

Semester	THREE
Course	Major
Paper Code	S2ST230311P
Paper Title	Programming in C and R
No. of Credits	3
Theory / Practical /Composite	Practical
Minimum No. of preparatory hours per week a student has to devote	3
Module	2

Course Outcomes

Module I: C Programming

1. Remember the fundamental language constructs, including constants, variables, keywords, and relational/logical operators.
2. Understand the logic and flow of conditional statements (If-Else) and iterative loop structures (For, While, Do-While).
3. Apply user-defined functions, function prototypes, and recursion to build structured multi-function programs.
4. Analyze the organization and data manipulation requirements of single-dimensional and two-dimensional arrays.
5. Evaluate the methods for generating random samples from various probability distributions and their statistical applications.
6. Create integrated programming solutions that combine control structures, arrays, and functions to solve problems derived from the unit topics

Module II: Introduction to R

1. Remember the R environment setup, including CRAN, the use of libraries, mathematical functions, and unary/binary operators ¹ 2.
2. Understand the various modes of data storage such as vectors, matrices, data frames, and lists ² 3.
3. Apply commands for data subsetting, merging objects via cbind or rbind, and linear regression modeling using lm() ³ 4.
4. Analyze data distributions by comparing diagrammatic representations like histograms, bar diagrams, and box plots ⁵ .
5. Evaluate descriptive measures of central tendency, dispersion, skewness, and kurtosis using the 'moments' package ⁴ .
6. Create complex visualizations that incorporate legends, titles, labels, and specific axis limits ⁵ .

Syllabus

Unit/Module	Content	No. of lectures	CO mapping	Cognitive levels
Module I Unit 1	Introduction: Constants, Variables and Keywords. Relational and logical operators. Conditional statements – If, If- Else. Loop structures – For, While, Do-While. Control statements: Break, Exit and Continue functions.	14	CO1 CO2 CO6	K1 K2 K6
Unit 2	Array: Single dimensional array, Two dimensional array.	14	CO4 CO6	K4 K6
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. Recursion function.	14	CO3 CO6	K3 K6
Unit 4	Generation of random samples from different probability distributions and their applications.	10	CO5 CO6	K5 K6
Module II	History and overview of R, the CRAN, installing the R Software, The R-console and the R-script. Saving and accessing files. Libraries in	3	CO1 CO2	K1 K2

Unit 1	R. Loading and installing packages in R. The <code>ls()</code> and the <code>rm()</code> commands. R as a calculator– Basic mathematical functions. Defining variables, calling variables, Unary and Binary operators on variables.			
Unit 2	Modes of Data Storage: Vectors, Matrices, Data Frames, Lists. The <code>c()</code> , <code>edit()</code> commands. Defining attributes. Creating patterned data – the <code>rep()</code> and <code>seq()</code> commands. Extracting rows and columns in data frames and lists. Assigning names to columns of data frames and matrices and rows of lists. The <code>\$</code> operator. The <code>attach()/detach()</code> command. Conditional selections and subsetting of objects. The <code>length()</code> command. Merging multiple vectors or columns of different data frames into one - The <code>cbind()</code> , <code>rbind()</code> and <code>merge()</code> commands. Inter-conversions of the various modes of storages.	6	CO2 CO3	K2 K3
Unit 3	Diagrammatic representations of data: <code>plot()</code> command. Line Diagram, bar (horizontal and vertical) diagrams, multiple bar diagrams, multiple line diagrams, pie and subdivided charts. Column diagrams and histograms. Box plots - the <code>summary()</code> command. Cumulative frequency diagrams. Adding legends, title, labels, limits on the axis.	8	CO4 CO6	K4 K6

	The <i>par()</i> parameter and its arguments.			
Unit 4	Applications in Probability and Statistics: Descriptive measures of central tendency, dispersion, skewness and kurtosis. The ' <i>moments</i> ' package and its functions. Scatterplot, Various forms of correlations. Regression theory – the <i>lm()</i> command, <i>abline()</i> command, polynomial regression. Residual plots. Density, distribution function, quantile function and random generation for different distributions	9	CO3 CO5	K3 K5
List of Suggested Practical	<ul style="list-style-type: none"> • Basic statistical measures using C and R. • Problems on numerical analysis using C. • Frequency distribution and Diagrammatic representation of data. 			

Reading/Reference list

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.
5. Dalgaard, P : Introductory Statistics with R, Springer Publications, 2nd Edition, 2008.
6. Maindonald, J. & Braun, J. : Data Analysis and Graphics Using R , Cambridge University Press, Cambridge, 2nd Edition, 2007.
7. Faraway, J. J. : Linear Models with R ,Chapman &Hall/CRC Texts in Statistical Science.

Evaluation

Paper Structure	C Programming		Introduction to R		Total
	CA: 30	End Sem: NA	CA: 20	End Sem: NA	
					50

CO	CO Description for Module I	Cognitive levels
CO1	Remember the fundamental language constructs, including constants, variables, keywords, and relational/logical operators.	K1
CO2	Understand the logic and flow of conditional statements (If-Else) and iterative loop structures (For, While, Do-While).	K2
CO3	Apply user-defined functions, function prototypes, and recursion to build structured multi-function programs.	K3
CO4	Analyze the organization and data manipulation requirements of single-dimensional and two-dimensional arrays.	K4
CO5	Evaluate the methods for generating random samples from various probability distributions and their statistical applications.	K5
CO6	Create integrated programming solutions that combine control structures, arrays, and functions to solve problems derived from the unit topics	K6

CO	CO Description for Module II	Cognitive levels
CO1	Remember the R environment setup, including CRAN, the use of libraries, mathematical functions, and unary/binary operators ¹² .	K1
CO2	Understand the various modes of data storage such as vectors, matrices, data frames, and lists ²³ .	K2
CO3	Apply commands for data subsetting, merging objects via cbind or rbind, and linear regression modeling using lm() ³⁴ .	K3
CO4	Analyze data distributions by comparing diagrammatic representations like histograms, bar diagrams, and box plots ⁵ .	K4
CO5	Evaluate descriptive measures of central tendency, dispersion, skewness, and kurtosis using the 'moments' package ⁴ .	K5
CO6	Create complex visualizations that incorporate legends, titles, labels, and specific axis limits ⁵ .	K6