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|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Branch Name:</b>          | Artificial Intelligence And Data Science                                                                                                                                                         |
| <b>Program Code:</b>         | ET108                                                                                                                                                                                            |
| <b>Semester/Year:</b>        | Semester VIII / Fourth Year                                                                                                                                                                      |
| <b>Subject Title:</b>        | R Programming for Data Science                                                                                                                                                                   |
| <b>Subject Code:</b>         | 1ET1080802                                                                                                                                                                                       |
| <b>Pre-requisite Course:</b> | Knowledge of statistical theory in mathematics. Understanding of different types of graphs for data representation and most important is that we should have prior knowledge of any programming. |

**Course Objective:**

- Understand the use of the R and R Studio interactive environment
- Expand R by installing R packages
- Utilize and R Data types for developing programs.
- Understand the different data structures in R

**Teaching and Examination Scheme:**

| Teaching Scheme<br>(Hours per week) |                 |                  |        | Evaluation Scheme (Marks) |                          |                          |                          |                  |
|-------------------------------------|-----------------|------------------|--------|---------------------------|--------------------------|--------------------------|--------------------------|------------------|
| Lecture<br>(L)                      | Tutorial<br>(T) | Practical<br>(P) | Credit | Theory (Marks)            |                          | Practical (Marks)        |                          | Total<br>(Marks) |
|                                     |                 |                  |        | University<br>Assessment  | Continuous<br>Assessment | University<br>Assessment | Continuous<br>Assessment |                  |
| 04                                  | -               | 02               | 05     | 70                        | 30                       | 30                       | 20                       | 150              |

**Subject Contents**

| Sr.<br>NO | Topic                                                                                                                                                                                                                                         | Total<br>Hours | Weightage |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-----------|
| 1         | <b>Introduction to R Programming:</b><br>Overview of R programming, R and Python, Variables and Data Types, Control Structures, Array, Matrix, Vectors, Factors, Functions                                                                    | 08             | 10        |
| 2         | <b>R-Data Types, Operators and Packages:</b><br>Data types, Variables: Variable assignment, Finding Variable ls(), Deleting Variables, Operators, Decision Making, R Loops, Vectors, Lists, Matrices, Arrays, Factors, Data Frame, R Packages | 07             | 10        |

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |    |    |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|
| 3 | <b>R-Function :</b><br>Function definition, Built in functions: mean(), paste(), sum(), min(), max(), seq(), user-defined function, calling a function, calling a function without an argument, calling a function with argument values - R-Strings – Manipulating Text in Data: substr(), strsplit(), paste(), grep(), toupper(), tolower() - R Vectors – Sequence vector, rep function, vector access, vector names, vector math, vector recycling, vector element sorting - R List - Creating a List, List Tags and Values, Add/Delete Element to or from a List, Size of List, Merging Lists, Converting List to Vector - R Matrices – Accessing Elements of a Matrix, Matrix Computations: Addition, subtraction, Multiplication and Division- R Arrays: Naming Columns and Rows, Accessing Array Elements, Manipulating Array Elements, Calculation Across Array Elements - R Factors –creating factors, generating factor levels gl(). | 07 | 25 |
| 4 | <b>R advance:</b><br>Data Reshaping, Transpose a Matrix, Joining rows and columns in Data Frame, Merging Data Frame, Melt the Data, Casting of Molten Data, Object-Oriented Programming in R- Objects and Classes in R, S3 Class, S4 Class,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 08 | 20 |
| 5 | <b>R Studio IDE:</b><br>Environment setup with R Studio, R Commands, R command Prompt, R script file, comments – Handling Packages in R: Installing R Packages, Few commands to get started: installed.packages(), packageDescription(), help(), find.package(), library() - Input and Output – Entering Data from keyboard – Printing fewer digits or more digits – Special Values functions : NA, Inf and -inf.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 06 | 15 |
| 6 | <b>R Data Interfaces:</b><br>R-CSV Files - Input as a CSV file, Reading a CSV File, Analyzing the CSV File, R -Excel File, R-Binary Files, R- XML Files, R- JSON Files, R Database                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 06 | 10 |
| 7 | <b>R Data Visualization:</b><br>R Pie Charts: Pie Chart title and Colors – Slice Percentages and Chart Legend, 3D Pie Chart, R Histograms, RBoxplots, R Bar Charts, R Line Graphs, R Scatterplots                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 06 | 10 |

**List of Reference Books:**

1. An Introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics. W. N. Venables, D.M. Smith and the R Development Core Team
2. SandipRakshit, R Programming for Beginners, McGraw Hill Education (India), 2017, ISBN : 978-93-5260-455-5.
3. Jared P Lander, R for everyone: advanced analytics and graphics, Pearson Education, 2013
4. Joseph F Hair, William C Black et al , “Multivariate Data Analysis” , Pearson Education, 7th edition, 2013.
5. Mark Gardener, “Beginning R - The Statistical Programming Language”, John Wiley & Sons, Inc., 2012.
6. W.N.Venables, D. M. Smith and the R Core Team, “An Introduction to R”, 2013.

**List of Suggested titles of Experiments:**

1. Installation of R in Windows
2. Write a program to store data into Data frame and perform different operations
3. Write a program to find biggest of three elements. Write a program to make a simple calculator that can add, subtract, multiply and divide using switch cases and functions. Write a program to find factorial of a number using recursion
4. Write a program to create a simple bar plot of five subjects marks
5. Write a program to take input from the user (name and age) and display the values. Also print the version of R installation.
6. Write a program to get the details of the objects in memory
7. Write a program to create a sequence of numbers from 20 to 50 and find the mean of the numbers from 20 to 60 and sum of numbers from 51 to 91
8. Write a program to get the unique numbers of a given string and unique numbers of vector.

**Course Learning Outcomes (CLO): On completion of this course, the students will be able to:**

| CLO  | Description                                           | Bloom's Taxonomy Level           |
|------|-------------------------------------------------------|----------------------------------|
| CLO1 | Show the installation of R Programming Environment    | 1 Remembering<br>2 Understanding |
| CLO2 | Utilize and R Data types for developing programs.     | 1 Remembering<br>2 Understanding |
| CLO3 | Make use of different R Data Structures.              | 4 Analyze                        |
| CLO4 | Develop programming logic using R Packages.           | 3 Applying                       |
| CLO5 | Analyze the datasets using R programming capabilities | 3 Applying                       |

**Mapping of CLOs with POs & PSOs**

| Course Learning Outcomes | Program Outcomes (POs) |      |      |      |      |      |      |      |      |       |       |       | Program Specific Outcomes (PSOs) |       |       |       |
|--------------------------|------------------------|------|------|------|------|------|------|------|------|-------|-------|-------|----------------------------------|-------|-------|-------|
|                          | PO 1                   | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1                            | PS O2 | PS O3 | PS O4 |
| CLO1                     |                        |      |      |      | M    | L    |      |      |      |       |       | H     | H                                | M     | L     |       |
| CLO2                     | M                      |      | H    | M    | L    |      |      |      |      | M     |       | M     |                                  | L     | H     |       |
| CLO3                     |                        | L    | M    |      | M    |      |      |      |      |       |       |       |                                  | H     |       | L     |
| CLO4                     | M                      | M    |      |      | L    |      |      | M    |      |       |       |       | L                                |       | M     | H     |
| CLO5                     |                        |      |      |      | L    |      |      |      |      |       |       |       |                                  | M     |       |       |

**H: High, M: Medium, L: Low**