. **INDIAN STATISTICAL INSTITUTE**

STUDENTS' BROCHURE

B.STAT.(HONS.) PROGRAMME
2002-03

GENERAL INFORMATION

1.1 Admission

In order to be eligible for admission, a student should have successfully completed 10+2 years of Higher Secondary Education (or its equivalent) with Mathematics & English as subjects of study. Any student who is asked to discontinue the B.Stat.(Hons.) programme is not eligible for readmission into this programme.

1.2 Duration

The total duration of the B.Stat.(Hons.) programme is six semesters. An academic year usually starts in July-August and continues till May, consisting of two semesters with a recess inbetween. The classes are generally held only on the weekdays from 10.15 a.m. to 5.30 p.m. There is a study-break of one week before the semestral examinations in each semester.

1.3 Courses

The B.Stat.(Hons.) programme has 30 one-semester credit courses, five per semester, as given in the curriculum below. Several groups of three elective courses in natural and social sciences is offered, out of which, one group has to be chosen. Besides the above courses, a non-credit course on Remedial English is offered in the first semester of the first year. This course is compulsory for those who are found to have deficiency in English comprehension and writing, as determined through a test. If the time table permits, a student is allowed to take one additional elective course per semester as a non-credit course.

1.4 Examinations

The final (semestral) examination in a course is held at the end of the semester. Besides, there is a mid-semestral examination in each course. The schedule for the examinations is announced in advance. Usually, the scores of homeworks/assignments, mid-semestral and semestral examinations are combined to get the composite score in a course, as explained in Section 1.5 below. If the composite score of a student is below 45% in a credit course, or below 35% in a non-credit course the student may take a back-paper examination to improve the score. If the score of a student in the back-paper examination of *Remedial English* is below 35%, he/she is allowed to repeat the course in the following year along with the new first year students. A student is not allowed to continue in the B.Stat.(Hons.) programme if he/she fails the Remedial English course even after these three attempts.

At most one back-paper examination is allowed in a particular course. Moreover, a student can take at most four back-paper examinations (for credit courses) in each of the first and second years, and at most two in the third year. The decision to allow a student to appear for the back-paper examination is taken by the appropriate Teachers' Committee. The back-paper examination covers the entire syllabus of the course. A student may take more than the allotted quota of back-paper examinations in a given academic year, and decide at the end of that academic year which of the back-paper examination scores should be disregarded.

The semestral examination of the Statistics Comprehensive course is conducted in the form of a viva voce, where questions are asked on material from the various Statistics courses taken by the students in the first five semesters. The *viva voce* is conducted by a panel of at least five teachers (at a time) who taught Statistics courses to the concerned group of students. No back-paper examination is allowed in this course.

If a student misses the mid-semestral or semestral examination of a course due to medical or family emergency, the Teachers' Committee may, on an adequately documented representation from the student, allow him/her to take a supplementary examination in the course. The supplementary semestral examination is held at the same time as the back-paper examinations for that semester and a student taking this examination is not given any other examination in the course. The maximum a student can score in a supplementary semestral examination is 60%.

1.5 Scores

The composite score in a course is a weighted average of the scores in the mid-semestral and semestral examinations, home-assignments, and the practical record book (and/or project work) in that course. In case of courses which involve field work, some weight is given to the field reports also. The semestral examination normally has a weight of at least 50%. The weights are announced beforehand by the Dean of Studies, or the Class Teacher, in consultation with the teacher concerned.

The minimum composite score to pass a credit or non-credit course is 35%.

When a student takes back-paper examination in a credit course, his/her final score in that course is the higher of the back-paper score and the earlier composite score, subject to a maximum of 45%.

When a student takes supplementary semestral examination in a course, the maximum he/she can score in that examination is 60%. The score in the supplementary examination is used in place of the semestral examination score to arrive at the composite score.

Every student is required to bring a scientific calculator for use in the practical classes. Calculators can be purchased with contingency grants.

1.6 Attendance

Each student is required to attend at least 75% of all the classes held in a semester. Inadequate attendance record in any semester would lead to reduction of stipend in the following semester; see Section 1.11.

Students with inadequate attendance are given warning and urged to improve their attendance.

If a student fails to attend any course continuously for one week or more, he/she is required to furnish explanation to the Dean of Studies or the Class Teacher for such absence. If such explanations are found to be satisfactory by the Teachers' Committee, then the calculation of percentage of attendance is determined disregarding the period for which explanation has been provided by the student and accepted by the Teachers' Committee. In case a satisfactory explanation is not available, the student may be warned and his/her guardian informed. A student is also required to furnish proper notice in time and provide satisfactory explanation if he/she fails to take any mid-semestral or semestral examination.

1.7 Promotion

Here and in what follows, copying in the examination, rowdyism or some other breach of discipline or unlawful/unethical behaviour etc. are regarded as **unsatisfactory conduct.**

A student passes a semester of the programme only when he/she secures composite score of

35% or above in every course and his/her conduct has been satisfactory. If a student passes both the semesters in a given year, the specific requirements for promotion to the following year are as follows:

First Year to Second Year: Average composite score in all the credit courses taken in the first year is not less than 45%.

Second Year to Third Year: Average composite score in all the credit courses taken in the second year is not less than 40%.

No student is allowed to repeat B.Stat.(Hons.) First Year or Second Year.

1.8 Final Result

At the end of the third academic year the overall average of the percentage composite scores in all the credit courses taken in the three-year programme is computed for each student. Each of the credit courses carries a total of 100 marks, while Statistics Comprehensive carries 200 marks. The student is awarded the B.Stat.(Hons.) degree in one of the following categories according to the criteria he/she satisfies, provided his/her conduct is satisfactory, and he/she passes all the semesters. If a student has satisfactory conduct, passes all the courses but does not fulfill the requirements for the award of the degree with honours, then he/she is eligible for the B.Stat. pass degree (see below).

Final Result	*Scores*
B.Stat.(Hons.) - First Division with distinction	(i) The overall average score is at least 75%, (ii) average score in the sixteen statistics and probability courses is at least 60%, and (iii) the number of composite scores less than 45% is at most four.
B.Stat.(Hons.) - First Division	(i) The overall average score is at least 60% but less than 75%, (ii) average score in the sixteen statistics and probability courses is at least 60%, and (iii) the number of composite scores less than 45% is at most six.
B.Stat.(Hons.) - Second Division	(i) Not in the First Division with distinction or First Division, (ii) the overall average score is at least 45%, (iii) average score in the sixteen statistics and probability courses is at least 45%, and (iv) the number of composite scores less than 45% is at most eight.
B.Stat. - Pass	Not in the First Division with Distinction, First Division or Second Division.

The **sixteen statistics and probability courses** in which a student must have a minimum average score in order to be placed in a particular division are: **Stat101A, Stat101B, Stat101C, Stat101D, Stat102, Stat103, Stat104, Stat105A, Stat105B, Stat106, Stat107, Stat108, Prob101A, Prob101B, Prob101C and Prob102.** A student fails if his/her composite score in any credit or non-credit course is less than 35%.

A student who fails in the third year is allowed to repeat that year. A student who secures B.Stat. Pass and has at most eight composite scores (in credit courses) of less than 45% in the

first two years are allowed to repeat the final year of the B.Stat.(Hons.) programme. All the students repeating third year do not get stipend and contingency grant. The scores obtained during the repetition of the third year are taken as the final scores in the third year. A student is not given more than one chance to repeat the final year of the programme. For a student who fails and repeats the programme, the same rules continue to apply.

1.9 Award of Certificates

A student passing the B.Stat. degree examination is given a certificate which includes (i) the list of all the credit courses taken in the three-year programme along with the respective composite scores, (ii) the list of all non-credit courses passed and (iii) the category (Hons. First Division with Distinction or Hons. First Division or Hons. Second Division or Pass) of his/her final result.

The Certificate is awarded in the Annual Convocation of the Institute following the last semestral examinations.

1.10 Class Teacher

One of the instructors of a class is designated as the Class Teacher. Students are required to meet their respective Class Teachers periodically to get their academic performance reviewed, and to discuss their problems regarding courses.

1.11 Stipend

Stipend, if awarded at the time of admission, is valid initially for the first semester only. The amount of stipend to be awarded in each subsequent semester depends on academic performance, conduct, and attendance, as specified below, provided the requirements for continuation in the academic programme (excluding repetition) are satisfied; see Sections 1.6 and 1.7.

1. *Performance in course work*

   - If, in any particular semester, (i) the composite score in any course is less than 35%, or (ii) the composite score in more than one course (two courses in the case of the first semester of the first year) is less than 45%, or (iii) the average composite score in all credit courses is less than 45%, no stipend is awarded in the following semester.
   - If all the requirements for continuation of the programme are satisfied, the average composite score is at least 60% and the number of credit course scores less than 45% is at most one in any particular semester (at most two in the first semester of the first year), the full value of the stipend is awarded in the following semester.
   - If all the requirements for continuation of the programme are satisfied, the average composite score is at least 45% but less than 60%, and the number of credit course scores less than 45% is at most one in any particular semester (at most two in the first semester of the first year), the stipend is halved in the following semester.

   All composite scores are considered after the respective back-paper examinations. Stipend is fully withdrawn as soon as the requirements for continuation in the academic programme are not met.

2. *Attendance*

If the overall attendance in all courses in any semester is less than 75%, no stipend is awarded in the following semester.

3. *Conduct*
   The Dean of Studies or the Class Teacher, **at any time,** in consultation with the respective Teachers' Committee, may withdraw the stipend of a student fully for a specific period if his/her conduct in the campus is found to be unsatisfactory.

Note: Once withdrawn, stipends may be restored in a subsequent semester based on improved performance and/or attendance, but no stipend is restored with retrospective effect.

Stipends are given after the end of each month for eleven months in each academic year. The first stipend is given two months after admission with retrospective effect provided the student continues in the B.Stat.(Hons.) programme for at least two months.

Contingency grants can be used for purchasing a scientific calculator and other required accessories for the practical class, text books and supplementary text books and for getting photostat copies of required academic material. All such expenditure should be approved by the respective Class Teacher. No contingency grants are given in the first two months after admission.

1.12 ISI Library Rules

Any student is allowed to use the reading room facilities in the library and allowed access to the stacks. B.Stat.(Hons.) students have to pay a security deposit of Rs. 250 in order to avail of the borrowing facility. A student can borrow at most three books at a time.

Any book from the Text Book Library (TBL) collection may be issued out to a student only for overnight or week-end reference provided at least one copy of that book is left in the TBL. Only one book is issued at a time to a student. *Fine is charged if any book is not returned by the due date stamped on the issue-slip*. The library rules, and other details are posted in the library.

1.13 Expenses for the Field Training Programmes

All expenses for the necessary field training programmes are borne by the Institute, as per the Institute rules.

1.14 Change of Rules

The Institute reserves the right to make changes in the above rules, course structure and the syllabi as and when needed.

B.STAT.(HONS.) CURRICULUM

All the courses listed below are allocated **three lecture sessions** and one practical/tutorial session per week. The practical/tutorial session consists of **two** periods in the case of Statistics, Computer and Elective courses, and **one** period in case of Mathematics and Probability courses. The periods are meant to be used for discussion on problems, practicals, computer outputs, assignments, for special lectures and self study, etc. All these need not be contact hours.

First Year

Semester I

1. **Math101A: Analysis I**
2. **Prob101A: Probability Theory I**
3. **Math102A: Vectors and Matrices I**
4. **Stat101A: Statistical Methods I**
5. **Comp101A: Computational Techniques and Programming I**
6. **Engl101N: Remedial English (non-credit)**

Semester II

1. **Math101B: Analysis II**
2. **Prob101B: Probability Theory II**
3. **Math102B: Vectors and Matrices II**
4. **Stat101B: Statistical methods II**
5. **Comp101B: Computational Techniques and Programming II**

Second Year

Semester I

1. **Math101C: Analysis III**
2. **Prob101C: Probability Theory III**
3. **Stat101C: Statistical Methods III**
4. **Comp102: C & Data Structures**
5. **Elective Course I**

Semester II

1. **Math102: Elements of algebraic structures**
2. **Stat102: Economic Statistics & Official Statistics**
3. **Stat101D: Statistical Methods IV**
4. **Stat103: Demography (half semester) and SQC & OR (half semester)**
5. **Elective Course II**

Third Year

Semester I

1. **Stat104: Linear Statistical Models**
2. **Stat105A: Statistical Inference I**
3. **Stat106: Sample Surveys**
4. **Math103: Differential Equations**
5. **Elective Course III**

Semester II

1. **Prob102: Introduction to Stochastic Processes**
2. **Stat105B: Statistical Inference II**
3. **Stat107: Design of Experiments**
4. **Stat108: Statistics Comprehensive**
5. **Comp103: Database Management Systems**

ELECTIVE COURSES

Objectives of the Elective Courses

The primary objective is to impart knowledge in natural and social sciences so that the students may learn the language of the scientists and the fundamental concepts in these fields, and develop familiarity with some of the basic and important problems in these fields which call for statistical analysis along with the corresponding techniques used. The secondary objective is to enrich the general scientific knowledge which may be of use later in professional work.

Elective Groups

The elective courses are organized into groups as follows.	**Second year**	**Second year**	**Third year**
	Semester I	***Semester II***	***Semester I***
Group I	**Economics I**	**Economics II**	**Economics III**
Group II	**Economics I**	**Economics II**	**Introduction to Sociology and Sociometry**
Group III	**Biology I**	**Biology II**	**Introduction to Anthropology and Human Genetics**
Group IV	**Physics I**	**Physics II**	**Geology**

Choice of Electives

A Student has to choose one group of elective courses for credit. The choice has to be given in writing to the Dean of Studies within the first four weeks of the first semester of the second year. Once the choice has been made, it cannot be altered.

A student may also take one additional elective course per semester as a non-credit course, although it is not mandatory to take these additional elective courses. A student is given up to four weeks to decide whether he/she wants to take a particular elective course as non-credit. If a student decides to take any additional elective course as non-credit, he/she has to attend that course regularly and obtain at least the pass mark (35%). All non-credit courses taken by a student are also recorded and mentioned in his/her mark-sheet.

The Group I elective courses are pre-requisites for the QE specialization in the M.Stat. programme. This condition would be satisfied if a student takes these courses, some as credit and some as non-credit.

Use in Advanced Courses

Economics I, II and III are **pre-requisites** for the QE specialization in M.Stat. Biology I and II are desirable for the BSDA specialization in M.Stat. Anthropological and sociological data would be used in courses on multivariate statistical analysis and analysis of categorical data, in particular Geological data would be used in the courses on multivariate statistical analysis and analysis of directional data, in particular. Examples from natural and social sciences would generally be discussed in all methodological and modelling courses in statistics.

Note: The B.Stat.(Hons.) curriculum has been designed as a part of the five-year programme leading to the M.Stat. degree. It may be helpful to know the M.Stat. curriculum along with

the list of specialization courses in order to make decision on the choice of elective courses. The Class Teacher may be consulted in order to know the scope of the different specializations offered in the M.Stat. programme.

BRIEF SYLLABI OF THE B.STAT.(HONS.) COURSES

Statistics Courses

Statistical Methods I (Stat101A):

Different types of statistical problems and related data analysis (emphasis should be on concrete examples and real scientific investigations where statistics is relevant).

Collection and summarization of univariate and bivariate data. Descriptive statistics: measures of location, spread, skewness, kurtosis; measures of association; various properties of these measures and their utility (illustration with specific examples and numerical exercises, possibly using statistical packages).

History of Statistics.

Statistical Methods II (Stat101B):

Summarization and analysis of different types of multivariate data. Regression. Partial and multiple correlation.

Fitting probability distributions and stochastic models to observed data. Goodness of fit. (General emphasis should be on specific data analytic examples from real scientific studies.)

Simulation of probability distributions and stochastic models. Applications of simulation techniques.

Practicals using statistical packages.

Statistical Methods III (Stat101C):

Formulation of inference problems with concrete illustrations. Point estimation: Different methods and criteria for good estimates. Data analytic illustrations.

Tests of hypotheses: Different types of statistical hypotheses. Error probabilities (level of significance, power). Tests for parameters when sampling from one and two normal distributions. Tests for parameters in binomial and Poisson distributions. Conditional tests. Data analytic illustrations.

Elements of Time Series analysis: Trend/secular, seasonal/cyclic and random components of a time series, moving averages, autocorrelation function,

correlogram and periodogram.

Sampling distributions of sample proportion, sample mean and sample variance. Central and non-central χ^2, t and F distributions.

Practicals using statistical packages.

Statistical Methods IV (Stat101D):

Statistical inference for parameters in bivariate and multivariate normal distributions. Inference problems in simple and multiple linear regression. Inference on partial and multiple correlation coefficients. Logistic and probit analysis. Data analytic illustrations.

Distribution theory for linear and quadratic forms.

Large-sample tests and confidence intervals. Variance stabilizing transformations. χ^2-tests for independence and homogeneity. Data analytic illustrations.

Order statistics: their distributions and applications.

Practicals using statistical packages.

Reference texts for Statistical Methods I-IV:

1. *Statistics: A Guide to the Unknown* by J.M. Tanur (ed.).
2. *Statistics* by D. Freedman, R. Pisani and R. Purves.
3. *An Investigation for a Course in Statistics* by M. Tanner.
4. *The Advanced Theory of Statistics, Vol. 1 and 2* by M.G. Kendall and A. Stuart.
5. *Mathematics of Statistics* by J.F. Kenney and E.S. Keeping.
6. *An Introduction to the Theory of Statistics* by G.U. Yule and M.G. Kendall.
7. *Linear Statistical Inference and its Applications* by C.R. Rao.
8. *Applied General Statistics* by F.E. Croxton and D.J. Cowden.
9. *Statistics: A New Approach* by W.A. Wallis and H.V. Roberts.
10. *The Analysis of Time Series: An Introduction* by C. Chatfield.

Economic Statistics and Official Statistics (Stat102):

Index numbers: Construction of index numbers, properties, some well-known index number formulae, problem of construction of index numbers, chain indices, cost of living indices, splicing of index numbers, different types of index numbers used in India.

Analysis of income and allied size distributions: Pareto and log-normal distributions, genesis, specification and estimation, Lorenz curve, Gini coefficient.

Demand analysis: Classification of commodities, Engel curve analysis using cross-section and time series data, Engel curves incorporating household characteristics, demand projection, specific concentration curves. Production analysis: Profit maximization, cost minimization, returns to scale, Cobb-Douglas and ACMS production functions.

Indian Statistical System: NSSO, CSO, Office of the Registrar General. National income and related aggregates. Population statistics.

Measurement of vital rates: SRS, Life table, Literacy rate, etc.

Statistics of Production: agriculture and industry, annual survey of industries, index of industrial production.

Price Statistics, consumer price index numbers.

Income and consumer expenditure distribution, poverty.

Employment and unemployment.

International Statistical Systems.

Reference Texts:

1. *Statistics for Economists* by P.H. Karmel and M. Polasek.
2. *Price Index Numbers* by R.G.D. Allen.
3. *Income Inequality and Poverty* by N. Kakwani.
4. *An Introduction to Econometrics* by L.R. Klein.
5. *Empirical Econometrics* by J.S. Cramer.
6. *Econometric Models, Techniques and Applications* by M.D. Intrilligator.
7. *Indian Official Statistical Systems* by M.R. Saluja.

Demography and SQC&OR (Stat103):

Demography: Sources of demographic data - census, registration of vital events. Rates and ratios. Measures of mortality. Life Table - construction and applications. Stable and stationary population. Measures of fertility and reproduction. Indian data. Standardization of vital rates. Population growth curves, population estimates and projections. Measures of migration. Use of demographic data for policy formulation.

Statistical Quality Control and Operations Research: Introduction to SQC. Control charts. Acceptance sampling. Illustrations and applications. Introduction to O.R.; Linear programming, simplex method, applications.

Practicals using statistical packages.

Reference Texts for Demography :

1. *Technical Demography* by R. Ramkumar.
2. *Demographic Techniques and Applications* by K. Srinivasan.
3. *An Introduction to the Study of Population* by B.D. Mishra.
4. *The Methods and Materials in Demography* by H.S. Shryock

Reference Texts for SQC & OR:

1. *Introduction to Statistical Quality Control* by D.C. Montgomery.
2. *Principles of Quality Control* by Jerry Banks.
3. *Quality Control and Industrial Statistics* by A.J. Duncan.
4. *Process Quality Control* by E.Q. Ott.
5. *Operations Research - An Introduction* by H.A. Taha.
6. *Principles of Operations Research* by H M Wagner.
7. *Operations Research* by F.S. Hiller and G.J. Liberman.

Linear Statistical Models (Stat104):

Introduction to stochastic models; formulation and illustrations. Linear statistical models; illustrations. Linear estimation. Tests of linear hypotheses. Multiple comparisons. Linear regression. *ANOVA*. Analysis of covariance. Log-linear models.

Practicals using statistical packages.

Reference texts:

1. *Linear Models* by S.R. Searle.
2. *An introduction to Linear Statistical Models, Vol. I,* by F.A. Graybill.
3. *Linear Statistical Models* by J.H. Stapleton.
4. *Methods and Applications of Linear Models* by R.R. Hocking.
5. *Plane Answers to Complex Questions: The Theory of Linear Models* by R.Christensen.

Statistical Inference I (Stat105A):

Formulation of the problems. Reduction of data, sufficiency, Factorization theorem (proof only in the discrete case), minimal sufficiency, Lehmann-Scheffe method. Monotone likelihood ratio family of distributions. Exponential families of distributions.

Point Estimation: Criteria for goodness, mean square error, unbiasedness, relative efficiency, Cramer-Rao inequality, Bhattacharya bounds, UMVUE, Rao-Blackwell theorem, completeness, methods of estimation and their simple properties, consistency, illustrations. *M* and *R* estimators of location. Bayesian techniques, priors, posteriors, Bayes estimators and Bayesian credible region.

Tests of Hypotheses: Statistical hypothesis, simple and composite hypothesis, critical regions, randomized tests, error probabilities of a test, level and size of test, power of a test, Neyman-Pearson Lemma, MP, UMP, UMPU and LMP tests; illustrations. Likelihood ratio tests.

Practicals using statistical packages.

Statistical Inference II (Stat105B):

Confidence Intervals: Criteria for goodness, pivotal quantities, relationship with tests of hypotheses, illustrations.

Nonparametric Methods: Formulation of the problems, order statistics and their distributions. Tests and confidence intervals for population quantiles. Sign test. Test for symmetry, signed rank test, Wilcoxon-Mann-Whitney test, Kruskal-Wallis test. Run test, tests for independence. Concepts of asymptotic efficiency. Estimation of location and scale parameters.

Sequential Analysis: Need for sequential tests. Wald's SPRT, ASN, OC function. Stein's two stage fixed length confidence interval. Illustrations with Binomial and Normal distributions. Elements of sequential estimation.

Practicals using statistical packages.

Reference texts for Statistical Inference I-II:

1. *Mathematical Statistics* by P.J. Bickel and K.A. Doksum.

2. *Statistical Inference* by G. Casella and R.L. Berger.
3. *Linear Statistical Inference and its Applications* by C.R. Rao.
4. *Theory of Point Estimation* by E.L. Lehmann.
5. *Testing Statistical Hypotheses* by E.L. Lehmann.
6. *Nonparametrics: Statistical Methods Based on Ranks* by E.L. Lehmann.
7. *Theory of Rank Tests* by J. Hájek and Z. Sidak.

Sample Surveys (Stat106):

Scientific basis of sample surveys. Complete enumeration vs. sample surveys. Principal steps of a sample survey; illustrations, *N.S.S.*, Methods of drawing a random sample. *SRSWR* and *SRSWOR*: estimation, sample size determination. Stratified sampling; estimation, allocation, illustrations. Systematic sampling, linear and circular, variance estimation. *PPS* sampling: selection and estimation. Two-stage sampling. Cluster sampling. Nonsampling errors. Ratio and Regression methods.

Reference texts:

1. *Sampling Techniques* by W.G. Cochran.
2. *Sampling Theory and Methods* by M.N. Murthy.
3. *Theory and Methods of Survey Sampling* by P. Mukhopadhyay.

Design of Experiments (Stat107):

The need for experimental designs and examples, basic principles, blocks and plots, uniformity trials, use of completely randomized designs.

Designs eliminating heterogeneity in one direction: General block designs and their analysis under fixed effects model, tests for treatment contrasts, pairwise comparison tests; concepts of connectedness and orthogonality of classifications with examples; randomized block designs and their use.

Orthogonal designs eliminating heterogeneity in two or more directions: analysis and use of Latin square designs and mutually orthogonal latin square designs; construction of MOLs based on Galois fields.

Idea of efficiency and relative efficiency of designs based on average variance.

Missing plot technique.

Use of concomitant variables in orthogonal designs and related analysis.

General full factorial designs, their use, advantage and analysis; confounding and partial confounding in 2^n designs and relative efficiencies of the effects; experiments with factors at 3 levels, useful designs using confounding in 3^2, 3^3 experiments.

Split-plot designs, their use and analysis.

Practicals using statistical packages.

Reference texts:

1. *Design and Analysis of Experiments* by A. Dean and D. Voss.
2. *Design and Analysis of Experiments* by D.C. Montgomery.

3. *Experimental Designs* by W.G. Cochran and G.M. Cox.
4. *The Design and Analysis of Experiments* by O. Kempthorne.
5. *Theory of Block Designs* by A. Dey.

Statistics Comprehensive (Stat108):

Review of Statistical Methods I-IV (*Stat101A-D*), Linear Models (*Stat104*), Statistical Inference I (*Stat105A*), Sample Surveys (*Stat106*) and statistical issues related to Field Reports prepared in Elective Courses.

Project Work (involving survey and data collection).

Special Topics assigned by the teacher related to (but not restricted to) Project Work.

Probability Courses

Probability Theory I (Prob101A):

Orientation, Elementary concepts: experiments, outcomes, sample space, events. Discrete sample spaces and probability models.

Combinatorial probability, Fluctuations in coin tossing and random walks, Combination of events.

Composite experiments, conditional probability, Polyá urn schemes, Bayes theorem, independence.

Discrete random variables. Standard discrete distributions. Expectation/mean, variance, moments, moment generating functions, probability generating functions.

Joint distributions of discrete random variables, conditional distributions. Functions of discrete random variables.

Probability Theory II (Prob101B):

CDFs and properties, univariate continuous distributions, Examples of standard densities. Normal distribution and properties.

Expectation/mean of a continuous random variable, variance, moments. Moment generating function. Distribution of a function of a random variable.

Bivariate continuous distributions, independence, distribution of sums, products and quotients for bivariate continuous distributions, t, χ^2, F densities.

Conditional and marginal distributions, conditional expectation, examples, Bivariate Normal distribution.

Cauchy-Schwartz and Chebychev inequalities, WLLN for finite variance case.

Probability Theory III (Prob101C):

Bivariate CDFs, multivariate distributions and properties. Multivariate densities and multivariate singular distributions.

Conditional distributions and independence. Distributions of functions of random

vectors and Jacobian formula. Examples of multivariate densities.

Properties of multivariate normal, linear and quadratic forms. Dirichlet density and properties.

Characteristic functions: properties, illustrations, inversion formula, continuity theorem. Different modes of convergence and their relations, Scheffe's theorem. Laws of large numbers, CLT for iid finite variance case. Multivariate CLT. Slutsky's method.

Reference Texts for Probability Theory I-III:

1. *Introduction to the Theory of Probability and its Applications, Vol. 1 and 2* by W. Feller.
2. *Elementary Probability Theory* by K.L. Chung.
3. *A First Course in Probability* by S.M. Ross.
4. *Basic Probability Theory* by R. Ash.
5. *Introduction to Probability Theory* by P.G. Hoel, S.C. Port and C.J. Stone.
6. *Probability* by J. Pitman.

Introduction to Stochastic Processes (Prob102):

Discrete Markov chains with countable state space. Classification of states - recurrence, transience, periodicity. Stationary distributions, limit theorems, positive and null recurrence, ratio limit theorem, reversible chains.

Several illustrations including the Gambler's ruin problem, queuing chains, birth and death chains etc.

Poisson process, continuous time markov chain with countable state space, continuous time birth and death chains.

Reference Texts:

1. *Introduction to the Theory of Probability and its Applications, Vol. 1* by W. Feller.
2. *Introduction to Stochastic Processes* by P.G. Hoel, S.C. Port and C.J. Stone.
3. *Stochastic Processes* by S.M. Ross.
4. *Stochastic Processes, Vol. 1* by S. Karlin and J. Taylor.
5. *Finite Markov Chains* by J.G. Kemeny, J.L. Snell and A.W. Knapp.

Mathematics Courses

Analysis I (Math101A):

Real numbers, functions, sequences, limits, limsup, liminf, series, tests for convergence, absolute convergence, rearrangement of terms, Cauchy product. Infinite products. Continuous functions of one real variable. Differentiation. Chain rule. Rolle's theorem. Mean value theorem. Higher order derivatives. Leibnitz' formula. Taylor series expansion. L'Hospital's rule. Maxima and minima of functions.

Analysis II (Math101B):

Riemann integration. Fundamental theorem of Calculus. Computation of definite integrals. Improper integrals. Sequences and series of functions. Double sequences. Pointwise and uniform convergence. Term-by-term differentiation and integration. Power series, Weierstrass approximation theorem. Fourier series.

Analysis III (Math101C):

Functions of several variables. Continuity. Partial derivatives. Differentiability. Taylor's theorem. Maxima and minima. Multiple integrals. Repeated integrals. The Jacobian theorem. Line, surface and volume integrals. Differential forms. Theorems of Green and Stokes.

Reference Texts for Analysis I-III:

1. *Principles of Mathematical Analysis* by W. Rudin.
2. *Mathematical Analysis* by Tom Apostol.
3. *Calculus I and II* by Tom Apostol.
4. *Introduction to Calculus and Analysis, Vol. I and II* by R. Courant and F. John.

Vectors and Matrices I (Math102A):

Vector spaces over real and complex fields, subspace, linear independence, basis and dimension, sum and intersection of subspaces, direct sum, complement and projection.

Linear transformation and its matrix with respect to a pair of bases, properties of matrix operations, use of partitioned matrices.

Column space and row space, rank of a matrix, nullity, rank of AA^*.

Homogeneous and non-homogeneous systems of linear equations, condition for consistency, solution set as a translate of a subspace, g-inverse and its elementary properties.

Left inverse, right inverse and inverse, inverse of a partitioned matrix, lower and upper bounds for rank of a product, rank-factorization of a matrix, rank of a sum.

Elementary operations and elementary matrices, Echelon form, Normal form, Hermite canonical form and their use (sweep-out method) in solving linear equations and in finding inverse or g-inverse. LDU-decomposition.

Vectors and Matrices II (Math102B):

Determinant of n-th order and its elementary properties, expansion by a row or column, statement of Laplace expansion, determinant of a product, statement of Cauchy-Binet theorem, inverse through classical adjoint, Cramer's rule, determinant of a partitioned matrix.

Idempotent matrices, matrix version of Fisher-Cochran theorem.

Norm and inner product on R^n and C^n, norm induced by an inner product, Orthonormal basis, Gram-Schmidt orthogonalization starting from any finite set of vectors, orthogonal complement, orthogonal projection into a subspace, orthogonal projector into the column space of A, orthogonal and unitary matrices.

Characteristic roots, relation between characteristic polynomials of AB and BA

when *AB* is square, Cayley-Hamilton theorem, idea of minimal polynomial, eigenvectors, algebraic and geometric multiplicities, characterization of diagonable matrices, spectral representation of Hermitian and real symmetric matrices, singular value decomposition.

Quadratic form, category of a quadratic form, use in classification of conics, Lagrange's reduction to diagonal form, rank and signature, Sylvester's law, determinantal criteria for n.n.d. and p.d. quadratic forms, Hadamard's inequality, extrema of a p.d. quadratic form, statement of interlacing theorem, simultaneous digonalization of two quadratic forms one of which is p.d., simultaneous orthogonal diagonalization of commuting real symmetric matrices, Square-root method.

Note: Geometric meaning of various concepts like subspace and flat, linear independence, projection, determinant (as volume), inner product, norm, orthogonality, orthogonal projection, eigenvector should be discussed. Only finite-dimensional vector spaces to be covered.

Reference Texts for Vectors and Matrices I-II:

1. *Linear Statistical Inference and Its Applications* by C.R. Rao.
2. *Linear Algebra* by A. Ramachandra Rao and P. Bhimasankaram.
3. *Linear Algebra* by K. Hoffman and R. Kunze.
4. *Elementary Matrix Algebra* by F.E. Hohn.
5. *Finite Dimensional Vector Spaces* by P.R. Halmos.

Elements of Algebraic Structures (Math103):

Definitions, elementary properties, and examples of Groups, Subgroups, Rings, Ideals, and Fields.

Groups, equivalence classes, cosets, normal subgroups, quotient groups. Cyclic groups. Homomorphism theorems. Examples of Isomorphisms and Automorphisms. Permutation groups. Finite direct product. Finite Abelian groups. Sylow's theorems and applications. 4-5 weeks.

Rings. Ideals and quotient rings. Prime ideals and Integral domains. Maximal ideals, PID, UFD. Polynomial rings (over commutative rings). Gauss' theorem. (6 weeks)

Fields. Roots of polynomials. Field extensions. Splitting fields. Finite fields. (3 weeks)

Applications to elementary number theory. (1 week)

Reference Texts:

1. *Algebra* by M. Artin (Chap. 2, 10, 11.1-11.6, 13.1-13.6).
2. *Topics in Algebra* by I.N. Herstein (Chap. 2, 5.1-5.5, 7.1).
3. *Basic Algebra I* by N. Jacobson (Chap. 2).
4. TIFR pamphlet on Galois Theory.
5. *Undergraduate Algebra* by S. Lang.
6. *A First Course in Abstract Algebra* by J. Rotman.
7. *Algebra* by L. Rowen.

***Differential Equations (Math104)*:**

First and second order linear differential equations with constant and variable coefficients. Power series solutions and special functions. Existence and uniqueness of solution of $x'=f(x,t)$. Picard's method. Calculus of variation. Euler's differential equation. System of first order equations. Introduction to Partial Differential Equations.

Reference Texts:

1. *Differential Equations* by George F. Simmons.
2. *An Introduction to Ordinary Differential Equations* by E.A. Coddington.

Computer Courses

Computational Techniques and Programming I / Computers (Comp101A):

Introduction and brief history of evolution of computers.

Computer basics.

1. Classification of computers: special purpose and general purpose; analog, digital and hybrid; Super, main-frame etc.
2. Organization of general purpose digital computers: CPU, main memory and peripherals. Mass storage devices and other I/O devices.
3. Computer languages: Machine code language (machine language), assembly language and high level languages.
4. Software: Operating systems, linker, loader, compiler, interpreter and assembler.

Computer programming.

1. Algorithm and flow-chart.
2. Storage of information: concepts of records and files. File organization: sequential, relative and indexed.
3. Programming in FORTRAN:
   Constants, simple and subscripted variables, records and record structures;
   Operators: arithmetic, string, logical and relational.
   Expressions: arithmetic, string and logical.
   Statements: specification, assignment (arithmetic, string, logical and aggregate), control, I/O and FORMAT (variable, run-time), BLOCK DATA, statement function.
   Function and Subroutine subprograms.
4. Problem solving using FORTRAN and use of debugger.
5. Number System: binary, octal, hexadecimal.
6. Internal representation of numbers and characters in computers.

Reference Texts:

1. *Computer Studies : A First Year Course* by Ron Andersen.
2. *Minicomputer Systems Organization, Programming and Applications* by R.H.

Eckhouse and L.R. Morris.

3. *Microcomputer Organization : Hardware and Software* by C.E. Holt.
4. *Inside the PC* by Peter Norton.
5. *Introduction to Minicomputer and Microcomputer* by M.E. Sloan.
6. *SUN FORTRAN Language Reference*.
7. *SUN FORTRAN Programmer's Guide*.
8. *Theory and Problems of Programming with FORTRAN 77* by W.E. Mayo and M. Cwiakala.

Computational Techniques and Programming II / Numerical Analysis (Comp101B):

Significant digits, round-off errors.

Finite computational processes and computational errors.

Floating point arithmetic and propagation of errors. Loss of significant digits.

Interpolation with one variable: finite differences, divided differences. Lagrangian and Newtonian methods. Iterative methods. Aitken Neville's iterative scheme. Spline interpolation. Errors and remainder terms. Inverse interpolation. Interpolation with two variables.

Numerical integration: Newton-Cotes; Orthogonal polynomials and Gaussian quadrature. Accuracy of quadrature formulae.

Numerical differentiation.

Numerical solution of ordinary differential equations: one step and multistep methods. Euler's, Adam's, Runge-Kutta's methods. Predictor-corrector methods. Errors and accuracy.

Numerical solution of nonlinear equation in one variable:

1. Separation of roots and initial approximation. Sturm's theorem.
2. Improvement of the initial solution using methods of bisection, Regula Falsi and Newton-Raphson. Fixed point iterative schemes. Errors. Order of convergence and degree of precision.

Computation in Linear Algebra:

1. Numerical solution of system of linear equations and matrix inversion: Gaussian elimination, square Root, L-U methods.
2. Reduction to bidiagonal / tridiagonal form: Householder transformation, Given's transformation.
3. Numerical computation of eigenvalues and eigenvectors: Jacobi's method, power method.

Reference Texts:

1. *Elementary Numerical Analysis: An Algorithmic Approach* by S.D. Conte and C. de Boor.
2. *Computationl Methods in Linear Algebra* by D.K. Faddeev and V.H. Faddeeva.
3. *Computer Solution of Linear Algebraic Systems* by G.E. Forsythe and G.B. Moler.

C and Data Structures (Comp102):

Programming in a structured language such as C.

Data Structures: definitions, operations, implementations and applications of basic data structures. Array, stack, queue, dequeue, priority queue, doubly linked list, orthogonal list, binary tree and traversal algorithm, threaded binary tree, generalized list.

Binary search, Fibonacci search, binary search tree, height balance tree, heap, B-tree, digital search tree, hashing techniques.

Reference Texts:

1. *The C Programming Language* by Brian W. Kernighan and Dennis M. Ritchie.
2. *Theory and Problems of Programming with C* by Byron S. Gottfried.
3. *Data Structures and Algorithms* by A. Aho, J. Hopcroft and J. Ullman.
4. *Data Structure Techniques* by T.A. Standish.
5. *Data Structures using PASCAL* by A.M. Tanenbaum and M.J. Augesestein.

Database Management Systems (Comp103):

Introduction. Purpose of database systems. Database abstraction. Data models. Instances and schemes. Data independence. Data definition and data manipulation languages. Database manager, Administrator and users.

Entity relationship model. Entities and entity sets. Relationships and relationship sets. Attributes. Mapping constraints. Keys. Entity relationship diagram. Reducing E-R diagrams to tables. Aggregation. Design of an E-R database scheme.

Relational models. Structure of relational database. Distributed database. Relational algebra. Relational commercial languages. SQL. Relational database design. Query languages and query processing. Crash recovery. Concurrency control.

Hierarchical model. Network model.

Reference Texts:

1. *Database System Concepts* by H.F. Korth and A. Silberschatz.
2. *Introduction to Database Systems* by C.J. Date.

Elective Courses

Economics I / Microeconomics (Econ101A):

Theory of consumer behaviour: Utility theory, consumer demand, comparative statics analysis, market demand.

Theory of firm: Production function, law of variable proportions, returns to scale, elasticity of substitution.

Theory of cost: concepts of long-run and short-run costs, cost curves.

Markets: Perfect competition, monopoly, oligopoly, factor markets.

General equilibrium and welfare.

Reference Texts:

1. *Intermediate Microeconomics* by J.P. Quirk.
2. *Microeconomic Analysis* by H. Varian.

Economics II / Macroeconomics (Econ101B):

National income accounting.

National income determination - short-term macroeconomic models:

1. Simple Keynesian model - fiscal and monetary policies for raising employment and output.
2. Monetary sector and investment function - IS-LM model, discussion on effectiveness of fiscal and monetary policies.
3. Open economy macroeconomics - determination of exchange rate under perfect capital mobility and flexible exchange rate, adjustments in a fixed exchange rate.

Reference Texts:

1. *Macroeconomics* by R. Dornbusch and S. Fischer.
2. *Macroeconomics* by N. Mankiw.

Economics III / Econometric Methods (Econ101C):

Classical Linear regression model (CLRM): Specification and estimation, specific issues in CLRM - multicollinearity, dummy variables, notion of non-spherical disturbance terms.

Generalized least squares: Specification and estimation, heteroscedasticity - tests and efficient estimation, serial correlation - tests and estimation.

Stochastic regressors: errors in variables, distributed lag models.

Introduction to simultaneous equation systems: Specification, identification and estimation.

Reference Texts:

1. *Introduction to Econometrics* by G.S. Maddala.
2. *Econometric Methods* by J. Johnston and J. Dinardo.

Introduction to Sociology and Sociometry (Socl101):

Identification of major areas of contemporary sociological study

1. Rural development (decentralized administration and planning, Panchayati system, land reforms) (4 classes)
2. Social welfare (women's status, health issues, total literacy movement, child labour) (6 classes)
3. Social structure and collective action (systems of social stratification, social

organization and social networks, peasant movement, national movement for independence and self-reliance) (8 classes)

4. Socio-cultural tradition in India (Indian tradition of religious syncretism, ethnic problems and national identity) (4 classes)

Major schools of sociological thinkers (Western sociology and contemporary Indian sociology, e.g., Durkheim, Weber and Marx, Nirmal Bose, Ramkrishna Mukherjee and M.N. Srinivas) (6 classes)

Interface between sociology and statistics (5 classes)

Logic and techniques of sociological research (hypothesis formulation, types of field-work, data analysis, validity and reliability, interpretation (7 classes).

Illustrative case studies (Total literacy campaign, primary education, social networks, peasant movement) (10 classes).

Reference Texts:

1. *Indian Development: Selected Regional Perspectives* by Jean Dreze and Amartya Sen.
2. *Rural Change in South-East India, 1950s to 1980s* by Kathleen Gough.
3. *Sociometry and the Science of Man* by J.L. Moreno.
4. *Social Network Analysis: A Handbook* by John Scott.
5. *Modern India* by Sumit Sarkar.
6. *Introduction to Statistics for the Social Sciences* by Frederick D. Herzon and Michael Hooper.
7. *Founding Fathers of Sociology* by C. Wright Mills.
8. *The Religion of Man* by Rabindranath Tagore.

Biology I (Biol101A):

Theory

Distinctive differences between non-living matter and living organisms (1 class).
How did living organisms originate from non-living matter? (2 classes).
Biological evolution: its evidence and time scale, fossil evidence, molecular evidence, and theories of evolution (3 classes).

1. The cell as a unit of living organisms: size and shape, structure of a plant cell, cell differentiation and specialization, unicellular organisms, multicellular organisms and tissues (4 classes).
2. Natural quantitative variation in animals and plants (Provide extensive quantitative data with explanations of causes of variation) (3 classes).
3. Taxonomy - grouping living organisms into classes: Why taxonomy? Systems of identification - what are the principles? What characters should be used? Taxonomic methodology - qualitative and quantitative (Provide examples) (4 classes).
4. How does a living organism grow? Mitosis growth, patterns and requirements, food (photosynthesis), respiration and digestion (digestive system of man, carbohydrate metabolism), role of hormones in growth (6 classes).
5. How does a living organism leave descendants" reproduction: (Vegetative, asexual and sexual), Meiosis: cell division, nucleus, chromosomes, DNA,

Mendel's laws (3 classes).

6. Associations of living organisms with the environment: ecosystems of the earth, ecological groups (4 classes).

Practical (4 classes)

The students will be asked to collect quantitative data on natural variation in animals and plants, to make sections of tissues and fix on slides, staining and identification of slides, etc.

Biology II (Biol101B) (prerequisite: Biol101A):

Theory

1. How does a plant grow? (Exemplify with paddy)
   Requirements for growth
   Food and water (soil types, nutrient requirements, water requirements, necessity of food and water at important stages of growth) (4 classes)
   Enzyme action and kinetics (3 classes)
   Resistance (pests, diseases, resistance to insecticides) (3 classes)
   Miscellaneous (importance of germ plasm, importance of biodiversity, importance of diversity of farming systems) (2 classes)
2. How does an animal grow? (2 classes)
3. Similarity between plant growth and animal growth (1 class)
4. Plant and animal experiment (Exemplify with yield of paddy and milk yield of cow)

Primary considerations for improvement - environment and genes (2 classes)
Environmental considerations (2 classes)
Genetic considerations (2 classes)
Relative contributions of genes and environment on yield (rice yield, milk yield) (2 classes)
Genotype-environment interaction: Is it important? (1 class)

5. Introduction to mathematical and statistical models in biology (Planning of experiments, population growth and predator-prey models, population genetic models) (7 classes)

Practical (4 classes)

1. The students will be asked to perform soil analysis and biochemical enzyme assay.

2. Analysis of quantitative data (The students will be asked to analyze quantitative data generated by them in (i) and/or data supplied by the teacher).

Reference Texts for Biology I-II:

1. *The Cell: A Molecular Approach* by G.M. Cooper.
2. *Biochemistry* by D. Voet and J.G. Voet.
3. *Plant Physiology* by R. Devlin.
4. *Indian Council of Agricultural Research Handbook of Indian Agriculture*.

Introduction to Anthropology and Human Genetics (Anth101) (prerequisites:

Biol101A-B):

Theory

1. Introduction to Anthropology: definition and scope, subdivisions, relationships with other disciplines (2 classes).
2. Structural and functional specialization of man (3 classes).
3. Origins and overview of human biological variation (5 classes).
4. Causes of human variation (2 classes).
5. Population composition and structure:

Population composition (2 classes).
Mating patterns (2 classes).
How do social factors influence biological variation? (2 classes)

6. Environmental adaptation:

Physical (2 classes).
Sociological (2 classes).
Biological (in response to nutrition and disease) (4 classes).
Estimation of allele frequencies and test of Hardy-Weinberg equilibrium (3 classes).

7. Stochastic forces (Mutation, Genetic Drift, Founder effect) (3 classes).
8. Comparison of contemporary human population groups:

Traits used (2 classes).
Methodology: distance and cluster analysis (3 classes).
Major findings of some recent studies (2 classes).

9. Interaction between heredity and environment:

Twin studies (2 classes)
Family twins (2 classes)
Heritability (2 classes)

Practical

1. Anthropometric measurements and observations: methods (3 classes).
2. Calculation of allele frequencies and statistical analyses of allele frequency data (3 classes).
3. Dermatoglyphic techniques (3 classes).

Field Work

Reference Texts:

1. *Human Biology: An Introduction to Human Evolution, Variation, Growth and Adaptability* by G.A. Harrison, J.M. Tanner, D.R. Pilbeam and P.T. Baker.
2. *To Be Human: An Introduction to Anthropology* by A. Alland, Jr..
3. *Genetics of Human Populations* by L.L. Cavalli-Sforza and W.F. Bodmer.

Physics I (Phys101A):

Mechanics: Conservation of energy, linear momentum and angular momentum. Derivation of Lagrange's equations from D'Alembert's and variational principles. Central force, Kepler's laws, collisions. Postulates of special theory of relativity,

concepts of length contraction and time dilation, Lorentz transformation, addition of velocities.

Electrodynamics: Introduction to vector calculus, electrostatic fields and potentials for simple arrangement of charges, conductors and insulators. Maxwell's equations, Ohm's law, resistance networks and Kirchhoff's laws, LCR circuits.

Reference Texts:

1. *Classical Mechanics* by H. Goldstien.
2. *Mechanics* by L.D. Landau and E.M. Lifshitz.
3. *Special Theory of Relativity* by R. Resnick.
4. *Electrodynamics* by D.J. Griffiths.
5. *Foundations of Electromagnetic Theory* by J.R. Reitz, F.J. Milford. and R.W. Christy.

Physics II (Phys101B):

Statistical Mechanics & Thermodynamics: Statistical formulation of mechanical problems, state of a system, ensembles, postulates, probability calculations, partition function, its properties and its connection with thermodynamic quantities. Laws of thermodynamics, Maxwells's relations and thermodynamic functions, Kinetic theory of dilute gases.

Modern Physics & Quantum Mechanics: Planck's radiation law, photoelectric effect, Compton effect, wave particle duality, de Broglie's wavelength, Heisenberg's uncertainty principle, Bohr's theory, Schrödinger's equation and 1-d potentials, Conductors, Insulators, Semiconductors, p-n junction, transistor, super conductors, x-ray spectrum, lasers and laser light, working of a laser, radio-active decay, nuclear reactions.

Reference Texts:

1. *Thermodynamics and Statistical Mechanics* by A. Sommerfeld.
2. *Thermodynamics* by H.B. Callen.
3. *Thermal Physics* by C. Kittel.
4. *Quantum Mechanics* by J.L. Powell and B. Crasemann.
5. *Quantics I* by J.-M. Lévy-Leblond and F. Balibar.
6. *Introduction to Solid State Physics* by C. Kittel.

Geology (Geol101):

Theory

1. Definition and objectives of Geology: different branches of geology, its relationship with other subjects and its contribution to mankind.
2. The earth: the earth and the solar system, physical and chemical characteristics of the earth, minerals and rocks, ores etc., definition, origin and types of sedimentary, igneous and metamorphic rocks, surface processors - weathering and erosion, deep seated processes and their products - folds and faults, major geologic features of the earth's exterior, major developments in the lithosphere.
3. Time in Geology: Geological time scale, absolute and relative time, fossils and their usage, succession of the through time, organic evolution.

4. Important Geologic Principles.
5. Geology vis-a-vis industry (with reference to India): Raw material for steel, ferro-alloy, Cu-Al-Pb-Za industries, cement, refractory, building material, coal, oil, gas and water resources.
6. Quantitative aspects of Geology: Nature and source of geologic data, possible applications of various statistical and mathematical tools, example of such usage.

Practical

1. Identification of minerals, rocks and fossils.
2. Introducing topsheets and simple geological maps.
3. Measurement and graphical representation of grain-size and paleocurrent data.
4. Field Work: basic geologic mapping, collection of scalar and vector data, mine visits, etc.

Reference Texts:

1. *Understanding Earth* by Frank Press and Raymond Siever.
2. *Introduction to the Rock Forming Minerals* (4th Edition) by W.A. Deer, R.A. Howie and J. Zussman.
3. *Principles of Structural Geology* by J. Suppe.
4. *Sedimentology and Sedimentary Basins* by M.R. Leeder.
5. *Invertebrate Palaeontology and Evolution* by E.N.K. Clarkson.
6. *Statistics and Data Analysis in Geology* by J.C. Davis.

Remedial English Course

Remedial English (Engl101N):

Just after the admission to the B.Stat.(Hons.) programme all students are required to take a test in English language (comprehension and ability in writing). The students who fail this test are required to take the non-credit course in Remedial English. The syllabus of this course will help the students to improve their English reading, comprehension and verbal ability. It will also include an exposure to usual mistakes in mathematical/statistical English (for example: `let we consider', `the roots of the equation is', `we now discuss about', `stationery process') and their corrections. This course will have three lecture-hours and one tutorial session per week. If a student fails this course, even after the back-paper examination, he/she would be allowed to repeat the course in the following year along with the new first year students. A student will not be allowed to continue the B.Stat.(Hons.) programme if he/she fails the course even after these three chances. (Two sessions of two periods each in a week.)

The information provided in this brochure is in accordance with the decisions of the Academic Council of ISI till January 13, 2003, and is subject to change by future decisions of this Council.