

COURSE CURRICULUM & SYLLABUS

B.Sc. (Hons.) Mathematics 3 Year (6 Semester) Programme 2023-2024 Session

SUMMARY

Sem.	Core Subject (Mathematics)		Generic Courses (Computing Courses)		Ability Enhancement Courses (AEC)		Total	
	Number of Courses	Credit	Number of Courses	Credit	Number of Courses	Credit	Number of Courses	Credit
I	3	12	2	6	2	6	7	24
II	3	12	2	4	2	8	6	24
III	3	12	2	6	1	4	6	22
IV	4	16	2	6	1	4	7	26
V	5	18	2	6	-	-	7	24
VI	5	24	-	-	-	-	7	24
Total	23	94	9	28	6	22	34	144

Sr. No.	Course Code	Course Title	Teaching			Credit
			L	T	P	
SEMESTER I						
1	SCUCMT111T	Calculus - I	4	-	-	4
2	SCUCMT112T	Algebra	4	-	-	4
3	SCUCMT113T	Geometry	4	-	-	4
4	CASCPSC10T	Fundamentals of Computer and C- Programming	4	-	-	4
5	CASCPSC10P	C- Programming Lab	-	-	4	2
6	ARSPCSC11T	Introduction to Professional Communication	2	-	-	2
7	PTSPSC10T	Professional Proficiency	4	-	-	4
Total			22	-	4	24
SEMESTER II						
1	SCUCMT211T	Calculus - II	4	-	-	4
2	SCUCMT212T	Real Analysis - I	4	-	-	4
3	SCUCMT213T	Ordinary Differential Equation	4	-	-	4
4	CASCPSC20T	Fundamentals of Data Science	4	-	-	4
5	CASCPSC20P	Fundamentals of Data Science Lab	-	-	4	2
5	SCUCEV201T	Environmental Science	2	-	-	2
6	PTSPSC20T	Professional Proficiency	4	-	-	4
Total			22	-	4	24

Sr. No.	Course Code	Course Title	Teaching			Credit
			L	T	P	
SEMESTER III						
1	SCUCMT301T	Probability and Statistics	4			4
2	SCUCMT302T	Group Theory	4			4
3	SCUCMT303T	Mechanics	4			4
4	CASCPSC30T	Image Processing Using MATLAB	4			4
5	CASCPSC30P	Image Processing Using MATLAB Practical	-	-	4	2
6	PTSPSC30T	Professional Proficiency	4			4
Total			20	-	4	22
SEMESTER IV						
1	SCUCMT401T	Complex Analysis	4	-	-	4
2	SCUCMT402T	Linear Algebra	4	-	-	4
3	SCUCMT403T	Partial Differential Equation	4	-	-	4
4	SCUCMT404T	Mathematical Methods	4			4
5	CASCPYC40T	Python Programming	4	-	-	4
6	CASCPYC40P	Python Programming Lab	-	-	4	2
7	PTSPSC40T	Professional Proficiency	4	-	-	4
Total			24		4	26

Sr. No.	Course Code	Course Title	Teaching			Credit
			L	T	P	
SEMESTER V						
1	SCUCMT501T	Numerical Method	4	-	-	4
2	SCUCMT501P	Numerical Method Lab	-	-	4	2
3	SCUCMT502T	Advanced Algebra	4	-	-	4
4	SCUCMT503T	Real analysis - II	4	-	-	4
5	SCUCMT504T	Number Theory	4	-	-	4
6	CASCPSC50T	A I and Machine Learning	4	-	-	4
7	CASCPSC50P	A I and Machine Learning Lab	-	-	4	2
Total			20	-	8	24
SEMESTER VI						
1	SCUCMT601T	Differential Geometry and Tensor Analysis	4	-	-	4
2	SCUCMT602T	Linear Programming	4	-	-	4
3	SCUCMT-6101T-6103T	Elective - I	4	-	-	4
4	SCUCMT-6201T-6203T	Elective - II	4	-	-	4
5	SCUCMT601P	Project	-	-	4	8
Total			16		4	24

L - Lecture, T - Tutorial, P- Practical

CA - Continuous Assessment

ESE - End Semester Examination

ELECTIVE COURSE

B.Sc. (Hons.) Mathematics VI Semester

Student would choose one course from each group

Group	S.No	Course Code	Course Title	L-T-P	Credits
Elective - I	1	SCUCMT6101T	Advanced Differential Equation	4	4
	2	SCUCMT6102T	Operation Research	4	4
	3	SCUCMT6103T	Cryptography	4	4
Elective - II	1	SCUCMT6201T	Discrete Mathematics	4	4
	2	SCUCMT6202T	Mathematical Modelling and Boolean Algebra	4	4
	3	SCUCMT6203T	Principles of Computer Science	4	4

Syllabus for B.Sc. (Hons.) Mathematics

Course Title: CALCULUS - I

Course Code: SCUCMT111T

Semester: I

L	T	P	C
4	0	0	4

Objective:

To familiar students with fundamental concepts and function of graphical, numerical, analytical and relationship between the derivative..

Unit	Content	Hours
1	Real number system: Completeness axiom, density of rationals (irrationals) in reals, convergence of a sequence, Sandwich theorem, Monotone sequences, Cauchy Criterion, Subsequence, Bolzano-Weierstrass theorem.	9
2	Limit and Continuity ϵ - δ definition of limit of a real valued function, Limit at infinity and infinite limits; Continuity of a real valued function, Properties of continuous functions, Intermediate value theorem, Geometrical interpretation of continuity, Types of discontinuity; Uniform continuity.	9
3	Differentiability, Differentiability of a real valued function, Geometrical interpretation of differentiability, Relation between differentiability and continuity, Differentiability and monotonicity, Chain rule of differentiation; Successive differentiation, Leibnitz's theorem.	9
4	Expansions of Functions Maclaurin's and Taylor's theorems for expansion of a function in an infinite series, Taylor's theorem in finite form with Lagrange, Cauchy and RocheSchlomilch forms of remainder; Maxima and minima.	9
5	Curvature, Asymptotes and Curve Tracing Curvature; Asymptotes of general algebraic curves, Parallel asymptotes, Asymptotes parallel to axes; Symmetry, Concavity and convexity, Points of inflection,	9

Course Outcomes

- Find limits of functions (graphically, numerically and algebraically)
- Analyze and apply the notions of continuity and differentiability to algebraic and transcendental functions.
- Determine derivatives by a variety of techniques including explicit differentiation, implicit differentiation, and logarithmic differentiation. Use these derivatives to study the characteristics of curves. Determine derivatives using implicit differentiation and use to study characteristics of a curve.
- Construct detailed graphs of nontrivial functions using derivatives and limits.

Recommended Text Books

1. Gorakh Prasad (2016). Differential Calculus (19th edition). Pothishala Pvt. Ltd.
2. Shanti Narayan, Differential Calculus, S Chand Publication.

Recommended Reference Books

1. Howard Anton, I. Bivens & Stephan Davis (2016). Calculus (10th edition). Wiley India.
2. Gabriel Klambauer (1986). Aspects of Calculus. Springer-Verlag.
3. Wieslaw Krawcewicz & Bindhyachal Rai (2003). Calculus with Maple Labs. Narosa.
4. George B. Thomas Jr., Joel Hass, Christopher Heil & Maurice D. Weir (2018) Thomas' Calculus (14th edition). Pearson Education.

Syllabus for B.Sc. (Hons.) Mathematics

Course Title: ALGEBRA

Semester: I

L T P C
4 0 0 4
Course Code: SCUCMT112T

Objective:

Students will be able to recognize that complex numbers are an extension of real numbers and understand that complex numbers , Method for solving advanced problems in matrices.

Unit	Content	Hours
1	Theory of Equations and Complex Numbers Elementary theorems on the roots of an equations including Cardan's method, The remainder and factor theorems, Synthetic division, Factored form of a polynomial, The Fundamental theorem of algebra	9
2	Relations between the roots and the coefficients of polynomial equations, Imaginary roots, Integral and rational roots; Polar representation of complex numbers, The nth roots of unity, De Moivre's theorem for integer and rational indices and its applications.	9
3	Relations and Basic Number Theory Relations, Equivalence relations, Equivalence classes; Functions, Composition of functions, Inverse of a function; Finite, countable and uncountable sets; The division algorithm, Divisibility and the Euclidean algorithm, The fundamental theorem of arithmetic, Modular arithmetic and basic properties of congruences; Principles of mathematical induction and well ordering.	9
4	Row Echelon Form of Matrices and Applications Systems of linear equations, Row reduction and echelon forms, Linear independence, The rank of a matrix and applications.	9
5	Introduction to linear transformations, The matrix of a linear transformation, Matrix operations, Determinants, The inverse of a matrix, Characterizations of invertible matrices; Applications to Computer Graphics; Eigenvalues and eigenvectors, The characteristic equation and the Cayley–Hamilton theorem.	9

Course Outcomes

After completion course, Student will be able-

- To evaluate square roots of negative numbers,
- To understand that a complex number is a number that is formed of a complex of two parts: a real part and an imaginary part,
- Identify the real and imaginary parts of a complex number.
- To find the inverse of a square matrix.
- To Solve the matrix equation $Ax = B$ using row operations and matrix operations.
- Understand the concept of square matrix, and of the inverse of an invertible matrix.

Recommended Text Books

1. A.R. Vasishtha, Linear Algebra & Matrices text book for B.Sc., KRISHNA PRAKASHAN, Eighteen Edition 2020.
2. Dr. B.S.Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publication

Recommended Reference Books

1. Titu Andreescu, & Dorin Andrica (2014). Complex Numbers from A to...Z. (2nd edition). Birkhäuser.
2. David C . Lay, Linear Algebra and It's Application, 3rd Edition, Pearson Education Asia, Indian Reprint, 2007

Syllabus for B.Sc. (Hons.) Mathematics

Course Title: **GEOMETRY**

Semester: **I**

L T P C
4 0 0 4
Course Code: **SCUCMT113T**

Objective:

The course aims to explore the knowledge of student on geometric ideas, theorems of Euclidean geometry with conceptual meaning of measurement.

Unit	Content	Hours
1	Transformation of rectangular axes. General equation of second degree and its reduction to normal form. Systems of conies. Polar equation of a conic.	10
2	Projection and direction cosine, straight line and plane.	8
3	Sphere	8
4	Cone and cylinder	10
5	Central conicoids, paraboloids, plane sections of conicoids. Generating lines. Reduction of second degree equations to normal form; classification of quadrics.	9

Course Outcomes

After completion course, Student will be able-

- To understand Polar equation of a conic
- To understand lines & Plane in 3 dimensions.
- To Finding equation in various form of line & plane circle, ellipse, sphere, cones, cylinder etc.

Recommended Text Books

1. R. S. Gupta and R. D. Pathak: Conic Sections.
2. N. Saran and R. S. Gupta: Analytical Geometry of three dimensions.
3. Shanti Narayan, Analytical Geometry of three dimensions.

Recommended Reference Books

1. Bell, R. J. T., Elementary Treatise on Coordinate geometry.
2. Chaki, M. C., A Text book of Analytical Geometry, Calcutta Publishers.
3. P K Mittal, Mathematics for Degree Students B. Sc. 1St Yr ISBN : 9788121932400 S. Chand Publishing

Syllabus for B.Sc. (Hons.) Mathematics

Course Title: FUNDAMENTALS OF COMPUTER AND C- PROGRAMMING

Course Code: CASCPSC10T

Semester: I

Objective:

L T P C
4 0 0 4

The course is designed to provide the foundation of logic development. This course will provide the base of further programming related courses. Students could develop their own logic and construct the programs & applications in C.

Unit	Content	Hours
1	Introduction to Programming: The Basic Model of Computation, Algorithms, Flow-charts, Programming Languages, Compilation, Linking and Loading, Testing and Debugging, Documentation. Algorithms for Problem Solving: Exchanging values of two variables, summation of a set of numbers, Decimal Base to Binary Base conversion, Reversing digits of an integer, GCD (Greatest Common Division) of two numbers, Test whether a number is prime, Organize numbers in ascending order, Find square root of a number, factorial computation, Fibonacci sequence, Evaluate 'sin x' as sum of a series, Reverse order of elements of an array, Find largest number in an array, Print elements of upper triangular matrix, multiplication of two matrices, Evaluate a Polynomial.	8
2	Introduction to 'C' Language.: Character set, Variables and Identifiers, Built-in Data Types, Variable Definition, Arithmetic operators and Expressions, Constants and Literals, Simple assignment statement, Basic input/output statement, Simple 'C' programs. Conditional Statements and Loops: Decision making within a program, Conditions, Relational Operators, Logical Connectives, if statement, if-else statement, Loops: while loop, do while, for loop, Nested loops, Infinite loops, Switch statement, structured Programming. Arrays: One dimensional arrays: Array manipulation; Searching, Insertion, Deletion of an element from an array; Finding the largest/smallest element in an array; Two dimensional arrays, Addition/Multiplication of two matrices, Transpose of a square matrix; Null terminated strings as array of characters, Standard library string functions.	10
3	Functions: Top-down approach of problem solving, Modular programming and functions, Standard Library of C functions, Prototype of a function: Formal parameter list, Return Type, Function call, Block structure, Passing arguments to a Function: call by reference, call by value, Recursive Functions, arrays as function arguments. Storage Classes: Scope and extent, Storage Classes in a single source file: auto, extern and static, register, Storage Classes in a multiple source files: extern and static.	9
4	Structures and Unions: Structure variables, initialization, structure assignment, nested structure, structures and functions, structures and arrays: arrays of structures, structures containing arrays, unions. Pointers: Address operators, pointer type declaration, pointer assignment, pointer initialization, pointer arithmetic, functions and pointers, Arrays and Pointers, pointer arrays, pointers and structures, dynamic memory allocation.	10
5	Self-Referential Structures and Linked Lists Creation of a singly connected linked list, Traversing a linked list, Insertion into a linked list, Deletion from a linked list. File Processing: Concept of Files, File opening in various modes and closing of a file, Reading from a file, Writing.	8

Course Outcomes

- Develop efficient algorithms for solving a problem.
- Use the various constructs of a programming language viz. conditional, iteration and recursion.
- Implement the algorithms in "C" language.
- Use simple data structures like arrays, stacks and linked list in solving problems.
- Handling File in "C".

Recommended Text Books

1. Byron S Gottfried "Programming with C" Second edition, Tata Mc Grawhill, 2007 (Paperback)
2. R.G. Dromey, "How to solve it by Computer", Pearson Education, 2008.
3. Kanetkar Y, "Let us C", BPB Publications, 2007.
4. Hanly J R & Koffman E.B, "Problem Solving and Program design in C", Pearson Education, 2009.

Recommended Reference Books

1. E. Balagurusamy, "Programming with ANSI-C", Fourth Edition, 2008, Tata Mc GrawHill.
2. Venugopal K. R and Prasad S. R, "Mastering 'C'", Third Edition, 2008, Tata McGraw Hill.
3. B.W. Kernighan & D.M. Ritchie, "The C Programming Language", Second Edition, 2001, Pearson Education.
4. ISRD Group, "Programming and Problem-Solving Using C", Tata Mc GrawHill, 2008.

Syllabus for B.Sc. (Hons.) Mathematics

Course Title: **C- PROGRAMMING LAB**

Course Code: **CASCPC10P**

Semester: **I**

Objective: The course aims to acquire logical thinking, Implement the algorithms, Identify the correct and efficient ways of solving problems.

L	T	P	C
0	0	4	2

Note: A minimum of ten experiments from the following should be performed.

- Write a program to find sum of all prime numbers between 100 and 500.
- Write a program to obtain sum of the first 10 terms of the following series for any positive integer value of X :
 $X + X^3/3! + X^5/5! + X^7/7! + \dots$
- Write a program to reverse the digits of a given number. For example, the number 9876 should be returned as 6789.
- Write a program to compute the wages of a daily laborer as per the following rules: -Hours Worked Rate Applicable

Upto first 8 hrs	Rs 50/-
For next 4hrs	Rs 10/- per hr
extra For next 4hrs	Rs 20/- per hr
extra For next 4hrs	Rs 25/- per hr
extra For rest	Rs 40/- per hr
extra	

Accept the name of the laborer and no. of hours worked. Calculate and display the wages. The program should run for N number of laborers as specified by the user.

- Write a program to input 20 arbitrary numbers in one-dimensional array. Calculate Frequency of each number. Print the number and its frequency in a tabular form.
- Define 2 dimensional array a (3,3), b (3,3), sum (3,3), diff (3,3), mult (3,3). Store 9 arbitrary numbers in a (3,3) and 9 arbitrary numbers in b (3,3). Do the following:
 - a) Calculate sum of a (3,3) and b (3,3) and store in sum (3,3) where $\text{sum}(i,j) = a(i,j) + b(i,j)$
 - b) Calculate difference of a (3,3) and b (3,3) and store in diff (3,3) where $\text{diff}(i,j) = a(i,j) - b(i,j)$
 - c) Calculate product of two arrays a (3,3) and b (3,3) and store in mult (3,3) where $\text{mult}(i,j) = \text{summation of } a(i,k) * b(k,j) \text{ over } k \text{ where } k=1 \text{ to } 3.$

Print the result in a tabular form

- Write a function, str_search (char* s1, char* s2, int n) , that takes two strings and an integer, as arguments and returns a pointer to the nth occurrence of 1st string s1 in 2nd string s2, or NULL if it is not present.
- Write a C function to remove duplicates from an ordered array. For example, if input array contains 10,10,10,30,40,40,50,80,80,100 then output should be 10,30,40,50,80,100
- Apply recursive call to do the following:
 - (i) Input 'n'(1-200). Calculate sum of 'n' numbers.
 - (ii) Input 'n'(1-20). Calculate product of 'n' numbers.
 - (iii) Input 'n'(2-20). Print 'n' number of Fibonacci numbers. In Fibonacci sequence the sum of two successive terms gives the third term. The following are few terms of Fibonacci sequence: -1 1 2 3 5 8 13
- Write a program which will arrange the positive and negative numbers in a one-dimensional array in such a way that all positive numbers should come first and then all the negative numbers will come without changing original sequence of the numbers.

Example:

Original array contains: 10, -15, 1, 3, -2, 0, -2, -3, 2, -9

Modified array : 10, 1, 3, 0, 2, -15, -2, -2, -3, -9

- Write a menu driven program to maintain a Telephone Directory having following file structure:
 1. Name: Character type: Length =20 characters.
 2. Address Character type: Length =40 characters.
 3. Phone: Character type: Length =12 characters.

Menu

1. Addrecord(s)
2. Display record(s)
3. Search record(s)
4. Modify record(s)
5. Delete record(s)
6. Backup copy of File
7. Exit

Type your choice= 1,2,3,4,5,6,7— ->

Laboratory Outcomes: After Completing of this lab course, students are able to –

- Understand the logic for a given problem.
- Write the algorithm of a given problem.

- Draw a flow chart of a given problem.
- Recognize and understand the syntax and construction of C programming code.
- Gain experience of procedural language programming.

Syllabus for B.Sc. (Hons.) Mathematics

Course Title: INTRODUCTION TO PROFESSIONAL COMMUNICATION

L T P C
2 0 0 2
Course Code: ARSPCSC10T

Semester: I

Objectives:

1. To put in use the basic mechanics of Grammar.
2. To provide an outline to effective Organizational Communication.
3. Understand the role of communication in personal & professional success.
4. Prepare and present messages with a specific intent.

Unit	Content	Hours
1	Components of Technical Writing and Functional Grammar Words and Phrases: Word formation; Root words from foreign languages & their use in English; Prefixes & Suffixes: Derivatives; Modals; Infinitives; vocabulary development: technical vocabulary, vocabulary used in formal letters/emails and reports.	6
2	Fundamentals of Technical Communication Introduction to Communication; Process of Communication; Technical Communication: features: Distinction between General And Technical Communication; The flow of communication: Downward, Upward, Lateral/Horizontal (Peer group); Barriers to Communication; Dimensions of Communication: Reading, Listening & Comprehension: skills, types & methods.	6
3	Technical Style & Written Communication Technical Style: Features; types; Requisites of Sentence Construction; Types of Sentences; Paragraph Development: Techniques and Methods: Inductive, Deductive, Spatial, Linear, Chronological etc. Devices;	6
4	Written Business Communication Letter writing: Principles, Type: Sales; Credit letters; Claim; Adjustment Letters; Job Application & official letter; Reports: Types; Significance; Structure, & drafting of Reports. Technical Proposal; Types; Writing of Proposal; Significance; Seminar & Conference paper writing; Expert Technical Lecture: Theme clarity; Analysis & Finding; Notices; Agenda; Minutes of Meeting.	6
5	Presentation Strategies & Oral Communication Analysis of Audience and Locale; Nuances and Modes of Delivery; Kinesics; Proxemics; Dimensions of Speech: Syllable; Accent; Pitch; Rhythm; Intonation; Paralinguistic features of voice; Methods of Presentation: Interpersonal; Impersonal; Audience Participation: Quizzes & Interjections; Flow in Speaking; Public Speaking: method; Techniques: Clarity of substance; emotion; Humour ;	6

Course Outcomes

- Students would be able to create substantial base by the formation of strong professional vocabulary for its application at different platforms and through numerous modes as Comprehension, reading, writing and speaking etc.
- Students will be enabled to understand the basic objective of the course by being acquainted with specific dimensions of communication skills i.e. Reading, Writing, Listening, Thinking and Speaking.
- Students will cultivate relevant technical style of communication & presentation at their work place & also for academic uses.
- Students will apply it at their work place for writing purposes such as Presentation/official drafting/administrative communication and use it for document/project/report/research paper writing.
- Students will apply it for practical and oral presentation purposes by being honed up in presentation skills and voice-dynamics. They will apply techniques for developing interpersonal communication skills and positive attitude leading to their professional competence.

Recommended Text Books

1. Improve your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, New Delhi.
2. Technical Communication- Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2007, New Delhi.
3. Functional skills in Language and Literature, by R.P. Singh, Oxford Univ. Press, 2005, New Delhi.
4. Ashraf Rizvi, "Effective Technical Communication", 2nd Edition, McGraw Hill Education, 2017.

Recommended Reference Books

1. Communication Skills for Engineers and Scientists, Sangeeta Sharma et.al. PHI Learning Pvt. Ltd, 2011, New Delhi.
2. Business Correspondence and Report Writing by Prof. R.C., Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd. , 2001, New Delhi.
3. Word Power Made Easy by Norman Lewis, W.R. Goyal Pub. & Distributors, 2009, Delhi.
4. Developing Communication Skills by Krishna Mohan, Mecra Bannerji- Macmillan India Ltd. 1990, Delhi.

Syllabus for B.Sc. (Hons.) Mathematics

L T P C
4 0 0 4

Course Title: PROFESSIONAL PROFICIENCY

Course Code: PTSPpsc10T

Semester: I

Objectives:

Students should be able to read and write correct English, attain reasonable fluency in the Language and should also be exposed to introductory lessons of Aptitude Building.

Unit	Content	Hours
1	Revision : 1) Grammar (Basics) 2)Preposition 3)Tense 4) Subject-Verb Agreement 5)Synonyms & Antonyms	10
Hard Skills	The goal is to teach Grammar implicitly through reading comprehensions. A short story/paragraph should be given for the students to identify the parts of speech and the other topics mentioned above. The classes should be learner centric and the students should be able to apply the lessons learnt in their daily conversations.	
2	Speaking: Etiquettes (not theoretical/written but practical) of Listening, Speaking, Writing, Speech Delivery.	15
Soft Skills	The aim should be to attempt to make the students the centre of the learning process and break the ice with speaking the language. They should develop the confidence to speak and think in the language for further professional exposure. They should be engaging in intelligent conversation with the instructor and expressing themselves in English.	
Practice Sheet	Questions (Subjective and Objective) based on the instruction given every week. The aim should be to bring the instruction given in practice by making them write, speak and think along the lines of the instruction given. The practice sheet should be evaluated and necessary feedback must be given. Some exercise on compositional skills must be given so they develop a sense of writing and expressing themselves through the written word.	
3	Quantitative Aptitude & Logical Reasoning · Simplification & Approximation · Alpha-Numeric Series & Miscellaneous · Coding-Decoding	20

Course Outcomes

- Better representation of himself/herself in terms of communication skills, overall personality development and aptitude building required for jobs.
- This program will help students employable and ready for Industries /corporate and other Public and Private Sector jobs.

Syllabus for B.Sc. (Hons.) Mathematics

Course Title: CALCULUS - II	L T P C 4 0 0 4
Semester: II	Course Code: SCUCMT211T

Objective:

The course is designed to provide the study of function of several variables & vector calculus.

Unit	Content	Hours
1	Partial Differentiation Functions of several variables, Level curves and surfaces, Limits and continuity, Partial differentiation, Tangent planes, Chain rule, Directional derivatives, The gradient, Maximal and normal properties of the gradient, Tangent planes and normal lines.	10
2	Differentiation Higher order partial derivatives, Total differential and differentiability, Jacobians, Change of variables, Euler's theorem for homogeneous functions, Taylor's theorem for functions of two variables and more variables, Envelopes and evolutes.	7
3	Extrema of Functions and Vector Field Extrema of functions of two and more variables, Method of Lagrange multipliers, Constrained optimization problems, Definition of vector field, Divergence, curl, gradient and vector identities.	10
4	Double and Triple Integrals Double integration over rectangular and nonrectangular regions, Double integrals in polar coordinates, Triple integral over a parallelepiped and solid regions, Volume by triple integrals, Triple integration in cylindrical and spherical coordinates, Change of variables in double and triple integrals, Dirichlet integral.	8
5	Green's, Stokes' and Gauss Divergence Theorem Line integrals, Applications of line integrals: Mass and Work, Fundamental theorem for line integrals, Conservative vector fields, Green's theorem, Area as a line integral, Surface integrals, Stokes' theorem, The Gauss divergence theorem.	10

Course Outcomes

After completion course, Student will be able-

1. To understand partial differentiation for several variables
2. To understand expansion of functions for several variables
3. To understand vector differentiation & integration.

Recommended Text Books

1. G. B. Thomas and R. L. Finney, *Calculus*, (9th Edition), Pearson Education, Delhi, 2005.
2. M. J. Strauss, G. L. Bradley and K. J. Smith, *Calculus*, (3th Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007.
3. Shanti Narayan, *Integral Calculus*, S. Chand Publication.
4. Shanti Narayan, *Vector Calculus*, S. Chand Publication.

Recommended Reference Books

1. E. Marsden, A. J. Tromba and A. Weinstein, *Basic multivariable Calculus*, Springer (SIE), Indian reprint, 2005.
2. James Stewart, *Multivariable Calculus, Concepts and Contexts*, (2nd Ed.), Brooks/Cole, Thomson Learning, USA, 2001.
3. P K Mittal, *Mathematics for Degree Students B. Sc. 1St Yr* ISBN : 9788121932400 S. Chand Publishing

Syllabus for B.Sc. (Hons.) Mathematics

	L T P C 4 0 0 4
Course Title: REAL ANALYSIS - I	Course Code: SCUCMT212T
Semester: II	

Objective:

To expose the students to the basics of real analysis. More precisely, learn about Riemann integrals , sequences and series of functions.

Unit	Content	Hours
1	Real Number System Algebraic and order properties of \mathbb{R} , Absolute value of a real number; Bounded above and bounded below sets, Supremum and infimum of a nonempty subset of \mathbb{R} , The completeness property of \mathbb{R} , Archimedean property, Density of rational numbers in \mathbb{R} , Definition and types of intervals, Nested intervals property; Neighbourhood of a point in \mathbb{R} , Open, closed and perfect sets in \mathbb{R} , Connected subsets of \mathbb{R} , Cantor set and Cantor function.	10
2	Sequences of Real Numbers Convergent sequence, Limit of a sequence, Bounded sequence, Limit theorems, Monotone sequences, Monotone convergence theorem,	8
3	Subsequence, Bolzano–Weierstrass theorem for sequences, Limit superior and limit inferior of a sequence of real numbers, Cauchy sequence, Cauchy’s convergence criterion.	8
4	Infinite Series Convergence and divergence of infinite series of positive real numbers, Necessary condition for convergence, Cauchy criterion for convergence; Tests for convergence of positive term series; Basic comparison test, Limit comparison test, D’Alembert’s ratio test, Cauchy’s nth root test, Integral test; Alternating series, Leibniz test, Absolute and conditional convergence, Rearrangement of series and Riemann’s theorem.	10
5	Riemann Integration Riemann integral, Integrability of continuous and monotonic functions, Fundamental theorem of integral calculus, First mean value theorem, Bonnet and Weierstrass forms of second mean value theorems.	9

Course Outcome

After completion course, Student will be able -

- To understand the basics of Real analysis
- To Get clear idea about the real numbers and real-valued

- To obtain the skills of analysing the concepts and applying appropriate methods for testing the convergence of a sequence
- To understand Riemann integration of functions
- To know the geometrical interpretation of mean value

Recommended Text Books

1. N. N. Bhattacharya: Elementary Analysis.
2. S. C. Malik: *Mathematical Analysis*.
3. Elements of Real Analysis as per UGC Syllabus by Shanti Narayan and Dr. M.D. Raisinghaniya, published by S.chand & Company Pvt. Ltd. New Delhi

Recommended Reference Books

1. Books Re R. G. Bartle and D. R. Sherbert, *Introduction to Real Analysis*, John Wiley.
2. T.M. Apostol, *Calculus* Vol. 1
3. W. Rudin, *Principles of Mathematical Analysis* McGraw-Hill Education

Syllabus for B.Sc. (Hons.) Mathematics

Course Title: ORDINARY DIFFERENTIAL EQUATIONS	L T P C 4 0 0 4
Semester: II	Course Code: SCUCMT213T

Objective:

The major aim of the course is to explore the knowledge on differential equation and select and apply the appropriate analytical technique for finding the solution of first order and selected higher order ordinary differential equations.

Unit	Content	Hours
1	First Order Differential Equations Basic concepts and genesis of ordinary differential equations, Order and degree of a differential equation, Differential equations of first order and first degree, Equations in which variables are separable, Homogeneous equations, Linear differential equations and equations reducible to linear form, Exact differential equations, Integrating factor	9
2	First order higher degree equations solvable for x, y and p. Clairaut's form and singular solutions. Picard's method of successive approximations and the statement of Picard's theorem for the existence and uniqueness of the solutions of the first order differential equations.	9
3	Second Order Linear Differential Equations Statement of existence and uniqueness theorem for linear differential equations, General theory of linear differential equations of second order with variable coefficients, Solutions of homogeneous linear ordinary differential equations of second order with constant coefficients, Transformations of the equation by changing the dependent/independent variable, Method of variation of parameters and method of undetermined coefficients, Reduction of order, Coupled linear differential equations with constant coefficients.	9
4	Higher Order Linear Differential Equations Principle of superposition for a homogeneous linear differential equation, Linearly dependent and linearly independent solutions on an interval, Wronskian and its properties, Concept of a general solution of a linear differential equation, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler-Cauchy equation, Method of variation of parameters and method of undetermined coefficients, Inverse operator method.	9

5	Series Solutions of Differential Equations Power series method, Legendre's equation, Legendre polynomials, Rodrigue's formula, Orthogonality of Legendre polynomials, Frobenius method, Bessel's equation, Bessel functions and their properties, Recurrence relations.	9
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Course Outcomes

- Student will be able to solve first order differential equations utilizing the standard techniques for separable, exact, linear, homogeneous cases.
- Student will be able to solve higher order linear differential equations using reduction of order, undetermined coefficients, or variation of parameters.

Recommended Text Books

1. S. L. Ross, *Differential Equations*, (3 rd Edition) John Wiley and sons, India, 2004.
2. M. D. Raisinghania, *Ordinary and Partial Differential Equations*, S, Chand and Co. Ltd, 2013.
3. E. Kreyszig, *Advanced Engg. Mathematics*.

Recommended Reference Books

1. Belinda Barnes and Clenn R. Fulford, *Mathematical Modeling with Case Studies, A Differential equation Approach using Maple and Matlab*, 2nd Ed., Taylor and Francis group, London and New York, 2009.
2. C. H. Edwards and D. E. Penny, *Differential Equations and Boundary Value problems Computing and Modeling*, Pearson Education India, 2005.
3. G. F. Simmons, *Differential Equations*

Syllabus for B.Sc. (Hons.) Mathematics

	L T P C
	3 0 0 2
Course Title: FUNDAMENTALS OF DATA SCIENCE	Course Code: SCUCMT204T
Semester: I	

Objective:

To create awareness towards various environmental issues like global warming, urbanization, pollutions, ozone layer depletion etc; their causes and remedial steps for protecting impacted society.

Unit	Content	Hours
1	Introduction: What is Data Science? Data Science process; Matrices-Matrices to represent relations between data, and necessary linear algebraic operations on matrices-Approximately representing matrices by decompositions (SVD and PCA); Statistics: Descriptive Statistics: distributions and probability - Statistical Inference: Populations and samples - Statistical modeling - probability distributions - fitting a model - Hypothesis Testing, Intro to Python.	9
2	Data preprocessing: Data cleaning - data integration - Data Reduction, Data Transformation and Data Discretization. Evaluation methods: Confusion matrix, Students T-tests and ROC curves-Exploratory Data Analysis (EDA): Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA, Feature Generation and Feature Selection - Feature Selection algorithms - Filters; Wrappers.	10
3	Basic Machine Learning Algorithms: Association Rule mining- Linear Regression- Logistic Regression - Classifiers - k-Nearest Neighbors (k-NN), k-means- Decision tree- Naive Bayes- Ensemble Methods- Random Forest. Decision Trees and Random Forests.	10

4	Clustering: Choosing distance metrics- Different clustering approaches-hierarchical agglomerative clustering, k-means (Lloyd's algorithm), - DBSCAN- Relative merits of each method- clustering tendency and quality.	8
5	Regression and Anova: Regression: Linear and Logistic regression, ANOVA, R-square, Correlation and causation. Data Visualization: Basic principles, ideas and tools for data visualization.	8

Course Outcomes

- Apply principles of Data Science to the analysis of business problems.
- Use data mining software to solve real-world problems.
- Employ cutting edge tools and technologies to analyze Big Data.
- Apply algorithms to build machine intelligence.
- Demonstrate use of team work, leadership skills, decision making and organization theory.

Recommended Text Books

1. Cathy O'Neil and Rachel Schutt, "Doing Data Science, Straight Talk From The Frontline", O'Reilly, 2014.
2. Jiawei Han, Micheline Kamber and Jian Pei, "Data Mining: Concepts and Techniques", Third Edition. ISBN 0123814790, 2011.

Recommended Reference Books

1. Mohammed J. Zaki and Wagner Miera Jr, "Data Mining and Analysis: Fundamental Concepts and Algorithms", Cambridge University Press, 2014.
2. Matt Harrison, "Learning the Pandas Library: Python Tools for Data Munging, Analysis, and Visualization, O'Reilly, 2016.
3. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media, 2015.
4. Wes McKinney, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly Media, 2012.

Syllabus for B.Sc. (Hons.) Mathematics

Course Title: FUNDAMENTALS OF DATA SCIENCE LAB

Course Code: CASCPS20P

Semester: II

L T P C

0 0 4 2

Objective: The course should enable the students to:

1. Understand the basics of Python Programming Language.
2. Exposure on solving of data science problems.
3. Understand the visualization effect.

List of Experiments:

INTRODUCTION TO PYTHON-

1. A program to compute distance between two points taking input from the user Write a program add.py that takes 2 numbers as command line arguments and prints its sum.
2. Write a Program for checking whether the given number is an even number or not.
3. Write a Program to demonstrate list and tuple in python. Write a program using a for loop that loops over a sequence. Write a program using a while loop that asks the user for a number, and prints a countdown from that number to zero.
4. Write a program to count the numbers of characters in the string and store them in a dictionary data structure Write a program to use split and join methods in the string and trace a birthday of a person with a dictionary data structure.

5. Write function to compute gcd, lcm of two numbers.

READING AND WRITING DIFFERENT TYPES OF DATASETS-

- Reading different types of data sets (.txt, .csv) from web and disk and writing in file in specific disk Location.
- Reading Excel data sheet.
- Reading XML dataset.

VISUALIZATIONS-

- Find the data distributions using box and scatter plot.
- Find the outliers using plot.
- Plot the histogram, bar chart and pie chart etc. on sample data.

Lab Outcomes:

Upon completion of the course, students will be able to

- Analyse and interpret results from descriptive and predictive data analysis
- Apply their knowledge to a given problem domain and articulate potential data analysis problems
- Identify potential pitfalls, and social and ethical implications of data science
- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.

Syllabus for B.Sc. (Hons.) Mathematics

Course Title: ENVIRONMENTAL SCIENCE

L T P C
4 0 0 4
Course Code: SCUCEV201T

Semester: II

Objective:

To create awareness towards various environmental issues like global warming, urbanization, pollutions, ozone layer depletion etc; their causes and remedial steps for protecting impacted society.

Unit	Content	Hours
1.	Introduction to Environmental Studies: Multidisciplinary nature of environmental studies; Scope and importance; Environmental education; Concept of sustainability and sustainable development. Ecosystems: Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological pyramids. Nutrient cycle (carbon cycle, nitrogen cycle, Sulphur cycle, water cycle, oxygen cycle).	6
2.	Natural Resources: Renewable and non-renewable Resources, Land resources and land use change; Land degradation, soil erosion and desertification. Deforestation: Causes and impact due to mining dam building on environment. Water: use and over exploitation of surface and ground water, floods, droughts. Water borne and water induced diseases.	6

3.	Environmental Pollution: air pollution, water pollution, thermal pollution, noise pollution, soil pollution; Solid Waste Management; Environmental Impact Assessment.	6
4.	Biodiversity and Conservation: Levels of biological diversity: genetic, species and ecosystem diversity; hot spots; threats to biodiversity; Conservation of biodiversity: in-situ and ex -situ conservation of biodiversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and informational value.	6
5.	Impact of energy usage on environment: Global warming, Climate change, Depletion of ozone layer, Acid rain. Environmental ethics, Role of NGOs, Environmental Laws: Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection. Act. Forest Conservation Act.	6

Course Outcomes

- Students will be able to understand the environmental issues pertaining to day-to-day living; gain awareness for the need of environmental education vis-à-vis education for sustainable development.
- Students will acquire knowledge in ecological perspective and value of environment, biotic components, ecosystem process: energy, food chain, water cycle etc.
- Students will be able to understand water quality standards and parameters, assessment of water quality, air pollution, pollutants, acid rain, global climate change and green house gases.
- Students will learn to understand variety of social issues associated with environmental deterioration involving human components such as population, ethics and urban settlements.

Recommended Text Books

1. Deswal & Deswal, “Environment and Ecology” Dhanpat Rai & Co.
2. Smriti Srivastava, “Environment and Ecology” KATSON”

Recommended Reference Books

1. Environmental studies - R, Rajgopalan -Oxford Publication.
2. Benny Joseph, “Environmental Studies” Tata McGraw-Hill Education.
3. AK De “Environmental Studies” New Age International Publisher, New Delhi.
4. Shashi K Singh and Anisha Singh, “Environmental Science & Ecology” A.B. Publication.

Syllabus for B.Sc. (Hons.) Mathematics

Course Title: **PROFESSIONAL PROFICIENCY**

L T P C
4 0 0 4
Course Code: **PTSPSC20T**

Semester: **II**

Objectives:

Listening, Speaking, Reading, and Writing skills to be developed to enable the students to read and write correct English, attain reasonable fluency in the Language and should also be exposed to introductory lessons of Aptitude Building.

Unit	Content	Hours
1. Hard Skills	Transformation of Sentences (Simple, Complex, Compound), Direct-Indirect Speech, Active Passive Voice. Reading Comprehension. The goal is to teach Grammar implicitly through reading comprehensions. A short story/paragraph should be given for the students to identify the parts of speech and the other topics mentioned above. The classes should be learner centric and the students should be able to apply the lessons learnt in their daily conversations.	10
2. Soft Skills	Speaking: Group Discussion, Role Play, Skit, Interviews. The aim should be to develop the students' interpersonal skills through the activities and they should be in a position to better engage with their peers and also develop language speaking skills according to the situation that they are in. They should be comfortable in the use of the language by now and therefore should be in a better position to engage with their peers in the language.	15
Practice Sheet	Questions (Subjective and Objective) based on the instruction given for hard skills to be distributed every week. The aim should be to bring the instruction given in practice by making them write, speak and think along the lines of the instruction given. The practice sheet should be evaluated and necessary feedback must be given. Some exercise on compositional skills must be given so that they develop a sense of writing and expressing themselves through the written word.	
3.	Quantitative Aptitude & Logical Reasoning • Clock • Average • Calendar	20

Course Outcomes

- Better representation of himself/herself in terms of communication skills, overall personality development and aptitude building required for jobs.

- This program will help students employable and ready for Industries /corporate and other Public and Private Sector jobs.