Program	ADP Data Science
Course Code	MS-002
Course Title	Math Deficiency II

Credit Hours	Theory	Lab
	3	0

Lecture Duration	90 minutes (1.5 Hours), 2 lectures per week
Semester	2

Pre-requisites	Courses	Knowledge
	Nil	Nil

Follow Up Courses	

Aims and Objectives	1. Understand the basic concept of Complex numbers and its arithmetic properties 2. Learn about the idea of sequence and series, and their properties 3. Learn about Permutations and Combinations, Basic Probability 4. Understand the basic concept of Limits of functions, and its properties 5. Understand the basic concept of continuity and discontinuity of functions, and their properties 6. Understand the concept of derivatives, formulas and properties related to derivative 7. Under the concept of Increase, Decrease, Concavity, Relative Extrema, Absolute Maxima and Minima 8. Understand the Basic definitions of definite and indefinite Integrals, 9. Learn about the Fundamental Theorem of Calculus 10. Learn how to Evaluate Definite Integrals by Substitution
	11. Learn how to Evaluate the integral of Logarithmic and Other Functions

Learning Outcomes	• Students can understand what a computing problem is. • Students can formally define a computing problem. • Students can solve simple to moderate level computing problems. (Students can develop an I-P-O chart for a specific programming problem. Develop an algorithm to solve a specific programming problem by using pseudo-code or flowcharting. Use sequence, selection, and repetition structures to solve a problem. Apply the appropriate design for a specific program. Apply modular designs for programs, including sending arguments and returning values. Implement data validation, internal and external documentation in a program. Use objects and methods to solve problems in an object-oriented programming environment. Incorporate objectoriented tools within a program.)
Syllabus	Complex Numbers, Arithmetic with Complex Numbers (Add, subtract, multiply and divide complex numbers), Trigonometric Polar Form of Complex Numbers, De Moivre's Theorem and nth Roots, Recursion, Arithmetic and Geometric Sequences, Sigma Notation, Arithmetic Series, Geometric Series (Sum infinite and finite geometric series and categorize geometric series), Counting with Permutations and Combinations, Basic Probability, Binomial Theorem, Limit Notation, Graphs to Find Limits, Tables to Find Limits, Substitution to Find Limits, Rationalization to Find Limits, One Sided Limits and Continuity, Instantaneous Rate of Change, Tangent Lines and Rates of Change, The Derivative Function, Introduction to Techniques of Differentiation, The Product and Quotient Rules, Derivatives of Trigonometric Functions, The Chain Rule, Derivatives of Logarithmic Functions, Derivatives of Exponential and Inverse
	Trigonometric Functions, Increase, Decrease, and Concavity, Relative Extrema, Absolute Maxima and Minima, An Overview of the Area Problem, Area Under a Curve, The Indefinite Integral, Integration by Substitution, The Definition of Area as a Limit; Sigma Notation, The Definite Integral.

Contents	1. Complex Numbers,
	    1.1. Arithmetic with Complex Numbers (Add, subtract, multiply and divide complex numbers),
	    1.2. Trigonometric Polar Form of Complex Numbers,
	    1.3. De Moivre's Theorem and nth Roots,
	2. Recursion
	    2.1. Arithmetic and Geometric Sequences,
	    2.2. Sigma Notation,
	    2.3. Arithmetic Series,
	    2.4. Geometric Series (Sum infinite and finite geometric series and categorize geometric series),
	3. Counting
	    3.1. Permutations
	    3.2. Combinations,
	4. Basic Probability,
	5. Binomial Theorem,

	6. Limit Notation,
	   6.1. Graphs to Find Limits,
	   6.2. Tables to Find Limits,
	   6.3. Substitution to Find Limits,
	   6.4. Rationalization to Find Limits,
	   6.5. One Sided Limits and Continuity
	7. Instantaneous Rate of Change,
	   7.1. Tangent Lines and Rates of Change
	8. The Derivative Function,

	8.1. Introduction to Techniques of Differentiation,
	8.2. The Product and Quotient Rules,
	8.3. Derivatives of Trigonometric Functions,
	8.4. The Chain Rule,
	8.5. Derivatives of Logarithmic Functions,
	8.6. Derivatives of Exponential and Inverse
	8.7. Trigonometric Functions,
	9. Increase, Decrease, and Concavity,
	   9.1. Relative Extrema,
	   9.2. Absolute Maxima and Minima,
	10. An Overview of the Area Problem,
	   10.1. Area Under a Curve,
	   10.2. The Indefinite Integral,
	   10.3. Integration by Substitution,
	   10.4. Sigma Notation,
	11. The Definite Integral.
	   11.1. The Definition of Area as a Limit;

Teaching-learning Strategies	• Interactive class session • Hands on practices in class • Brainstorming and Group discussion sessions
Assignments	• Paper based written assignments
Textbooks	• Textbook of Algebra and Trigonometry Class XI is published by • Punjab Textbook Board (PTB) Lahore, Pakistan. Calculus and Analytic Geometry, MATHEMATICS 12 (Mathematics FSc Part 2 or HSSC-II), Punjab Text Book Board Lahore
Reference Material/Suggested Readings	• • Mark J. Christensen, Computing for Calculus, 1st Edition, Academic Press, (1st January 1981), 240pages, ISBN: 9781483271088. Lay, L. D. 2015. Probability and Statistics for Engineering and the Sciences, 9th Ed. Cengage Learning, Boston, MA, USA. • Howard, Anton, Irl Bivens, Stephen Davis, Calculus, 10th Ed, 2011, John Wiley & Sons, Inc. (1318 Pages)

Notes	• Academic integrity is expected of all students. Plagiarism or cheating in any assessment will result in at least an F grade in the course, and possibly more severe penalties.
	• You bear all the responsibility for protecting your assignments from plagiarism. If anyone else submits your assignment or uses your
	code in his/her assignment, you will be considered equally responsible. • The instructor reserves the right to modify the grading scheme/marks division and course outline during the semester. • Introductory knowledge of using the computers is assumed for this course. All code written in quizzes, assignments, homework's, and exams must be in JavaScript. Code must be intelligently documented (commented). Undocumented code may not be given any credit. • The IDE use is not allowed, Notepad++ has to be used for coding. • There is no makeup for a missed sessional grading instruments like quizzes, assignments, and homework's.

Detailed Lecture wise plan

Week	Lecture	Topic	Source eBook (Ch#)	Recommendation for Learning Activities
1	1	**Straight Lines:** Inclination of straight line, slope of lines, slopeintercept form of a line, two points form of a line.	A(18)	
	2	Intercept form of lines, normal form of lines, intersection of lines. Problem involving application of straight lines.	A(17)	**Assign-1**
2	3	**Complex Numbers:** Real number system, complex number system. The complex plane. Addition, multiplication of complex numbers. Properties of complex numbers. Inverse of a complex number.	A(17)	**Quiz#1**
	4	The modulus and conjugate of complex numbers. The argument of a complex number. The modulusargument form of a complex number.	A(17)	

3	5	Multiplication and De Moivre's Theorem. Taking powers of a complex number.	A(17)	**Assign-2**
	6	Functions of a complex variable, the complex exponential function. Complex trigonometric function. Complex nth roots of a complex number.	B(7)	**Quiz#2**
4	7	**Permutations, Combinations and Binomial Theorem:** Counting principal and factorial, permutations, combinations, probability.	B(7)	
	8	Sequences. Sequences defined recursively. Arithmetic progression (A.P.). Common difference. General Term of A.P.	A(18)	
5	9	Geometric sequence. Common ratio. General term of a G.P. (Geometric progression).	A(18)	
	10	Series. Sum of arithmetic and geometric series involving finite terms. Sum of a convergent geometric series. Harmonic sequences.	A(18)	**Assign-3**
6	11	**Limits:** Limits an intuitive approach, one sided limit, two sided limits, sampling pitfalls, infinite limits, vertical asymptotes.	A(18)	**Quiz#3**

Week	Lecture	Topic	Source eBook (Ch#)	Recommendation for Learning Activities
	12	**Computing limits:** Some basic limits, limits of polynomials and rational functions as x approaches a, limits involving radicals, limits of piecewise functions.	B(18)	
7	13	**Limits at infinity:** Horizontal asymptotes, limits of rational functions when x approaches infinity, a quick method to evaluate a rational function when x approaches infinity, end behavior of trigonometric, logarithmic, exponential functions.	A(19) B(8)	
	14	Continuity of trigonometric, exponential and inverse functions, obtaining limits by squeezing.	Q	**Assign-4**
8	15	**Derivatives:** Tangent lines and rate of change, slopes, definition of derivative function, differentiability, the relationship between differentiability and continuity.	A(19) B(8)	**Quiz#4**

	16	Introduction to techniques of differentiation, derivative of a constant, derivatives of power functions, derivative of a constant times a function, derivatives of sum and differences, higher derivatives.	Hand outs	
9	17	The product and quotient rules, derivatives of trigonometric functions, the chain rule.	B(15) A(20)	
	18	**Implicit differentiation:** Functions defined explicitly and implicitly. Differentiability of functions defined implicitly. Derivatives of logarithmic functions. Logarithmic differentiation. Derivatives of real powers of x.	A(19) B(10)	
10	19	Derivatives of exponential and inverse trigonometric functions. Increasing or decreasing functions are one-to-one. Related rates. Local linear approximation.	A(18) B(15)	**Assign-5**
	20	**The derivative in graphing and applications:** Increasing and decreasing functions. Concavity. Inflection points. Logistic curves. Analysis of functions.	A(20) B(15)	**Quiz#5**

Week	Lecture	Topic	Source eBook (Ch#)	Recommendation for Learning Activities
11	21	Critical points. Relative maxima and relative minima. First derivative test and second derivative test. Geometric implications of multiplicity. Analysis of polynomials.	B(14)	
	22	Absolute maxima and absolute minima. Applied maximum and minimum problems.	B(15)	
12	23	Rolle's theorem. Mean Value theorem. Velocity interpretation of Mean Value Theorem. Consequences of Mean Value Theorem. The constant difference theorem.	B(12)	**Assign-6**
	24	**Integration:** An overview of area problem. The rectangle problem of finding areas. The anti-derivative method for finding areas.	B(12)	**Quiz#6**
13	25	The indefinite integral. Integration formulas. Properties of indefinite integrals. Integration from the view point of differential equations. Slope fields.	B(12)	

Week	Lecture	Topic	Source Book (Ch#)	Recommendation for Learning Activities
	26	Integration by substitution. Easy to recognize substitutions. Less apparent substitutions. Integration using Computer Algebra Systems (CAS).	B(15)	
14	27	The definition of area as limit. Sigma notation. The Fundamental Theorem of Calculus. The relationship between definite and indefinite integrals. Differentiation and integration are inverse processes.	B(14)	**Assign-7**
	28	Evaluating definite integral by substitution. Area between curves.	A(20)	**Quiz#7**
15	29	Product rule and integration by parts. Guidelines for integration by parts. Repeated integration by parts. A tabular method for repeated integration by parts. Integration by parts for definite integrals.	A(20)	
	30	Reduction formulas. Integration of trigonometric functions. Wallis sine and cosine formulas.	A(20)	
16	31	Trigonometric substitutions. Integral involving ax^2+bx+c. Integration of rational functions by partial fractions. Integrating improper rational functions. Improper integrals.	A(20)	**Assign-8**
Week	**Lecture**	**Topic**	**Source Book (Ch#)**	**Recommendation for Learning Activities**
	32	Taylors and Maclaurin Series. Approximations of functions in the vicinity of x=a.	Hand outs	**Quiz#8**