*Progressive Education Society's*
Modern College of Arts, Science & Commerce, (Autonomous)
Ganeshkhind, Pune 411016

# Program Code: BSC DS10
# Bachelor of Science (Data Science)
# (Under Faculty of Science & Technology)

## *A.Y: 2025 – 2026*
## *S.Y.B.Sc.(Data Science)*

Opposite to University of Pune, Pashan Road 411016
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***Name of Program: Bachelor of Science (Data Science) with Actuarial Analysis)***

*Introduction:*

B.Sc. (Data Science) is a Four Year Full Time Graduate Program. It is an interdisciplinary field that combines statistics, mathematics, computer science, and domain expertise which is a career-focused program designed to equip students with latest technologies and various programming skills and become proficient in the Data Analytics field.

*Program Structure:*

- The Program is a Four Year (Eight semesters) Full Time Degree Program.
- The Program shall be based on a credit system comprising 176 credits.

*Objectives:*

1) To expose and provide a strong foundation to the students in the upcoming era of Data Science and Artificial Intelligence
2) The programme aims at providing a rigorous training in fundamental concepts of Statistics, Mathematics, & Computers Science which creates a strong knowledge base in Data Science domain.
3) To provide a complete understanding of the subject by introducing projects from the Second semester on the relevant subject.
4) Focus on blending theory with practical and industry application to enhance understanding and learning.
5) Focus on the overall development of the students to help gain knowledge and skillsets required for further studies after completion of the course.

*Eligibility Criteria:*

- Candidate must have passed 10 + 2 or equivalent examination from a recognized board with Mathematics/ Mathematics & Statistics as compulsory subject with minimum 50% aggregate marks in any stream (Science/Commerce/Arts with Mathematics/ Mathematics & Statistics).
- Three Years Diploma Course, after S.S.C. (10th standard) of Board of Technical Education conducted by Government of Maharashtra or its equivalent.
- English Language Proficiency.
- Intake: 80 Seats

**Medium of Instruction: English**

**Instructions for Teachers for Internal Evaluation for 20 Marks and 40 Marks:**

The purpose of internal evaluation is to assess the depth of knowledge, understanding and awareness. For this purpose, a teacher is expected to use different evaluation methods in order to have rational and objective assessment of the learners and available resources.

**External Examination:**

There will be a written Examination of 30 marks in 2 hrs. duration and 60 marks of 3 hrs. for every course at the end of each Semester only for major and minor subjects.

*Award of Class:*

| Letter Grade | Grade Point |
|---|---|
| O (outstanding) | 10 |
| A+ (Excellent) | 9 |
| A (Very good) | 8 |
| B+ (Good) | 7 |
| B (Above average) | 6 |
| C (Average) | 5 |
| P (Pass) | 4 |
| F (Fail) | 0 |
| Ab (Absent) | 0 |

Question Paper Pattern:CIE

| Max. Marks: 20 (Credit:02, Duration: 50 Min.) | | | | |
|---|---|---|---|---|
| Question No. | **Question** | **No. of sub questions** | **Marks to each sub question** | **Total Question Marks** |
| 1 | Multiple Choice Questions 5 | 5 | 1 | 5 |
| 2 | Define any 5 | 6 | 1 | 5 |
| 3 | Attempt any two of the following | 3 | 2 | 4 |
| 4 | Attempt any two of the following | 3 | 3 | 6 |
| Total Marks: | | | | **20** |

| Max. Marks: 20 (Credit 4, Duration: 50Min.) | | | | |
|---|---|---|---|---|
| Question No. | **Question** | **No. of sub questions** | **Marks to each sub question** | **Total Question Marks** |
| 1 | Multiple Choice Questions 5 | 5 | 1 | 5 |
| 2 | Define any 5 | 6 | 1 | 5 |
| 3 | Attempt any two of the following | 3 | 2 | 4 |
| 4 | Attempt any two of the following | 3 | 3 | 6 |
| Total Marks: | | | | **20** |

For 2 credits CIE 20 Marks for internal Examination and 20 Marks for CBCS activity (Open book test, Seminars, Online Test, Surprise Test, Preparation of Models, Group Discussions etc.) average of 40 marks will be considered.

Question Paper Pattern: ESE

| Max. Marks: 60 (Credit:04, Duration: 3 Hrs.) | | | | |
|---|---|---|---|---|
| Question No. | **Question** | **No. of sub questions** | **Marks to each sub question** | **Total Question Marks** |
| 1 | Attempt All | 10 | 1 | 10 |
| 2 | Attempt any 5 | 7 | 2 | 10 |
| 3 | Attempt any 5 | 7 | 3 | 15 |
| 4 | Attempt any 3 | 5 | 5 | 15 |
| 5 | Attempt any 2 | 4 | 5 | 10 |
| Total Marks: | | | | **60** |

| Max. Marks: 30 (Credit 2, Duration: 2 Hrs.) | | | | |
|---|---|---|---|---|
| Question No. | **Question** | **No. of sub questions** | **Marks to each sub question** | **Total Question Marks** |
| 1 | Attempt All | 5 | 1 | 5 |
| 2 | Attempt any 5 | 7 | 2 | 10 |
| 3 | Attempt any 2 | 4 | 5 | 10 |
| 4 | Attempt any 1 | 2 | 5 | 5 |
| Total Marks: | | | | **30** |

# B.Sc. Data Science Curriculum & Syllabus

| Programme Specific Outcomes (PSOs) | |
|---|---|
| ***After the successful completion of B.Sc. Data Science program the students are expected to*** | |
| **PSO1** | Apply foundations of Mathematics, Statistics and Computer Science in Solving real world problems. |
| **PSO2** | Design, develop, implement, and apply Analytical skills related to Research, consultancy, and multidisciplinary domains. |
| **PSO3** | Equip with requisite theoretical and practical skills to enable them to pursue multidisciplinary courses at postgraduate level and to obtain placement opportunities. |
| **PSO4** | To develop the speed and accuracy levels of analysis and drawing inferences. |

| Programme Outcomes (POs) | |
|---|---|
| ***On successful completion of the B.Sc. Data Science students will be able to*** | |
| **PO1** | Gain fundamental knowledge and ability to expertise in Data Science and analytics. |
| **PO2** | Utilize the features and new updates of Excel,Python, R, Tableau and Power BI to enhance analytical reasoning. |
| **PO3** | Establish the ability to listen, read, proficiently communicate, and articulate data and information through traditional and digital channels to audiences with diverse perspectives. |
| **PO4** | Apply critical thinking by understanding financial mathematics, time series analysis, real analysis, artificial intelligence, deep learning, data security that are applied in actuarial science and cloud computing. |
| **PO5** | Acquire appropriate knowledge base in domain specific areas leading to the pursue of an advanced level of study. |
| **PO6** | Design and develop research-based solutions for complex problems with specified needs with appropriate ethical consideration for public health, safety, culture, society, and the environment. |
| **PO7** | Inculcate professional effective communication skills, teamwork, multidisciplinary approach and an ability to relate issues to broader social context. |

| **Suggested internal assessment tools for courses:** |
| --- |
| 1. Students Seminar<br>2. Short Quizzes / MCQ Test<br>3. Home Assignments<br>4. Tutorials/ Practical<br>5. Oral test<br>6. Research Project<br>7. Group Discussion<br>8. Open Book Test<br>9. Study Tour<br>10. Written Test<br>11. PPT presentation<br>12. Field Visit<br>13. Industrial Visit<br>14. Viva |

| **Teaching Methodology** |
| --- |
| 1. Classroom Teaching<br>2.Guest Lectures<br>3. Hands on training<br>4.Group Discussions<br>5. Surveys<br>6. Power Point Presentations<br>7. Visit to Institutions / Industries<br>8. Research Papers & Projects<br>9. e-Content |

| S.Y.BSc (Data Science)<br>Semester -III | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Type** | **Course Code** | **Course Title** | **Credits** | | **Evaluation** | | |
| | | | **TH** | **PR** | **CIE** | **ESE** | **Total** |
| Major Mandatory (4T) + (2P) | 24DSC23101 | Introduction to Python Programming | 2 | - | 20 | 30 | 50 |
| | 24DSC23102 | Testing of Hypothesis | 2 | - | 20 | 30 | 50 |
| | 24DSC23103 | Practical on Python & Testing of Hypothesis | - | 2 | 20 | 30 | 50 |
| Major Specific IKS | 24DSC23104 | Timeline of Computing | 2 | - | 20 | 30 | 50 |
| Minor 2T+2P | 24DSC23201/ 24DSC23205 | Course in Linear Algebra | 2 | - | 20 | 30 | 50 |
| | 24DSC23202/ 24DSC23206 | Course in Linear Algebra Practical | - | 2 | 20 | 30 | 50 |
| OE1(2) | | OE (From Arts/Commerce Basket) | 2 | - | 20 | 30 | 50 |
| VSEC(2) | 24DSC23401/ 24DSC23407 | Multivariate Analysis | 2 | - | 20 | 30 | 50 |
| AEC(2) | | Hindi/Marathi | 2 | - | 20 | 30 | 50 |
| CC (2) | 24NSS12601/ 24NCC12601/ 24RED12601/ 24DRM12601/ 24ANM12601/ 24JWD12601/ 24CUL12601/ 24SPO12601/ 24YOG12601 | NSS/ NCC/ Red Cross/ Theatre & Drama/ Animation/ Jewellery Design/ Culinary Arts/ Sports Physical Education/ Yoga | 2 | - | 20 | 30 | 50 |
| FP(2) | 24DSC23601/ 24DSC23608 | Field Project | - | 2 | 20 | 30 | 50 |
| | | Total | 16 | 6 | 220 | 330 | 550 |

CIE :- Continuous Internal Examination, ESE :- End Semester Examination

| S.Y.BSc (Data Science)<br>Semester -IV | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Type** | **Course Code** | **Course Title** | **Credits** | | **Evaluation** | | |
| | | | **TH** | **PR** | **CIE** | **ESE** | **Total** |
| Major Mandatory (4T) =(2T+2T)<br><br>+2P | 24DSC24101 | Advanced Python Programming | 2 | - | 20 | 30 | 50 |
| | 24DSC24102 | Regression Analysis | 2 | - | 20 | 30 | 50 |
| | 24DSC24103 | Practical on Calculus & Regression Analysis | - | 2 | 20 | 30 | 50 |
| Minor (4) 2T+2P | 24DSC24201/ 24DSC24204 | Actuarial Statistics | 2 | - | 20 | 30 | 50 |
| | 24DSC24202/ 24DSC24205 | Practical on Actuarial Statistics | - | 2 | 20 | 30 | 50 |
| OE3(2) | | OE (From Arts/Commerce Basket) | 2 | - | 20 | 30 | 50 |
| VSEC(2) | 24DSC24401/ 24DSC24406 | Calculus | 2 | - | 20 | 30 | 50 |
| SEC(2) | 24DSC24402/ 24DSC24407 | Advanced Python Programming Practical | - | 2 | 20 | 30 | 50 |
| AEC(2) | | Hindi | 2 | | | | |
| CC (2) | 24NSS12601/ 24NCC12601/ 24RED12601/ 24DRM12601/ 24ANM12601/ 24JWD12601/ 24CUL12601/ 24SPO12601/ 24YOG12601 | NSS/ NCC/ Red Cross/ Theatre & Drama/ Animation/ Jewellery Design/ Culinary Arts/ Sports Physical Education/ Yoga | 2 | - | 20 | 30 | 50 |
| CEP(2) | 24DSC24601/ 24DSC24608 | Community Engagement and Services | - | 2 | 20 | 30 | 50 |
| | | Total | 14 | 8 | 220 | 330 | 550 |


Third
Semester

**Course Title: - Introduction to Python Programming**
**Course Type: Major Mandatory Paper 1(Theory)**
**Course Code: 24DSC23101**
**Semester- III**

| **Teaching Scheme:** | **No. of Credits:** | **No. of Lectures:** | **Examination Scheme:** |
|---|---|---|---|
| **2 Hours / Week** | **2** | **30** | **CIE: 20 Marks ESE: 30 Marks** |

**Prerequisites: Student should have basic knowledge of:**

- Familiarity with simple programming ideas like variables and loops
- Basic understanding of math concepts like arithmetic and sets.

**The main objectives of this course are to:**

- Build a strong foundation in Python programming and its basic concepts.
- Gain the ability to manipulate data using Python's lists, dictionaries, sets, and tuples.
- Explore real-world applications, including regular expressions and functional programming tools.

**Expected Course Outcomes:**

**On the successful completion of the course, student will be able to:**

| | | |
|---|---|---|
| CO1 | Learn and understand Python basics, data types, and control structures. | B1,B2 |
| CO2 | understand and apply Master lists, tuples, dictionaries, sets, and string manipulation. | B3,B4 |
| CO3 | Develop functions, handle files, and work with modules. | B5, B6 |
| CO4 | Implement exception handling, recursion, and regular expressions. | B3,B5 |

**B1** - Remember; B**2** - Understand; B**3** - Apply; B**4** - Analyze; B**5** - Evaluate; B**6**– Create

| **UNIT** | **Contents** | **No of Lectures** | **CO targeted** |
|---|---|---|---|
| **1** | **An Introduction to Python.**<br>● The Python Programming Language, History, features, Applications, Installing Python, Running Simple Python program<br>● Standard data types - basic, none, Boolean (true & False), numbers, Variables, Constants,Python identifiers and reserved words, Lines and indentation, multi-line statements and Comments,Input/output with print and input ,functions Declaration, Operations on Data such as assignment, arithmetic, relational, logical and bitwise operations, dry run, Simple Input and output etc. | 4 | CO1 |
| **2** | **Control Statement.**<br>• **Sequence Control** – Precedence of operators, Type conversion.**Conditional Statements**: if, if-else, nested if-else,<br>• **Looping**- for, while, nested loops, loop control statements (break, continue, pass)<br>• **Strings**: declaration, manipulation, special operations, escape<br>o character, string formatting operator, Raw String, Unicode | 3 | CO1 |

| | | | |
|---|---|---|---|
| | ○ strings, Built-in String methods. | | |
| 3 | **List, tuples and dictionaries, Sets.**<br>● **Python Lists:** Concept, creating and accessing elements, updating & deleting lists, traversing a List, reverse Built-in List Operators, Concatenation, Repetition, In Operator, Built-in List functions and methods.<br>● **Tuples:** Tuples, Accessing values in Tuples, Tuple Assignment, Tuples as return values, Variable-length argument tuples, and Basic tuples operations, Concatenation, Repetition, in Operator, Iteration, Built-in tuple functions, indexing, slicing and matrices.<br>● **Dictionaries:** Creating a Dictionary, Accessing Values in a dictionary, Updating Dictionary, Deleting Elements from Dictionary, Properties of Dictionary keys, Operations in Dictionary, Built-In Dictionary Functions, Built-in Dictionary Methods.<br>● **Sets:** Definition, transaction of set(Adding, Union, intersection), working with sets. | 6 | CO2 |
| 4 | **Functions**<br>• **Functions:** Definitions and Uses, Function Calls, Type Conversion Functions, Math Functions, Adding New Functions, Flow of Execution, Parameters and Arguments, Variables and Parameters, Stack Diagrams, Void Functions, Anonymous functions Importing with from, Return Values, Boolean Functions, More Recursion, Functional programming tools - filter(), map(), and reduce(),recursion, lambda forms. | 7 | CO3 |
| 5 | **Modules, working with Files, Exception Handling**.<br>● **Modules:** Importing module, Creating & exploring modules, Math module, Random module, Time module.<br>● **Packages:** Importing package, creating package, examples.<br>● **Working with files:** Creating files and Operations on files (open, close, read, write), File object attributes, file positions, Listing Files in a Directory, Testing File Types, Removing files and directories, copying and | 10 | CO4 |

| | | | |
|---|---|---|---|
| | renaming files, splitting pathnames, creating and moving directories.<br>● **Regular Expression-** Concept of regular expression, various types of regular expressions, using match function.<br>● **Exception Handling:** Built-in Exceptions, Handling Exceptions, Exception with Arguments, User-defined Exceptions. | | |

| **Text Books** |
|---|
| ● Python Programming, Nirali Publication - ISBN: 978-93-54511-95-0<br>● Python Programming, Vision Publication- ISBN: 978-93-90646-58-6 |

| **Reference Books** |
|---|
| 1. An Introduction to Computer Science using Python 3 by Jason Montojo, Jennifer Campbell, Paul Gries, The pragmatic bookshelf-2013.<br>2. James Payne, "Beginning Python: Using Python and Python 3.1,Wrox Publication.<br>3. Introduction to Computer Science Using Python- Charles Dierbach, Wiley Publication Learning with Python ", Green Tea Press, 2002<br>4. Introduction to Problem Solving with Python by E-balguruswamy, TMH publication 2016<br>5. Beginning Programming with Python for Dummies Paperback – 2015 by John Paul Mueller<br>6. Object-oriented Programming in Python, Michael H. Goldwasser, David Letscher, Pearson Prentice Hall-2008. |

| **Related Online Content (MOOCS, SWAYAM, NPTEL, WEBSITES etc.)** |
|---|
| **Online Courses**<br>● Python Programming for Beginners to Intermediate: www.udemy.com/course/python-programming-for-beginners-to-intermediate/<br>● Complete Python 3 Programming Bootcamp: https://www.udemy.com/course/complete-python-programming-course-beginner-to-advanced/?couponCode=BFCPSALE24 |

**Course Title: - Testing of Hypothesis**
**Course Type: (Theory)**
**Course Code: 24DSC23102**
**Semester- III**

| **Teaching Scheme: 2 Hours / Week** | **No. of Credits: 2** | **No. of Lectures: 30** | **Examination Scheme: CIE: 20 Marks ESE: 30 Marks** |
|---|---|---|---|

**Prerequisites: Student should have basic knowledge of:**

- Inferential statistics
- Probability and sampling distributions
- Sampling Methods

**The main objectives of this course are to:**

To study how hypothesis ensures the entire research process remains scientific and reliable

**Expected Course Outcomes:**

**On the successful completion of the course, student will be able to:**

| | | |
|---|---|---|
| CO1 | Differentiate between type I and type II error with respect to their measures | B2,B5 |
| CO2 | Understand tests for means, proportions based on normal distribution, | B2 |
| CO3 | Apply tests for means,proportions based on t distribution, | B4,B5 |
| CO4 | Handle situations where non- parametric tests are applicable | B1,B6 |

**B1** - Remember; B**2** - Understand; B**3** - Apply; B**4** - Analyze; B**5** - Evaluate; B**6**– Create

| **UNIT** | **Contents** | **No of Lectures** | **CO targeted** |
|---|---|---|---|
| **1** | **Introduction to the testing**<br>● Statistic and Parameter.<br>● Sampling distribution, standard error of a statistic with illustrations. Statistical Inference:<br>● Examples of statistics, parameters and sampling distribution.<br>● Introduction to the problem of Estimation and testing of hypotheses.<br>● Estimator and estimate. Unbiased estimator (definition and simple illustrations only) (proof on the basis of population of 4 observation s and using sampling method SRSWOR ,SRSWR )<br>● Point and interval estimation. | **6** | CO1 |

| | | | |
|---|---|---|---|
| **2** | **Tests of Significance:**<br>● Statistical hypothesis, null and alternative hypothesis, simple and composite hypothesis, one sided and two sided alternative hypothesis, critical region and acceptance region type I error ,type II error, level of significance.<br>● Tests of hypotheses using<br>○ Critical region approach<br>○ Confidence interval approach.<br>● Tests for population means (large sample / approximate tests):<br>○ single population(two sided, variance known)<br>○ two populations( two sided, variance known)<br>○ Construction of two sided confidence interval for $\mu$ and $\mu 1 - \mu 2$<br>● Tests for population means (small sample / exact test):<br>○ t test for single population mean( two sided, variance known)<br>○ t test for two populations( two sided, variance unknown)<br>○ Paired t test<br>Chi square test<br>○ Single population variance<br>○ Independence of attributes<br>○ Goodness of fit<br>● F test for Tests for population variance (small sample / approximate tests):<br>○ Two population variances<br>○ One way ANOVA<br>● Tests for population proportions:<br>○ Single population( two sided, one sided test)<br>○ Two population( two sided, one sided test)<br>○ Construction of two sided confidence interval for $P \; and \; P1 - P2$ | **18** | CO2, CO3 |

| | | | |
|---|---|---|---|
| **3** | **Non-parametric Tests**<br><br>● Concept of non-parametric tests. Distinguish between parametric and nonparametric Tests.<br>● Concept of distribution free statistics.<br>● One tailed and test procedure of<br>○ Sign test<br>○ Wilcoxon signed rank test for single population<br>○ Run test, one sample and two samples problems | **6** | CO4 |

| **Books** |
|---|
| ● Statistical Theory,B.W. Lindgren (1993), 4th Edition,CRC Press London<br>● Applied Nonparametric Statistics,Daniel, W.W. (2000),Duxbury Press Boston<br>● Modern Mathematical Statistics,Dudewecz, E.J. and Mishra, S.N. (1988),John Wiley and Sons,Inc.<br>● Non parametric Statistical Inference,Gibbons J.D. andChakraborti, S. (2010).,CRC Press, London<br>● Introduction to Statistical Theory,Hoel, P.G. Port, S. and Stone, C.(1972).,Houghton Mifflin Company (International) Dolphin Edition<br>● Introduction to Mathematical Statistics,Hogg, R.V. McKean, J. and Craig A.T. (2012), 7th Edition,Pearson<br>● An Introduction to Probability Theory and Statistics,Kendall, M. and Stuart, A. (1943).,Wiley, New York<br>● An Introduction of Probability Theory and Its Applications,Feller W. (1968), Vol. I, 3rd Edn.Wiley, |

**Course Title: -Practical Python & Testing of Hypothesis**
**Course Type: Major Mandatory Paper 3(Practical)**
**Course Code: 24DSC23103**
**Semester- III**

| **Teaching Scheme: 2 Hours / Week** | **No. of Credits: 2** | **No. of Practicals: 10** | **Examination Scheme: CIE: 20 Marks ESE: 30 Marks** |
|---|---|---|---|

**Prerequisites: Student should have basic knowledge of:**

- Knowledge of different types of distributions
- Concepts required for testing

**The main objectives of this course are to:**

- Introduce the students the important techniques of testing of the general statement regarding the population
- To understand the fundamental concepts of databases.
- To understand user requirements and frame it in a data model.
- To understand creations, manipulation and querying of data in databases.

## Expected Course Outcomes:

## On the successful completion of the course, student will be able to:

| | | |
|---|---|---|
| CO1 | Apply various tests in an appropriate situations | B1,B2 |
| CO2 | Handle situations where non- parametric tests are applicable | B3,B4 |
| CO3 | Learn to write simple Python programs and use Python IDEs. | B5,B1 |
| CO4 | Work with strings, functions, and perform operations on lists, tuples, sets, and dictionaries. | B6,B2,B4 |

**B1** - Remember; B**2** - Understand; B**3** - Apply; B**4** - Analyze; B**5** - Evaluate; B**6**– Create

| **UNIT** | **Contents** | **No of Practicals** | **CO targeted** |
|---|---|---|---|
| 1 | Computation of type I and type II error | 1 | CO1 |
| 2 | Large sample test (one and two samples) | 1 | CO1 |
| 3 | Test based on t distribution (mean test ,Paired t test) | 1 | CO1 |
| 4 | Chi square test for single population variance, independence of attributes and goodness of fit test. | 1 | CO1 |
| 5 | Test based on F distribution | 1 | CO1 |
| 6 | ANOVA test | 1 | CO1 |
| 7 | Non parametric test | 2 | CO2 |
| 8 | Python basics and IDE, Simple Python Program | 2 | CO3,CO4 |
| 9 | Strings and Functions. | 2 | CO4 |
| 10 | List, Tuple, Sets and Dictionary. | 2 | C03 |
| 11 | File Handling and Date-Time. | 2 | CO3,CO4 |
| 12 | Exception Handling and Regular Expression. | 2 | CO3,CO4 |

**Course Title: -Timeline of Computing**
**Course Type: Major Mandatory Paper 4(Theory) ( Major Specific IKS)**
**Course Code: 24DSC23104**
**Semester- III**

| **Teaching Scheme:** 2 Hours / Week | **No. of Credits:** 2 | **No. of Lectures:** 30 | **Examination Scheme:** CIE: 20 Marks ESE: 30 Marks |
|---|---|---|---|

**Prerequisites: Student should have basic knowledge of:**

- General computing systems and Modern technology
- Arithmetic skills and number systems
- Key inventions and scientific inventors

**The main objectives of this course are to:**

- Understand the evolution of computing from early tools to modern technologies.
- Analyze the contributions of key inventors, devices, and innovations in computing history.
- Recognize the impact of technological milestones on society and industries.
- Connect historical advancements to modern computing trends and future developments.

**Expected Course Outcomes:**

**On the successful completion of the course, student will be able to:**

| | | |
|---|---|---|
| CO1 | To understand the history of computing and the era of computing. | B1,B2 |
| CO2 | To learn the foundations of modern computing. | B3,B4 |
| CO3 | To understand computing in the 21st century. | B5, B6 |

**B1** - Remember; B**2** - Understand; B**3** - Apply; B**4** - Analyze; B**5** - Evaluate; B**6**– Create

| **UNIT** | **Contents** | **No of Lectures** | **CO targeted** |
|---|---|---|---|
| **1** | **Pre-Computing Era**<br>● Introduction to Computing Concepts<br>● Definition of computing<br>● Early calculation tools: Abacus, Slide Rule<br>● Historical Milestones in Pre-Computing<br>● Mechanical calculators: Pascaline, Leibniz Wheel<br>● Charles Babbage's Difference and Analytical Engines<br>● Contributions of Ada Lovelace | 4 | CO1 |
| **2** | **Foundations of Modern Computing**<br>● Evolution of Programming :<br>● Early programming languages (Fortran, COBOL, Lisp)<br>● Machine language and assembly<br>● Turing's concept of a universal machine<br>● Birth of Electronic Computing<br>● First generation of computers: ENIAC, UNIVAC<br>● Vacuum tube technology<br>● Alan Turing's contributions to cryptography | 8 | CO2 |

| | | | |
|---|---|---|---|
| | ● Transition to Transistors and Integrated Circuits:<br>● Second and third-generation computers<br>● Rise of IBM and mainframes<br>● Impact of Moore's Law | | |
| 3 | **Personal Computing Revolution**<br>● Development of Microprocessors:<br>● Intel 4004 and subsequent chips<br>● Evolution of processors in personal computers<br>● Birth of the PC Era:<br>● Role of companies like Apple, IBM, and Microsoft<br>● Rise of graphical user interfaces (GUIs)<br>● Early operating systems (DOS, Windows, MacOS)<br>● Networking and the Internet:<br>● ARPANET and the rise of networking<br>● Birth of the World Wide Web (Tim Berners-Lee)<br>● Impact of email and early web browsers | 8 | CO3 |
| 4 | **Computing in the 21st Century**<br>● Mobile Computing and Devices:<br>● Evolution of mobile phones to smartphones<br>● Impact of operating systems like iOS and Android<br>● Cloud Computing and Big Data:<br>● Introduction to cloud platforms (AWS, Azure)<br>● Role of big data in computing<br>● AI, Machine Learning, and Quantum Computing:<br>● Basics of artificial intelligence and machine learning<br>• Introduction to quantum computing and its potential<br>• Blockchain and Decentralized Systems:<br>• Basics of blockchain technology<br>• Applications in finance, healthcare, and beyond | 10 | CO3 |

| Reference Books |
| --- |
| • Computer: A History of the Information Machine by Martin Campbell-Kelly and William Aspray<br>• https://books.google.co.in/books?id=0MZVDgAAQBAJ&lpg=PA1&pg=PT27#v=onepage&q&f=false |

| Related Online Content (MOOCS, SWAYAM, NPTEL, WEBSITES etc.) |
| --- |
| • **https://fortran-lang.org/**<br>• **https://unacademy.com/content/bank-exam/study-material/computer-knowledge/notes-on-lisp/**<br>• **https://www.ibm.com/topics/cobol**<br>• **https://ieeexplore.ieee.org/abstract/document/6369705** |

**Course Title: -Course in Linear Algebra**
**Course Type:Minor (Theory)**
**Course Code: 24DSC23201**
**Semester- III**

| **Teaching Scheme:** 2 Hours / Week | **No. of Credits:** 2 | **No. of Lectures:** 30 | **Examination Scheme:** CIE: 20 Marks ESE: 30 Marks |
|---|---|---|---|

**Prerequisites: Student should have basic knowledge of:**

- Basic Mathematics Skills

**The main objectives of this course are to:**

- To understand the basic arithmetic operations on vectors and matrices, including determinants, using technology where appropriate.
- To solve systems of linear equations, using technology to facilitate row reduction.
- To understand the basic terminology of linear algebra in Euclidean spaces, including linear independence, spanning, basis, rank, nullity, subspace, and linear transformation.
- To understand, find the eigenvalues and eigenvectors of a matrix or a linear transformation, and using them to diagonalize a matrix.

**Expected Course Outcomes:**

**On the successful completion of the course, student will be able to:**

| | | |
|---|---|---|
| CO1 | Solve systems of linear equations using methods by Gaussian elimination. | B1,B2 |
| CO2 | Demonstrate understanding of the concepts of vector space, linear independence and basis | B3,B4 |
| CO3 | Determine eigenvalues and eigenvectors and solve eigenvalue problems. | B5, B6 |

**B1** - Remember; B**2** - Understand; B**3** - Apply; B**4** - Analyze; B**5** - Evaluate; B**6**– Create

| **UNIT** | **Contents** | **No of Lectures** | **CO targeted** |
|---|---|---|---|
| **1** | **System of Linear Equations and Matrices**<br>• Matrices and Matrix operations<br>• Introduction to system of linear equations<br>• Gaussian Elimination method<br>• Determinants by cofactor expansion method<br>• Determinant by row reduction method | 09 | CO1 |
| **2** | **General Vector space**<br>• Real vector spaces<br>• Subspaces<br>• Linear Independence<br>• Basis and Dimension<br>• Row space, column space, null space, rank and nullity | 11 | CO1, CO2 |
| **3** | **Eigen values and Eigen vectors**<br>• Eigen values and Eigen vectors<br>• Diagonalization | 5 | CO3 |
| **4** | **Linear Transformation**<br>• Linear Transformation : Definition and examples<br>• Kernel and range<br>• Matrix of a Linear Transformation | 5 | |

| Text Books |
| --- |
| Elementary Linear Algebra by Howard Anton, Chris Rorres.(Seventh Edition) John Wiley & Sons, Inc. |

| Reference Books |
| --- |
| K. Hoffman and R. Kunze, Linear Algebra, 2nd edition(2014), Prentice Hall of India, New Delhi |

| Related Online Content (MOOCS, SWAYAM, NPTEL, WEBSITES etc.) |
| --- |
| ● https://textbooks.math.gatech.edu/ila/<br>● 032199888X.pdf<br>● https://ia801400.us.archive.org/9/items/linear-algebra-by-strang-4-th-edition/linear%20algebra%20by%20strang%204%20th%20edition.pdf<br>● https://math.mit.edu/~gs/linearalgebra/ila6/ILA6website01.pdf<br>**Online Courses:**<br>● https://onlinecourses.nptel.ac.in/noc24_ma69/preview<br>● Top Linear Algebra Courses Online - Updated [November 2024] |

**Course Title: - Course in Linear Algebra Practical**
**Course Type: Minor (Practical)**
**Course Code: 24DSC23202**
**Semester- III**

| **Teaching Scheme:** 2 Hours / Week | **No. of Credits:** 2 | **No. of Practicals: 10** | **Examination Scheme:** CIE: 20 Marks ESE: 30 Marks |
|---|---|---|---|

**Prerequisites: Student should have basic knowledge of:**

- **Basic Mathematical Skills**

**The main objectives of this course are to:**

- To understand the basic arithmetic operations on vectors and matrices, including determinants, using technology where appropriate.
- To solve systems of linear equations, using software to facilitate row reduction.
- To understand the basic terminology of linear algebra in Euclidean spaces, including linear independence, spanning, basis.
- To abstract notions of vector space and inner product space.
- To understand, find the eigenvalues and eigenvectors of a matrix and using them to diagonalize a matrix.

**Expected Course Outcomes:**

**On the successful completion of the course, student will be able to:**

| | | |
|---|---|---|
| CO1 | Solve systems of linear equations using Python Software. | B1,B2 |
| CO2 | Demonstrate understanding of the concepts of vector space. | B3,B4 |
| CO3 | Determine eigen values and eigenvectors and solve eigenvalue problems. | B5, B6 |

**B1** - Remember; B**2** - Understand; B**3** - Apply; B**4** - Analyze; B**5** - Evaluate; B**6**– Create

| **UNIT** | **Contents** | **No of sessions** | **CO targeted** |
|---|---|---|---|
| **1** | Problem Solving on System of Linear Equation (Written+software) | 4 | CO1 |
| **2** | Problem Solving on Vector Spaces (Written+software) | 4 | CO2 |
| **3** | Problem Solving on Eigenvalues and Eigenvectors (Written+software) | 4 | CO3 |
| **4** | Problem Solving on Linear Transformation(written) | 3 | CO3 |

**Text Books**

Howard Anton, Chris Rorres, Elementary Linear Algebra, Application Version, Ninth Edition, Wiley, 11th edition.

**Related Online Content (MOOCS, SWAYAM, NPTEL, WEBSITES etc.)**

**Online Courses:**

- https://home.csulb.edu/~woollett/mbe4solve.pdf
- https://home.csulb.edu/~woollett/mbe5matrix.pdf
- https://maxima.st/maxima_tutorial.pdf
- linear algebra practical using maxima software pdf - Search

**Course Title: - Multivariate Analysis**
**Course Type: VSEC (Theory)**
**Course Code: 24DSC23401**
**Semester- III**

| **Teaching Scheme: 2 Hours / Week** | **No. of Credits: 2** | **No. of Lectures: 30** | **Examination Scheme: CIE: 20 Marks ESE: 30 Marks** |
|---|---|---|---|

**Prerequisites: Student should have basic knowledge of:**

- Matrix Algebra
- Discrete and continuous probability distributions

**The main objectives of this course are to:**

- tabulate the large scale data
- find the type of relationships between several variables simultaneously.

**Expected Course Outcomes:**

**On the successful completion of the course, student will be able to:**

| | | |
|---|---|---|
| CO1 | understand and arrange the multi-dimensional data. | B2 |
| CO2 | apply various exploratory data analysis tools to analyze the multivariate data | B3 |
| CO3 | find insights from the analyzed data | B4 |

**B1** - Remember; B**2** - Understand; B**3** - Apply; B**4** - Analyze; B**5** - Evaluate; B**6**– Create

| **UNIT** | **Contents** | **No of Lectures** | **CO targeted** |
|---|---|---|---|
| **1** | **Discrete Bivariate Probability Distributions**<br>• Joint and marginal Probability mass function (p.m.f.) of (X,Y), conditional p.m.f. of X\|Y=y and Y\|X=x.<br>• Computation of mean and variance, Computation of conditional mean and conditional variance.<br>• Simple numerical problems and real life examples | 4 | CO1 & CO3 |
| **2** | **Continuous Bivariate Probability Distributions**<br>• Joint and marginal p.d.f. of (X,Y), conditional p.d.f. of X\|Y=y and Y\|X=x.<br>• Computation of mean and variance, Computation of conditional mean and conditional variance.<br>• Simple numerical problems and real life examples | 4 | CO1 & CO3 |
| **3** | **Multinomial distribution**<br>• Description of multinomial random variable and its joint p. m. f., means and variance-covariance matrix<br>• univariate marginal distribution, distribution of Xi + X j , conditional distribution of Xi given Xi + X j = r<br>• Simple numerical problems and real life examples | 4 | CO1 & CO3 |

| | | | |
|---|---|---|---|
| **4** | **Bivariate Normal Distribution**<br>• Probability density function of bivariate normal random variable (X,Y), identification of parameters, marginal and conditional distributions<br>• Regression of Y on X and of X on Y, independence and uncorrelatedness<br>• Simple numerical problems and real life examples | 5 | CO1 & CO3 |
| **5** | **Multivariate Normal distribution**<br>• Exploratory multivariate Data Analysis using Sample mean vector, Dispersion Matrix, Correlation Matrix.<br>• Linear transformation and its mean and variance<br>• Simple numerical problems and real life examples | 5 | CO1 & CO3 |
| **6** | **Principal Component Analysis (PCA)**<br>• Principal component Analysis (by using covariance and correlation method, standardized method) | 4 | CO2 |
| **7** | **Multivariate ANOVA (MANOVA)** | 4 | CO2 |

**Reference Book**


- Introduction to Multivariate Analysis,Anderson, T. W. (1984)John Wiley
- Symmetric Multivariate and RelatedDistributions,Fang ,K., Kotz, S., Ng K. W. (1990),Chapman and Hall
- Applied Multivariate Statistical Analysis,Härdle, W. K. & Simar, L. (2012),Springr, New York
- Multivariate Statistics: Exercises and Solutions,Härdle, W. K., Hlávka, Z. (2007),Springer, New York
- Applied Multivariate Statistical Analysis,Johnson R.A. &Wichern, D.W. (1988),Prentice Hall Inc.
- Continuous Multivariate Distributions, Volume 1, Models and Applications,Kotz, S., Balakrishnan N. and Johnson N. L. (2000),John Wiley & Sons
- Multivariate Analysis,Kshirsagar, A. M. (1983),Marcel Dekker
- Directional Statistics,Mardia,K. V. and Jupp, P,E. (2000),John Wiley & Sons
- Multivariate Statistical Methods,Morrison, D.F. (1990),McGraw Hill Co.

**Course Title: - Field Project**
**Course Type: FP (Theory)**
**Course Code: 24DSC23601**
**Semester- III**

| **Teaching Scheme:** 2 Hours / Week | **No. of Credits:** 2 | **No. of Practicals: 10** | **Examination Scheme:** CIE: 20 Marks ESE: 30 Marks |
|---|---|---|---|

**Prerequisites: Student should have basic knowledge of:**

- Technologies Like Google Form, Microsoft form.
- Select Topic from Day Today's Problem from the Surrounding And Take Survey about the corresponding topic.
- Data analysis libraries, and data visualization tools.
- Data cleaning and preprocessing.

**The main objectives of this course are to:**

- To get knowledge of data collection and preparation.
- To understand data exploration and descriptive analysis.
- To learn how to design data using visualization tools.
- To get knowledge of data reporting and presentation.
- To learn how to implement and deploy the model.

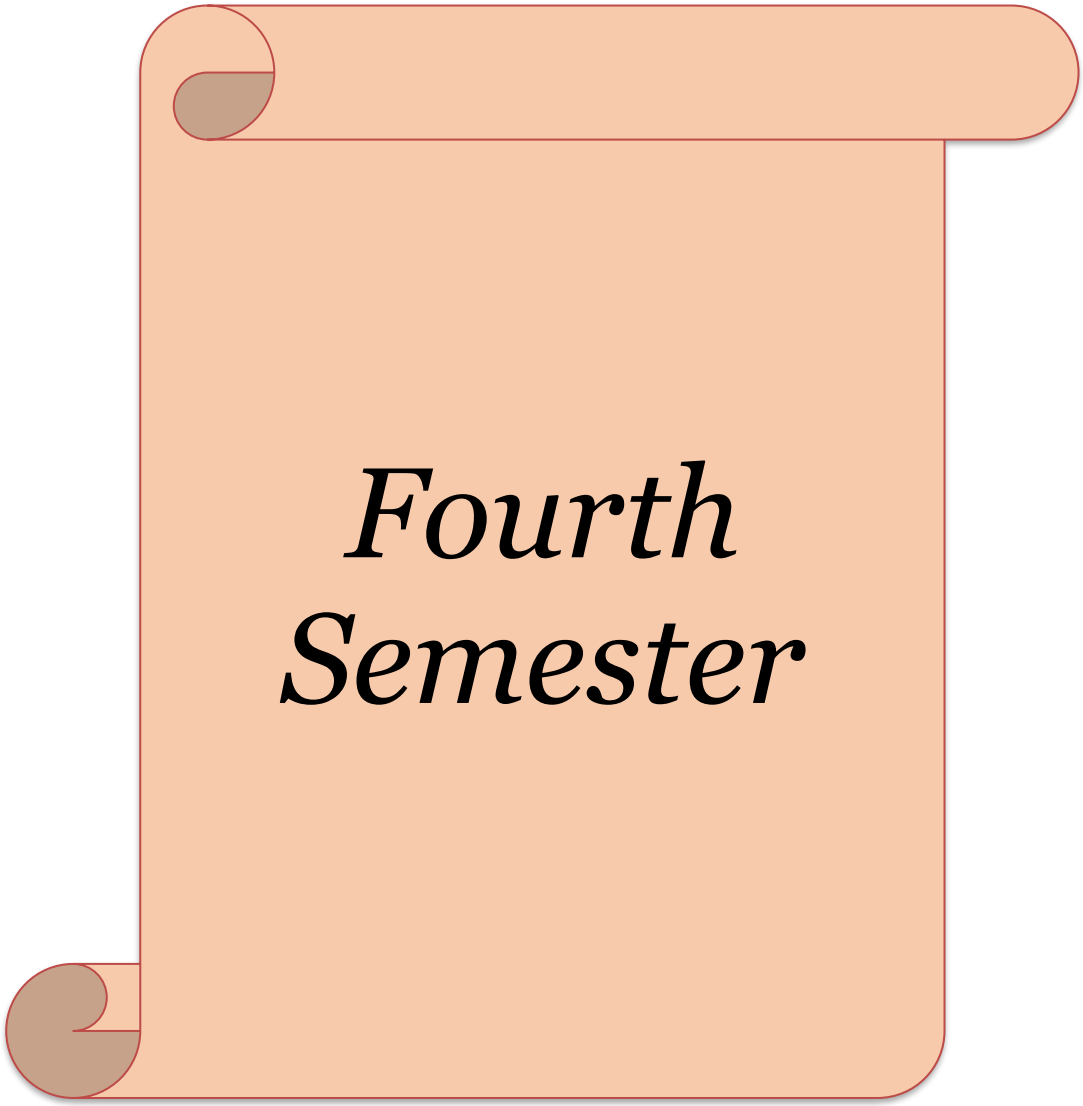
**Expected Course Outcomes:**

**On the successful completion of the course, student will be able to:**

| | | |
|---|---|---|
| CO1 | To discover valuable insights and make informed decisions, solve problems, or optimize processes. | B1,B2 |
| CO2 | To make the data more understandable and accessible using visual representations of data, such as charts, graphs, and dashboards. | B3,B4 |
| CO3 | To generate reports by communicating the results to stakeholders, management, or clients. | B5, B6 |

**B1** - Remember; B**2** - Understand; B**3** - Apply; B**4** - Analyze; B**5** - Evaluate; B**6**– Create

| **UNIT** | **Content** | **CO targeted** |
|---|---|---|
| **1** | Selection of Topic | CO1,CO2, CO3 |
| **2** | Problem Definition (Explanation about Selected Topic) | |
| **3** | Methodology(which Methods You have Used To Take Survey eg. Google Forms, real time Survey ) | |
| **4** | Data Collection (Screenshot Of Google Form.) | |
| **5** | Explanation of All Questions included in Google Form (why you ask this Question) | |
| **6** | Data Analysis/Report (Screenshot of Excel Data, Pie Charts and Graphs) Description about Analysis (Description about what you have analyze for Survey) | |
| **7** | Conclusion | |
| **8** | References | |


Fourth
Semester

**Course Title: - Advanced Python Programming**
**Course Type: Major Mandatory Paper 1(Theory)**
**Course Code: 24DSC24101**
**Semester- IV**

| **Teaching Scheme:** 2 Hours / Week | **No. of Credits:** 2 | **No. of Lectures:** 30 | **Examination Scheme:** CIE: 20 Marks ESE: 30 Marks |
|---|---|---|---|

**Prerequisites: Student should have basic knowledge of:**

- **Basic concepts of python like data types, control statements and function calls**

**The main objectives of this course are to:**

- Master Python basics, including collections, object-oriented programming (OOP) concepts and apply them to create reusable and modular code.
- Handle exceptions and errors, work with files and perform input/output (I/O) operations,
- Develop graphical user interfaces (GUI) using various widgets and events.
- Learn data analysis and handle databases.

## Expected Course Outcomes:

## On the successful completion of the course, student will be able to:

| | | |
|---|---|---|
| CO1 | Develop object-oriented Python code, encapsulating data and behavior in classes and objects. | B1,B2 |
| CO2 | Handle exceptions and errors gracefully to ensure smooth program execution and perform input/output (I/O) operations. | B3,B4 |
| CO3 | Perform data analysis and establish connection between database and python program | B5, B6 |

**B1** - Remember; B**2** - Understand; B**3** - Apply; B**4** - Analyze; B**5** - Evaluate; B**6**– Create

| **UNIT** | **Contents** | **No of Lectures** | **CO targeted** |
|---|---|---|---|
| **1** | **Object-oriented programming concepts**<br>• Class and object<br>• Access modifiers<br>• Abstraction and encapsulation<br>• Inheritance<br>• Polymorphism<br>• Types of Constructors<br>• Operator overloading, Method overloading<br>• Method overriding | 4 | CO1 |
| **2** | **Exception handling**<br>• Simple exceptions<br>• Multiple exceptions<br>• Using else and finally<br>• Raise an exception<br>• Assert statement | 3 | CO2 |
| **3** | **I/O streams and buffers**<br>• Access modes<br>• Exceptions in file<br>• Writing to files and Reading from file<br>• File operations: seek() and tell() methods, readline() and readlines() methods, Renaming and deleting files. | 3 | CO2 |
| **4** | **GUI in Python**<br>• Components and events<br>• Widgets, Attributes for widgets, Label widget, Button widget, Image button, Entry widget, Combo box widget, Check button widget, Radio button widget, Canvas widget, Frame widget, | 7 | CO3 |

| | | | |
|---|---|---|---|
| | Message box widget, Message widget, Menu widget, Methods, Menu button, Implementation<br>• GUI example | | |
| **5** | **Data Analysis**<br>• Introduction to Pandas<br>• Pandas data structures<br>• Series and DataFrame Data wrangling using pandas<br>• Loading a dataset into a dataframe<br>• Selecting Columns from a dataframe<br>• Selecting Rows from a dataframe<br>• Adding new data in a dataframe<br>• Deleting data from a dataframe | 7 | CO3 |
| **6** | **Database Programming using Python**<br>● Connecting to a database (sqlite) using Python<br>● Sending DML and DDL queries<br>● processing the result from a Python Program | 6 | CO3 |

| **Reference Books** |
|---|
| Python Cookbook, 3rd Edition by David Beazley and Brian K. Jones |
| Python for Data Analysis by Wes McKinney |
| Python GUI Programming Cookbook by Burkhard A. Meier |

**Related Online Content (MOOCS, SWAYAM, NPTEL, WEBSITES etc.)**

**Online Courses:**

- **100-days-of-code The Complete Python Pro Bootcamp**
  **https://www.udemy.com/course/100-days-of-code/?couponCode=24T3MT120924**
- **Python 3 Programming: Beginners to pro Masterclass**
  **https://www.udemy.com/course/python-3-beginner-to-pro/?couponCode=24T3MT120924**

**Course Title: - Regression Analysis**
**Course Type: Major (Theory)**
**Course Code: 24DSC24102**
**Semester- IV**

| **Teaching Scheme: 2 Hours / Week** | **No. of Credits: 2** | **No. of Lectures : 30** | **Examination Scheme: CIE: 20 Marks ESE: 30 Marks** |
|---|---|---|---|

**Prerequisites: Student should have basic knowledge of:**

- Basics of descriptive statistics.
- Prior information about matrices.

**The main objectives of this course are to:**

- Learn how the dependent and independent variables are interrelated with each other.
- Make reliable predictions about the dependent variable.
- Examine the validity and robustness of the regression model

## Expected Course Outcomes:

## On the successful completion of the course, student will be able to:

| | | |
|---|---|---|
| CO1 | Recall the concept of fitting of simple regression models. | B1 |
| CO2 | Understand the necessity of building multiple linear regression and logistic regression models and analyze it. | B2,B4 |
| CO3 | Compare residual diagnostics and apply corrective measures. | B4,B5 |
| CO4 | Determine tests of hypothesis of model parameters, AIC and BIC criteria. | B5 |

**B1** - Remember; B**2** - Understand; B**3** - Apply; B**4** - Analyze; B**5** - Evaluate; B**6**– Create

| **UNIT** | **Contents** | **No of Lectures** | **CO targeted** |
|---|---|---|---|
| **1** | **Simple Linear Regression model**<br>● Review of simple linear regression model : Y = $\beta$0 + $\beta$1X + $\epsilon$,<br>● where $\epsilon$ is continuous random variable with E($\epsilon$) = 0,<br>● V($\epsilon$) = $\sigma$2. Assumptions of simple linear regression.<br>● Estimation of $\beta$0 and $\beta$1, by the method of least squares.<br>● Properties of estimators of $\beta$0, and $\beta$1.<br>● Estimation of $\sigma$2.<br>● Tests of hypothesis of $\beta$1.<br>● Interval estimation in a simple linear regression model.<br>● Coefficient of determination.<br>● Interpretation of three plots produced by lm command in R | **6** | CO1,CO4 |

| | | | |
|---|---|---|---|
| **2** | **Multiple Linear Regression Model**<br>● Review of multiple linear regression model<br>● Y = $\beta$0 + $\beta$1X1+ … +$\beta$pXp + $\epsilon$, where $\epsilon$ is a continuous<br>● random variable with E ($\epsilon$) = 0, V($\epsilon$) = $\sigma$2. Assumptions of multiple linear regression.<br>● Estimation of regression parameters$\beta$0, $\beta$1, … and $\beta$p by the method of least squares, obtaining normal equations, solutions of normal equations.<br>● Test for significance of regressors, tests of hypothesis of regression parameters.<br>● Interval estimation in regression model.<br>● Interpretation of three plots produced by lm command in R. | **6** | CO2,CO4 |
| **3** | **Regression Diagnostics and model Building Strategies**<br>● Residual Analysis: Residual and its scaling, Residual plots, partial regression and partial residual plots<br>● Diagnostic checks and correction: graphical techniques, tests for normality (Shapiro test), uncorrelatedness, homoscedasticity; Criteria for model adequacy: R2, adjusted R2, Mallow's Cp etc.<br>● Outlier, leverage points, influential points, PRESS statistic, Cook's D statistic.<br>● Multicolinearity: consequences, tools for detection and remedies. | **12** | CO3,CO4 |
| **4** | **Logistic Regression Model**<br>● Binary response variable<br>● Logit transformation<br>● Estimation of parameters<br>● Interpretation of parameters<br>● Tests of hypotheses of model parameters, model deviance,<br>● Test based on likelihood ratios(LR). AIC and BIC criteria for model selection.<br>● Interpretation of output produced by glm command in R.<br>● Introduction to Multiple logistic regression | **6** | CO2 and CO4 |

**Books Recommended:**

| **Reference Books** |
|---|
| Applied Regression analysis,Draper, N. R. and Smith, H. (1998),(John Wiley) Third Edition. |
| Introduction to Linear Regression,Montgomery, D. C., Peck, E. A. and Vining, G.G. (2003).,Wiley |
| Applied Linear Statistical Models,Neter, J., W., Kutner,M. H. ;Nachtsheim, C.J. and Wasserman, W. (1996),fourth edition.,Irwin USA |
| Regression Analysis by Example,Chatterjee S. and Hadi A.S.(2012),5thEdition,Wiley. |
| Logistic Regression,Kleinbaum G. and Klein M. (2011),Third Edition |

**Course Title: - Practical on Calculus & Regression Analysis**
**Course Type: Major Mandatory Paper 1(Theory)**
**Course Code: 24DSC24103**
**Semester- IV**

| **Teaching Scheme:** | **No. of Credits:** | **No. of Lectures:** | **Examination Scheme:** |
|---|---|---|---|
| **2 Hours / Week** | **2** | **30** | **CIE: 20 Marks ESE: 30 Marks** |

**Prerequisites: Student should have basic knowledge of:**

- Regression analysis
- R software

**The main objectives of this course are to:**

To introduce the student to the most commonly used statistical technique for model building and forecasting .

**Expected Course Outcomes:**

**On the successful completion of the course, student will be able to:**

| | | |
|---|---|---|
| CO1 | Recall the concept of fitting of simple,multiple and logistics regression model | B1,B2 |
| CO2 | Compare residual diagnostics and apply corrective measures | B3,B4 |
| CO3 | will learn basic concepts of calculus | B5, B6 |

**B1** - Remember; B**2** - Understand; B**3** - Apply; B**4** - Analyze; B**5** - Evaluate; B**6**– Create

| **UNIT** | **Contents** | **No of Practicals** | **CO targeted** |
|---|---|---|---|
| **1** | Simple linear regression analysis by using R software | 1 | CO1 |
| **2** | Multiple linear regression analysis by using R software | 1 | CO1 |
| **3** | Simple logistic regression | 1 | CO1 |
| **4** | Multiple logistic regression | 1 | CO1 |
| **5** | Detection of outliers | 1 | CO2 |
| **6** | Regression diagnosis by using R software | 1 | CO2 |
| **7** | Model Building Strategies using R software | 1 | CO2 |
| **8** | Transformation and weighting to correct model inadequacies. | 1 | CO2 |
| **9** | Limits | 1 | CO3 |
| **10** | Continuity | 1 | |
| **11** | Differentiability , L' Hospital's Rule | 1 | |
| **12** | Successive Differentiation | 1 | |
| **13,14** | Application of derivative | 2 | |
| **15** | Miscellaneous | 1 | |

**Text Books**

Calculus of a single variable Ron Larson , Bruce Edwards, tenth edition.

| Course Title: - Actuarial Statistics<br>Course Type: Major Mandatory Paper 1(Theory)<br>Course Code: 24DSC24201<br>Semester- IV | | | |
|---|---|---|---|
| **Teaching Scheme: 2 Hours / Week** | **No. of Credits: 2** | **No. of Lectures: 30** | **Examination Scheme: CIE: 20 Marks ESE: 30 Marks** |

**Prerequisites: Student should have basic knowledge of:**

- Probability
- Survival Models
- Basic Mathematics

**The main objectives of this course are to:**

- To use statistical and analytical skills to solve business problems

**Expected Course Outcomes:**

**On the successful completion of the course, student will be able to:**

| | | |
|---|---|---|
| **CO1** | Recall the concepts of financial mathematics and probability theory, Construct life tables for different age groups of people. | **B1,B2** |
| **CO2** | Computing premiums, interest rates and other financial indices | **B3,B4** |
| **CO3** | Compare statistical distributions of life length random variables on the basis of survival curves and the force of mortality curves. | **B5, B6** |

**B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6– Create**

| UNIT | Contents | No of Lectures | CO targeted |
|---|---|---|---|
| **1** | **Introduction to Actuarial Science**<br>● Insurance companies as business organizations.<br>● Role of insurance business in Economy.<br>● Concept of risk and their type<br>● Introduction of terms: premium, policy, policyholder.<br>● Role of Statistics in insurance business.<br>● Roles of actuaries in insurance and finance | **2** | **CO1** |
| **2** | **Survival Distribution and Life Tables**<br>● Time- until death random variable, its distribution function and survival function in actuarial notation.<br>● Force of mortality. Curtate future life random variable, its probability mass function and survival function in actuarial notation.<br>● Construction of life table using random survivorship approach | **9** | **CO1** |

| | | | |
|---|---|---|---|
| **3** | **Models for Life Insurance**<br>● Introduction of simple and compound interest rate policy<br>● Different types of Interest rates. Insurance payable at the end of the year death, present value random variable, actuarial present value.<br>● Derivation of actuarial present value for n-year term life insurance, whole life insurance and n-year endowment insurance | **9** | **CO1, CO3** |
| **4** | **Annuities**<br>● Annuities – certain, annuity due, annuity immediate<br>● Discrete life annuities: n-year temporary life annuity due and a whole life annuity due, present value random variables of the payment, and their actuarial present values.<br>● Interrelations between life annuity due and immediate cases. | **5** | **CO2,CO 3** |
| **5** | **Benefit Premiums**<br>● Concept of a loss random variable. Computation of fully discrete premium for n-year term life insurance, whole life insurance and endowment insurance.<br>● Principle to calculate premiums: Equivalence principle,Percentile principle,Exponential principle. | **5** | **CO2** |

| **Text Books** |
|---|
| Actuarial Statistics , Pravin R Waldhe , Nirali Prakashan |

| **Reference Books** |
|---|
| Actuarial Mathematics,Bowers N.L. Jr., H.S.Gerber, J.C. Hickan, D.A.Jones, C.J.Nesbitt, (1997).,Society of Actuaries, U.S. |
| Actuarial Statistics,Deshmukh, S. R. (2009),Universities Press,Hyderabad |

| **Related Online Content (MOOCS, SWAYAM, NPTEL, WEBSITES etc.)** |
|---|
| **Online** **https://www.mooc-list.com/course/actuarial-science-financial-math-actuaries-part-1-edx** |

**Course Title: - Practical on Actuarial Statistics**
**Course Type: Major Mandatory Paper 1(Theory)**
**Course Code: 24DSC24202**
**Semester- IV**

| Teaching Scheme: 2 Hours / Week | No. of Credits: 2 | No. of Lectures: 30 | Examination Scheme: CIE: 20 Marks ESE: 30 Marks |
|---|---|---|---|

**Prerequisites: Student should have basic knowledge of:**

- Probability and probability model
- Survival functions
- Finance

**The main objectives of this course are to:**

To learn statistical methods, like probability theory and statistical modelling and analysis, and applies these to real world problems to forecast the likelihood of certain events.

**Expected Course Outcomes:**

**On the successful completion of the course, student will be able to:**

| | | |
|---|---|---|
| **CO1** | Recall the concepts of financial mathematics and probability theory, Construct life tables for different age groups of people. | **B1,B2** |
| **CO2** | Computing premiums, interest rates and other financial indices | **B3,B4** |
| **CO3** | Compare statistical distributions of life length random variables on the basis of survival curves and the force of mortality curves. | **B5, B6** |

**B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6– Create**

| UNIT | Contents | No of Practicals | CO targeted |
|---|---|---|---|
| 1 | Calculation of effective rate of interest, rate of discount, force of interest and discounted value. | 2 | CO1 |
| 2 | Force of mortality for various distributions and its graphs | 2 | CO1 |
| 3 | Construction of life table | 2 | CO1,CO2 |
| 4 | Computation of Present value, accumulated value | 2 | CO2 |
| 5 | Calculation of actuarial present values for n-year term life insurance, whole life insurance and n-year endowment insurance | 2 | CO2,CO3 |
| 6 | Calculation of actuarial present values for n-year temporary life annuity due and a whole life annuity due | 2 | CO2,CO3 |
| 7 | Calculation of fully discrete premium for n-year term life insurance, whole life insurance and endowment insurance. | 2 | CO2,CO3 |
| 8 | Case study on actuarial data | 2 | CO1,CO2,CO3 |

| Text Books |
| --- |
| Actuarial Statistics , Pravin R Waldhe , Nirali Prakashan |

| Reference Books |
| --- |
| Actuarial Mathematics,Bowers N.L. Jr., H.S.Gerber, J.C. Hickan, D.A.Jones, C.J.Nesbitt, (1997).,Society of Actuaries, U.S. |
| Actuarial Statistics,Deshmukh, S. R. (2009),Universities Press,Hyderabad |

**Course Title: - Calculus**
**Course Type: Major Mandatory Paper 1(Theory)**
**Course Code: 24DSC24401**
**Semester- IV**

| Teaching Scheme: 2 Hours / Week | No. of Credits: 2 | No. of Lectures: 30 | Examination Scheme: CIE: 20 Marks ESE: 30 Marks |
|---|---|---|---|

**Prerequisites: Student should have basic knowledge of:**
Sets, Functions and its properties

**The main objectives of this course are to:**

- Understand and explore the basics of calculus.
- To apply theorems in solving practical problems.
- To develop strong foundation for professional growth and lifelong learning in Mathematics.

**Expected Course Outcomes:**

**On the successful completion of the course, student will be able to:**

| | | |
|---|---|---|
| **CO1** | Students will learn one variable differential calculus | **B1,B2** |
| **CO2** | Students will be able to demonstrate algorithms used in interdisciplinary areas. | **B3,B4** |
| **CO3** | Students will be able to evaluate or synthesize any real-world applications using derivatives. | **B5, B6** |

**B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6– Create**

| UNIT | Contents | No of Lectures | CO targeted |
|---|---|---|---|
| **1** | **Limits,Continuity and Differentiability of one variable function**<br>● Limits<br>● Continuity and Properties of continuous functions defined on [a, b] (Without proof) and examples.<br>● Differentiability , L' Hospital's Rule (without proof) | 15 | B1,B2 |
| **2** | **Successive Differentiation**<br>● The nth derivatives of standard functions.<br>● Leibnitz's Theorem (with proof). | 5 | B3,B4 |
| **3** | **Taylor's and Maclaurin's Theorems**<br>● Taylor's and Maclaurin's Theorems without proof).<br>● Taylor's and Maclaurin's Series. | 5 | B5, B6 |
| **4** | **Application of derivative**<br>● Finding Maxima and minima of one variable and two variable functions | 5 | B5, B6 |

**Text Books**

Calculus: Gilbert Strang , Wellesley Cambridge Press

**Reference Books**

Calculus of a single variable Ron Larson , Bruce Edwards, tenth edition.

| Course Title: - Community Engagement and Services<br>Course Type: 24DSC24601<br>Course Code:<br>Semester- IV | | | |
|---|---|---|---|
| **Teaching Scheme:**<br>**2 Hours / Week** | **No. of Credits:**<br>**2** | **No. of Lectures: 30** | **Examination Scheme:**<br>**CIE: 20 Marks ESE: 30 Marks** |

**Course Objectives:**

After successfully completing this course, students will be able to :

- Build partnerships with community leaders, organizations, and residents to co-create solutions that address identified issues.
- Learn about the different ways to work with communities and why community engagement is important

| UNIT | List of Activities |
|---|---|
| **1** | River Cleaning Activity(Clean areas near by River) |
| **2** | Orphanage Engagement:(Host storytelling, sports days, or art workshops for children in orphanages.) |
| **3** | Computer Literacy Camp in Rural by Areas |
| **4** | Cyber Security Awareness (Aware People about cyber crime and teach people how to avoid ) |
| **5** | Blood Donation Camp (Collaborate with local hospitals or Red Cross to organize drives.) |
| **6** | Tree Plantation (Collaborate with local authorities to plant trees in urban and rural areas) |
| **7** | Recycling Programs (Start campaigns to teach proper waste segregation and recycling) |
| **8** | Clean-Up Drives (Start campaigns to teach proper waste segregation and recycling.) |
| **9** | Women's Empowerment: Offer skill training workshops (tailoring, baking, coding) for women to become self-reliant. |
| **10** | Food Distribution: Cook and distribute meals to homeless people or struggling families. |