EVALUATION SCHEME & SYLLABI

for

Master of Science in Mathematics

TWO-YEARS FULL-TIME PROGRAMME
(Effective from session 2026-2027)

First Year

Department of Applied Sciences & Humanities

INVERTIS UNIVERSITY

Invertis Village
Bareilly-Lucknow NH-24, Bareilly-243123, India

M.Sc. Mathematics

The proposed PG course structure in mathematics along with detailed syllabus shall be governed by the department of Applied sciences and Humanities, Invertis University, Bareilly.

1. There shall be four semesters in the two-year M.Sc. course in Mathematics.
2. Each paper will be of 100 marks. This will include an internal assessment of 30 marks. Duration for examination of a paper will be 3hours.
3. Three lectures and one tutorial per week are to be allotted to each paper.
4. A Project work/Dissertation Examination of 100 marks will be held during Semester IV. The Board of Examiners will consist of one External and two internal examiners recommended for appointment by the BOS. The Chairman of the Board will be the senior-most from amongst the internal examiners.
5. There shall be 600 marks for I and II Sem. For III and IV semester there shall be 650 marks and 650 marks respectively Thus, for the entire course it comes out to be a total of 2500 marks.

The course prescribed for various semesters shall be the following and marks distribution is described in the table.

INVERTIS UNIVERSITY BAREILLY

I Year (Mathematics)

I Year									
I Semester			**Teaching Scheme**			**Marks Distribution**			
PAPER	**CODE**	**SUBJECT**	**L**	**T**	**P**	**MSM**	**ESM**	**Total**	**Credit**
Paper 1	MMA101	Abstract Algebra	3	1	0	30	70	100	4
Paper 2	MMA102	Real Analysis and Measure Theory	3	1	0	30	70	100	4
Paper 3	MMA103	Advanced Differential Equations	3	1	0	30	70	100	4
Paper 4	MMA104	Fundamental of computer and c programming	3	1	0	30	70	100	4
Paper 5	MMA105	Numerical Methods	3	1	0	30	70	100	4
Paper 6	EPC001	AI Based English Proficiency Course-I	0	0	0	0	50	50	2
LAB 1	MMA151	C-Programming Lab	0	0	4	15	35	50	2
Total			**15**	**5**	**4**	**165**	**435**	**600**	**24**
II Semester									
PAPER	**CODE**	**SUBJECT**	**L**	**T**	**P**	**MSM**	**ESM**	**Total**	**Credit**
Paper 6	MMA201	Linear Algebra	3	1	0	30	70	100	4
Paper 7	MMA202	Complex Analysis	3	1	0	30	70	100	4
Paper 8	MMA203	Topology	3	1	0	30	70	100	4
Paper 9	MMA204	Statistical Methods and Data Analysis	3	1	0	30	70	100	4
Paper 10	MMA205	Operations Research	3	1	0	30	70	100	4
Paper 11	EPC001	AI Based English Proficiency Course – II	0	0	0	0	50	50	2
LAB 2	MMA251	Data Analytics Lab	0	0	4	15	35	50	2
Total			**15**	**5**	**4**	**165**	**435**	**600**	**24**

II Year (Mathematics)

III Semester			Teaching Scheme			Marks Distribution			
PAPER	**CODE**	**SUBJECT**	**L**	**T**	**P**	**MSM**	**ESM**	**Total**	**Credit**
Paper 1	MMA301	Python	3	1	0	30	70	100	4
Paper 2	MMA302	Functional Analysis	3	1	0	30	70	100	4
Paper 3	MMA303	Mathematical Methods	3	1	0	30	70	100	4
Paper 4	MMA304	Probability and Stochastic Processes	3	1	0	30	70	100	4
Paper 5	MMA031	DSE-I	3	1	0	30	70	100	4
Lab	MMA351	Python Lab	0	0	4	15	35	50	2
Lab	MMA 352	Field Project / Internship*	0	0	0	30	70	100	4
Total			**15**	**5**	**4**	**195**	**455**	**650**	**26**

IV Semester									
PAPER	**CODE**	**SUBJECT**	**L**	**T**	**P**	**MSM**	**ESM**	**Total**	**Credit**
Paper 6	MMA401	Mathematical Modeling	3	1	0	30	70	100	4
Paper 7	MMA041	DSE-II	3	1	0	30	70	100	4
Paper 8	MMA042	DSE- III	3	1	0	30	70	100	4
Paper 9	MMA043	DSE-IV	3	1	0	30	70	100	4
Lab	MMA451	MATLAB	0	0	4	15	35	50	2
Project	MMA452	Project work* / Dissertation	0	0	0	50	150	200	8
Total			**12**	**4**	**4**	**185**	**465**	**650**	**26**

*** Project will be given in end of III semester & submitted in IV semester and a Field project / Internship done by student during program will be evaluated in Third Semester.**

Mathematics

Discipline Specific Elective (DSE)

MMA031 / MMA041 / MMA042 / MMA043				
S. No.	**Course Name**	**L-T-P**	**Credit**	**Contact Hrs.**
1.	Discrete Mathematics	4-0-0	4	40
2.	Data Analysis and Visualization	4-0-0	4	40
3.	Finite Element Method	4-0-0	4	40
4.	Numerical Linear Algebra	4-0-0	4	40
5.	Bio Mathematics	4-0-0	4	40
6.	Multivariable Calculus	4-0-0	4	40
7.	Introduction to Algebraic Geometry	4-0-0	4	40
8.	Theory of Analytic functions	4-0-0	4	40
9.	Fourier Analysis and applications	4-0-0	4	40
10.	Network Models	4-0-0	4	40
11.	Stochastic Programming and applications	4-0-0	4	40
12.	Differential Geometry	4-0-0	4	40
13.	Modern theory of PDE	4-0-0	4	40
14.	Fluid Mechanics	4-0-0	4	40
15.	Numerical Methods of PDE	4-0-0	4	40
16.	Tensors & Riemannian Geometry	4-0-0	4	40
17.	Number theory and Cryptography	4-0-0	4	40
18.	Integral Equation and Calculus of variations	4-0-0	4	40
19.	Financial Mathematics	4-0-0	4	40

Skill Enhancement Courses (SEC) for Pure Mathematics

S. No.	Course Name	Code	L-T-P	Credit	Contact Hrs.
1.	Artificial Intelligence and Machine Learning	MMA 104	**3-1-0**	4	40
2.	Fundamental of Computer and C Programming	MMA 044	**4-1-0**	4	40
3.	Data Analysis and Visualization	MMA 045	**4-1-0**	4	40
4.	Python Lab	MMA 351	**0-0-2**	2	20
5.	Advanced Mathematical Statistical Lab (R- Based)	MMA 251	**0-0-2**	2	20
6.	Statistical Methods and Data Analysis	MMA 204	**3-1-0**	4	40

Ability Enhancement Compulsory (AECC)

S. No.	Course Name	Code	L-T-P	Credit	Contact Hrs.
1.	Dissertation	MMA 452	**0-0-4**	4	40

II Year (Data Science)

III Semester			Teaching Scheme			Marks Distribution			
PAPER	**CODE**	**SUBJECT**	**L**	**T**	**P**	**MSM**	**ESM**	**Total**	**Credit**
Paper 1	MMA301	Python	3	1	0	30	70	100	4
Paper 2	MMA304	Probability and Stochastic Processes	3	1	0	30	70	100	4
Paper 3	MMA305	Artificial Intelligence and Machine Learning	3	1	0	30	70	100	4
Paper 4	MMA306	Data Warehouse and Data Mining	3	1	0	30	70	100	4
Paper 5	MMA032	DSE-I	3	1	0	30	70	100	4
Lab	MMA351	Machine Learning with Python Lab	0	0	4	15	35	50	2
Lab	MMA352	Field Project/ Internship*	0	0	0	30	70	100	4
Total			**15**	**5**	**4**	**195**	**455**	**650**	**26**

IV Semester (Data Science)									
PAPER	**CODE**	**SUBJECT**	**L**	**T**	**P**	**MSM**	**ESM**	**Total**	**Credit**
Paper 6	MMA401	Mathematical Modeling	3	1	0	30	70	100	4
Paper 7	MMA402	Database Management System	3	1	0	30	70	100	4
Paper 8	MMA044	DSE-II	3	1	0	30	70	100	4
Paper 9	MMA045	DSE- III	3	1	0	30	70	100	4
Lab	MMA453	Database Management System Lab	0	0	4	15	35	50	2
Paper 10	MMA452	Project work* / Dissertation	0	0	0	50	150	200	8
Total			**12**	**4**	**4**	**185**	**465**	**650**	**26**

*** Project will be given in end of III semester & submitted in IV semester and a Field project / Internship done by student during program will be evaluated in Third Semester.**

Data Science

Discipline Specific Elective (DSE)

MMA032 / MMA044 / MMA045				
S. No.	**Course Name**	**L-T-P**	**Credit**	**Contact Hrs.**
1.	Discrete Mathematics			
2.	Big Data Analysis	4-0-0	4	40
3.	Software Reliability	4-0-0	4	40
4.	Statistical Inference	4-0-0	4	30
5.	Advance Machine Learning	4-0-0	4	30
6.	Portfolio Management	4-0-0	4	40
7.	Quality Management	4-0-0	4	40
8.	Data Structures & Algorithms	4-0-0	4	40
9.	Marketing Research	4-0-0	4	40
10.	Logistics and supply chain management	4-0-0	4	40
11.	Financial Management	4-0-0	4	40
12.	Reliability and Maintenance theory	4-0-0	4	40
13.	Recording and Analysis of Business Operations	4-0-0	4	40

MMA101- Abstract Algebra	
Teaching Scheme Lectures:3hrs/Week Tutorials:1hr/Week Credits:4	**Examination Scheme** ClassTest-12Marks TeachersAssessment-6 Marks Attendance– 12Marks End Semester Exam–70marks

Course Objectives

1. To understand the fundamental structure and properties of finite groups, including Sylow theory and the structure theorem for finitely generated abelian groups.
2. To develop the ability to analyze composition series, normal/subnormal series, and the solvability and simplicity of groups.
3. To introduce the theory of field extensions and to classify algebraic, transcendental, finite and simple extensions.
4. To develop an understanding of Galois theory, Galois extensions, and the Fundamental Theorem of Galois Theory.
5. To apply Galois theory to determine the solvability of polynomial equations by radicals.

Detailed Syllabus

UNIT 1	**Class Equation:** Group theory fundamentals, Cauchy's theorem, Index theorem, Cayley's theorem, Conjugacy relation and conjugacy classes, Conjugacy in S_n, Class equation.
UNIT 2	**Sylow Theory:** p-groups, Sylow p-subgroups, Sylow theorems and their consequences, Direct product of groups, finitely generated abelian groups, structure theorem for finitely generated abelian groups.
UNIT 3	**Solvability:** Simple groups and examples, Composition series, Jordan-Holder theorem, Solvable groups, Normal and subnormal series, Introduction to the insolvability of S_n for $n \geq 5$.
UNIT 4	**Field Extensions:** Field extensions, Finite extensions, algebraic and transcendental extensions, Simple extensions, Splitting fields, Algebraic closures, Perfect fields, Primitive elements, trace and norm of field extensions, Finite fields and their basic properties.
UNIT 5	**Galois Theory:** Automorphisms of field extensions, Normal and separable extensions, Galois extensions, Fundamental Theorem of Galois Theory, Galois groups of polynomials over $\mathbb{Q}$, radicals and solvability by radicals, Applications of Galois Theory to solvability of polynomial equations.

Text Books

1. Vijay K. Khanna and S. K. Bhambri, A Course in Abstract Algebra, 4th Edition, Vikas Publishing House, 2013.
2. I. N. Herstein, Topics in Algebra, 2nd Edition, Wiley India, 2006.
3. Joseph A. Gallian, Contemporary Abstract Algebra, 9th Edition, Cengage Learning, 2016.
4. John B. Fraleigh, A First Course in Abstract Algebra, 7th Edition, Pearson, 2003.

Reference Books

1. David S. Dummit and Richard M. Foote, Abstract Algebra, 3rd Edition, John Wiley & Sons, 2004.
2. Michael Artin, Algebra, 2nd Edition, Pearson, 2011.
3. Serge Lang, Algebra, 3rd Edition, Springer, 2002.
4. N. Jacobson, Basic Algebra I & II, 2nd Edition, Dover Publications, 2009.
5. P. B. Bhattacharya, S. K. Jain, S. R. Nagpaul, Basic Abstract Algebra, 2nd Edition, Cambridge University Press, 1994.

Course Outcomes

At the end of the course, the student should be able to:

1. Understand and apply Sylow theorems and the structure theorem for finite and abelian groups.
2. Analyze composition series, and determine the solvability and simplicity of groups.
3. Classify field extensions and construct splitting fields and algebraic closures.
4. Apply the Fundamental Theorem of Galois Theory to determine the structure of field extensions.
5. Determine the solvability of polynomial equations by radicals using Galois theory.

MMA102- Real Analysis and Measure Theory	
Teaching Scheme	**Examination Scheme**
Lectures:3hrs/Week Tutorials:1hr/Week Credits:4	ClassTest-12Marks TeachersAssessment-6 Marks Attendance– 12Marks End Semester Exam–70marks

Course Objectives:

1. To understand the concept of sequence and series of functions and their convergence
2. To distinguish between point-wise and uniform convergence of sequence of functions.
3. To understand the concept, definition, and fundamental properties of RS integration
4. To analyze the concept of continuity and differentiability of function of one and more variables.
5. To understand the fundamental concepts of measure theory and Lebesgue integrations and their role in modern analysis.

Detailed Syllabus

UNIT 1	**Sequence and Series of Functions:** Point-wise and uniform convergence, Cauchy criterion for uniform convergence, M_n – test, Weierstrass M-test, Abel's and Dirichlet's tests for uniform convergence, Uniform convergence and continuity, Uniform convergence and differentiation, Weierstrass approximation theorem.
UNIT 2	**Continuity and Differentiability:** Continuity (ε-δ) and its properties, differentiability and its properties, mean value theorems and their applications, Taylor's theorem with remainder, functions of several variables, partial derivatives, extrema of functions of several variables; Lagrange multipliers.
UNIT 3	**Riemann-Stieltje's Integral:** Definition and existence of Riemann-Stieltje's integral, Properties, Integration and differentiation, Fundamental theorem of calculus.
UNIT 4	**Lebesgue Measure**: Introduction Borel sets and their measurability, Measurable and Non-measurable sets. Measurable Functions: Definition and properties of measurable functions, Step functions, Characteristic functions, Simple functions Littlewood's three principles,
UNIT 5	**Lebesgue Integral:** Lebesgue integral of bounded function, Integration of non-negative functions, General Lebesgue integrals, Integration of series, Comparison of Riemann and Lebesgue integrals.

Text Books:

1. S.C. Malik, *Principle of Real Analysis,* New Age International Publishers, Fifth Edition-2021.
2. P.K. Jain and V.P. Gupta, Lebesgue measure and integration, Wiley, 1986.
3. Tom M. Apostol, *Mathematical Analysis*, Second Edition, 2018.
4. G. de Barra, *Measure Theory and Integration*, New Age International Publishers, Third Edition.

Reference Books:

1. Walter Rudin, *Principle of Mathematical Analysis,* McGraw Hill International Editions.
2. H. L. Royden, *Real Analysis,* Macmillan Publishing Company, New York.

Course Outcomes:

At the end of the course, the student should be able to:

1. Define and identify point-wise and uniform convergence of sequence of functions.
2. Determine whether a given sequence or series of functions converges and classify the type of convergence.
3. Apply convergence tests to establish the convergence of sequence and series of functions.
4. To evaluate RS integrals and apply their properties to solve problems in real analysis
5. To compute measures and Lebesgue integrals and apply measure theoretic techniques to solve problems.

MMA103- Advanced Differential Equations	
Teaching Scheme Lectures:3hrs/Week Tutorials:1hr/Week Credits:4	**Examination Scheme** Class Test-12Marks Teachers Assessment-6 Marks Attendance– 12Marks End Semester Exam–70marks

Course Objectives:

1. Develop a rigorous understanding of advanced concepts in ordinary and partial differential equations.
2. Study analytical techniques for solving higher-order ordinary differential equations and systems of differential equations.
3. Introduce series solutions and special functions associated with differential equations.
4. Understand boundary value problems and their applications in mathematical and physical sciences.
5. Apply advanced differential equation techniques to solve problems arising in science, engineering, and applied mathematics.

Detailed Syllabus

UNIT 1	**Existence Theory:** Existence and uniqueness theorems for ordinary differential equations, Picard's method of successive approximations, Lipschitz condition, continuation of solutions, dependence of solutions on initial conditions and parameters, Gronwall's inequality, qualitative behavior of solutions, autonomous differential equations, singular solutions.
UNIT 2	**Systems of Ordinary Differential Equations**: Systems of first-order ordinary differential equations, matrix formulation of linear systems, existence and uniqueness of solutions for systems, linear systems with constant coefficients, eigenvalue and eigenvector methods, fundamental matrix, variation of parameters, reduction of higher-order differential equations to systems of first-order equations.
UNIT 3	**Series Solutions and Special Functions:** Power series solutions of ordinary differential equations, ordinary and singular points, regular singular points, Frobenius method, Legendre's differential equation and Legendre polynomials, Bessel's differential equation and Bessel functions, recurrence relations, orthogonality properties, generating functions, and applications of special functions.
UNIT 4	**Boundary Value Problems and Applications**: Boundary value problems for ordinary differential equations, Sturm–Liouville problems, eigenvalues and eigenfunctions, orthogonality of eigenfunctions, Green's functions, and applications to heat conduction, vibration, wave propagation, population dynamics.
UNIT 5	**Advanced Partial Differential Equations:** First-order quasi-linear partial differential equations, Charpit's method, Cauchy problem, second-order linear partial differential

	equations, canonical forms, classification into elliptic, parabolic, and hyperbolic equations, method of separation of variables, D'Alembert solution of the wave equation, Laplace and heat equations.

Text Books:

1. Coddington, E. A., An Introduction to Ordinary Differential Equations, Dover Publications, New York, 1989.
2. Tenenbaum, M. and Pollard, H., Ordinary Differential Equations, Dover Publications, New York, 1985.
3. Simmons, G. F., Differential Equations with Applications and Historical Notes, 2nd Edition, McGraw-Hill Education, New Delhi, 1991.

Reference Books:

1. Boyce, W. E. and DiPrima, R. C., Elementary Differential Equations and Boundary Value Problems, 10th Edition, John Wiley & Sons, New York, 2012.
2. Hale, J. K., Ordinary Differential Equations, Dover Publications, New York, 2009.
3. Hartman, P., Ordinary Differential Equations, SIAM, Philadelphia, 2002.

Course Outcomes:

At the end of the course, the student should be able to:

1. Explain the existence, uniqueness, and qualitative behavior of solutions of ordinary differential equations.
2. Solve systems of ordinary differential equations using matrix methods and analytical techniques.
3. Obtain series solutions of differential equations and apply special functions such as Legendre and Bessel functions to mathematical and physical problems.
4. Analyze and solve boundary value problems using Sturm–Liouville theory and green's functions.
5. Solve first- and second-order partial differential equations using appropriate analytical methods and apply them to problems in science and engineering.

MMA104: Fundamental of computers and C programming	
Teaching Scheme	**Examination Scheme**
Lectures:3hrs/Week	ClassTest-12Marks
Tutorials:1hr/Week	TeachersAssessment: 6Marks
	Attendance– 12Marks
Credits:4	End Semester Exam–70marks

Course Objectives:

The main objectives of this course are to:

1. To impart knowledge about Computer fundamentals
2. To understand the concepts and techniques in C Programming
3. To equip and indulge themselves in problem solving using C
4. To understand control statements and functions
5. To understand the concept of Pointers and File handling

Detailed Syllabus

Unit 1: Fundamentals of Computer

Fundamentals of Computers : Introduction, History of Computers, Generations of Computers, Classification of Computers, Basic Anatomy of a Computer System, Input Devices,Processor, Output Devices, Memory Management, Types of Software, Overview of Operating System, Programming Languages, Translator Programs, Problem Solving Techniques

Unit 2: Overview of C

Introduction, Character set, C tokens, keyword & Identifiers, Constants, Variables, Data types, Declaration of variables , Assigning values to variables, Defining Symbolic Constants, Arithmetic, Relational, Logical, Assignment, Conditional, Bitwise, Special, Increment and Decrement operators , Arithmetic Expressions, Evaluation of expression, precedence of arithmetic operators, Type conversion in expression, operator precedence & associativity, Mathematical functions, Reading & Writing a character, Formatted input and output.

Unit 3: Control Statements: Test Conditions, Conditional execution and selection, Iteration and Repetitive Executions, Nested loops.

Arrays: Introduction to contiguous data types. One dimensional arrays, multidimensional arrays, Array as strings, multidimensional character arrays. Operations on strings.

Unit 4: Functions

Library Functions, User defined functions, Functions prototype, Function call, and Function Definition, Nested and Recursive Function, Function Arguments and Return Types, Passing Arrays to Function, Passing Strings to Function, Passing Arguments by Value, Passing Arguments by Address, Scope visibility and lifetime of a variable, Local and Global Variable

Unit 5: Pointers and File handling

Introduction, The & and * operator, Declaration of pointer, Chain of Pointers, Pointer Arithmetic, Pointers and Arrays, Pointers and Character Strings, Array of Pointers, Pointers as Function Arguments, Function Returning pointers, Pointers and Structures, Dynamic Memory Allocation,

Concept of File, Opening and closing of File, Input Output Operations in File, Random access in File, Error Handling in Files

Course Outcomes:

After successful completion of the course, students will be able to:

1. Explain the fundamental concepts of computers, including computer generations, classification etc.
2. Demonstrate an understanding of the fundamentals of C programming
3. Develop C programs using control statements and arrays, including conditional statements, loops etc.
4. Design modular and reusable C programs using library and user-defined functions
5. Apply pointers, dynamic memory allocation, structures, and file-handling concepts to develop efficient C programs

Recommended Books:

1. Norton, P., Introduction to Computers, Tata McGraw Hill(2008).

2. Shelly, G.B., Cashman T.J., Vermaat M.E., Introduction to Computers, Cengage India Pvt Ltd(2008).

3. Kerninghan, B. W. and Ritchie D.M., The C Programming Language, PHI(1989)

4. Kanetkar, Y., Let Us C, BPB(2007).

5. Forouzan, A., Structured Programming Approach Using C, Cengage India Pvt Ltd(2008).

MMA105- Numerical Methods	
Teaching Scheme Lectures:3hrs/Week Tutorials:1hr/Week Credits:4	**Examination Scheme** ClassTest-12Marks TeachersAssessment-6 Marks Attendance– 12Marks End Semester Exam–70marks

Course Objectives:

1. Apply numerical methods to solve nonlinear algebraic and transcendental equations
2. Solve systems of linear equations and determine eigen values and eigenvectors using numerical techniques
3. Implement interpolation and approximation methods for numerical data analysis
4. Apply numerical integration techniques to evaluate definite integrals accurately.
5. Solve ordinary differential equations using single-step and multi-step numerical methods and analyze their convergence and stability

Detailed Syllabus

UNIT 1	**Numerical Solution of Nonlinear Equations:** Roots of transcendental equations and polynomial equations, Bisection method, Iteration based on first degree equations, Regula-Falsi methods, Rate of convergence, Generalized Newton-Raphson method.
UNIT 2	**Numerical Methods for Systems of Linear Equations and Eigenvalue Problems:** System of linear equation: Direct method-: Gauss Elimination method, Triangularization method, Iterative methods-: Jacobi's method, Gauss-Seidel method, SOR method, Given's power method for Eigen value and Eigenvectors.
UNIT 3	**Interpolation and Polynomial Approximation:** Interpolation and Approximation Lagrange's and Newton's divided difference, Finite difference operators, Hermite interpolation, piecewise & cubic spline interpolation, least square approximation, Min-Max polynomial approximation method, Chebyshev polynomial, Lanczos economization.
UNIT 4	**Numerical Integration (Quadrature Methods):** Newton cotes methods, Method based on undetermined coefficients, Gauss Legendre integration method.

UNIT 5	**Numerical Methods for ODE:** Single step method-Euler's method, Taylor series method, Runge- Kutta method of 2^{nd}and4^{th}order, Numerical methods for BVP, Multi step method-predictor corrector method, Adams Bash forth method, Adams Moulton method, Milne method, convergence and stability.

Text Books:

1. M. K. Jain , S. R. K. Iyengar, & R. K. Jain; "Numerical Methods for Scientific and Engg. Computation"., Wiley Eastern, 1985.
2. V. S.Ryaben'kii, S. V.Tsynkov, "A Theoretical Introduction to Numerical Analysis", Chapman & Hall ,2007.
3. R. S. Mishra (1965). A Course in Tensors with Applications to Riemannian Geometry. Pothishala Pvt. Ltd.

Reference Books:

1. B. Bradie; " A Friendly Introduction to Numerical Analysis" , Pearson Prentice Hall,2007.
2. C. F. Gerald and P. O. Wheatley; "Applied Numerical Analysis", , Addison Wesley, 5th Edn.,1994.
3. G. M. Phillips and P. J. Taylor; "Theory and Applications of Numerical Analysis", Academic Press, 2nd Edn., 1965.

Course Outcomes:

At the end of the course, the student should be able to:

1. Solve nonlinear algebraic and transcendental equations using appropriate numerical methods.
2. Apply direct and iterative numerical techniques to solve systems of linear equations and compute eigenvalues and eigenvectors.
3. Use interpolation and approximation methods to estimate functions and analyze numerical data
4. Evaluate definite integrals using suitable numerical integration (quadrature) methods.
5. Solve ordinary differential equations and boundary value problems using numerical methods while assessing convergence and stability

MMA 151 – C Programming Lab	
Teaching Scheme	**Examination Scheme**
Lab: 2Hrs/Week Tutorials: 0 Hrs./Week Credits: 2	Internal-15Marks External- 35 Marks

Course Objectives:

1. To Define fundamental concept computer i.e., hardware and software.
2. To describe basic knowledge of operating system, algorithms and number system.
3.To introduce the principles of designing structured programs
4. To develop the programming skills of students
5. To write basic programs using conditional statements, iteration statements, functions, pointers, arrays,strings, and file handling.

Assignments for lab classes are as follows:

1.Introduction of Computer System: I/O devices, storage devices.
2.Getting familiar with software: OS and C compiler.
3.Write a program to print Hello.
4.Write a program to add two integers.
5.Write a program to compute factorial of a number.
6.Write a program to determine whether a number is prime or not.
7.Write a program to print Fibonacci series. .
8.Write a program in C to check whether a given number is Armstrong or not?
9.Write a program to calculate factorial of an integer using recursion.
10. Show with example (program) how arguments are passed using „Call by value" and „Call by reference" respectively.
11. Write a program to print the sum of all values of an array.
12 Write a program in C that accepts N x N matrix as input and prints transpose of this matrix.
13.Write a program to add the elements of two arrays in to third array using dynamic memory allocation.
14. Write a program in C to calculate the sum of series up to first 10 terms 1^ 4+ 2^4+ 3^4 + 4^4 + 5^4 + 6^4 + 7^4……10 terms.
15. Write a program in C that takes input from a file and write it into another file.
16.Write a program to implement stack operation (Push & Pop).
17.Write a program to create a link list.

Reference Books:

1. Jeri R. Hanly, Elliot B. Koffman, "Problem Solving and Program Design in C", Pearson Addison-Wesley, 2006.
Victor Alvarado, Mocygo San Jose,"M. S. Office For ME Word, Excel, Power Point, CA" 3.Balagurusamy, "Programming in ANSI „C", TMH, 3rd Edition".

Course Outcomes:

1. Develop small applications using c programming knowledge.
2. Design various application software components and also easily understand other programming concepts.
3. Design programs connecting decision structures, Write, Compile and Debug programs in C language
4. Develop simple C Programs using pointers and Functions

MMA 201- Linear Algebra	
Teaching Scheme Lectures:3hrs/Week Tutorials:1hr/Week Credits:4	**Examination Scheme** ClassTest-12Marks TeachersAssessment-6 Marks Attendance– 12Marks End Semester Exam–70marks

Course Objectives:

1. To understand the concept of vector space, subspace, bases and their dimensions with applications.
2. To understand about linear transformation, rank and nullity and their application in finding the relation between vector spaces.
3. To learn about the matrix representation of linear mapping.
4. To be familiar with inner product space and orthogonality.
5. To know about dual spaces, diagonalization and canonical forms of a linear transformation.
6. To understand the concept of bilinear forms and operator algebra.

Detailed Syllabus

UNIT 1	**Vector Spaces:** Vector spaces, Subspaces, Linear dependence and independence, Linear combinations, Spanning sets, Basis and dimensions, Sums and direct sums, Quotient spaces.
UNIT 2	**Linear Transformations:** Linear mapping, Null space and range of a Linear mapping, Rank and nullity, Rank-nullity theorem, Algebra of linear transformations, homomorphism, Isomorphisms, Isomorphism theorems, Invertibility and the change of coordinate matrix, Matrix representation of a linear operator, Change of basis, Similarity, Matrix representation of general linear mapping.
UNIT 3	**Diagonalization and Canonical forms:** Characteristic and minimal polynomial of a linear operator, Diagonalizability, Cayley-Hamilton theorem, Invariant Spaces, Triangular Forms, Invariant direct sum decomposition, Jorden Canonical Forms, Rational canonical forms.
UNIT 4	**Inner Product Spaces and Dual Space:** Inner product spaces, Cauchy-Schwartz inequality, norms, Orthonormal basis, Gram-Schmidt orthogonalization process, Orthogonal complements, Bessel's inequality. Dual spaces, Double dual, Dual basis, Transpose of a linear transformation and its matrix in the dual basis, Annihilators;
UNIT 5	**Bilinear Forms, Operator Algebra:** Bilinear forms, Bilinear forms and matrices, Symmetric bilinear forms, Quadratic forms, reduction and classification of quadratic forms, Law of inertia, the adjoint of a linear operator, Normal, Self-adjoint, Unitary and orthogonal operators and their properties, Change of orthonormal basis, Positive definite and positive operators, Diagonalization and canonical forms in inner product spaces, Spectral Theorem.

Reference Books:

1. Stephen H. Fiedberg, Arnold J. Insel & Lawrence E. Spence. Linear Algebra (4th ed.). Prentice-Hall of India Pvt. Ltd. New Delhi, 2003.

Additional Readings:

1. Seymour, Lipschutz, And Mark Lipson, Schaum's Outline of Linear Algebra. (6th ed.). McGraw-Hill Education, 2017.
2. Sheldon, Axler. Linear Algebra Done Right, (4th ed.), Springer Cham, 2024.
3. David C. Lay, Steven R. Lay, & Judi J. McDonald. Linear Algebra and its Applications (5th ed.). Pearson Education, 2016.
4. Stephen Andrilli & David Hecker, Elementary Linear Algebra (5th ed.). Academic Press, Elsevier India Private Limited, 2016.
5. Kenneth, Hoffman, and Ray Kunze. Linear Algebra. 2nd ed., Prentice-hall, 1971.
6. Serge Lang, Linear Algebra (3rd ed.). Springer, 1987.

Course Outcomes:

At the end of the course, the student should be able to:

1. Develop an understanding of structure and properties of a vector space, subspace, basis, and dimension.
2. Grasp the concept of linear transformation and it's application to find the relation between vector spaces.
3. Be familiar with rank, nullity and famous rank nullity theorem.
4. Appreciate that linear transformation can be represented by a matrix.
5. Understand the concept of inner product space and its application to introduce orthogonality in vector space.
6. Be familiar with the diagonalization process, find the Jordan and rational canonical forms along with the dual of a vector space.

MMA202 - Complex Analysis	
Teaching Scheme	**Examination Scheme**
Lectures:3hrs/Week	ClassTest-12Marks
Tutorials:1hr/Week	TeachersAssessment-6 Marks Attendance– 12Marks
Credits:4	End Semester Exam–70marks

Course Objectives:

1. To understand the concepts of complex analysis, including visualization of complex functions.
2. To apply Cauchy's integral theorems and series expansions to solve complex variables.
3. To evaluate complex function residues and use them for advanced integration.
4. To develop analytical reasoning skills through rigorous applications of differentiability and calculus.
5. To evaluate the distribution of zeros of analytic functions using canonical products, Jensen's formula, and the Poisson-Jensen formula.

Detailed Syllabus

UNIT 1	**Analytic function and Complex Integration:** Review of Analytic function and C-R Equations, Complex integration, Cauchy-Goursat Theorem, Cauchy's integral formula, Higher order derivatives, Morera's Theorem, Cauchy's inequality, Liouville's theorem and the fundamental theorem of algebra, Maximum modulus principle, Schwarz lemma. Power series representation of analytic functions, Taylor's theorem, Laurent's theorem.
UNIT 2	**Singularities and Residues:** Isolated singularities and their classification, Zeros of Analytic functions, Behavior of function near isolated singular points, Casorati-Weierstrass theorem. The Argument principle, Rouche's theorem. Residues, Cauchy's residue theorem, Evaluation of integrals.
UNIT 3	**Meromorphic and Entire Function:** Meromorphic functions, Mittag Leffler Theorem, Entire functions, Weierstrass' factorization theorem, Gamma function and its properties, Riemann zeta function, Riemann's functional equation.
UNIT 4	**Bilinear transformations:** Bilinear transformations and their properties, classifications: Definitions and examples of conformal mappings, Branches of many valued functions with special reference to arg z, log z.
UNIT 5	**Analytic Continuation:** Analytic Continuation, Uniqueness of direct analytic continuation, Uniqueness of analytic continuation along a curve, Power series method of analytic continuation. Canonical products, Jensen's formula, Poisson-Jensen formula.

Text and Reference Books:

1. Complex Variables with an Introduction to Conformal Mapping and its Applications, Schaum's Outlines, McGraw-Hill, 2009.
2. Churchill and Brown, Complex Variables and Applications,8th Edition, McGraw Hill, 2009.
3. Joseph Bak and Donald J. Newman, Complex analysis (2nd Edition), Undergraduate Texts in Mathematics, Springer-VerlagNew York, Inc., New York, 1997.
4. Walter Rudin, Real and Complex Analysis, McGraw-Hill Co., 1966.
5. John B. Convey, Functions of One Complex Variable, Springer., 1978.
6. H. S. Kasana, Complex Variables: Theory and Applications, PHI Learning, 2005.
7. S. Ponnusamy, Foundations of Complex Analysis, Narosa Pub, 2004.
8. Shanti Narayan, Theory of Functions of a Complex Variable, S. Chand & Co., New Delhi, 2005.

Course Outcomes:

At the end of the course, the student should be able to:

1. Understand the significance of differentiability of complex functions leading to the understanding of Cauchy-Riemann equations.
2. Evaluate the contour integrals and understand the role of the Cauchy integral formula.
3. Expand some simple functions as their Taylor and Laurent series, classify the nature of singularities, find residues and apply Cauchy Residue theorem to evaluate integrals.

4. Demonstrate the ability to integrate knowledge and ideas of complex differentiation and complex integration in a coherent and meaningful manner and use appropriate techniques
5. Have a rigorous understanding of the concept of analytic Continuation and Canonical products.

MMA 203: Topology	
Teaching Scheme	**Examination Scheme**
Lectures:3hrs/Week Tutorials:1hr/Week Credits:4	ClassTest-12Marks Teachers Assessment-6 Marks Attendance-12Marks End Semester Exam–70marks

Course Objectives:
The course is designed to teach:

1. To introduce the fundamental concepts of topological spaces as a generalization of metric spaces.
2. To develop an understanding of continuity, homeomorphisms, and structural invariants in topology.
3. To explore separation axioms and their roles in characterizing different geometric and analytic spaces.
4. To master the core topological properties of compactness and connectedness.
5. To build rigorous mathematical reasoning and proof-writing skills in abstract spaces.

Detailed Syllabus

UNIT 1	**Topological Spaces:** Definition through open set axioms, Examples including usual topology, Ray, Lower limit and upper limit topologies on R, Co-finite and co-countable topologies, Weak and strong topologies, Algebra of Topologies, Equivalent metrics, Metrizable spaces, Open Set, Neighborhood, Limit Points, Derived Set, Closed Sets, Closure of a Set, Separated Set, Interior points and the Interior of a Set, Exterior of a Set, Boundary Points, Denseness, Perfect sets.
UNIT 2	**Topological Structures & Continuity:** Characterization of topologies in terms of closed sets, neighborhoods and Kuratowski's closure axioms , Base for a topology, Sub-bases, Local base, First Countable Space, Second Countable Space, Relative topology and Subspaces, Hereditary property, Separable Space, Lindeloff theorem. Continuous Function, Open Mapping, Sequential Continuity, Homeomorphism, Topological properties.
UNIT 3	**Separation axioms:** – T_0, T_1, T_2, T_3, $T_{3/2}$, regular space, normal space, completely regular space, completely normal space, T4 and T5, their characterizations and basic properties, Urysohn's lemma and Teitze Extension Theorem, Urysohn's Metrization Theorem.

UNIT 4	**Compactness:** Compact Space, Locally Compact Space, Finite Intersection Property, Bolzano Weierstrass Property, Sequentially Compact, Uniformly Continuous, Lebesgue Covering Lemma.
UNIT 5	**Connectedness:** Connected Set, Disconnected Set, Connectedness on the Real Line, components, Maximal Connected Set, Locally Connected Space and Totally Disconnected Set.

Textbooks & Reference Books:

1. James R. Munkres, Topology, 2nd Edition, Pearson International,2000.
2. George F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill,1963.
3. J.N. Sharma and J.P. Chauhan, "Topology", Krishna Publication Meerut.
4. J. L. Kelley, General Topology, Van Nostrand,1995.
5. K. D. Joshi, Introduction to General Topology, Wiley Eastern,1983.
6. J. Dugundji, Topology, Prentice-Hall of India, 1966.
7. N. Bourbaki, General Topology, Part I, Addison-Wesley,1966.
8. S. Willard, General Topology, Addison-Wesley,1970.

Course Outcomes:

At the end of the course, the student should be able to:

1. Define and construct various topological spaces using open sets, bases, and sub-bases.
2. Analyze and evaluate functions for continuity, open mappings, and homeomorphisms.
3. Classify spaces using separation axioms (T_0 through T_5) and apply major theorems like Urysohn's Lemma.
4. Identify and prove properties related to compactness and connectedness in abstract settings.
5. Demonstrate proficiency in applying topological concepts to real-line analysis and advanced mathematics.

MMA204: Statistical Methods and Data Analysis	
Teaching Scheme	**Examination Scheme**
Lectures:3hrs/Week	Class Test-12Marks
Tutorials:1hr/Week	Teachers Assessment-6 Marks
	Attendance-12Marks
Credits:4	End Semester Exam–70marks

Course Objectives:

The course is designed to teach:

1. The Python environment, data types, operators used in Python.
2. The use of control structures and numerous native data types with their methods.
3. The design and implement user defined functions, modules, and packages.

4. Creating and handling files in Python
5. Object Oriented Programming (OOP)

Detailed Syllabus

UNIT 1	Introduction to Statistical Analysis: Statistics, Types of Statistics, Population, Sample, basic terminology, Measurement & Scaling, characteristics. Types of Variables: Nominal and Ordinal, Interval & ratio scales, Quantitative variables, Qualitative or categorical variables, Data, Sources of Data, cross-section data, Time-series data.
UNIT 2	Standard discrete and continuous univariate distributions. sampling distributions, standard errors and asymptotic distributions, distribution of order statistics and range.
UNIT 3	Methods of estimation, properties of estimators, confidence intervals. Tests of hypotheses, likelihood ratio tests, Analysis of discrete data and chi-square test of goodness of fit, large sample tests, Simple nonparametric tests for one and two sample problems, rank correlation and test for independence, Elementary Bayesian inference.
UNIT 4	Gauss-Markov models, estimability of parameters, best linear unbiased estimators, confidence intervals, tests for linear hypotheses, Analysis of variance and covariance, Fixed, random and mixed effects models, Simple and multiple linear regression, Elementary regression diagnostics. Logistic regression.
UNIT 5	Multivariate normal distribution, Wishart distribution and their properties, Distribution of quadratic forms, Inference for parameters, partial and multiple correlation coefficients and related tests, Data reduction techniques, Principal component analysis, Discriminant analysis, Cluster analysis, Canonical correlation. Simple random sampling, stratified sampling and systematic sampling

Text and Reference Books:

1. G. Jay Kerns: “Introduction to Probability and Statistics Using R”, 2014.
2. S.C. Gupta and V.K. Kapoor - Fundamentals of Mathematical Statistics- 12th ed.- Sultan Chand & Sons- New Delhi- 2020.
3. P. Mukhopadhyay, Mathematical Statistics-3rd ed. Books and Allied (P) Ltd- Kolkata2018.
4. B.L. Agarwal, Basic Statistics- 6th ed. New Age International Publication- 2015.
5. V.K. Rohatgi and E. Saleh, An Introduction to Probability and Statistics- 3rd ed.- John Wiley & Sons Inc., New Jersey- 2015.

Course Outcomes:

At the end of the course, the student should be able to:

1. Able to solve the problems of central tendency
2. illustrate the use of probability distributions
3. Utilize the test of hypothesis in different practical problems
4. Understanding the use of variance, co-variance and analysis of variance
5. Understanding the scope of multivariate distribution

MMA205- Operations Research	
Teaching Scheme Lectures:3hrs/Week Tutorials:1hr/Week Credits:4	**Examination Scheme** ClassTest-12Marks TeachersAssessment-6 Marks Attendance– 12Marks End Semester Exam–70marks

Course Objectives:

1. Understand and apply optimization techniques to solve linear and integer programming problems.
2. Develop the ability to solve assignment and transportation problems using mathematical optimization methods.
3. Analyze decision-making and scheduling problems using game theory and sequencing techniques.
4. Understand inventory and queuing models for efficient resource planning and service system analysis
5. Apply network analysis and scheduling techniques for effective project planning, resource allocation, and optimization.

Detailed Syllabus

UNIT 1	**Linear Programming Problems (LPP):** The origin of OR, Definition and scope of Operation Research, Classification of OR models, Formulation of Linear-programming model, graphical solution, Simplex method. Big-M method, two-phase method, Duality, Dual Simplex method. **Integer Linear Programming Problems:** Integer Programming Problems, Mixed Integer Programming Problems, Cutting Plane Method, Branch and Bound Method.
UNIT 2	**Assignment and Transportation Problems:** Assignment problem and its mathematical formulation, solution of assignment problem (Hungarian method), Transportation problem and its mathematical formulation. Initial basic feasible solution of transportation problem by North-West corner rule, Lowest-Cost Entry method and Vogel's Approximation method, optimal solution of transportation problem.
UNIT 3	**Game Theory:** Two Persons Zero Sum Game, Solution With/Without Saddle Point, Dominance Rule, Different Methods Like Algebraic, Graphical, Linear Programming Methods. Approximation Method for Solution of Game. **Sequencing Problem:** Introduction, Assumption, Johnson's Procedure for N Jobs on Two Machines and N Jobs on Three Machines.
UNIT 4	**Inventory Models:** General inventory model, static economic order quantity (EOQ) Models, Deterministic inventory models-production model-Buffer stock **Queuing Theory:** Introduction to Queues, Basic Elements of Queuing Models, Queue Disciplines, Memory less Distribution, Role of Exponential and Poisson Distributions, Markovian Process, Erlang Distribution, Symbols and Notations, Distribution of Arrivals, Distribution of Service Times, Definition of Steady and Transient State, Poisson Queues.

UNIT 5	**CPM and PERT:** Network Diagram-Events and Activities- Project Planning Reducing Critical Events and Activities-Critical Path Calculations-Examples-Resources and Man Power Leveling. Sequencing Problems-Travelling Salesman Problems –Machine Scheduling Problem (Job-Shop).

Text Books:

1. Kanti Swaroop, P. K. Gupta and Man Mohan, *Operations Research*, Sultan Chand & Sons, New Delhi.
2. H. A. Taha, *Operations Research –An Introduction*, Macmillan.
3. S. S. Rao, *Optimization Theory and Applications*, Wiley Eastern.

Reference Books:

1. F. S. Hiller and G. J. Lieberman, *Introduction to Operations Research* (6th Edition), McGraw-Hill International Edition, 1995.
2. G. Hadley, *Nonlinear and Dynamic Programming*, Addison Wesley.
3. Edwin K. P. P. Chong, Stanislaw H. Zak, An Introduction to Optimization, Johan Welly & Sons Inc 2001.

Course Outcomes:

At the end of the course, the student should be able to:

Formulate and solve linear and integer programming problems using optimization techniques.

1. Formulate and solve linear and integer programming problems using optimization techniques.
2. Solve assignment and transportation problems using appropriate optimization algorithms.
3. Analyze and solve game theory and sequencing problems for effective decision-making.
4. Apply inventory and queuing models to optimize production and service systems.
5. Use CPM, PERT, and scheduling techniques for project planning, monitoring, and resource optimization.

MMA251 – Data Analytics Lab	
Teaching Scheme	**Examination Scheme**
Lab: 2Hrs/Week Tutorials: 0 Hrs./Week Credits: 2	Internal-15Marks External- 35 Marks

Course Objectives: Students will be able to learn the data objects, produce graphics, analyze data using
common statistical methods, and generate reproducible statistical reports. With the following programming in R

1. Introduction and Basics of R
2. Introduction to Data frames in R
3. Merging and Importing Data in R

4. Handing Numerical and categorical variables
5. Data manipulation in R
6. Data Preprocessing in R
7. Plotting of Histogram and Pie chart
8. Plotting Bar charts and Scatter plot
9. Probability Distribution in R
10. Statistical tests in R

Correlation & Regression

Course Outcomes:

After studying these topics, the students will be able to

1. Use of R Studio, read R documentation, and write R scripts.
2. Import, export and manipulate data.
3. Produce statistical summaries of continuous and categorical data.
4. Produce basic graphics using standard functions, and produce more advanced graphics using the
5. lattice and gplot2 packages.
6. Perform common hypothesis tests, and run simple regression models in R
7. Produce reports of statistical analyses in R Markdown.

Reference Books:

1. Paul Teetor. R Cookbook: Proven recipes for data analysis, statistics, and graphics. O'Reilly
2. Media, Inc., 2011.
3. Norman Matloff. The art of R programming: A tour of statistical software design. No Starch
4. Press, 2011.
5. Winston Chang. R graphics cookbook. O'Reilly Media, Inc., 2012.
6. Hadley Wickham and Garrett Grolemund. R for data science. (2016).
7. Phil Spector. Data manipulation with R. Springer Science & Business Media, 2008.

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AI English Proficiency

Adaptive Syllabus — Bands 1

Listening·Speaking·Reading·Writing

1-Year Programme·2 Semesters·Powered by AI FluentEdge

Paper	Code	Subject	L	T	P	MSM	ESM	Total	Credits

G.Core	EPC001	AI Based English Proficiency Course - II	0	0	0	0	50	50	2

[Course objectives, detailed syllabus, text/reference books and course outcomes to be provided by the concerned Board of Studies.]

How to Read This Syllabus

Each band section lists 5 units per skill. The first 2 units are mandated — these form the assessed curriculum (120 lessonspersemester).Units3–5areoptionalenrichmentthatstudentsareencouragedtocompletebutcarrynomarks.

✓ **Mandated**	Assessed · contributes to 10-mark Course Completion component
Optional	Encouraged enrichment · no marks attached · unlocked on platform

Programme Overview — All Bands

BETBaselinedetermineseachstudent'sstartingbandindependentlyforeachskill.Studentsbeginfromtheirdiagnosed band and complete the 2 mandated units of that level each semester.

Band	CEFR	Platform Level	MandatedUnits(per skill)	Lessons / Skill	Total Lessons
Bands 1–3	A1	Beginner	Unit 1 &2	30	120
Band 4	A2	Elementary	Unit 1 &2	30	120
Band 5	B1	Intermediate	Unit 1 &2	30	120
Bands 6–7	B2	Upper-Intermediate	Unit 1 &2	30	120
Band 8	C1	Advanced	Unit 1 &2	30	120
Band 9	C2	Proficient	Unit 1 &2	30	120

Note: Studentsat Bands1,2, and3allbeginatBeginnerlevel.StudentsatBands6and7beginatUpper-Intermediate.Platform unlocks adaptive progression within and across levels.

Bands 1, 2 &3

CEFR: A1 · Beginner

✓ **Mandated:** Units 1 & 2 per skill · 30 lessons/skill · 120 lessons total per semester

Optional: Units 3, 4 & 5 per skill (encouraged, ungraded)

Bands1,2,and3aregroupedtogetherattheBeginnerlevel(CEFRA1).Studentsareplacedwithinthislevelatdiff

erentstartingpoints by the BET Baseline — Band 1 at the earliest point, Band 3 slightly further in — but all cover the same mandated units.

Listening	Unit Name	Lessons	Status	Sub-topics
1	Workplace Greetings	15	✓ Mandated	15
2	Basic Instructions	15	✓ Mandated	15
3	Office Objects	15	Optional	15
4	Simple Schedules	15	Optional	15
5	Basic Requests &Medication	15	Optional	14

Speaking	Unit Name	Lessons	Status	Sub-topics
1	Introducing Yourself	15	✓ Mandated	13
2	Talking About Daily Tasks	15	✓ Mandated	12
3	Asking for Directions	15	Optional	8
4	Making Simple Requests & IT Support	15	Optional	29
5	Following Up	15	Optional	2

Reading	Unit Name	Lessons	Status	Sub-topics
1	Reading Simple Emails	15	✓ Mandated	15
2	Following Return Policy Instructions	15	✓ Mandated	15
3	Following Simple Financial Documents	15	Optional	15
4	Understanding Office Signs & Workplace Etiquette	15	Optional	22
5	Regulatory Documents	15	Optional	2

Writing	Unit Name	Lessons	Status	Sub-topics
1	Writing a Short Job Description	15	✓ Mandated	5
2	Writing a Simple Email	15	✓ Mandated	10

3	Writing Basic Instructions	15	Optional	10
4	Taking Simple Work Notes	15	Optional	8
5	Meeting Follow-up	15	Optional	6

Band 4

CEFR: A2 · Elementary

✓ **Mandated:** Units 1 & 2 per skill · 30 lessons/skill · 120 lessons total per semester

Optional: Units 3, 4 & 5 per skill (encouraged, ungraded)

Listening	Unit Name	Lessons	Status	Sub-topics
1	Scheduling Meetings	15	✓ Mandated	15
2	Email Follow-ups	15	✓ Mandated	15
3	Work Routines	15	Optional	15
4	Office Roles	15	Optional	10
5	Basic Phone Calls & Handling Complaints	15	Optional	12

Speaking	Unit Name	Lessons	Status	Sub-topics
1	Scheduling Meetings	15	✓ Mandated	15
2	Writing and Responding to Emails	15	✓ Mandated	12
3	Work Roles and Responsibilities	15	Optional	12
4	Giving Feedback on Tasks	15	Optional	8
5	Talking About Company Policies	15	Optional	9

Reading	Unit Name	Lessons	Status	Sub-topics
1	Reading Company Policies	15	✓ Mandated	15
2	Understanding Meeting Agendas	15	✓ Mandated	15
3	Reading Customer Inquiries	15	Optional	15
4	Internal Office Communication	15	Optional	15

5	Understanding Workflow Charts	15	Optional	15

Writing	Unit Name	Lessons	Status	Sub-topics
1	Writing Follow-Up Emails	15	✓ Mandated	15
2	Summarizing Workplace Tasks	15	✓ Mandated	15
3	Creating Short Reports	15	Optional	15
4	Writing Formal Meeting Invitations	15	Optional	15
5	Describing Company Policies	15	Optional	15

Band 5

CEFR: B1 · Intermediate

✓ **Mandated:** Units 1 & 2 per skill · 30 lessons/skill · 120 lessons total per semester

Optional: Units 3, 4 & 5 per skill (encouraged, ungraded)

Listening	Unit Name	Lessons	Status	Sub-topics
1	Client Calls	15	✓ Mandated	15
2	Daily Briefings	15	✓ Mandated	15
3	Handling Complaints	15	Optional	15
4	Meeting Agendas	15	Optional	15
5	Team Discussions	15	Optional	15

Speaking	Unit Name	Lessons	Status	Sub-topics
1	Team Discussions	15	✓ Mandated	15
2	Handling Client Communication	15	✓ Mandated	15
3	Managing Workplace Challenges	15	Optional	15
4	Giving Performance Feedback	15	Optional	15
5	Handling Workplace Negotiations	15	Optional	15

Reading	Unit Name	Lessons	Status	Sub-topics
1	Analyzing Business Reports	15	✓ Mandated	15
2	Reading Project Proposals	15	✓ Mandated	15
3	Understanding Corporate Emails	15	Optional	15
4	Reviewing Meeting Minutes	15	Optional	15
5	Handling Client Requests	15	Optional	15

Writing	Unit Name	Lessons	Status	Sub-topics
1	Writing Business Proposals	15	✓ Mandated	15
2	Composing Structured Workplace Emails	15	✓ Mandated	15
3	Drafting Performance Reviews	15	Optional	15
4	Summarizing Client Feedback	15	Optional	15
5	Writing Detailed Project Updates	15	Optional	15

Bands 6 &7 CEFR: B2 · Upper-Intermediate

✓ **Mandated:** Units 1 & 2 per skill · 30 lessons/skill · 120 lessons total per semester

Optional: Units 3, 4 & 5 per skill (encouraged, ungraded)

Bands6and7aregroupedtogetherattheUpper-Intermediatelevel(CEFRB2).Studentsareplacedatdifferentstartingpointswithin this level based on their BET score, but both cover the same mandated units.

Listening	Unit Name	Lessons	Status	Sub-topics
1	Strategy Meetings	15	✓ Mandated	15
2	Budget Discussions	15	✓ Mandated	15
3	Project Feedback	15	Optional	15
4	Performance Reviews	15	Optional	15
5	Internal Memos	15	Optional	15

Speaking	Unit Name	Lessons	Status	Sub-topics
1	Strategy Meetings	15	✓ Mandated	15
2	Budget Discussions	15	✓ Mandated	15
3	Handling Corporate Presentations	15	Optional	15
4	Reviewing Project Proposals	15	Optional	15
5	Discussing Market Trends	15	Optional	15

Reading	Unit Name	Lessons	Status	Sub-topics
1	Reading Financial Reports	15	✓ Mandated	15
2	Understanding Competitive Analysis	15	✓ Mandated	15
3	Reviewing Business Strategies	15	Optional	15
4	Evaluating Employee Performance Reports	15	Optional	15
5	Reading Corporate Case Studies	15	Optional	15

Writing	Unit Name	Lessons	Status	Sub-topics
1	Drafting Strategic Plans	15	✓ Mandated	15
2	Writing Executive Summaries	15	✓ Mandated	15
3	Composing High-Level Business Reports	15	Optional	15
4	Writing Structured Financial Forecasts	15	Optional	15
5	Preparing Official Corporate Documentation	15	Optional	15

Band 8

CEFR: C1 · Advanced

✓ **Mandated:** Units 1 & 2 per skill · 30 lessons/skill · 120 lessons total per semester

Optional: Units 3, 4 & 5 per skill (encouraged, ungraded)

Listening	Unit Name	Lessons	Status	Sub-topics

1	Negotiation Strategies	15	✓ Mandated	14
2	Financial Analysis	15	✓ Mandated	15
3	Business Development	15	Optional	15
4	Policy Changes	15	Optional	15
5	Crisis Management	15	Optional	15

Speaking	Unit Name	Lessons	Status	Sub-topics
1	Negotiation Strategies	15	✓ Mandated	15
2	Financial Analysis Discussions	15	✓ Mandated	15
3	Business Development Talks	15	Optional	15
4	Crisis Communication	15	Optional	15
5	Discussing Global Business Policies	15	Optional	15

Reading	Unit Name	Lessons	Status	Sub-topics
1	Reviewing Investment Proposals	15	✓ Mandated	15
2	Analyzing Global Business Trends	15	✓ Mandated	15
3	Understanding Market Research Reports	15	Optional	15
4	Reading International Trade Agreements	15	Optional	15
5	Corporate Risk Assessments	15	Optional	15

Writing	Unit Name	Lessons	Status	Sub-topics
1	Writing Complex Business Case Studies	15	✓ Mandated	15
2	Preparing International Trade Analysis	15	✓ Mandated	15
3	Drafting Industry Regulatory Reports	15	Optional	15
4	Writing Professional Negotiation Scripts	15	Optional	15
5	Composing Thought Leadership Articles	15	Optional	15

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Band 9

CEFR: C2 · Proficient

✓ **Mandated:** Units 1 & 2 per skill · 30 lessons/skill · 120 lessons total per semester

Optional: Units 3, 4 & 5 per skill (encouraged, ungraded)

Listening	Unit Name	Lessons	Status	Sub-topics
1	Boardroom Debates	15	✓ Mandated	15
2	Industry Forecasts	15	✓ Mandated	15
3	Investor Meetings	15	Optional	15
4	Competitive Analysis	15	Optional	15
5	International Mergers	15	Optional	15

Speaking	Unit Name	Lessons	Status	Sub-topics
1	Boardroom Debates	15	✓ Mandated	15
2	Industry Forecasts	15	✓ Mandated	15
3	Investor Meetings	15	Optional	15
4	Competitive Analysis	15	Optional	15
5	International Mergers	15	Optional	15

Reading	Unit Name	Lessons	Status	Sub-topics
1	Reading Boardroom Briefings	15	✓ Mandated	15
2	Analyzing International Mergers	15	✓ Mandated	15
3	Reviewing High-Stakes Legal Contracts	15	Optional	15
4	Reading Complex Financial Audits	15	Optional	15
5	Understanding Multinational Business Strategies	15	Optional	15

Writ	Unit Name	Lessons	Status	Sub-topics

ing				
1	Writing Global Business Transformation Whitepapers	15	✓ Mandated	15
2	Composing Investment Proposals	15	✓ Mandated	15
3	Drafting Multinational Expansion Strategies	15	Optional	15
4	Preparing High-Impact Financial Reports	15	Optional	15