Affiliated to the
UNIVERSITY OF MUMBAI

Program: B.Sc.-Applied Statistics and Data Analytics (Hons.)

F. Y. B. Sc.

Semester I & II

Choice Based Credit System (CBCS) with effect from the Academic year 2021-22

A.C. No: *11*

Agenda No: *3(ii)*

PROGRAMME SPECIFIC OUTCOMES (PSO'S)

On completion of the B.Sc. in Applied Statistics & Data Analytics the learners should be enriched with knowledge and be able to-

PSO1: <u>Acquire:</u>
   (i) Fundamental/systematic or coherent understanding of the academic field of Statistics and its different learning areas and applications;
   (ii) procedural knowledge that creates different types of professionals related to subject area of Statistics, including professionals engaged in government/public service and private sectors;
   (iii) skills in areas related to one's specialization area within the disciplinary/subject area of Statistics and emerging developments in the field of Statistics.

PSO2: <u>Demonstrate</u> the ability to use skills in Statistics and different practicing areas for formulating and tackling Statistics related problems and identifying and applying appropriate principles and methodologies to solve a wide range of problems associated with Statistics.

PSO3: <u>Recognize</u> the importance of statistical modeling and computing, and the role of approximation and mathematical approaches to analyze the real problems using various Statistical tools.

PSO4: <u>Plan and execute</u> Statistical experiments or investigations, analyze and interpret data/information collected using appropriate methods, including the use of appropriate statistical software including programming languages, and report accurately the findings of the experiment/investigations.

PSO5: <u>Demonstrate</u> relevant generic skills and global competencies such as
   (i) problem-solving skills that are required to solve different types of Statistics related problems with well-defined solutions, and tackle open-ended problems that belong to the disciplinary-area boundaries;
   (ii) investigative skills, including skills of independent thinking of Statistics-related issues and problems

PSO6: <u>Demonstrate</u> professional behavior such as
   (i) being objective, unbiased and truthful in all aspects of work and avoiding unethical, irrational behavior such as fabricating, falsifying or misrepresenting data or committing plagiarism;
   (ii) the ability to identify the potential ethical issues in work-related situations.
   (iii) communication skills involving the ability to listen carefully, to read texts and reference material analytically and to present information in a concise manner to different groups/audiences of technical or popular nature;

   (iv) analytical skills involving paying attention to detail and ability to construct logical

arguments using correct technical language related to Statistics and ability to translate them with popular language when needed;

(v)   ICT skills;

(vi)   personal skills such as the ability to work both independently and in a group.

Preamble

Credit Based Semester & Grading System (CBSGS) with continuous evaluation consisting of components of Internal Assessment & External Assessment was introduced by Mumbai University from the academic year 2011-12.

Mithibai College being granted the autonomous status for 10 years up to 2027-28.

The semester pattern for academic transactions and the Choice Based Credit system is followed for assessment. Continuous assessment is an integral part of the credit system. This will help students learn the subject systematically and thoroughly.

We live in a very complicated world. Data gets generated from various activities that we undertake. Very few issues are clear-cut and without controversy. In order to understand and form an opinion about the nature we need to gather information, or data. To make the best use of data, one must have some knowledge of Statistics. Statistics is basically the art of learning from data.

For the last two decades, large amount of data has been handled with the help of computers and more sophisticated statistical techniques can be used in an effective manner to draw valid conclusions. Knowledge of different aspects of Statistics has become crucial in the present scenario. There is a continuous demand for statisticians in fields of education, industry, medicine, pharmacology, software and research and so on. The syllabi of three-year B.Sc. degree course in Statistics are framed in such a way that the students at the end of the course, can be thorough in statistical techniques for pursuing higher studies and simultaneously can apply statistical tools judiciously to a variety of data sets to arrive at some valid conclusions.

Statistical concepts and techniques will be taught to students so that they not only know how and when to use the statistical procedures but also to understand why these procedures should be used. Efforts will be taken to explain the ideas behind the statistical concepts and techniques. Concepts are motivated, illustrated, and explained in a way that attempts to increase one's intuition. It is only when a student develops a feel or intuition for statistics that she or he is really on the path toward making sense of data. To illustrate the diverse applications of statistics and to offer students different perspectives about the use of statistics, a wide variety of examples and problems from different reference books will be worked by students.

Along with the knowledge of Statistics the learner will also need the knowledge of Mathematics. The knowledge of Discrete Mathematics and Real Analysis will be a great help to the students to under the concepts of theoretical Statistics.

To learn the applications of Statistics student should have required knowledge of computer programing and applications. The students will complete two such required courses based on computer applications.

The courses are as follows: -

Semester I : USMAAS101 :   Descriptive Statistics 1
USMAAS102 :   Probability and Probability Distributions 1
USMAAS103 :   Discrete Mathematics 1
USMAAS104 :   Real Analysis 1
USMAAS105 :   Computer Arithmetic and DBMS MYSQL
USMAAS106 :   Algorithms and C Programming
USMAAS107 :   Environmental Studies.

Semester II : USMAAS201 :   Descriptive Statistics 2
USMAAS202 :   Probability Distributions 2
USMAAS203 :   Discrete Mathematics 2
USMAAS204 :   Real Analysis 2
USMAAS205 :   Data Analysis using Excel
USMAAS206 :   Introduction to R software.
USMAAS207 :   Soft Skills.

I profusely thank all the committee members for their efforts in drafting the syllabus.

N.B.- (i)   The duration of each theory lecture will be of 60 minutes. A course consists of 3 units. For each unit the number of hours allotted are 12. The total number of lecture hours for each course will thus be 36.

(ii)   There will be one practical per batch for each course. The duration of each practical will be of 2 hours, i.e. of 120 minutes.
For practical component the value of One Credit is equal to 30 learning hours.

(iii)   Thus in a week, a student will study 3 hours of theory and 2 hours of practical's.

Evaluation Pattern for theory papers

The performance of the learner will be evaluated in two components. The first component will be a Continuous Assessment with a weightage of 25% of total marks per course. The second component will be a Semester end Examination with a weightage of 75% of the total marks per course. The allocation of marks for the Continuous Assessment and Semester end Examinations is as shown below:

a) Details of Continuous Assessment (CA)

25% of the total marks per course:

Continuous Assessment	Details	Marks
Component 1 (CA-1)	Test /Assignment.	15 marks
Component 2 (CA-2)	Test / Assignment / Project.	10 marks

b) Details of Semester End Examination

75% of the total marks per course. Duration of examination will be two and half hours.

Question Number	Description	Marks	Total Marks
Q1 to Q3	Attempt any two sub questions out of Three sub questions. A sub question may be further divided into 2 or more sub questions.	10	20 Marks 20 x 3 = 60 Marks
Q4	Attempt any three sub questions (out of Five sub questions)	5	15
		Total Marks	75

Evaluation Pattern for practical papers

In the Practical Exams, there will be 20% assessment for journal and laboratory work and 80% as term end component to be conducted as a semester end exam per course. For each course there will be one examiner per batch who will assess the practical examination answerbooks.

Signature
HOD

Signature
Approved by Vice –Principal

Signature
Approved by Principal

Program: B.Sc.- Applied Statistics And Data Analytics (Hons.)				Semester : I	
Course: Descriptive Statistics 1				Course Code: USMAAS101	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment and Evaluation (CAE) (Marks - 25)	Term End Examinations (TEE) (Marks-75 in Question Paper)
03	02	-	3+1 = 4	25	75

Learning Objectives:
- To Define and use the basic terminology used in Statistics.
- To Analyze and compare different sets of data
- To Classify the data by means of diagrams and graphs.
- To learn the measures of central tendency and dispersion.
- Explain the statistical concepts of central tendency, dispersion. skewness, Kurtosis.
- Describe the data graphically using a scatter plot.
- Explain the concepts of correlation, regression and the coefficient of determination.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Differentiate between terms used in statistics.

CO2: Apply various types of sampling methods to data collection.

CO3: Create and interpret frequency tables.

CO4: Display data graphically and interpret graphs: stem plots, histograms, and box plots.

CO5: Describe, and calculate the measures of location of data: quartiles and percentiles describe, and calculate the measures of the center of data: mean, median, and mode.

CO6: Describe, and calculate the measures of the spread of data: variance, standard deviation, and range.

CO7: From a scatterplot, the learner will classify the trend as being increasing, decreasing, or non-existent; determine strong or weak association, and indicate its shape; students can recognize if r is positive or negative and give an approximate value for r. For two scatterplots, he will be to compare them in context, concerning trend, strength of the association, and shape outliers.

CO8: To understand that a perfect correlation is given by −1 or 1. Use the formulae to compute the appropriate correlation coefficient Calculate the correlation coefficient for bivariate frequency data.

CO9: Identify the independent variable (predictor) and the (response) dependent variable, Use a given linear regression equation to predict a value of the output variable, given an input value, interpret the slope and intercept.

CO10: Understand the coefficient of determination as measure of how well the data fits to the model and its interpretation.

Outline of Syllabus: (per session plan)

Module	Description	No of hours
1	Classification of Data and Measures of Central Tendency.	15
2	Measures of Dispersion, Skewness & Kurtosis.	15
3	Correlation and Regression.	15
	Total	**45**
PRACTICALS		**30**

Module	Descriptive Statistics 1	No. of Hours/Credits 45/3
1	**Classification of Data and Measures of Central Tendency**	**15**
	Concepts of a statistical population and sample from a population; qualitative and quantitative data; nominal and ordinal data; cross sectional and time series data; discrete and continuous data; frequency and non-frequency data. Different types of scales - nominal, ordinal, ratio and interval.	3
	Collection and Scrutiny of Data: Primary data, designing a questionnaire and a schedule; checking their consistency. Secondary data, its major sources including some government publications. Complete enumeration, controlled experiments, observational studies and sample surveys. Scrutiny of data for internal consistency and detection of errors of recording. Ideas of cross-validation.	3
	Various measures of association for two and three-way classified data. Odds ratio. Analysis of Quantitative Data:	3
	Univariate data - Concepts of central t e n d e n c y or location, and their measures including those based on quantiles and moments.	6
2	**Measures of Dispersion, Skewness & Kurtosis.**	**15**
	Concept of dispersion and its measures absolute as well as relative. Range, semi-inter quartile range, Mean absolute deviation, Variance, standard deviation, combined standard deviation (with proof) and their relative measures of dispersion. Box Whisker Plot.	5
	Raw and Central moments up to fourth order, Proofs of the relationships between them.	5
	Concept of Skewness and Kurtosis and their measures based on moments and quartiles. Karl Pearson's and Bowley's coefficients. Their applications. Sheppard's corrections for moments for grouped data (without derivation).	**5**
3	**Correlation and Regression.**	**15**
	Bivariate Data: Scatter diagram. Product - moment correlation coefficient and its properties. Coefficient of determination. Correlation ratio.	5
	Rank Correlation - Spearman's and Kendall's measures.	2
	Curve Fitting: Principle of least squares, Fitting of curves reducible to polynomials by transformation to linear form.	3
	Regression concepts, Concepts of error in regression. Fitting of linear regression and related results. Coefficient of determination.	5

PRACTICALS	
Sr. No.	**Topic.**
1	Diagrammatic Representation of Data.
2	Graphical Representation of Data: frequency and cumulative frequency distribution, frequency polygon, Ogives.
3	Histogram, Dot plot, Stem and Leaf diagram.
4	Classification and Tabulation.
5	Measures of Central tendency. Mean, Median and Mode.
6	Measures of Central tendency. Quartiles. Deciles, Percentiles & Quantiles
7	Measures of Dispersion. Range, Quartile Deviation, Absolute Deviation, Box Plot.
8	Measures of Dispersion: Standard deviation, Variance, Combined variance, Missing Observations.
9	Measures of Central Tendency and Dispersion: Missing observations
10	Correlation
11	Curve Fitting
12	Regression

RECOMMENDED READING:

Text Books:
1. Prem S. Mann, Introductory Statistics, 9th edition, Wiley plus. July 2018
2. Hogg R.V. and Tannis E.P., Probability and Statistical Inference, McMillan Publishing Co.
3. Jay L. Devore, Probability and Statistics for Engineers and the Sciences, 9th edition, Cengage Learning.

Reference Books
1. S. M. Ross Sheldon, Introductory Statistics.4th edition, Academic Press.
2. Statistics - An Introduction, Roger Kirk, 5th edition, Thompson Wadsworth.
3. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams - Statistics for Business & Economics-Cengage (2019).
4. Ken Black, Business Statistics for Contemporary Decision making, 9th edition, Wiley plus.
5. Roxy Peck, Jay L. Devore, Statistics: The Exploration & Analysis of Data, 7th edition, Cengage Learning.
6. Statistics for Management, Masood Husain Siddiqui, Richard I. Levin, David S. Rubin, Sanjay Rastogi, 8th edition, Pearson.
7. Jay L. Devore, Kenneth N. Berk (auth.) - Modern Mathematical Statistics with Applications, 2nd edition, Springer-Verlag, New York (2012).

Program: B.Sc.- Applied Statistics And Data Analytics (Hons.)	Semester : I
Course: Probability & Probability Distributions 1	Course Code: USMAAS102

Teaching Scheme				Evaluation Scheme	
Lecture (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment and Evaluation (CAE) (Marks - 25)	Term End Examinations (TEE) (Marks-75 in Question Paper)
03	02	-	3+1 = 4	25	75

Learning Objectives:

- To make the learner understand the meaning of probability and probabilistic experiments and to familiarize him/her with the approached to probability including the axiomatic approach.
- To make use of Venn diagrams to represent set operations.
- To make the learner understand what is reduced sample space and conditional probability.
- To make the learner understand the concept of random variables both discrete as well as continuous.
- To make the learner distinguish between independent and dependent random variables.
- To make the learner represent the probability mass functions and probability density functions.
- To compute the cumulative distribution function and its use in computing the probabilities.
- To equip the learner with the concepts and results of various discrete distributions and their use in real life situations.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Compute probabilities under different probabilistic situations, Know the laws of union, intersection and complement of events.

CO2: Compute the conditional probabilities

CO3: Compute the posterior probabilities using Bayes theorem.

CO4: To compute the mean, variance raw and central moments for discrete and continuous r.v'.s.

CO5: To know the nature and shape of a distribution using the concept of skewness and kurtosis.

CO6: To compute various measures for distribution in general.

CO7: Define and identify Uniform, Bernoulli, Binomial, Poisson, Hyper geometric, Geometric, Negative Binomial random variables.

CO8: Be able to compute the mean, variance and raw and central moments of the above r.v.'s.

CO9: Solve problems involving the above r.v.'s.

CO10: Learner how to fit a given data to an appropriate standard discrete distribution.

Outline of Syllabus: (per session plan)

Module	Description	No of hours
1	Probability	15
2	Random Variables	15
3	Standard Discrete Distributions I	15
	Total	**45**
PRACTICALS		**30**

Module	Probability & Probability Distributions 1	No. of Hours/Credits 45/3
1	Probability	**15**
	Probability Concepts: Random Experiment: Trial, sample point and sample space, definition of an event, operation of events, mutually exclusive and exhaustive events. Definitions of probability-classical and relative frequency approach to probability, Richard Von Mises, Cramer and Kolmogorov's approaches to probability, merits and demerits of these approaches, only general ideas to be given).	5
	Discrete sample space, properties of probability based on axiomatic approach, Addition theorem of probability, conditional probability, independence of events, multiplication theorem, conditional probability, independence of events, pairwise independence of events.	6
	Bayes' theorem and its applications.	4
2	Random Variables	**15**
	Definition of discrete and continuous random variables - probability mass function, distribution functions and probability density functions and their properties.	5
	Mathematical Expectation of the random variable and its properties.	10
3	Standard Discrete Distributions I	**15**
	Standard Univariate Discrete Distributions and their properties: Discrete Uniform, Hyper geometric, Bernoulli, Binomial, Poisson, Geometric and Negative Binomial distributions.	4 4 4
	Derivations of the different generating functions, mean, variance, Recurrence relations., skewness and kurtosis wherever possible.	
	Approximation of Hypergeometric to Binomial and Binomial to Poisson.	3

PRACTICALS	
Sr. No.	Topic.
1	Probability: Basic.
2	Probability: Conditional and Independence.
3	Probability: Bayes Theorem.
4	Random variables: p.m.f's, c.d.f's.
5	Random variables: Expectation and Variance. Properties.
6	Uniform and Hypergeometric distributions.

7	Bernoulli and Binomial Distributions.
8	Poisson Distributions.
9	Geometric and Negative Binomial distributions.
10	Fitting of Distributions.

RECOMMENDED READING:

Text Books:
1. Prem S. Mann, Introductory Statistics, 9th edition, Wiley plus. July 2018
2. Hogg R.V. and Tannis E.P., Probability and Statistical Inference, McMillan Publishing Co.
3. Jay L. Devore, Probability and Statistics for Engineers and the Sciences, 9th edition, Cengage Learning.

Reference Books
1. S. M. Ross Sheldon, Introductory Statistics.4th edition, Academic Press.
2. Statistics - An Introduction, Roger Kirk, 5th edition, Thompson Wadsworth.
3. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams - Statistics for Business & Economics-Cengage (2019).
4. Ken Black, Business Statistics for Contemporary Decision making, 9th edition, Wiley plus.
5. Roxy Peck, Jay L. Devore, Statistics: The Exploration & Analysis of Data, 7th edition, Cengage Learning.
6. Statistics for Management, Masood Husain Siddiqui, Richard I. Levin, David S. Rubin, Sanjay Rastogi, 8th edition, Pearson.
7. Jay L. Devore, Kenneth N. Berk (auth.) - Modern Mathematical Statistics with Applications, 2nd edition, Springer-Verlag, New York (2012).

Program: B.Sc.- Applied Statistics And Data Analytics (Hons.)				Semester : I	
Course: Discrete Mathematics 1				**Course Code: USMAAS103**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment and Evaluation (CAE) (Marks - 25)**	**Term End Examinations (TEE) (Marks-75 in Question Paper)**
03	02	-	3+1 = 4	25	75

Learning Objectives:

- To introduce the learner to the ideas and techniques from discrete mathematics.
- To make the learner think logically and mathematically and apply these techniques in solving problems.
- To expose the learners to mathematical reasoning, combinatorial analyses, discrete structures and algorithmic thinking.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Complete and use truth tables for expressions involving the following logical connectives: negation, conjunction, disjunction, conditional, bi-conditional.

CO2: Define and use the terms: proposition (statement), converse, inverse, contrapositive, tautology, and contradiction.

CO3: Apply standard logical equivalences and check whether two logical expressions are logically equivalent.

CO4: Determine if a logical argument is valid or invalid. Apply standard rules of inference including (but not limited to) Modus Ponens, Modus Tollens, Transitivity, and Elimination. Recognize fallacies such as the Converse Error and the Inverse Error.

CO5: Solve counting problems involving the multiplication rule, permutations, and combinations (with and without replacement). Use standard notation.

CO6: Apply the Addition Rule and the Principle of Inclusion and Exclusion; Make use of Pascal's formula and Pascal's Triangle, the Binomial Theorem, the Pigeonhole Principle.

CO7: State the Principle of Mathematical Induction. Construct induction proofs involving summations, inequalities, and divisibility arguments.

CO8: Use set notation, including the notations for subsets, unions, intersections, differences, complements, cross (Cartesian) products, and power sets.

CO9: Understand and use the terms cardinality, finite, countably infinite, and uncountably infinite, and determine which of these characteristics is associated with a given set

CO10: Define and use the terms function, domain, codomain, range, image, inverse image (preimage), and composition.

CO11: Define one-to-one functions (injections), onto functions (surjections), and one-to-one correspondences (bijections); Be able to find the inverse of an invertible function.

CO12: Explain the connection between cardinality of sets and one-to-one correspondences, and be able to prove that two sets have the same cardinality.

CO13: Define binary relation, reflexive, symmetric, transitive, equivalence relation, equivalence class, class representative, and partition.

CO14: Show that a binary relation on a set is an equivalence relation, give a counterexample.

CO15: To find the equivalence classes of the relation, given an equivalence relation on a set and show that they form a partition of the set.

CO16: Define partial orderings, technique for proving results of well-ordered sets, in particular ; lexicographic order.

Outline of Syllabus: (per session plan)		
Module	Description	No of hours
1	Logic and Counting	15
2	Advanced Counting Techniques.	15
3	Sets, Functions and Relations .	15
	Total	**45**
PRACTICALS		**30**

Module	Discrete Mathematics 1	No. of Hours/Credits 45/3
1	Logic and Counting	**15**
	Logic, Propositional Equivalences, Predicates and Quantifiers, nested Quantifiers, Methods of proof. The basics of counting, Permutations, Combinations, Pigeon Hole Principle, Generalized permutations and combinations, Generating Permutation and combinations.	5 5 5
2	Advanced Counting Techniques.	**15**
	Derangement's, Recurrence Relations and their solution, Divide and Conquer Algorithm and Recurrence Relations, Generating functions, Inclusion-Exclusion principle and it applications	5 5 5
3	Sets, Functions and Relations .	**15**
	Sets, Set Operations, Functions, Relations, their properties, n-ary Relations and their applications, Closure of relations and Equivalence Relations, Partial Ordering , Lexicographic order.	5 5 5

PRACTICALS	
Sr. No.	Topic.
1	Logic, Propositional Equivalences

2	Predicates, Quantifiers, Nested Quantifiers
3	Counting , Permutations, Combinations, Pigeon Hole Principle
4	Generalized permutations and combinations, Generating Permutation and combinations.
5	Derangement's, Recurrence Relations
6	Divide and Conquer Algorithm
7	Generating functions
8	Relations
9	Closure of Relations
10	Equivalence Relations

Suggested Readings:

Text Books:
1.   Kenneth Rosen, Discrete Mathematics and Its Applications with Combinatorics and Graph Theory (SIE) 8th Edition.

Reference Books
1.   Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics With Graph Theory, 3rd Edition.
2.   Bernard Kolman, Robert Busby, Sharon C. Ross. , Discrete Mathematical Structures [6 ed.] Pearson, Prentice Hall.

Program: B.Sc.- Applied Statistics And Data Analytics (Hons.)				Semester : I	
Course: Real Analysis 1				Course Code: USMAAS104	
Teaching Scheme				Evaluation Scheme	
Lecture (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment and Evaluation (CAE) (Marks - 25)	Term End Examinations (TEE) (Marks-75 in Question Paper)
03	02	-	3+1 = 4	25	75

Learning Objectives:

- To make the learner understand the basic properties of real number system which will used later in development of real analysis theory.
- Develop the logical thinking while solving the basic results of real analysis.
- To make the learner solve the problems of convergence and divergence of sequences and series.
- To develop an understanding of limits and functions in an abstract way and to show how they can be used in sequences, series, differentiation and integration.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Understand the many properties of the real line R including, completeness and Archimedean, denseness, Hausdroff property.

CO2: Learn to define sequences in terms of functions from N to a subset of R. Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and to calculate their limit superior, limit inferior, and the limit of a bounded sequence.

CO3: Apply the ratio, root, alternating series and limit comparison tests for convergence and absolute convergence of an infinite series of real numbers.

CO4: to solve different examples based on convergent sequences

CO5: find the superior and inferior limits of bounded sequences.

CO6: To identify a Cauchy sequence and its characteristics, To apply the Cauchy criterion of convergence.

CO7: To perform different test like Alembert's ratio test, Cauchy's n[th] root test; Alternating series, Leibniz test,

CO8: Identify absolute and conditional convergence.

CO9: Define different types of functions, Find the limit of a function, use the sandwich theorem.

CO10: Find one sided limits; right hand and left -hand.

CO11: Make use of important limit formulae.

Outline of Syllabus: (per session plan)		
Module	Description	No of hours
1	Real Number System, Sequences and Sub Sequences	15
2	Infinite Series, Limit of Functions	15
3	Limits of a function, Continuous functions and their Properties	15
	Total	**45**
PRACTICALS		**30**

Module	Real Analysis 1	No. of Hours/Credits 45/3
1	Real Number System, Sequences and Sub Sequences	**15**
	Real Number System R. Algebraic and order properties of R, Absolute value of a real number; Bounded above and bounded below sets, Supremum and infimum of a nonempty subset of R . Properties of R. The completeness property of R , Archimedean property, Density of rational numbers in R ; Definition and types of intervals, Nested intervals property; Neighborhood of a point in R , Open and closed sets in R. Hausdroff property. Examples. Convergent sequence, Limit of a sequence, Bounded sequence, Limit theorems, Monotone sequences, Monotone convergence theorem, Subsequences, Bolzano−Weierstrass theorem for sequences.	5 5 5
2	Infinite Series, Limit of Functions	**15**
	Limit superior and limit inferior for bounded sequence, Cauchy sequence, Cauchy's convergence criterion. Convergence and divergence of infinite series of real numbers, Necessary condition for convergence, Cauchy criterion for convergence; Tests for convergence of positive term series: Integral test, Basic comparison test, Limit comparison test, Alembert's ratio test, Cauchy's n^{th} root test; Alternating series, Leibniz test, Absolute and conditional convergence.	5 5 5
3	Limits of a function, Continuous functions and their Properties	**15**
	Functions as a relation, Domain and range of a function, examples of specified functions, Algebraic operations on functions, composite and inverse functions, algebraic and transcendental functions, Functions with range in R, Bounded functions with range in R, Monotone real valued functions, at a point. Limit of a function, Algebra of limits, sandwich theorem on functions, general principle of existence of limits, one sided limits from above (right), from below (left), Infinite limits, one sided limits from inf or from –inf. Basic limit formulae, Upper and lower limits of indetermination.	5 5 5

Suggested Readings:

Text Books:
1.   Malik S.C. and Savita Arora: Mathematical Analysis, Second Edition, Wiley Eastern Limited, New Age International Limited, New Delhi, 1994.
2.   T. Apostol, Mathematical Analysis, Narosa Publishing House.
3.   Goldberg. Method of Real Analysis.

Reference Books

1. Bartle, Robert G., & Sherbert, Donald R. (2015). Introduction to Real Analysis (4th ed.). Wiley India Edition. New Delhi.
2. Bilodeau, Gerald G., Thie, Paul R., & Keough, G. E. (2010). An Introduction to Analysis (2nd ed.). Jones & Bartlett India Pvt. Ltd. Student Edition. Reprinted 2015. Department of Mathematics, University of Delhi.
3.. Denlinger, Charles G. (2011). Elements of Real Analysis. Jones & Bartlett India Pvt. Ltd. Student Edition. Rep.
4. K.A. Ross, Elementary Analysis- The Theory of Calculus Series- Undergraduate Texts in Mathematics, Springer Verlag, 2003.
5. Goldberg. Method of Real Analysis.
6. Somasundram D. and Chaudhary B.: A First Course in Mathematical Analysis, Narosa Publishing House, New Delhi, 1987.
7. Gupta S.L. and Nisha Rani: Principles of Real Analysis, Vikas Publ. House Pvt. Ltd., 4th Edition.New Delhi, 1995.
8. Shanti Narayan: A course of Mathematical Analysis, 12th Edition, S. Chand & Co. (Pvt.) Ltd., New Delhi, 1987.
9. Singal M.K. and Singal A.R.: A First Course in Real Analysis, 24th Edition, R. Chand & Co., New Delhi, 2003.
10. Ghorpade, Sudhir R. and Limaye, Balmohan V. (2006): A Course in Calculus and Real Analysis, Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint.

Program: B.Sc.- Applied Statistics And Data Analytics (Hons.)				Semester: II	
Course: Computer Arithmetic and DBMS MYSQL				Course Code: USMAAS105	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment (CA) (Marks - 25)	Semester End Examinations (SEE) (Marks- 75 in Question Paper)
3	2	-	4	25	75

Learning Objectives:

- To introduce the learner to, different systems.
- To equip the learner with the applications of computer arithmetic.
- To introduce the learner to Boolean algebra and its applications. Logic gates and circuits of different types.
- To Introduce the learner to Database Management System and applications.

Course Outcomes:

After completion of the course, learners would be able to:

 CO1: Convert between binary and decimal numbers. Perform algebra of binary numbers.

 CO2: Add, subtract, multiply, and divide binary numbers.

 CO3: Represent signed binary numbers with 1 and 2's complement.

 CO4: To perform Boolean algebra

 CO5: Understand the working & application of logic gates, adder, flip flop circuits & applications.

 CO6: Distinguish between data and information and Knowledge

 CO7: Distinguish between file processing system and DBMS

 CO8: Describe the advantages and disadvantages of DBMS.

 CO9: Describe Database users including data base administrator

CO10: Describe data models, schemas and instances.

CO11: Describe DBMS Architecture & Data Independence

CO12: Describe Data Languages, relational data models.

CO13: Implement DDL, DML, DCL Commands using SQL.

CO14: Design database by using ER Diagrams.

CO15: Apply key constrains to get a normalized database.

CO16: Implement procedures and functions using PL/SQL

Outline of Syllabus: (per session plan)

Module	Description	No of Hours
1	Computer arithmetic	45
2	Introduction to DBMS, Data Models and Relational Data models	45
3	Schema definition, DDL, DCL and DML statements	45
	Total	

PRACTICALS	30

Module	Computer Arithmetic and DBMS MYSQL	**No. of Hours /Credits 45/3**
1	Computer arithmetic	**15**
	Computer Codes: Introduction, Decimal System, Binary System, Hexadecimal System, Octal System, 4-bit Binary Coded Decimal (BCD) Systems, 8-bit BCD Systems,16-bit Unicode, Conversion of Numbers. Computer Arithmetic: Binary Addition & Multiplication, Binary Subtraction & Division, Signed/unsigned Numbers, Complements of Binary Numbers, Binary Subtraction Using Complements, Representing Numbers, Integer Arithmetic, Floating-point Arithmetic, Errors in Arithmetic, Laws of Arithmetic. Boolean Algebra of Switching Circuits: Elements of Boolean Algebra, Basic Postulates of Boolean Algebra, Boolean Operations, Principle of Duality, Basic Laws of Boolean Algebra DE Morgan's Theorem, Boolean Expressions, Venn Diagram. Logic Gates and Digital Circuits: Basic Logic Gates Derived Logic Gates, Conversion of Boolean Functions, Adder Circuits, Flip-flop Circuits, Application of Flip-flops.	
2	Introduction to DBMS, Data Models and Relational Data models	**15**
	Introduction to DBMS – Database, DBMS – Definition, Overview of DBMS, Advantages of DBMS, Levels of abstraction, Data independence, DBMS Architecture Data models - Client/Server Architecture, Object Based Logical Model, Record Based Logical Model (relational, hierarchical, network) Entity Relationship Model - Entities, attributes, entity sets, relations, relationship sets, Additional constraints (key constraints, participation constraints, weak entities, aggregation / generalization, Conceptual Design using ER (entities VS attributes, Entity Vs relationship, binary Vs ternary, constraints beyond ER) Relational data model– Domains, attributes, Tuples and Relations, Relational Model Notation, Characteristics of Relations, Relational Constraints - primary key, referential integrity, unique constraint, Null constraint ER to Table- Entity to Table, Relationship to tables with and without key constraints.	
3	Schema definition, DDL, DCL and DML statements	**15**
	Schema definition, DDL, DCL and DML statements. DDL Statements - Creating Databases, Using Databases, datatypes,	

	Creating Tables (with integrity constraints – primary key, default, check, not null), Altering Tables, Renaming Tables, Dropping Tables, DML Statements – Viewing the structure of a table insert, update, delete, select all columns, specific columns, unique records, conditional select, in clause, between clause, limit, aggregate functions (count, min, max, avg, sum), group by clause, having clause. Functions – String Functions (concat, instr, left, right, mid, length, lcase/lower, ucase/upper, replace, strcmp, trim, ltrim, rtrim), Math Functions (abs, ceil, floor, mod, pow, sqrt, round, truncate) Date Functions (adddate, datediff, day, month, year, hour, min, sec, now, reverse) Joining Tables – inner join, outer join (left outer, right outer, full outer). Subqueries – subqueries with IN, EXISTS, subqueries restrictions, Nested subqueries, ANY/ALL clause, correlated subqueries Database Protection: Security Issues, Role of DBA, Discretionary Access Control Views (creating, altering dropping, renaming and manipulating views) DCL Statements (creating/dropping users, privileges introduction, granting/revoking privileges, viewing privileges).	
PRACTICALS		**30**

Suggested Readings:

Text Books:
1. E Balagurusamy, Fundamentals Of Computers, Tata McGraw Hill Education Private Limited.
2. Ramez Elmasri & Shamkant B.Navathe, Fundamentals of Database Systems, Pearson Education, Sixth Edition, 2010.
3. Robert Sheldon, Geoff Moes, Beginning MySQL, Wrox Press, 2005.

Reference Books

1. V. Rajaraman, Neeharika Adabala, Fundamentals Of Computers,
2. A. Goel, Computer Fundamentals, Pearson Education, 2010.
3. P. K.Sinha, P. Sinha, Fundamentals of Computers, BPB Publishers, 2007
4. Ramakrishnam, Gehrke, Database Management Systems, McGraw-Hill, 2007
5. Ramakrishnam, Gehrke, Database Management Systems, McGraw-Hill, 2007
6. Joel Murach, Murach's MySQL, Murach, 2012.

Program: B.Sc.- Applied Statistics And Data Analytics (Hons.)				Semester: I	
Course : Algorithms & C Programming				Course Code: USMAAS106	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment (CA) (Marks - 25)**	**Semester End Examinations (SEE) (Marks- 75 in Question Paper)**
3	2	-	4	25	75

Learning Objectives:

- To develop a strong foundation for the fundamental principles of Problem Solving using computers
- Equipping the learner with basic programming concepts so that they can easily switch over to any other language in future.
- To provide exposure to problem-solving through C programming.
- To make the learner develop logic which will help them to create programs, applications in C.
- to equip the learner with understanding of code organization and functional hierarchical decomposition with using complex data types.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: have basic understanding of computers, the concept of algorithm and algorithmic thinking.

CO2: to analyze a problem, develop an algorithm to solve it.

CO3: Recollect various programming concepts to write program in C.

CO4: use the C programming language to implement various algorithms, and develops the basic concepts and terminology of programming in general.

CO5: choose proper data representation formats based on the requirements of the problem.

CO6: Implement different operations on arrays, functions, pointers, structures, unions and files.

CO7: Design, implement, test and debug programs that use different data types.

CO8: Write C programs for simple applications using files.

Outline of Syllabus: (per session plan)

Module	Description	No of Hours
1	Algorithms, Introduction to C. C-instructions, Decisions.	15
2	Loops, Functions and Data types	15
3	Arrays , Strings and Structures , Console I/O	15
	Total	**45**
PRACTICALS		**30**

Module	Algorithms & C Programming	No. of Hours /Credits 45/3
1	Algorithms, Introduction to C. C-instructions, Decisions.	**15**
	Algorithms: Implementation, program verification, efficiency and analysis of algorithms. Fundamentals of algorithms.: Exchange values of two variables, counting, summation, factorial, trigonometric functions, Fibonacci sequence, reversing the digits, character to numeric conversion. Factoring Methods: square root of a number, smallest divisor, g.c.d. prime numbers, pseudo random numbers, nth Fibonacci numbers Merging sorting and searching: two-way merge, selection sort, exchange sort, insertion sort, quick sort, Binary search, hash searching The First C Program: Form of a C Program, Comments in a C Program, main (), Variables and their Usage, print() and its Purpose, Compilation and Execution, Receiving Input. C Instructions: Types of Instructions, Type Declaration Instruction, Arithmetic Instruction, Integer and Float Conversions, Type Conversion in Assignments, Hierarchy of Operations, Associativity of Operators, Control Instructions. Decision Control Instruction: Decisions making, the if Statement, Multiple Statements within if, the if-else Statement, Nested if-elses, Forms of if. More Complex Decision Making, Use of Logical Operators, The else if Clause, The ! Operator, Hierarchy of Operators Revisited The Conditional Operators.	
2	Loops, Functions and Data types	**15**
	Loop Control: Instruction, Loops, the while Loop, Tips and Traps, More of Operators, Complex Repetitions, the for Loop, Nesting of Loops, Multiple Initializations in the for Loop, The break Statement, The continue Statement, The do-while Loop, The Odd Loop, Case Control Instruction, Decisions using switch, switch versus if-else Ladder, Functions: What and Why? Passing Values between Functions, Scope Rule of Functions, Order of Passing Arguments, Using Library Functions. Data Types Revisited, Integers, long and short, Integers, signed and unsigned, Chars, signed and unsigned, Floats and Doubles.	

3	Arrays , Strings and Structures , Console I/O	15
	Arrays: What are Arrays? A Simple Program using Array, Array Initialization, 1 dimentional and 2 dimentional arrays, Array Elements in Memory, Bounds Checking, Passing Array Elements to a Function, Pointers and Arrays, Passing an Entire Array to a Function, Memory Map of a Two-Dimensional Pointers and Two-Dimensional Arrays, Pointer to an Array, Passing 2-D Array to a Function, Array of Pointers. Three-Dimensional Array. Strings: What are Strings? Pointers and Strings, Standard Library String Functions, strlen( ) 299,strcpy( ) 301,strcat( ) 304,strcmp( ) 305, Handling Multiple Strings,Two-Dimensional Array of Characters, Array of Pointers to Strings, Limitation of Array of Pointers to Strings. Structures: Why use Structures? Declaring a Structure, Accessing Structure Elements, How Structure Elements are Stored? Nested structures, Array of Structures, Additional Features of Structures, uses of Structures.	

PRACTICALS	
Sr. No.	**TOPIC**
1	Converting °C temperature to °F.
2	To carry out arithmetic calculations.
3	To check whether given number is odd or even.
4	To check whether given number m is divisible by n or not.
5	To find maximum of 2 numbers or 3 numbers.
6	To find area of triangle and circle.
7	To find roots of quadratic equation.
8	To check whether integer is prime or not.
9	To find mean, Geometric mean and Harmonic Mean of n numbers.
10	To prepare multiplication table.
11	To find sum of digits of a number.
12	To solve simultaneous linear equations.(two equations in two variables)
13	To evaluate simple and compound interest
14	To solve transcendental equations using Newton-Raphson method.
15	To evaluate exp(x), sin (x), log (x) etc. using Taylor"s series expansion.

16	To convert decimal number to equivalent binary number.
17	To generate Fibonacci series like 0, 1, 1,2,3,5…
18	To test palindrome string using string function.
19	To sort a string using string function.
20	To search string using string function.
21	To combine given two strings using string function.
22	To find factorial of integer number (both recursive and non-recursive)
23	To find the value of Xn where n is integer.(both recursive and non-recursive)
24	To find GCD of two integer numbers(both recursive and non-recursive)
25	To find maximum/minimum of n numbers.(non-recursive)
26	To obtain addition of two matrices, multiplication of two matrices.
27	Program in C to prepare a frequency distribution with given class interval from raw data.
28	Program in C to find mean, variance, standard deviation and quartiles for given n observations and frequency distribution
29	Program in C to fit a Discrete distribution to given data.
30	Program in C to prepare a 2X2 contingency table and to check whether two attributes are independent.
31	To find mean, median, variance and coefficient of variation of frequency distribution.
32	To find correlation coefficient and line of best fit of Y on X (X on Y) for a given bivariate data.
33	To sort the given data in increasing/decreasing order of magnitude.
34	To obtain median of given n observations.

Suggested Readings:

Text Books:
1. E. Balaguruswamy, Computer Concepts and Programming in C,- McGraw-Hill Education (2016).
2. Rajaraman V, Computer programming in C, Prentice Hall of India.,

Reference Books:
1. Yashvant Kanetkar, Let Us C. EDITION 16, BPB publications.
2. Byron S Gottfried , Programming with C, 4th Edition (Schaum's Outlines)
3. Karnighan, Brian W. and Ritchi, Dennis M. (1988). The C programming language, Second edition, Prentice Hall.

Program: B.Sc.- Applied Statistics And Data Analytics (Hons.)				Semester: I	
Course : Environmental Studies				Course Code: USMAAS107	

Teaching Scheme				Evaluation Scheme	
Lecture (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment (CA) (Marks - 25)	Semester End Examinations (SEE) (Marks- 75 in Question Paper)
2		-	2	25	75

Learning Objectives:
• to make the learner understand the complex nature of the natural and the built environments.
• to make the learner acquire the knowledge, values, attitudes, and practical skills to participate in a responsible and effective way in anticipating and solving social problems, and in the management of the quality of the environment.

Course Outcomes:

After completion of the course, learners will:

CO1: Have developed the knowledge base which covers all attributes of the environment and enable him/her to attain scientific/technological capabilities to find answers to the fundamental questions before the society with regards to human action and environmental effects with due diligence.

CO2: Have enhanced the ability to apply his/her knowledge and proficiency to find solutions relating to environmental concerns of varied dimensions of present times.

CO3: Appreciate the necessity of framing environmental policy guidelines.

CO4: Motivate the society to appreciate that they are integral stakeholders in the environmental management of India irrespective of their future jobs or working.

CO5: Understand the concerns related to Sustainable Development Goals (SDGs) and the Indian obligations.

CO6: Provide with a direction and technical capability to carry on lifelong learning and show teamwork and collaborative endeavor, and decision making.

Outline of Syllabus: (per session plan)

Module	Description	No of Hours
1	Introduction to Environmental Studies , Ecosystems, Natural Resources, Biodiversity and Conservation	10
2	Biodiversity and Conservation, Environmental Pollution	10
3	Environmental Policies & Practices, Human Communities and the Environment	10
	Total	**30**
FIELD WORK		**5**

Module	Environmental Studies	No. of Hours /Credits 30/2
1	Introduction to Environmental Studies , Ecosystems, Natural Resources, Biodiversity and Conservation	10
	Introduction to environmental studies Multidisciplinary nature of environmental studies; components of environment – atmosphere, hydrosphere, lithosphere and biosphere. Scope and importance; Concept of sustainability and sustainable development	2
	Ecosystems : What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chain, food web and ecological succession. Case studies of the following ecosystems: a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)	5
	Natural Resources: Renewable and Non-renewable Resources Land Resources and land use change; Land degradation, soil erosion and desertification. Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state). Heating of earth and circulation of air; air mass formation and precipitation. Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.	3
2	Biodiversity and Conservation, Environmental Pollution	10
	Biodiversity and Conservation Levels of biological diversity: genetic, species and ecosystem diversity; Biogeography zones of India; Biodiversity patterns and global biodiversity hot spots India as a mega-biodiversity nation; Endangered and endemic species of India. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.	6

		Environmental Pollution	**4**
		Environmental pollution: types, causes, effects and controls; Air, water, soil, chemical and noise pollution	
		Nuclear hazards and human health risks	
		Solid waste management: Control measures of urban and industrial waste. Pollution case studies.	
3	Environmental Policies & Practices, Human Communities and the Environment		10
		Environmental Policies & Practices	**5**
		Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture.	
		Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife.	
		Protection Act; Forest Conservation Act; International agreements; Montreal and Kyoto protocols and conservation on Biological Diversity (CBD). The Chemical Weapons Convention (CWC).	
		Nature reserves, tribal population and rights, and human, wildlife conflicts in Indian context.	
		Human Communities and the Environment	**5**
		Human population and growth: Impacts on environment, human health and welfares.	
		Carbon foot-print.	
		Resettlement and rehabilitation of project affected persons; case studies.	
		Disaster management: floods, earthquakes, cyclones and landslides.	
		Environmental movements: Chipko, Silent valley, Bishnios of Rajasthan.	
		Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.	
		Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).	

Suggested Readings:

Text Books:
1. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.
2. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. Environment. 8th edition. John Wiley & Sons.
3. Rosencranz, A., Divan, S., & Noble, M.L. 2001. Environmental law and policy in India. Tripathi 1992.

Reference Books:

1.   Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. Environment. 8th edition. John Wiley & Sons.
2.   Sengupta, R. 2003.Ecology and economics: An approach to sustainable development. OUP.
3.   Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. Conservation Biology: Voices from the Tropics. John Wiley & Sons.
4.   Odum, E.P., Odum, H.T. & Andrews, J.1971. Fundamentals of Ecology. Philadelphia: Saunders
5.   Gleeson,B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge.
6.   Groom, Martha J. Gary K. Meffe, and Carl Ronald Carroll. Principles of Conservation Biology. Sunderland: Sinauer Associates, 2006.
7.   Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
8.   Gadgil, M., & Guha, R.1993. This *Fissured Land:* An Ecological History of India. Univ. of California Press.
9.   Carson, R. *2002. Silent Spring.* Houghton Mifflin Harcourt.
10.   Gleick, P.H. 1993. Water in *Crisis*. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
11.   Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339: 36-37.
12.   McCully, P.1996. Rivers no more: the environmental effects of dams(pp. 29-64). Zed Books.
13.   McNeil, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
14.   Rao, M.N. & Datta, A.K. 1987. Waste Water Treatment. Oxford and IBH Publishing Co. Pvt. Ltd.
15.   Thapar, V. 1998. Land of the Tiger: A Natural History of the Indian Subcontinent.
16.   Warren, C.E. 1971. Biology and Water Pollution Control. WB Saunders.
17.   Wilson, E.O. 2006. The Creation: An appeal to save life on earth. New York: Norton.
18.   World Commission on environment and Development. 1987. Our Common Future. Oxford University Press.
19.   www.nacwc.nic.in
20.   www.opcw.org

Program: B.Sc.- Applied Statistics And Data Analytics (Hons.)				Semester: II	
Course: Descriptive Statistics 2				Course Code: USMAAS201	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical** (Hours per week)	**Tutorial** (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 25)**	**Semester End Examinations (SEE) (Marks- 75 in Question Paper)**
3	2	-	4	25	75

Learning Objectives:

- To enrich the learner with knowledge of qualitative characteristics and their measures.
- To introduce the concepts of indices used to measure the changes which occur from point of time to another.
- To introduce the learner to the field of forecasting.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Identify the quantitative characteristics, check for consistency of the data and verify it the attributes are independent.

CO2: In the case of dependent attributes, the learner will be able to find the degree of association between the m using different measures.

CO3: Interpret and use a range of commonly used index numbers, define and explain the use of an index number.

CO4: Compute simple, composite and weighted index numbers, know the concept of the consumer price index (CPI) and the cost of living index number and compute the same, Tests to be satisfied by an index number.

CO5: Know how to deal with income inequality; Gini's coefficient, Lorenz curves along with the applications of Pareto and Lognormal as income distributions

CO6: Will have gained knowledge of the main concepts of time series theory and methods of analysis.

CO7: Will have adequate knowledge of traditional methods of time series analysis.

CO8: Will know how to use this knowledge for examining, understanding methods, of economic and financial situations and arriving at suitable results and conclusions.

CO9: understand specific economic problems, how to analyze economic time series.

CO10: get knowledge about how to compare different statistical models using in-sample and out-of-sample statistical measures of accuracy.

Outline of Syllabus: (per session plan)

Module	Description	No of Hours
1	Categorical data Analysis, Odds Ratio & Theory of Attributes	15

2	Index numbers	15
3	Time Series	15
	Total	**45**
PRACTICALS		**30**

Module	**Descriptive Statistics 2**	**No. of Hours /Credits 45/3**
1	Categorical data Analysis, Odds Ratio & Theory of Attributes	**15**
	Analysis of Categorical Data: Consistency of categorical data. Independence and association including partial association of attributes. Various measures of association for two and three-way classified data. Pearson's and Yule's measures, Goodman-Kruskal's γ. Odds Ratio. Fitting of logit model through least squares.	**5** **5** **5**
2	Index numbers	**15**
	Index numbers as comparative tool. Stages in the construction of Price Index Numbers. Measures of Simple and Composite Index Numbers. Laspeyre's, Paasche's, Marshal-Edgeworth's, Drobisch and Bowley's and Fisher's Index Numbers formula. Quantity Index Numbers and Value Index Numbers. Time reversal test, Factor reversal test, Circular test. Fixed base Index Numbers, Chain base Index Numbers. Base shifting, splicing and deflating of an index number series. Cost of Living Index Number. Concept of Real Income based on Wholesale Price Index Number. Measurement of income inequality: Gini's coefficient, Lorenz curves, Application of Pareto and Lognormal as income distributions.	**5** **5** **5**
3	Time Series	**15**
	Definition of Time series. Its components. Models of Time Series. Estimation of trend by: ➢ Freehand curve method; ➢ Method of Semi Averages; ➢ Method of Moving Averages; (Simple and Weighted) ➢ Method of Least Squares. Estimation of seasonal component by: ➢ Method of simple averages; ➢ Ratio to moving average method;	**5** **6**

	➤ Ratio to trend method;	
	➤ Method of link Relatives.	
	Exponential Smoothing methods.	**4**
	➤ Holt's Two Parameter method;	
	➤ Winter's Three Parameter method.	

PRACTICALS	
Sr. No.	**TOPIC**
1	Theory of Attributes 1
2	Measures of Association.
3	Index numbers 1.
4	Index Numbers 2
5	Index numbers 3
6	Time series 1
7	Time Series 2
8	Times Series 3

Suggested Readings:
Text Books:
1. Prem S. Mann, Introductory Statistics, 9th edition, Wiley plus. July 2018.
2. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams - Statistics for Business & Economics-Cengage (2019).
3. Fundamentals of Applied Statistics, Gupta and Kapoor, S. Chand.

Reference Books
1. Ken Black, Business Statistics for Contemporary Decision making, 9th edition, Wiley plus.
2. Jay L. Devore, Probability and Statistics for Engineers and the Sciences, 9th edition, Cengage Learning.
3. Roxy Peck, Jay L. Devore, Statistics: The Exploration & Analysis of Data, 7th edition, Cengage Learning.
4. Statistics for Management, Masood Husain Siddiqui, Richard I. Levin, David S. Rubin, Sanjay Rastogi, 8th edition, Pearson.
5. S. M. Ross Sheldon, Introductory Statistics.4th edition, Academic Press.
6. Statistics - An Introduction, Roger Kirk, 5th edition, Thompson Wadsworth.
7. Croxton F.E., Cowden D.J. & Klein (1969): Applied General Statistics, Prentice Hall.
8. Goon A. M, Gupta M.K, Dasgupta B.(1998):Fundamentals of Statistics (V-1),World Press.
9. Goon A.M, Gupta M.K., Dasgupta B. (1991): Fundamentals of Statistics, V- II, World Press
10. Fundamentals of Mathematical Statistics, Gupta and Kapoor, S. Chand.
11. Ken Black, Business Analytics and Statistics 1st edition, Wiley Direct.

Program: B.Sc.- Applied Statistics And Data Analytics (Hons.)					Semester: II	
Course: Probability Distributions 2					Course Code: USMAASDA202	
Teaching Scheme					Evaluation Scheme	
Lecture (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit		Continuous Assessment (CA) (Marks - 25)	Semester End Examinations (SEE) (Marks- 75 in Question Paper)
3	2	-	4		25	75

Learning Objectives:

- To equip the learner with the knowledge of different continuous distribution functions.
- To equip the learner with the knowledge and concepts of estimation theory and it applications
- To equip the learner with the procedure of solving testing of hypothesis problems.
- To equip the learner with the procedure of solving sample tests base on large samples (Normal Distribution) and on small samples (chi-square, t and F distributions).

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Explain the concept of estimation of parameters.

CO2: Explain the use of the central limit theorem and its applications.

CO3: Solve the problems related to point estimation and interval estimation.

CO4: Explain the concepts of Testing of Hypotheses, Type I error, Type II error, level of significance and power of test. Solve corresponding problems.

CO5: Hypothesize various advanced statistical techniques for modelling and exploring practical situations.

CO6: Solve the problems related to Large Sample Tests.

CO7: Solve the problems related to Small sample tests (Chi-square tests).

CO8: Solve the problems related to Small sample tests (t-tests).

CO9: Solve the problems related to Small sample tests (F-tests).

Outline of Syllabus: (per session plan)

Module	Description	No of Hours
1	Continuous Distributions I.	15
2	Sampling Distributions and concepts of estimation, Interval estimation & testing of hypothesis.	15
3	Large sample Tests and Applications of the Chi-square Distribution.	15
	Total	45
PRACTICALS		30

Module	Probability Distributions 2	No. of Hours /Credits 45/3
1	Continuous Distributions I.	**15**
	Uniform, Triangular and Exponential (single or double parameter) and Derivations of mean, median and variance, raw and central moments, Skewness and kurtosis for the above distributions	**6**
	Normal distribution. Properties of Normal distribution/curve. (with proofs)	**6**
	Normal approximation to Binomial and Poisson distribution (statement only).	**3**
	Fitting of distributions.	
2	Sampling Distributions and concepts of estimation, Interval estimation & testing of hypothesis.	**15**
	Concept of a statistic estimator and its sampling distribution. Parameter and it's estimator. Concept of bias and standard error of an estimator. Central Limit theorem (statement only). Sampling distribution of sample means and sample proportion. (For large sample only).	**4**
	Standard errors of sample mean and sample proportion.	**3**
	Point and Interval estimate of single mean, single proportion from sample of large size.	**3**
	Statistical tests: Concept of hypothesis Null and alternate hypothesis, Types of errors, Critical region, Level of significance.	**5**
	Large sample tests. To test:	
	➢ specified value of population mean.	
	➢ specified value in difference of two means	
	➢ specified value of population proportion.	
	➢ specified value of difference of population proportion.	
3	Large sample Tests and Applications of the Chi-square Distribution.	**15**
	Applications of Chi-Square, t and F Distributions: Concept of degrees of freedom Definition and properties of chi-square, t and F distributions. Applications of Chi-Square: Confidence interval for the variance of a Normal population; Test of significance for specified value of variance of a Normal population; Test for goodness of fit; Test for independence of attributes. Yates' correction.	**6**
	Applications of t distribution: Confidence interval for: Mean of Normal population; Difference between means of two independent Normal populations having the	**6**

	same variance. Test of significance of: mean of a Normal population, difference in means of two Normal populations; [based on: (i) independent samples with equal variances; (ii) dependent samples.] Applications of F distribution: Confidence interval for ratio of variances of two independent Normal populations. Test for equality of variances of two independent Normal populations.	**3**

Practicals	
Sr. No.	**TOPIC**
1	Uniform and Triangular distributions.
2	Exponential distribution.
3	Normal Distribution I.
4	Normal Distribution II.
5	Applications of the Central Limit Theorem.
6	Hypothesis Testing.
7	Large sample tests I
8	Large sample tests. II
9	Applications of the Chi square distribution I
10	Applications of the Chi square distribution II.
11	Applications of the t distribution.
12	Applications of the t and F distributions.

RECOMMENDED READING:

Text Books:
1. Prem S. Mann, Introductory Statistics, 9th edition, Wiley plus. July 2018
2. Hogg R.V. and Tannis E.P., Probability and Statistical Inference, McMillan Publishing Co.
3. Jay L. Devore, Probability and Statistics for Engineers and the Sciences, 9th edition, Cengage Learning.

Reference Books
1. S. M. Ross Sheldon, Introductory Statistics.4th edition, Academic Press.
2. Statistics - An Introduction, Roger Kirk, 5th edition, Thompson Wadsworth.
3. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams - Statistics for Business & Economics-Cengage (2019).
4. Ken Black, Business Statistics for Contemporary Decision making, 9th edition, Wiley plus.

5. Roxy Peck, Jay L. Devore, Statistics: The Exploration & Analysis of Data, 7th edition, Cengage Learning.
6. Statistics for Management, Masood Husain Siddiqui, Richard I. Levin, David S. Rubin, Sanjay Rastogi, 8th edition, Pearson.
7. Jay L. Devore, Kenneth N. Berk (auth.) - Modern Mathematical Statistics with Applications, 2nd edition, Springer-Verlag, New York (2012).

Program: B.Sc. **Applied Statistics And Data Analytics** (Hons)				Semester: II	
Course: Discrete Mathematics 2				**Course Code:** USMAASDA203	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical** (Hours per week)	**Tutorial** (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 25)**	**Semester End Examinations (SEE) (Marks- 75 in Question Paper)**
3	2	-	4	25	75

Learning Objectives:

- To introduce the learner to the ideas and techniques from discrete mathematics.
- To make the learner think logically and mathematically and apply these techniques in solving problems.
- To expose the learners to mathematical reasoning, combinatorial analyses, discrete structures and algorithmic thinking.
- To introduce the learner to the applications of trees and graphs.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Understand and construct mathematical arguments

CO2: Prove simple arguments.

CO3: Develop recursive algorithms based on mathematical induction.

CO4: Know basic properties of relations

CO5: Know essential concepts in graph theory and related algorithms.

CO6: Understand basic concepts in formal languages and computability.

CO7: Apply knowledge about discrete mathematics in problem solving

CO8: State the Principle of Mathematical Induction. Write induction proofs involving summations, inequalities, and divisibility arguments.

CO9: Understand the working of a tress and graphs.

CO10: Know the tress types and the methods of traversing a tree.

CO11: Use trees to model various kinds of network., find a minimal spanning tree.

CO12: Know following terms: Graph; nodes; edges; simple graph; multigraph; pseudograph; undirected and directed graph.

CO13: Use a graph to model a system of interconnected nodes.

Outline of Syllabus: (per session plan)

Module	Description	No of Hours
1	Algorithms, Integers, Matrices	45
2	Mathematical Reasoning, Induction and Recursion.	45
3	Trees and Graphs	45
	Total	

PRACTICALS		30

Module	Discrete Mathematics 2	No. of Hours /Credits 45/3
1	Algorithms, Integers, Matrices	
	Algorithms, The Growth of functions, Complexity of Algorithms, The Integers and Division, Integers and Algorithms, Applications to Number Theory, Matrices**.** Searching and Sorting, Enumeration of Permutations and Combinations	**5** **5** **5**
2	Mathematical Reasoning, Induction and Recursion.	
	Proof Strategy, Sequences and Summations, Mathematical Induction, and Recursive Definitions and Structural Induction, Recursive Algorithms, Solving Recurrence Relations; The Characteristic Polynomial, Generating Functions Program Correctness. Recursively Defined Sequences	**5** **5** **5**
3	Trees and Graphs	
	Introduction to trees, labeled tress, tree searching; traversal, spanning trees, undirected trees, Minimal Spanning Trees. Introduction to Graphs,, Graph terminology, Euler ; Hamilton paths and circuits, Shortest path Problems.	**7** **8**

PRACTICALS	
Sr. No.	**Topic.**
1	Algorithms
2	Growth of functions, Complexity of Algorithms
3	The Integers and Division, Integers and Algorithms
4	Number Theory, Matrices**.** Searching and Sorting, Enumeration of Permutations and Combinations
5	Sequences and Summations Mathematical Induction
6	Recursive Algorithms, Solving Recurrence Relations
7	The Characteristic Polynomial, Generating Functions Program Correctness. Recursively Defined Sequences
8	Trees and Minimal Spanning Trees.

9	Graphs,, Graph terminology, Euler.
10	Hamilton paths and circuits, Shortest path Problems

Suggested Readings:
Text Books:
1.   Kenneth Rosen, Discrete Mathematics and Its Applications with Combinatorics and Graph Theory (SIE) 8th Edition.

Reference Books
1.   Edgar G. Goodaire & Michael M. Parmenter, Discrete Mathematics With Graph Theory, 3rd Ed..
2.   Bernard Kolman, Robert Busby, Sharon C. Ross. , Discrete Mathematical Structures [6 ed.] Pearson, Prentice Hall.

Program: B.Sc. **Applied Statistics And Data Analytics** (Hons)					Semester: II	
Course: **Real Analysis 2**					Course Code: **USMAAS204**	
Teaching Scheme					**Evaluation Scheme**	
Lecture (Hours per week)	**Practical** (Hours per week)	**Tutorial** (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 25)**		**Semester End Examinations (SEE) (Marks- 75 in Question Paper)**
3	2	-	4	25		75

Learning Objectives:

- To explain the notion and concept a of a function, limit of a function, existence of limits
- To explain the notion and concept of continuity of a functions and different aspects of continuity.
- To upgrade the knowledge of derivatives. Use of mean value theorems and to familiarize the learner with Taylor and Maclaurins series and expansions.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Define different types of functions, continuous and discontinuous

CO2: Know theorems on continuous functions

CO3: Apply the Intermediate value theorem, Fixed point property, Continuity of inverse functions.

CO4: Find derivatives of higher order and apply Leibneitz theorem to compute the nth derivative.

CO5: Apply MVT's, Make use of indeterminate forms

CO6: Compute various series using Taylor and Maclaurain expansion/series

CO7: To define a differential equation, find its order and degree.

CO8: Solve homogenous and non-homogeneous differential equations.

CO9: Find partial derivatives, Solve exact differential equations.

CO10: Find out integrating factors to convert a differential equation into an exact one and then to solve it.

CO11: Identify a linear differential equation and find its solution. Also to solve the Bernoulli differential equation.

Outline of Syllabus: (per session plan)

Module	Description	No of Hours
1	Continuity of Functions	45
2	Differentiability	45
3	Ordinary Differential equations.	45
	Total	
PRACTICALS		**30**

Module	Real Analysis 2	No. of Hours /Credits 45/3
1	Continuity of Functions	**15**
	Continuous functions, Continuity at a point, continuity from right or left at a point, continuity on intervals (finite or infinite), continuity on an arbitrary set, Graphical representation and interpretation of continuity of a function, examples of continuous functions,	**5**
	Discontinuous functions, different types Saltus on an open interval, at a point. Continuity of some functions x^a, a^x etc.	**5**
	Theorems on continuous functions, Borel theorem, Boundedness theorem, Intermediate value theorem, Fixed point property, Continuity of inverse functions.	**5**
	Uniform continuity of functions.	
2	Differentiability	
	Differentiability, Differentiability implies continuity, Derivatives of higher order: Leibnitz theorem about the nth derivative of a product.	**4**
	Rolle's theorem, Lagrange's and Cauchy's Mean Value Theorem; L'Hospitals rules, Indeterminate forms.	**4**
	Taylors and Maclaurins theorem with Lagrange's form of remainder and the statement for Cauchy's form of remainder. Applications to approximations, stationery points, maxima and minima.	**4**
	Maclaurin and Taylor's series, expansions (1-x), $(1+x)^n$ as infinite series (assuming that the remainder tends to zero, Statement of their interval of convergence.	**3**
3	Ordinary Differential equations.	
	Differential equations, their classification, Solutions of equations of first order and first degree, homogeneous and non-homogeneous equations of first degree in x and y.	**6**
	Partial derivatives, exact differential equations, integrating factors, rules for finding integrating factors.	**5**
	Linear differential equations, Bernoulli's equation.	**4**

Practicals	
1	Continuous functions
2	Graphical representation and interpretation of continuity of a function, examples of continuous functions
3	Discontinuous functions, Uniform continuity of functions
4	Differentiability, Differentiability implies continuity, Derivatives of higher order
5	Leibnitz theorem about the nth derivative of a product
6	Rolle's theorem, Lagrange's and Cauchy's Mean Value Theorem; L'Hospitals rules, Indeterminate forms.

7	Taylors and Maclaurins theorem with Lagrange's form of remainder and the statement for Cauchy's form of remainder
8	Applications to approximations, stationery points, maxima and minima.
9	Maclaurin and Taylor's series, expansions
10	Solutions of equations of first order and first degree homogeneous and non homogeneous equations of first degree in x and y.
11	Partial derivatives exact differential equations, integrating factors, rules for finding integrating factors
12	Linear differential equations, Bernoulli's equation

Suggested Readings:

Text Books:
1. T.M. Apostol, Calculus (Vol. I), John Wiley and Sons (Asia) P. Ltd., 2002.
2. Malik S.C. and Savita Arora: Mathematical Analysis, Second Edition, Wiley Eastern
3. Shanti Narayan: A course of Mathematical Analysis, 12th Edition, S. Chand & Co. (Pvt.) Ltd., New Delhi, 1987.

Reference Books
1. Appostol T.M.: Mathematical Analysis, Second Edition, Narosa Publishing House, New Delhi, 1987.
2. Somasundram D. and Chaudhary B.: A First Course in Mathematical Analysis, Narosa Publishing House, New Delhi, 1987
3. R.G. Bartle and D. R Sherbert, Introduction to Real Analysis, John Wiley and Sons (Asia) P. Ltd., 2000. 4. E. Fischer, Intermediate Real Analysis, Springer Verlag, 1983.
4. Goldberg. Method of Real Analysis
5. K.A. Ross, Elementary Analysis- The Theory of Calculus Series- Undergraduate Texts in Mathematics, Springer Verlag, 2003.
6. Limited, New Age International Limited, New Delhi, 1994.
7. Gupta S.L. and Nisha Rani: Principles of Real Analysis, Vikas Publ. House Pvt. Ltd., 4th Edition. New Delhi, 1995.
8. Singal M.K. and Singal A.R.: A First Course in Real Analysis, 24th Edition, R. Chand & Co., New Delhi, 2003.
9. Ghorpade, Sudhir R. and Limaye, Balmohan V. (2006): A Course in Calculus and Real Analysis, Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint.

Program: B.Sc. Applied Statistics And Data Analytics (Hons)					Semester: II	
Course: Data Analysis Using Excel					Course Code: USMAASDA205	
Teaching Scheme					**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**		**Continuous Assessment (CA) (Marks - 25)**	**Semester End Examinations (SEE) (Marks- 75 in Question Paper)**
3	2	-	4		25	75

Learning Objectives:

To make the learner get hands on experience of the working prowess/competency aware of Ms Excel.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Execute excel commands, excel add ins,

CO2: Enter data into an excel sheet and use it to perform Exploratory Data Analysis.

CO3: Edit and make excellent presentation of graphs and charts.

CO4: Import data into an excel sheet and make use of the query wizard.

CO5: Use vlookup.

CO6: Compute various Statistical measures.

CO7: Generate random observations and compute the probabilities of different statistical distributions.

CO8: Perform various statistical tests.

CO9: Create pivot tables and their use for further analysis.

CO10: Compute and perform correlation and regression analysis.

CO11: Interpret the correlation and regression statistics.

CO12: Compute and interpret p-values.

Outline of Syllabus: (per session plan)

Module	Description	No of Hours
1	Getting Started With Excel, Working With Data & Working With Charts.	15
2	Describing Data & Probability Distributions	15
3	Statistical Inference , Tables & Regression And Correlation.	15
	Total	**45**
PRACTICALS		**30**

Module	Data Analysis Using Excel	No. of Hours /Credits 45/3
1	Getting Started With Excel, Working With Data & Working With Charts.	
	GETTING STARTED WITH EXCEL, Excel and Spreadsheets, Launching Excel, Viewing the Excel Window Running Excel Commands, Excel Workbooks and Worksheets, opening a Workbook, scrolling through a Workbook, Worksheet Cells, selecting a Cell, Moving Cells, Printing from Excel, Previewing the Print Job, Setting Up the Page, Printing the Page, Saving Your Work, Excel Add-Ins, Loading the Data Analysis ToolPak, Unloading an Add-In, Hidden Data, Setup Options, Exiting Excel.	**5**
	WORKING WITH DATA: Data Entry, Entering Data from the Keyboard, Entering Data with Autofill, Inserting New Data, Data Formats, Formulas and Functions, inserting a Simple Formula, inserting an Excel Function, Cell References, Range Names, Sorting Data, Querying Data, Using the AutoFilter, Using the Advanced Filter, Using Calculated Values, Importing Data from Text Files, Importing Data from Databases, Using Excel's Database Query Wizard, Specifying Criteria and Sorting Data. Vlookup.	**5**
	WORKING WITH CHARTS: Introducing Excel Charts, Introducing Scatter Plots, Editing a Chart, Resizing and Moving an Embedded Chart , Moving a Chart to a Chart Sheet, Working with Chart and Axis Titles, Editing the Chart Axes ,Working with Gridlines and Legends, Editing Plot Symbols , Identifying Data Points, Selecting a Data Row, Labeling Data Points, Formatting Labels, Creating Bubble Plots, Breaking a Scatter Plot into Categories, Plotting Several Variables	**5**
2	Describing Data & Probability Distributions	
	DESCRIBING DATA: Variables and Descriptive Statistics, Frequency Tables, Creating a Frequency Table, Using Bins in a Frequency, Defining customized Bin Values, Working with Histograms, Creating a Histogram, Shapes of Distributions, Breaking a Histogram into Categories, Working with Stem and Leaf Plots,	**6**
	Distribution Statistics, Percentiles and Quartiles, Measures of the Center: Means, Medians, and the Mode, Measures of Variability, Measures of Shape: Skewness and Kurtosis, Outliers, Working with Boxplots.	**4**
	PROBABILITY DISTRIBUTIONS: Probability, Probability Distributions, Discrete Probability Distributions, Continuous Probability Distributions, Random Variables and Random Samples. The Normal Distribution, Excel Worksheet Functions, Using Excel to Generate Random Normal Data Charting Random Normal Data, The Normal Probability Plot, Parameters	**5**

		and Estimators, The Sampling Distribution, Sampling Distributions, The Standard Error, The Central Limit Theorem .	
3		Statistical Inference , Tables & Regression And Correlation.	
		STATISTICAL INFERENCE Confidence Intervals, z Test Statistic and z Values, Calculating the Confidence Interval with Excel. Interpreting the Confidence Interval, Hypothesis Testing, Types of Error, Acceptance and Rejection Regions, p Values, The t Distribution, Constructing a t Confidence Interval, The Robustness of t, Applying the t Test to Paired Data, comparing the Pooled and Unpooled Test Statistics Working with the Two-Sample t Statistic. Testing for Equality of Variance Applying the t Test to Two-Sample Data	**5**
		TABLES: PivotTables, Removing Categories from a PivotTable, Changing the Values Displayed by the Pivot Table, Displaying Categorical Data in a Bar Chart, Displaying Categorical Data in a Pie Chart, Two-Way Tables, Computing Expected Counts, The Pearson Chi-Square Statistic Validity of the Chi-Square Test with Small Frequencies, Tables with Ordinal Variables Testing for a Relationship between Two Ordinal Variables, Custom Sort Order	**5**
		REGRESSION AND CORRELATION: Simple Linear Regression, The Regression Equation, Fitting the Regression Line, Regression Functions in Excel, Exploring Regression, performing a Regression Analysis, Plotting Regression Data, Calculating Regression Statistics, Interpreting Regression Statistics. Correlation, Correlation and Slope, Correlation and Causality, Spearman's Rank Correlation Coefficient's, Correlation Functions in Excel, Creating a Correlation Matrix , Correlation with a Two-Valued Variable, Adjusting Multiple p Values with Bonferroni , Creating a Scatter Plot Matrix	**5**

Practicals	
1	Introduction to the use of Excel.
2	Use of the formula and functions.,
3	Exploratory Data Analysis I
4	Exploratory Data Analysis II
5	Computing the Measures of Central Tendency.

6	Computing the Measures of Dispersion
7	Computing probabilities for Discrete Distributions.
8	Computing probabilities for Continuous Distributions.
9	Performing statistical tests I
10	Performing statistical tests I
11	Use of Vlookup, data sorting and filter.
12	Creation of Pivot tables.
13	Correlation and Regression analysis and forecasting.

Suggested Readings:
Text books:
1. Wayne Winston, Marketing Analytics, 2018 Reprint, Wiley
2. Mario F. Triola - Elementary Statistics Using Excel-Pearson (2018)
3. Brian D. Bissett - Automated Data Analysis Using Excel-Chapman & Hall CRC (2007

Reference Books
1. Kenneth N. Berk, Patrick Carey, Data Analysis with Microsoft® Excel.
2. Bill Jelen - Guerilla Data Analysis Using Microsoft Excel-Holy Macro! Books (2002).
3. Thomas Cleff - Applied Statistics and Multivariate Data Analysis for Business and Economics
4. Vijay Gupta - Statistical Analysis With Excel-VJ Books (2002)
5. A Modern Approach Using SPSS, Stata, and Excel-Springer International Publishing (2020)

Program: **B.Sc. Applied Statistics And Data Analytics (Hons)**					Semester: **II**	
Course : **Introduction to R**					Course Code: **USMAAS206**	
Teaching Scheme					**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**		**Continuous Assessment (CA) (Marks - 25)**	**Semester End Examinations (SEE) (Marks- 75 in Question Paper)**
3	2	-	4		25	75

Learning Objectives:

To introduce the learner to the powerful software used for statistical calculations and data analysis.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Load the r software and different packages.

CO2: Identify vectors and assign data items to vectors in different ways.

CO3: Make use of operators, perform basic calculations using inbuilt functions.

CO4: Create Matrices, arrays and list and be able to distinguish between them

CO5: Remove NA or Null items before any computations are to be done

CO6: Create, test and merge data frames, perform operations on data frames.

CO7: Identify data types, atomic, lists matrices, arrays, data frames, S3 and S4 objects.

CO8: Define functions.

CO9: Create graphs and charts

CO10: Read data into r using csv, xml, Web Data, JSON files, Databases, Excel files.

Outline of Syllabus: (per session plan)

Module	Description	No of Hours
1	Introduction	15
2	Data frames and Control Statements.	15
3	OOP, Graphics, Reading (Import) External Data.	15
	Total	**45**

PRACTICALS

Module	Introduction to R	No. of Hours /Credits

		45/3
1	Introduction	15
	Introduction: Introducing to R – R Data Structures – Help functions in R – Vectors – Scalars – Declarations – recycling – Common Vector operations – Using all and any – Vectorized operations – NA and NULL values – Filtering – Vectorised if-then else – Vector Equality – Vector Element names	5
	Matrices, Arrays And Lists: Creating matrices – Matrix operations – Applying Functions to Matrix Rows and Columns – Adding and deleting rows and columns – Vector/Matrix Distinction – Avoiding Dimension Reduction – Higher Dimensional arrays – lists – Creating lists – General list operations – Accessing list components and values – applying functions to lists – recursive lists	5
		5
2	Data frames and Control Statements.	15
	Data Frames: Creating Data Frames – Matrix-like operations in frames – Merging Data Frames – Applying functions to Data frames – Factors and Tables – factors and levels – Common functions used with factors – Working with tables - Other factors and table related functions –	5
		5
	Control statements – Arithmetic and Boolean operators and values – Default values for arguments - Returning Boolean values – functions are objects – Environment and Scope issues – Writing Upstairs - Recursion – Replacement functions – Tools for composing function code – Math and Simulations in R	5
3	OOP, Graphics, Reading (Import) External Data.	15
	OOP: S3 Classes – S4 Classes – Managing your objects – Input/Output – accessing keyboard and monitor – reading and writing files – accessing the internet - String Manipulation.	5
	Graphics – Creating Graphs – Customizing Graphs – Saving graphs to files – Creating three-dimensional plots	5
	Reference Class Reading and getting data into R (External Data): Using CSV files, XML files, Web Data, JSON files, Databases, Excel files.	5

Practicals	
1	Creation and algebra of vectors
2	Filtering of NA, NULL items.
3	Creation and algebra of matrices, arrays

4	Functions
5	Creating data frames
6	Control Statements
7	S3 and S4 classes
8	String manipulation.
9	Creating Graphs
10	Reading data from different file types.

Suggested Readings

Text Books:

1. Mark Gardener, Beginning R – The Statistical Programming Language, Wiley,2013
2. W. N. Venables, D. M. Smith and the R Core Team, "An Introduction to R", 2013.
3. Wickham Hadley, Advanced R, Chapman & hall / CRC press.

Reference Books:

1. Micheal Crawley, The R Book, 2nd Edition, 2012 Wiley.
2. Norman Matloff, "The Art of R Programming: A Tour of Statistical Software Design", NoStarch Press, 2011.
3. Jared P. Lander, "R for Everyone: Advanced Analytics and Graphics", Addison-Wesley Data & Analytics Series, 2013
4. Robert Knell, Introductory R: A Beginner's Guide to Data Visualisation, Statistical Analysis and Programming in R.

Program: B.Sc. **Applied Statistics And Data Analytics** (Hons)				Semester: II	
Course: Soft Skills				Course Code: USMAAS207	

Teaching Scheme				Evaluation Scheme	
Lecture (Hours per week)	**Practical** (Hours per week)	**Tutorial** (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 25)**	**Semester End Examinations (SEE) (Marks- 75 in Question Paper)**
2		-	2	25	75

Learning Objectives:

- To encourage the all-round development of the learners.
- To make the learners aware of the importance, the role and the content of soft skills through instruction, knowledge acquisition, demonstration and practice.
- To develop and nurture the soft skills in the learners through individual and group activities.
- To expose the learners to the correct attitudinal and behavioral aspects.
- To build these aspects same through individual and group activities

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Discover the inner traits/characteristics possessed by them.

CO2: Get rid of the fear of speaking out or communicating in a group.

CO3: Effectively communicate through verbal/oral communication.

CO4: Improve the listening skills.

CO5: Write precise briefs or reports and technical documents.

CO6: Actively participate in group discussions / meetings / interviews /chats and prepare & deliver presentations.

CO7: Become more effective individual through goal/target setting, self- motivation and practicing creative thinking.

CO8: Function effectively in multi-disciplinary and heterogeneous teams through the knowledge of team work, develop inter-personal relationships.

CO9: Face conflict management and leadership quality.

Outline of Syllabus: (per session plan)

Module	Description	No of Hours
1	Soft Skills, Self-Discovery, Positivity and Motivation, Interpersonal Communication:	45
2	Public Speaking, Group Discussion, Non-Verbal Communication, Teamwork and Leadership Skills:	45
3	Presentation Skills, Etiquette and Manners, Time Management, Personality Development.	45
	Total	

Module	Soft Skills	No. of Hours /Credits 30/2
1	Soft Skills, Self-Discovery, Positivity and Motivation, Interpersonal Communication	**30/2**
	Soft Skills: An Introduction – Definition and Significance of Soft Skills; Process, Importance and Measurement of Soft Skill Development. Self-Discovery: Discovering the Self; Setting Goals; Beliefs, Values, Attitude, Virtue. Positivity and Motivation: Developing Positive Thinking and Attitude; Driving out Negativity; Meaning and Theories of Motivation; Enhancing Motivation Levels. Interpersonal Communication: Interpersonal relations; communication models, process and barriers; team communication; developing interpersonal relationships 7 through effective communication; listening skills; essential formal writing skills; corporate communication styles – assertion, persuasion, negotiation.	**10**
2	Public Speaking, Group Discussion, Non-Verbal Communication, Teamwork and Leadership Skills:	
	Public Speaking: Skills, Methods, Strategies and Essential tips for effective public speaking. Group Discussion: Importance, Planning, Elements, Skills assessed; Effectively disagreeing, Initiating, Summarizing and Attaining the Objective. Non-Verbal Communication: Importance and Elements; Body Language. Teamwork and Leadership Skills: Concept of Teams; Building effective teams; Concept of Leadership and honing Leadership skills.	**10**
3	Presentation Skills, Etiquette and Manners, Time Management, Personality Development.	
	Presentation Skills: Types, Content, Audience Analysis, Essential Tips – Before, During and After, Overcoming Nervousness. Etiquette and Manners – Social and Business. Time Management – Concept, Essentials, Tips.	**10**

	Personality Development – Meaning, Nature, Features, Stages, Models; Learning Skills; Adaptability Skills.	

Suggested Readings:
Text Books:
1. Managing Soft Skills for Personality Development – edited by B.N.Ghosh, McGraw Hill India, 2012.
2. Lucas, Stephen E. The Art of Public Speaking. McGraw-Hill Book Co. International Edition, 11th Ed. 2014
3. Personality Development and Soft skills , Oxford University Press by Barun K.Mitra.

Reference Books
1. Butterfield, Jeff. Soft Skills for Everyone. New Delhi: Cengage Learning. 2010.
2. Chauhan, G.S. and Sangeeta Sharma. Soft Skills. New Delhi: Wiley. 2016
3. Soft skills Training – A workbook to develop skills for employment by Fredrick H. Wentz.
4. English and Soft Skills – S.P.Dhanavel, Orient Blackswan India, 2010.
5. Penrose, John M., et al. Business Communication for Managers. New Delhi: Thomson South Western. 2007.
6. Sharma, R.C. and Krishna Mohan. Business Correspondence and Report Writing. New Delhi: TMH. 2016.
7. Sharma, Sangeeta and Binod Mishra. Communication Skills for Engineers and Scientists. New Delhi: PHI Learning. 2009, 6th Reprint 2015.
8. Thorpe, Edgar and Showick Thorpe. Winning at Interviews. Pearson Education. 2004.
9. Turk, Christopher. Effective Speaking. South Asia Division: Taylor & Francis. 1985.
10. The Time Trap : the Classic book on Time Management by R. Alec Mackenzie