambridge.

## *FIRST SEMESTER*

## *INTER-DISCIPLINARY MINOR*

To be chosen from an MN course offered by other disciplines

## FIELD PROJECT/INTERNSHIP/APPRENTICESHIP
## AMS/FP/504: PROGRAMMING IN MATLAB

*Full Marks: 100 (4 Credits)*

**Unit-I :**

Overview of MATLAB, operators, Display format, elementary built-in functions, working with variables, General commands, data types, data import, arrays, operations with arrays.

**Unit-II :**

Matrices: Eigenvalues and Eigenvectors, Similarity Transformation and Diagonalization, Func tions, Script files, operators, Loops and Conditional Statements, Programming in MATLAB, Graphics- 2-D and 3-D Plots, input and output.

**Unit-III :**

Applications in Numerical Methods: System of linear equations, L U Decomposition, Gauss elimination method, Gauss Seidel Method, Gauss Jordan Method. Interpolation: Lagrange and Newton Polynomials, curve fitting, Bisection Method, False Position (Regula-Falsi) Method, Newton–Raphson) Method.

**Unit-IV :**

Applications to Numerical differentiation and integrations: Trapezoidal Method and Simpson Method, Runge–Kutta Method, Introduction to working with modules in MATLAB.

**References:**

1. Otto, S.R. and Denier, J.P. An Introduction to Programming and Numerical Methods in MATLAB. Springer-Verlag, 2005.
2. Pratap, R. Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers. Oxford University Press, 2016.
3. Yang, W. Y., Cao, W., Chung, T. and Morris, J. Applied Numerical Methods using MATLAB. John Wiley Interscience, 2005.
4. Kumar, S. S. and Lenina, S. V. B. Matlab: Easy Way of Learning. PHI Learning Pvt. Ltd., 2016.
5. Getting Started with MATLAB, Maths Works Inc. www. in.mathsworks.com

*SECOND SEMESTER*

## *DISCIPLINARY MAJOR*
## AMS/MJ/550: MATHEMATICAL MODELLING

*Full Marks: 100 (3 Credits)*

**Unit-I**

Simple situations requiring mathematical modelling, techniques of mathematical modeling, Clas sifications, Characteristics and limitations of mathematical models, Some simple illustrations. Mathematical modelling in population dynamics, Mathematical modelling of epidemics through systems of ordinary differential equations of first order.

**Unit-II :**

The need for Mathematical modelling through difference equations, linear growth and decay models, Nonlinear growth and decay models, Basic theory of linear difference equations with constant coefficients, Mathematical modelling through difference equations in economics and finance.

**Unit-III :**

Mathematical modelling through difference equations in population dynamics and genetics. Mathematical Modelling through difference equations in probability theory. Miscellaneous ex amples of Mathematical modelling through difference equations.

**Unit-IV :**

Situations that can be modelled through graphs, Mathematical models in terms of directed graphs Mathematical models in terms of signed graphs, Mathematical models in terms of weighted graphs.

**References:**


1. Kapur J. N. Mathematical Modelling, New Age International, 1988.
2. Rutherford, A. Mathematical Modelling Techniques. Courier Corporation, 2012.
3. Bender, E. A. An Introduction to Mathematical Modelling. Courier Corporation, 2000.
4. Clive, L. D. Principles of Mathematical Modelling. Elsevier, 2004.
5. Meerschaert, M. M. Mathematical Modelling. Academic Press, 2013.

*SECOND SEMESTER*

## *DISCIPLINARY MAJOR*
## AMS/MJ/551: OPERATIONS RESEARCH

*Full Marks: 100 (3 Credits)*

**Unit – 1:**

Definitions and scope of operation research, different types of models in operations research – their construction and general method of solution.

**Unit – II:**

Elements of linear programming problem (LPP): Canonical and standard forms, formulation of LPP, graphical method to solve two variable LPP, solution of LPP using simplex procedure, use of artificial variables in LPP, generation of extreme point solutions, principle of duality in LPP, statement and proof of duality theorem, simple problems based on duality theorem.

**Unit – III:**

Allocation Models: Transportation problem (T.P.), different methods of finding initial feasible solution of a T.P., UV method of finding optimal solution of a T.P., solution of assignment problem using Hungarian method. Inventory Control: Definitions of various costs involved in inventory control.

**Unit – IV:**

Theory of games: Two person zero-sum games, pure and mixed strategies, saddle point, maximin-minimax principle of rectangular games, games without saddle point, dominance and modified dominance principles, graphical solution of 2xN and Mx2 games, reduction of game problems to a L.P.P.

**References:**

1. Taha, H.A. (1999): Operations Research, Macmillan Publishing Company.
2. Hiller F.S. and Libermann G.J. (1995): Introduction to Operations Research, McGraw Hill.
3. Hadley G. (1965) : Linear programming, Addison Wesley.
4. Gass G.I. (1958): Linear Programming- Methods and Applications, McGraw Hill.
5. McKinsey J.C.C. (1952): Introduction to the Theory and Games, McGraw Hill Book Co.
Kanti Swaroop, Gupta P.K. and Singh M.M. (1985) : Operations Research, Sultan Chand and Sons.

*SECOND SEMESTER*

## *DISCIPLINARY MAJOR*
# AMS/MJ/552: MULTIVARIATE ANALYSIS

*Full Marks: 100 (3 Credits)*

**Unit – 1:**

Multivariate normal distribution and its properties. Random sampling from multivariate normal distribution. Maximum likelihood estimators of parameters, distribution of sample mean vector.

**Unit – II:**

Wishart matrix – its distribution and properties, distribution of sample generalized variance, null and non-null distribution of multiple correlation coefficients.

**Unit – III:**

Hotelling's $T^2$ and its sampling distribution, Classification problem- Standards of good classification, procedure of classification based on multivariate normal distributions.

**Unit – IV:**

Principal components, dimension reduction, canonical variates and canonical correlation : definition, use, estimation and computation.

**References:**


1. T.W. Anderson, An Introduction to Multivariate Statistical Analysis, 2nd Ed., Willey, 1983.
2. N.C. Giri, Multivariate Statistical Inference, Academic Press, 1977.
3. A.M. Kshirsagar, Multivariate Analysis, Marcel Dekker, 1972.
4. D.F. Morrison, Multivariate Statistical Methods, 2nd Ed. McGraw Hill, 1976.
5. R.J. Muirhead, Aspects of Multivariate Statistical Theory, J. Wiley, 1982

## *SECOND SEMESTER*

## *INTER-DISCIPLINARY MAJOR*

To be chosen from an MJ course offered by other disciplines

## *DISCIPLINARY MINOR*

# AMS/MN/553 (a): GRAPH THEORY

*Full Marks: 100 (2 Credits)*

**UNIT I** : **Graph Isomorphisms, Trees and Fundamental Circuits**

Euler and Hamiltonian graphs, Graph isomorphisms, Adjacency matrix and incidence matrix of a graph, Directed graphs and their elementary properties. Cayley's theorem on a counting tree.

**UNIT II** : **Cut-Sets and Cut-Vertices, Planar Graphs**

Cut-set of a graph and its properties, Fundamental circuits and cut-sets, Cut-vertices, Connec tivity and separability, Network flows, 1-isomorphism and 2- isomorphism. Planar graph, Euler theorem for a planar graph.

**References:**

1. R. Balakrishnan & K. Ranganathan (2012). A Textbook of Graph Theory. Springer.
2. Narsingh Deo (2016). Graph Theory with Applications to Engineering and Computer Science. Dover Publications.
3. Reinhard Diestel (2017). Graph Theory (5th edition). Springer.
4. Edgar G. Goodaire & Michael M. Parmenter (2018). Discrete Mathematics with Graph Theory (3rd edition). Pearson.
5. Douglas West (2017). Introduction to Graph Theory (2nd edition). Pearson.

## *DISCIPLINARY MINOR*
# AMS/MN/553 (b): CLASSICAL MECHANICS

*Full Marks: 100 (2 Credits)*

**Unit-I:**

Generalized coordinates; D' Alembert's Principle and Lagrange's equation; Hamilton equation. Motion of a rigid bodies in two dimention.

**Unit-II:**

Principle of least action. Equation of canonical invariants, equations of motion in Poisson bracket notation; infinitesimal contact transformations. Transformation; integral inrainants of Poin-care; Lagrange and Poisson brakets as canonical.

**References:**

1. Goldstein H., Poole, C. and Safko, J., Classical Mechanics, 3rd Edition, Addison Wesley (2002).
2. Doulas Greogory R, Classical Mechnaics, Cambridge University Press

*SECOND SEMESTER*

*DISCIPLINARY MINOR*

## AMS/MN/553 (c): DYNAMICAL SYSTEM

*Full Marks: 100 (2 Credits)*

**Unit- I:**

Definition of Dynamical System, Periodic points, Fixed point, Stability of Fixed points, Orbit, Family of Logistic Maps, Sinks, Source, Saddles, Lyapunov, The stable Manifold Theorem, Homoclinic and Heteroclinic Points.

**Unit-II:**

Proof of Stable Manifold theorem, Bifurcations Saddle-Node and Period Doubling Bifurcations, Chaotic Oribit, Chaotic Attractors of Expanding interval Maps.

**References :**

1. K.T. Alligood, T.D. Sauer, J.A. YorkeChaos, An introduction to Dynamical Systems, Springer International Edition, 2006
2. M.F. Barnsley, Fractals Everywhere, Academic Press, 1988.
3. R. Devaney, A first Course in Chaotic Dynamical Systems, Addison-Wesley, 1992.
4. R. Devaney & B. Cummings, Introduction to Chaotic Dynamical Systems, 1986.

## *SECOND SEMESTER*

## *DISCIPLINARY MINOR*

To be chosen from an MN course offered by other disciplines.

*SECOND SEMESTER*

*DISCIPLINARY MINOR*

# AMS/FP/554: DATA ANALYSIS USING SPSS

*Full Marks: 100 (4 Credits)*

**Unit-I:**

Type of scale of measurements, choosing appropriate scale and measurement to the data, preparing codebook. Getting to Know SPSS: Starting SPSS, working with data file, SPSS windows, menus, dialogue boxes. Preparing the data file: creating data file and entering data, defining the variables, entering data, modifying data file, import file. Screening and cleaning data, manipulation of data.

**Unit-II:**

Descriptive statistics: categorical variables, continuous variables, checking normality, outliers checking. Choosing the right statistics: overview of different statistical techniques, decision making process.

**Unit-III:**

nferential statistics for association: Pearson correlation, Chi-square test of independence,inferential Statistics for comparing means: one sample t test, paired- samples ttest, independent samples t Test, one-way ANOVA, repeated measures ANOVA.Non-parametric statistics: Mann- Whitney U-test, Wilcoxon signed rank test, Kruskal-Wallis test, Friedman test.

**Unit-IV:**

Correlation and linear regression: Pearson product moment correlation, Spearman rank correlation, partial correlation, simple linear regression, multiple linear regression: assumptions, overall significance, multicollinearity, variable selection methods. Advanced Models: Multivariate statistical techniques. Logistic Regression and Discriminant Analysis, Factor Analysis, Cluster Analysis

**References :**


1. IBM 2016, IBM Knowledge Center: SPSS Statistics, IBM, viewed 18 May 2016, https:// www.ibm.com/support/knowledgecenter/SSLVMB/ welcome/
2. HOW TO USE SPSS ® A Step-By-Step Guide to Analysis and Interpretation, Brian C. Cronk, Tenth edition published in 2018 by Routledge.
3. SPSS for Intermediate Statistics: Use and Interpretation, Nancy L. Leech et. al., Second edition published in 2005 by Lawrence Erlbaum Associates, Inc.
4. Bernando, J.M. and Smith, A.F.M. : Bayesian Theory, John Wiley and Sons.
5. Using IBM SPSS statistics for research methods and social science statistics, William E. Wagner, Fifth edition published in 2015 by SAGE Publications, Inc.

# *M.SC IN APPLIED MATHEMATICS*

***THIRD SEMESTER***

***DISCIPLINARY MAJOR***

## AMS/MJ/600-A: INTEGRAL TRANSFORM AND FOURIER ANALYSIS

*Full Marks: 100 (3 Credits)*

**UNIT-I: Laplace Transforms**

Laplace transform, Linearity, Existence theorem, Laplace transforms of derivatives and integrals, Shifting theorems, Change of scale property, Laplace transforms of periodic functions, Dirac's delta function.

**UNIT-II: Properties of Laplace Transforms and Applications**

Differentiation and integration of transforms, Convolution theorem, Integral equations, Inverse Laplace transform, Lerch's theorem, Linearity property of inverse Laplace transform, Translations theorems of inverse Laplace transform, Inverse transform of derivatives, Applications of Laplace transform in obtaining solutions of ordinary differential equations and integral equations.

**UNIT-III: Fourier Transforms**

Fourier and inverse Fourier transforms, Fourier sine and cosine transforms, Inverse Fourier sine and cosine transforms, Linearity property, Change of scale property, Shifting property, Modulation theorem, Relation between Fourier and Laplace transforms.

**UNIT-IV: Solution by Fourier Transforms**

Solution of integral equation by Fourier sine and cosine transforms, Convolution theorem for Fourier transform, Parseval's identity for Fourier trans form, Plancherel's theorem, Fourier trans form of derivatives, Applications of infinite Fourier transforms to boundary value problems, Finite Fourier transform, Inversion formula for finite Fourier transforms.

***References:***


1. James Ward Brown & Ruel V. Churchill (2011). Fourier Series and Boundary Value Problems. McGraw-Hill Education.
2. Charles K. Chui (1992). An Introduction to Wavelets. Academic Press.
3. Erwin Kreyszig (2011). Advanced Engineering Mathematics (10th edition). Wiley.
4. Walter Rudin (2017). Fourier Analysis on Groups. Dover Publications.
5. A. Zygmund (2002).Trigonometric Series (3rd edition). Cambridge University Press.

# *M.SC IN APPLIED MATHEMATICS*

***THIRD SEMESTER***

***DISCIPLINARY MAJOR***

## AMS/MJ/601-A: DIFFERENTIAL GEOMETRY

*Full Marks: 100 (3 Credits)*

**Unit-I: Curves in $\mathbb{R}^2$, $\mathbb{R}^3$ and Surfaces in $\mathbb{R}^3$:**

Local theory of curves-Space curves,tangent and arc length of space curves, Osculating plane, Normal line and normal plane, Principal normal and Binormal, fundamental planes,Curvature and Torsion, Serret-Frenet formula, Helices, Circular Helix.

**Unit-II : Curve in Space:**

Existence and Uniqueness theorem for space curves, Osculating circle and Osculating sphere, Locus of the centre of curvature and spherical curvature, Conical equation of curve, Involute and Evolutes, Spherical indicatrices and its curvature and torsion, Bertand curve and its properties.

**Unit-III: Geometry of Surfaces :**

Basic definitions and examples of surface, Parametric curve on a surface, Tangent plane and surface normal, The first and second fundamental form and its geometrical interpretation, Direction coefficient on a surface, Normal curvature, Principal direction and principal curvature, first curvature, mean curvature, Gausian curvature, Umbilic, Developable surface, Lines of curvature, Rodrigue's Formula, Line of curvature as parametric curve, Euler's theorem, Duplin's theorem

**Unit-IV: Fundamental equation of Surface Theory :**

Conjugate directions, Asymptotic lines, Third fundamental form, Relation between first, second and third fundamental form. Gauss equation for surface theory, Weingarten equation, Mainardi-Codazzi equation, Geodesics and their differential equation, Canonical geodesic equation, Normal properties of geodesic, Gauss Bonnet theorem.

**References:**


1. Christian BÓr (2010). *Elementary Differential Geometry*. Cambridge University Press.
2. Manfredo P. do Carmo (2016). *Differential Geometry of Curves & Surfaces* (Revised and updated 2nd edition). Dover Publications.
3. Alferd Gray (2018). *Modern Differential Geometry of Curves and Surfaces with Mathematica* (4th edition). Chapman & Hall/CRC Press, Taylor & Francis.
4. Richard S. Millman & George D. Parkar (1977). *Elements of Differential Geometry*. Prentice-Hall.
5. C. E. Weatherburn. Differential geometry of three dimentions. Radha publication house, Kolcatta.

# *M.SC IN APPLIED MATHEMATICS*

***THIRD SEMESTER***

***DISCIPLINARY MINOR***

## AMS/MN/602-A (a): Topology

*Full Marks: 100 (2 Credits)*

**Unit-I:**

Definition and examples of topological spaces, Closed sets. Closure, Dense subsets. Neighborhoods. Interior, exterior and boundary. Accumulation points and derived sets and bases, sub-bases. Subspaces and relative topology. First and Second Countable spaces. Lindelof's theo rems.

**Unit-II :**

Compactness, Continuous functions and compact sets, Basic properties of compactness. Com pactness and finite intersection property. Sequentially and countably compact sets. Local com pactness and one point compactification. Connected spaces. Connectedness on the real line. Components. Locally connected spaces.

**References :**

1. Munkers, James R. (1975): Topology-A First Course, Prentice-Hall of India Pvt. Ltd. New Delhi.
2. Simmons, George F. (1963): Introduction to Topology and Modern Analysis, MeGraw Hill Book Company.
3. Joshi, K.D. (1983): Introduction to General Topology, Wiley Eastern Ltd.
4. Hocking, J and Young, G. (1981): Topology, Addison-Wesley, Reading.
5. Pervin, W.J. (1964): Foundations of General Topology, Academic Press Inc. New York.

# *M.SC IN APPLIED MATHEMATICS*

***THIRD SEMESTER***

***DISCIPLINARY MINOR***

## AMS/MN/602-A (b): ECOLOGICAL MODELLING

*Full Marks: 100 (2 Credits)*

**Unit-I:**

Single species models, Exponential, logistic, Gompertz growth, Harvest model, Discrete-time and Delay model, Interacting population model, chemostate, prey-predator, competition & mutualism models.

**Unit-II:**

Dynamics of exploited populations, spatially structured models, Age-structured models, sex-Structured models, models of spread, two sex models, Leslie matrix.

**References:**

1. Mark Kot, Elements of Mathematical Ecology, Cambridge University Press, 2001
2. E.C.Pielou, Mathematical Ecology, Wiley, 2ndEditon, 1977
3. John Pastor, Mathematical Ecology of Populations and Ecosystems, Wiley- Blackwell, 1st Edition, 2008
4. Hallam, Thomas G., Levin, Simon A., Mathematical Ecology, Springer-Verleg Berlin Heidelberg, 1986

# *M.SC IN APPLIED MATHEMATICS*

***THIRD SEMESTER***

***DISCIPLINARY MINOR***

## AMS/MN/602-A (c): FLUID DYNAMICS

*Full Marks: 100 (2 Credits)*

**Unit-I:**

Equation of continuity, Euler's equation of motion for inviscid flow; Stream-lines, path of a particle, Potential flow.

**Unit-II:**

Two diamenztsional and axi-symmetric motion, Source and sinks, Vortex motion; Navier-Stokes equation for viscous fluid.

**References:**

1. Chorlton, F. (Text Book of Fluid Dynamics).
2. L.D., Landau & E. N. Lipschitz (Fluid Mechanics).
3. G. K., Batchelor (An Introduction to Fluid Mechanics)
4. Kundu and Cohen (Fluid Mechanics).

## *THIRD SEMESTER*

## *INTER-DISCIPLINARY MINOR*

To be chosen from an MN course offered by other disciplines.

## FIELD PROJECT/INTERNSHIP/APPRENTICESHIP

# AMS/FP/603-A: TYPE-SETTING IN LATEX

*Full Marks: 100 (4 Credits)*

**UNIT I :**

Preparing an input file, sentences and paragraphs, the document class, sectioning, display material, running LaTeX, changing the type style, producing mathematical symbols and mathematical formulae, arrays, delimiters, multiline formulae, putting one thing on other, spacing in math mode.

**UNIT II :**

Defining command and environments, Producing and including graphics in a LaTeX file, figures and other floating bodies, lining it up in columns, table of content, cross-reference, bibliography and citation, making index and glossary, slides, overlays and notes, letters.

**UNIT III :**

Design it yourself: document class, page style, title page, customizing the style, line and page breaking, numbering, length, spaces and boxes, formatting with boxes, centring and flushing, list making environments, changing font type size and special symbols, picture, picture envi ronments, picture objects, text, boxes, straight lines, arrow, stacks, circles, oval, framing, curve, grid, repeat patterns.

**UNIT IV :**

Making presentation slides in beamer class LaTeX, various styles in beamer presentation, dynamic slides. PostScript macros for Generic TeX (PsTrix): arguments, dimension, coordi nates, angles, line styles, fill styles, custom styles, custom graphics, picture tools, text tricks, node and connection special tricks.

**References:**

1. Leslie Lamport. A Document Preparation System User's Guide and Reference Manual, Addison-Wesley Publishing Company, 2001.
2. Kottwitz, S. LaTeX Beginner's Guide. Packt Publishing Ltd., UK, 2011.
3. Tantau,T. User Guide to the Beamer Class, http://latex-beamer.sourceforge.net.
4. Oetiker,Tobias. The Not So Short Introduction to LATEX2E, https://tobi.oetiker.ch/lshort/lshort.pdf

# *M.SC IN APPLIED MATHEMATICS*

## *FOURTH SEMESTER*

## *DISCIPLINARY MAJOR*
## AMS/MJ/650-A: ELASTICITY

*Full Marks: 100 (4 Credits)*

**UNIT-I : Strain and Stress analysis**

Analysis of Strain: Principal strains and invariants, general infinitesimal deformation, Example of Strain, Equations of Compatibility, Finite deformations.

Analysis of Stress: Stress tensor, Equation of equilibrium, Stress quadric of Cauchy, Principal stress and invariants, Maximum normal and shear stress, Plane stress, generalized plane stress, stresses and displacements in terms of complex potentials, simple problems.

**UNIT II : Equations of Elasticity, Wave equation**

Generalized Hook's Law, Homogeneous isotropic media, Equilibrium and dynamical equations for isotropic media, Strain-energy function, Uniqueness of solution, Beltrami-Michell Compatibility equations, Saint Venant's Principal.

D'Alembert's method of one dimensional wave equation, Waves in three dimensions, Harmonic waves, Spherical waves, Solution of equation of wave motion of stationary type by method of separation of variables.

**UNIT-III : Elastic Waves**

Wave propagation in isotropic elastic solid medium, Waves of dilation and distortion, Rayleigh waves, Love waves, Lamb waves, Stoneley waves.

**UNIT-IV : Reflection and refraction of Waves**

Reflection of P, SV and SH-waves from free surface of a half-space, Reflection and refraction of elastic waves (P, SV and SH-waves) at Solid-Solid and Solid-Liquid interface.

**References:**


1. I. S. Sokolnikoff: Mathematical Theory of Elasticity, Mc-Graw Hill, Inc.
2. P. K. Ghosh, The Mathematics of Waves and Vibrations, Macmillan Company of India Limited.
3. A. E. H. Love: A Treatise on Mathematical Theory of Elasticity, Dover Publications.
4. P. K. Ghosh, The Mathematics of Waves and Vibrations, Macmillan Company of India Limited.
5. K. E. Bullen and B. A. Bolt: An Introduction to the Theory of Seismology, Cambridge University Press, Cambridge (1985).
6. P. M. Shearer: Introduction to Seismology, Cambridge University Press (1999).
7. J.D. Achenbach: Wave propagation in elastic solids, ELSEVIER SCIENCE PUBLISHERS.(1973,1976)

# *M.SC IN APPLIED MATHEMATICS*

***FOURTH SEMESTER***

***DISCIPLINARY MAJOR***

## LSC/FP/651-A: PRACTICE TEACHING

*Full Marks: 100 (4 Credits)*

# *M.SC IN STATISTICS*

***THIRD SEMESTER***

***DISCIPLINARY MAJOR***

## STAT/III/DMj/07: DEMOGRAPHY

*Full Marks: 100 (3 Credits)*

**Unit – I:**

Coverage and content errors in demographic data, Chandrasekharan—Deming formula to check completeness of registration data, adjustment of age data, population transition theory.

**Unit – II:**

Measures of fertility; stochastic models for reproduction, distributions of time of birth, inter-live birth intervals and of number of births; parity progression ratios.

**Unit – III:**

Measures of Mortality; construction of abridged life tables, infant mortality rate and its adjustments, model life table.

**Unit – IV:**

Internal migration and its measurement, migration models, concept of international migration. Methods for population projection, component method of population projection, Stable populations.

**References :**


1. Kumar, R. (1986): Technical Demography, Wiley Eastern Ltd.
2. Benjamin, B. (1969): Demographic Analysis, George, Allen and Unwin.
3. Chiang, C.L. (1968): Introduction to Stochastic Progression.
4. Cox, P.R. (1970): Demography, Cambridge University Press.
5. Keyfitz, N. (1977): Introduction to the Mathematics of Population-with Revisions, Addison London.
6. Spiegelman, M. (1969): Introduction to Demographic Analysis, Harvard University Press.

Wolfenden, H.H. (1954): Population Statistics and Their Compilation, Am Actuarial Society

# *M.SC IN STATISTICS*

## *THIRD SEMESTER*

## *DISCIPLINARY MAJOR*

## STAT/III/DMj/08: ECONOMETRICS

*Full Marks: 100 (3 Credits)*

**Unit – I:**

Nature of econometrics, the general linear model (GLM) and its extensions, ordinary least squares (OLS) estimation and prediction, generalized least squares (GLS) estimation and prediction, heteroscedastic disturbances, pure and mixed estimation.

**Unit – II:**

Auto correlation, its consequences and tests. Theil BLUS procedure, estimation and prediction, multicollinearity problem, its implications and tools for handling the problem, ridge regression.

**Unit – III:**

Linear regression and stochastic regression, errors in variables, autoregressive linear regression, lagged variables, distributed lag models, estimation of lags by OLS method, Koyck's geometric lag model.

**Unit – IV:**

Simultaneous linear equations model and its generalization, identification problem, restrictions on structural parameters, rank and order conditions. Estimation in simultaneous equations model.

**References :**


1. Apte, P.G. (1990): Text books of Econometrics, Tata McGraw Hill.
2. Cramer, J.S. (1971): Empirical Econometrics, North Holland.
3. Gujarathi, D. (1979): Basic Econometrics, McGraw Hill.
4. Intrulligator, M.D. (1980): Econometric models—Techniques and applications, Prentice Hall of India.
5. Johnston, J. (1984): Econometric methods. Third edition, McGraw Hill.
6. Klein, L.R. (1962): An introduction to Econometrics, Prentice Hall of India.
7. Koutsoyiannis, A. (1979): Theory of Econometrics, Macmillan Press.
8. Malinvaud, E. (1966): Statistical methods of Econometrics, North Holland.
9. Srivastava, V.K. and Giles D.A.E. (1987): Seemingly unrelated regression equations models, Maicel Dekker.
10. Theil, H. (1982): Introduction to the theory and practice of Econometrics, John Wiley.
11. Walters, A. (1970): An introduction to Econometrics, Macmillan & Co.Wetherill, G.B. (1986): Regression analysis with applications, Chapman Hall

# *M.SC IN STATISTICS*

***THIRD SEMESTER***

***DISCIPLINARY MINOR***

## STAT/III/DMn/03(a): HEALTH STATISTICS AND EPIDEMIOLOGY

*Full Marks: 50 (2 Credits)*

**Unit-I:**

Health Statistics: Basic concepts of health and morbidity, sources of morbidity statistics, measures of morbidity, examples, Incidence Rate and Prevalence Rate, interrelationships between measures, prevalence and point prevalence, concept of International Classification of Diseases.

**Unit-II:**

Epidemiologic Methods, Introduction to epidemiology, aims of epidemiology, descriptive epidemiology, procedures in descriptive studies, analytical epidemiology : case control study: examples, estimation of risk, Odds Ratio; cohort study and their types, elements of cohort study, relative risk and attributable risk, concept of experimental epidemiology, randomized and nonrandomized control trials.

**References:**


1. C. Jennison and B. W. Turnbull (1999): Group Sequential Methods with Applications to Clinical Trials, CRC Press.
2. D. McNeil (1996). Epidemiological Research Methods. Wiley and Sons.
3. E. Marubeni and M. G. Valsecchi (1994): Analyzing Survival Data from Clinical Trials and Observational Studies, Wiley and Sons.
4. J. F. Jekel, J. G. Elmore, D.L. Katz (1996). Epidemiology, Biostatistics and Preventive Medicine. WB Saunders Co.
5. J. L. Fleiss (1989): The Design and Analysis of Clinical Experiments. Wiley and Son.
6. K. J. Rothman and S. Geenland (ed.) (1988). Modern Epidemiology, Lippincott-Raven.
7. L. M. Friedman, C. Furburg, D. L. Demets (1998): Fundamentals of Clinical Trials Springer Verlag.
8. MacMohan, Brian and Thomas (1970): Epidemiolgy : Principles and Methods, Little, Brown and Co, Boston.
9. P. Armitage and G Berry (1987): Statistical Methods in Medical Research, Blackwell Scientific Publications, Oxford
10. S. Selvin (1996). Statistical Analysis of Epidemiologic Data, Oxford University Press.
11. Swaroop and Satya (1960): Introduction to Health Statistics, E & S Livingstone Ltd., Edinburgh.

W. W. Daniel (1974): Biostatistics: A Foundation for Analysis in the Health Sciences, John Wiley and Sons, Inc., New York

# *M.SC IN STATISTICS*

***THIRD SEMESTER***

## *DISCIPLINARY MINOR*
## STAT/III/DMn/03(b): ADVANCED DESIGN OF EXPERIMENTS

*Full Marks: 50 (2 Credits)*

**Unit-I:**

Factorial experiements: $2^n$ and $3^n$ experimnets and their analysis, complete and partial confounding, partial confounding-Fractional replication in Factorial Experiments, Split plot and strip plot design and their analysis.

**Unit-II:**

BIBD - Types of BIBD - Simple construction methods - Concept of connectedness and balancing Intra Block analysis of BIBD Recovery of InterBlock information Partially Balanced Incomplete Block Design with two associate classes intra block analysis only.

**References :**

1. Das, M.N. and Giri, N.C(1979): Design and Analysis of Experiments, Wiley Eastern Ltd, (Relevant Chapters for Units II, III, IV and V)
2. Douglas C. Montgomery (1984) : Design and Analysis of Experiments, John Wiley and Sons, (Chapter 16 for Parts of Unit IV and Unit V)
3. Graybill, F.A(1961) : An Introduction to Linear Statistical Models, Mc Graw Hilll Book Company,(Chapter 5 & Parts of Chapter 6 for Unit I)
4. Pearce .S.C. (1984) : Design of Experiments , Wiley , New York

# *M.SC IN STATISTICS*

***THIRD SEMESTER***

***DISCIPLINARY MINOR***

## STAT/III/DMn/03(c): INRODUCTION TO ACTUARIAL STATISTICS

*Full Marks: 50 (2 Credits)*

**Unit-I:**

Theory of Interest rates: Rate of interest; Nominal rate of interest. Accumulation factors. Force of interest, present values, stoodley formula for the force of interest, present value of cash flows, valuing cash flows. Basic compound interest function, equations of values and yield on transaction-annuities certain, present values and accumulation, concepts of different annuities, continuously payable annuities, varying annuities.

**Unit-II:**

Utility theory, insurance and utility theory, models for individual claims and their sums, Aproximations for the distribution of the sum. Application to insurance. Survival function Time until-death for a person age x, curate future lifetime, force of mortality.

**References :**

1. N.L. Bowers, H.U. Gerber, J.C. Hickman, D.A.Jones and C.J.Nesbitt, (1986): Actuarial Mathematics, Society of Actuaries, Ithaca, llliois, U.S.A.Second Edition.
2. J.J.Mccutcheon and W.F.Scott: An Introduction to Mathematics of Finance, Butter Worth & Heinemann
3. Spurgeon E.T.(1972): Life Contingencies, Cambridge University Press. Neill A (1977) Life Contingencies, Heinemann

# *M.SC IN STATISTICS*

***THIRD SEMESTER***

**FIELD PROJECT/INTERNSHIP/APPRENTICESHIP**

## STAT/III/AP/03: PRACTICAL BASED ON THEORY PAPERS DMj/07 & DMj/08

# *M.SC IN STATISTICS*

### *FOURTH SEMESTER*

### *DISCIPLINARY MINOR*
## STAT/IV/DMj/09: SURVIVAL ANALYSIS

*Full Marks: 100 (3 Credits)*

**Unit – I:**

Concept of time, order and random censoring, likelihood in the distributions – Exponential, Gamma, Weibull, Lognormal, Pareto, Linear failure rate, inference for these distributions.

**Unit – II:**

Life tables, failure rate, mean residual life and their elementary classes and their properties, Multiple decrement life table.

**Unit – III:**

Estimation of survival function – Actuarial estimator, Kaplan-Meier estimator, estimation under the assumption of IFR/DFR, Two sample problem – Gehan test, Log rank test.

**Unit – IV:**

Semi-parametric regression for failure rate – Cox's proportional hazards model with one and several covariates, rank test for the regression coefficient, Competing risk model.

**References :**


1. Barlow, R.E. and Proschan, F. (1985): Statistical Theory of Reliability and Life Testing; Holt, Rinehart and Winston.
2. Lawless, J.F. (1982): Statistical Models and Methods of Life Time Data; John Wiley.
3. Nelson, W. (1982): Applied life Data Analysis; John Wiley.
4. Zacks, S.: Reliability Theory; Springer
5. Bain, L. J. and Engelhardt (1991): Statistical Analysis of Reliability and Life Testing Models; Marcel Dekker.

# *M.SC IN STATISTICS*

## *FOURTH SEMESTER*

## FIELD PROJECT/INTERNSHIP/APPRENTICESHIP

# STAT/IV/AP/04: PRACTICAL BASED ON THEORY PAPERS DMj/09