Semester	**THREE**
Paper Number	**HSTSE3011P**
Paper Title	**Introduction to C Programming**
No. of Credits	**2**
Theory/Composite	**Practical**
No. of periods assigned	**2+2**
Module	**Single**
Course description/objective	*At the end of the course, a student is expected to* 1. Understand the importance and uniqueness of C programming language. 2. Understand the loop structures and their uses. 3. Understand the conditional statements and their uses. 4. Create user defined functions and use them appropriately. 5. Know the basic ways of handling file in C. 6. Know the usage of C programming in some selected fields of Statistics and Mathematics.
Syllabus	**UNIT 1:** ***Introduction:*** Constants, Variables and Key Words. Relational and logical operators. Conditional Statements – *If, If-Else*. Loop Structures – *For* loop. Control statements: *Break, Exit* and *Continue* functions. Single Dimensional Array. [14L] **UNIT2:** ***Loop Structures:*** *While, Do-While*. Two Dimensional Arrays. [8L] **UNIT 3:** ***User- defined functions:*** A multi-function program using user-defined functions, definition of functions, return values and their types, function prototypes and calls. Category of Functions : no arguments and no return values, arguments but no return values, arguments with return values, no arguments but returns a value, functions that return multiple values. Recursion function. [20L] **UNIT 4:** ***Files and Pointers:*** Declaration and initialization of pointer variables, accessing the address of a variable, accessing a variable through its pointer, pointer expressions. Pointers and arrays, arrays of pointers, pointers as function arguments, functions returning pointers. Basic file handling. [10L]
List of Practical	1. Moment Measures of Central Tendency, Dispersion, Skewness and Kurtosis. 2. Quantile Measures of Central Tendency, Dispersion, Skewness and Kurtosis.

	3. Construction of a Frequency Distribution – Discrete and Continuous. 4. Computation of Simple Correlation Coefficient and Regression Lines. 5. Spearman's Rank Correlation Coefficient. 6. Addition, Multiplication and Transpose of Matrices. 7. Determinant of a matrix. 8. Inverse of a non-singular matrix. 9. Interpolation by Lagrange's Formula. 10. Solution of Equations by Bisection and Iteration Methods. 11. Numerical Integration – Trapezoidal and Simpson's One Third Rules. 12. Value of n! using recursion. 13. Random number generation from Uniform, Normal, Chi-square, t and F distributions. 14. Storage of output in a file.	
Reading/Reference Lists	1. Kernighan, B.W. and Ritchie, D. (1988): C Programming Language, 2nd Edition, Prentice Hall. 2. Balagurusamy, E. (2011): Programming in ANSI C, 6th Edition, Tata McGraw Hill. 3. Gottfried, B.S. (1998): Schaum's Outlines: Programming with C, 2nd Edition, Tata McGraw Hill. 4. Kanetkar Y. (2016): Let Us C, 15th Edition, BPB Publication.	
Evaluation	CIA: 20 End Sem: 80 Total: 100	
Paper Structure for End Sem	**Group-A: [30 Marks]:** Objective type Questions: 3 out of 5, carrying 10 Marks each. [3x10=30]	**Group-B:** **[50Marks] :** Based on Programming : 1 out of 2, carrying 10 marks each. 2 out of 4, carrying 20 marks each. [(1x10)+(2x20)=50]

Semester	**FOUR**
Paper Number	**HSTSE4021P**
Paper Title	**Statistical Data Analysis Using R**
No. of Credits	**2**
Theory/Composite	**Practical**
No. of periods assigned	**2+2**
Module	Single
Course description/objective	*At the end of the course, a student is expected to:* o Create, Access and Save Files, access help pages and load/install new packages. o Use R as a calculator to compute basic mathematical functions. o Draw diagrams and add titles and legends to them. o Compute statistical measures using in-built functions. o Learn programme structures and implement them to write one's own code. o Read and Write Data from external file sources.
Syllabus	**UNIT 1:** ***Introduction :*** History and Overview of R, the CRAN, Installing the R Software, The R-Console and the R-Script. Saving and Accessing Files. Libraries in R. Loading and Installing Packages in R. The *quit()* and the *history()* commands. [2L] ***R as a calculator :*** Basic Mathematical Functions. The Base Library. Defining variables, calling variables, Unary and Binary Operators on Variables. [3L] ***Modes of Data Storage :*** Vectors, Matrices, Data Frames, Lists. The *c(), edit()* and *scan()* commands. Defining Attributes. Creating Patterned Data – the *rep()* and *seq()* commands. Extracting rows and columns in data frames and lists. Assigning names to columns of data frames and matrices and rows of lists. The *$* operator. The *attach()/detach()* command. Conditional selections and subsetting of objects. The *length()* command. Merging multiple vectors or columns of different data frames into one - The *cbind(), rbind()* and *merge()* commands. Inter-

	Conversions of the various modes of storages. [6L] **UNIT 2:** ***Diagrammatic representations of Non-Frequency Data :*** the *plot()* command. Line Diagram, Bar (Horizontal and Vertical) diagrams, Multiple Bar diagrams, Multiple Line diagrams, Pie and Subdivided Charts. Adding legends, Title, labels, limits on the axis. The *'graphics'* package and the *'ggplot2'* package. The *par()* parameter and its arguments. [6L] ***Diagrammatic representations of Frequency Data :*** Frequency Distributions, the *table()* command. Column Diagrams and Histograms. Box Plots - the *summary()* command. Cumulative Frequency Diagrams. Juxtaposing frequency curves over histograms. [8L] **UNIT 3:** ***Univariate Statistics:*** Descriptive Measures of Central Tendency, Dispersion, Skewness and Kurtosis. The *'moments'* package and its functions. [4L] ***Bivariate Statistics:*** Scatterplot, Various forms of correlations. Regression Theory – the *lm()* command, polynomial regression. Residual Plots. [2L] ***Linear Algebra:*** Algebra of Matrices. The *'Matrix'* package. Obtaining Determinants, Trace, Rank and Inverse of a Matrix. Obtaining row reduced forms of matrices, obtaining an orthonormal basis. Eigen Values and Eigen Vectors. Solving a system of equations. Diagonalisation of Matrices. [2L] **UNIT 4:** ***Programming in R:*** Control Statements: if, if else. Loop Structures: for, while, repeat. User defined functions – Passing arguments, calling functions and returning values. [7L] ***Statistical Simulations:*** Drawing Random Samples from different finite and infinite probability distributions – the *set.seed()* command. Illustrations through statistical problems (probability estimates by long-run relative frequencies, Bias and MSE's of estimates, coverage of Confidence Intervals, calculating empirical level and power of tests). Optimisation of Functions – the *optim()* function and its various arguments. [8L] ***File Handling:*** Importing and Exporting Data from/to other softwares. [4L]
List of Practical	1. Computing Basic Mathematical Functions using R as a calculator.

	2. Storing Data in various modes - vectors, matrices, data frames and lists. 3. Representing Non-Frequency Data by diagrams. 4. Obtain Frequency distributions from raw discrete and continuous data. 5. Representing Frequency Data by diagrams. 6. Univariate Statistical Measures in R. 7. Bivariate Statistical Measures in R. 8. Arithmetical Operations on Matrices and computing determinants, rank, inverse, characteristic roots and vectors of matrices. 9. Control Structures and Loops in R. 10. Applications of control structures and loops to write programme codes of various statistical problems. 11. Export and Import Data from/to other software 12. Install and load new packages and libraries in R.
Reading/ Reference list	1. Dalgaard, P : Introductory Statistics with R, Springer Pubications, 2nd edition, 2008. 2. Maindonald, J. & Braun, J. : Data Analysis and Graphics Using R , Cambridge University Press, Cambridge, 2nd edition, 2007. 3. Faraway, J. J. : Linear Models with R ,Chapman& Hall/CRC Texts in Statistical Science.
Evaluation	CIA: 20 End Sem: 80 Total: 100

Semester	**FOUR**
Paper Number	**HSTSE452**
Paper Title	**Monte Carlo Method**
No. of Credits	**2**
Theory/Composite	**Practical**
No. of periods assigned	**2+2**
Module	**Single**
Course description/objective	*At the end of this course a student is expected to understand* o Random number generation through some popular approaches using computer. o Simulation using CDF inversion and Box-Muller method and its various applications. o Monte Carlo integration and basic idea of importance sampling
Syllabus	**UNIT 1:** Using the computer for random number generation (treated as a black box). A brief look at some popular approaches (no mathematical justification needed). Simulating a coin toss, a die roll and a card shuffle. [12L] **UNIT 2:** CDF inversion method. Simulation from standard distributions. Finding probabilities and moments using simulation. [10L] **UNIT 3:**

	Monte Carlo integration. Basic idea of importance sampling. (MCMC not included) [12L] **UNIT 4:** Generating from Binomial and Poisson distributions, and comparing the histograms to the PMFs. Generating from Uniform(0,1) distribution and applying inverse CDF transforms. Simulating Gaussian distribution using Box-Muller method. Approximating the expectation of a given function of a random variable using simulation. Graphical demonstration of the Law of Large Numbers. Approximating the value of pi by simulating dart throwing. [18L]
List of Practical	**1.** Using the computer for random number generation. **2.** Simulating a coin toss, a die roll and a card shuffle. **3.** Simulation from standard distributions using CDF inversion method. **4.** Finding probabilities and moments using simulation. **5.** Monte Carlo integration. **6.** Importance sampling. **7.** Generating from Binomial and Poisson distributions, and comparing the histograms to the PMFs. **8.** Generating from Uniform(0,1) distribution, and applying inverse CDF transforms. **9.** Simulating Gaussian distribution using Box-Muller method. **10.** Approximating the expectation of a given function of a random variable using simulation. **11.** Graphical demonstration of the Law of Large Numbers. **12.** Approximating the value of pi by simulating dart throwing.
Reading/ Reference list	1. Shonkwiler, Ronald W. and Mendivil, Franklin (2009): Explorations in Monte Carlo Methods (Undergraduate Texts in Mathematics) 2. Carsey, Thomas M. and Harden, Jeffrey J. (2014): Monte Carlo Simulation and Resampling Methods for Social Science.
Evaluation	50 marks: Continuous Internal assessment

Semester	**FOUR**
Paper Number	**HSTSE453**
Paper Title	**Research Methodology**
No. of Credits	**2**
Theory/Composite	**Theory**
No. of periods assigned	**2**
Module	**Single**
Course description/objective	*At the end of the course a student is expected to understand* • Different roles and types of research. • Survey methodology. • Various techniques for data analysis and interpretations. • Methods of Collecting survey data pertaining to a research problem. • Formats and presentations of Reports.
Syllabus	**UNIT 1:** What is Research? Role of Research in important areas. Characteristics of Scientific Method. Process of research: Stating Hypothesis or Research question, Concepts & Constructs, Units of analysis & characteristics of interest, Independent and Dependent variables, Extraneous or Confounding variables. Measurements and scales of Measurements. Types of research: Qualitative & Quantitative Research, Longitudinal Research, Survey & Experimental Research. [8L]

	UNIT 2: Survey Methodology and Data Collection, sampling frames and coverage error, non-response. [5L] **UNIT3:** Review of various techniques for data analysis covered in core statistics papers, techniques of interpretation, precaution in interpretation. [5L] **UNIT 4:** Develop a questionnaire, collect survey data pertaining to a research problem (such as gender discriminations in private v/s government sector, unemployment rates, removal of subsidy, impact on service class v/s unorganized sectors), questions and answers in surveys, Internal & External validity, , interpret the results and draw inferences. Formats and presentations of Reports – an overview. [8L]
List of Practical	NIL
Reading/ Reference list	1. Kothari, C.R. (2009): Research Methodology: Methods and Techniques, 2nd Revised Edition reprint, New Age International Publishers. 2. Kumar, R (2011): Research Methodology: A Step - by - Step Guide for Beginners, SAGE publications.
Evaluation	End Sem Exam : 40 Marks Continuous assessment: 10 marks Total: 50 marks

Paper Structure for End Sem Theory	Short questions (5 marks each)	Long questions (15 marks each)
	2 out of 4	2 out of 3