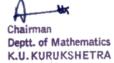
Session: 202	3-24(Scheme), 2024-25(Syllabus)	
PartA – Introduction		
Subject	Mathematics	
Semester	V	
Name of the Course	Sequences and Series	
Course Code	B23-MAT-501	
CourseType: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VA C)	CC/MCC	
Level of the course	300-399	
Pre-requisite for the course (ifany)		
CourseLearningOutcomes(CLO):	 After completing this course, the learner will be able to: 1. Understand basic concepts of real number system, set theory and preliminary results on neighbourhood of a point, interior and limit points, open sets, closed sets etc. 2. Learn about denumerability of subsets of real numbers, sequences, their limits, boundedness and convergence. Determine the convergence and divergence of a sequence. Understand Cauchy sequence and Cauchy general principle of convergence of sequence. 3. Attain skills to determine convergence of a series of real numbers by applying various tests. 4. To know absolute and conditional convergence of alternating series and apply theory to check the convergence of arbitrary series. 	
CLO 5 is related to the practical component of the course.	5*Attain cognitive and technical skill required to check the convergence of sequences and infinite series and verify the same by applying various available tests and tools.	

CC-5/MCC-9 Sequences and Series



Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Internal Assessment Marks	20	10	30
End Term Examination Marks	50	20	70
Examination Time	3 Hours	3 Hours	
Max Market100			

Max. Marks:100

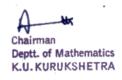
PartB-Contentsofthe Course

Instructions for Paper- Setter

Unit	Topics	Contact Hours
Ι	Boundedness of the set of real numbers, Least upper bound and Greatest lower bound of a set. Archimedean, algebraic and ordered properties in \mathbb{R} . The real number system as a complete ordered field. Neighbourhoods, interior points, isolated points, limit points, Open sets, closed sets, interior of a set, closure of a set in real numbers and their properties. Bolzano-Weierstrass theorem. Open covers, compact sets and Heine-Borel theorem.	12
II	Denumerable and non-denumerable sets, Denumerability of integers, rationals and non-denumerability of real numbers. Sequences: Real sequences and their convergence, Theorems on limit of sequence, Bounded and monotonic sequences, Cauchy's sequence, Cauchy general principle of convergence, Subsequences and subsequential limits, Limit superior and limit inferior.	12
III	Infinite series: Convergence and divergence of Infinite Series, Comparison tests of positive terms infinite series, Cauchy's general principle of Convergence of series, Convergence and divergence of geometric series, Hyper Harmonic series or p- series, D-Alembert's ratio test, Raabe's test, Logarithmic test, Cauchy's nth root test, De-Morgan and Bertrand's test, Gauss	12



	Test, Cauchy's integral test, Cauchy's condensation test.	
IV	Alternating series, Absolute and conditional convergence, Leibnitz test. Arbitrary series, Abel's and Dirichlet's test, Insertion and removal of parenthesis, Re-arrangement of terms in a series, Riemann's re-arrangement theorem and Pringsheim's theorem (statement only). Cauchy product of series (definitions and examples only).	12
	Practical	
	 The practical component of the course has two parts, Problem Solving and Practical's using Mathematica/ Matlab/Maple/Scilab/ Maxima etc. software. The examiner will set 4 questions at the time of practical examination asking two questions from the part (A) and two questions from the part (B) by taking course learning outcomes (CLOs) into consideration. The examinee will be required to solve one problem from the part (A) and to execute one problem successfully from the part (B). Equal weightage will be given to both the parts. The evaluation will be done on the basis of practical record, viva-voce, write up and execution of the program. (A) Problem Solving- Questions related to the following problems will be solved and their record will be maintained in the Practical Notebook: 1. Problem demonstrating that the set of rational numbers is not order complete. 2. Practical problems on finding lub and glb of a set. 3. Problem solving to find limit point of a set using Bolzano Weierstrass Theorem. 4. Problems demonstrating the use of Cauchy's first 	30



	and second theorems for convergence of sequences.	
	Problem solving on limit inferior and limit superior of a sequence.	
	Practical problems on convergence/divergence of positive	
	term series demonstrating the application of various	
	convergence tests.	
8.	Problem solving on	
	(a) conditional convergence and	
	(b) absolute convergence of an alternating series.	
	Practical problems to demonstrate	
	Cauchy product of two convergent series need not be convergent.	
11.	Cauchy product of two divergent series need not be	
	divergent.	
	Practical problems demonstrating the denumerability of the	
	cartesian product of denumerable sets.	
	Demonstrate the non-denumerability of the set of irrationals.	
	The following practicals will be done using	
, í		
	hematica/ Matlab/Maple/Scilab/ Maxima etc.software	
and	also verify results by applying various convergence	
tests	s. Their record will be maintained in the practical note	
bool	k:	
1.	Testing the convergence of infinite series of positive terms	
	by the use of sequence of partial sums.	
2.	Testing the convergence of an infinite positive term series.	
3.	Testing the absolute convergence of an alternating series	
	and comment about conditional convergence.	
	Practical problems on the convergence of series with	
	arbitrary terms.	
	Testing the convergence/divergence/oscillation behavior of sequences of real numbers.	
	Determine the lub and glb of the subset of real numbers	
	and observe whether they belong to the set or not.	



Suggested Evaluation Methods		
InternalAssessment: ➤ Theory 20 • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➤ Practicum • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam:	End Term Examination: ➤ Theory 50 Written Examination ➤ Practicum 20 Lab record, viva- voce, write up and execution of the program	

PartC-Learning Resources

Recommended Books:

1. T. M. Apostol (2008). *Mathematical Analysis: A Modern Approach to Advanced Calculus*. Pearson Education.

2. Charalambos D. Aliprantis& Owen Burkinshaw(1998). *Principles of Real Analysis* (3rd edition). Academic Pres.

3. Robert G. Bartle & Donald R. Sherbert (2015). *Introduction to Real Analysis* (4th edition). Wiley India.

4. Gerald G. Bilodeau, Paul R. Thie& G. E. Keough (2015). *An Introduction to Analysis* (2nd edition), Jones and Bartlett India Pvt. Ltd.

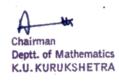
5. E. Hewitt & K. Stromberg (2013). Real and Abstract Analysis. Springer-Verlag.

6. K. A. Ross (2013). *Elementary Analysis*: The Theory of Calculus (2nd edition). Springer.

7. Walter Rudin. Principles of Mathematical Analysis (3rd edition), Tata McGraw Hill.

- 8. R. R. Goldberg (1970). Real Analysis. Oxford & I. B. H. Publishing Co., New Delhi.
- 9 Shanti Narayan & P. K. Mittal (2005). *A Course in Mathematical Analysis* . S. Chand and company, New Delhi.

10. S. C. Malik & S. Arora (2021). Mathematical Analysis. Wiley Eastern Ltd., Allahabad.



Session: 2023-2	24 (Scheme), 2024-25 (Syllabus)
Pa	rtA - Introduction
Subject	Mathematics
Semester	V
Name of the Course	Mechanics-I
Course Code	B23-MAT-502
CourseType: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	MCC
Level of the course	300-399
Pre-requisite for the course (ifany)	Mathematics as a subject at level 5.0
CourseLearningOutcomes(CLO):	 After completing this course, the learner will be able to: 1. Comprehensive, factual and theoretical knowledge of the basic concepts of forces, their resultant, moments and couples and to attain the problem solving skill for scientific problems. 2. Have deeper knowledge and understanding of the concepts of friction and laws of friction, centre of mass and centre of gravity and to solve problems related to these concepts. 3. Gain knowledge of concepts of dynamics like velocity, acceleration and angular velocity, simple harmonic motion and to develop the skill of solving simple dynamical problems within the chosen fields of learning. 4. Understand and learn the problems based on concepts of Newton's laws of motion, work, power, energy and apply them to solve related problems in real life.

MCC-10 Mechanics-I



CLO 5 is related to the practical component of the course.	5.Toattain cognitive and technical skills required for solving practical problems and case studies related to forces, couples, moments, velocity, acceleration, simple harmonic motion, Newton's laws of motion, power and energy. Have hands on skill to create simple program in MATLAB/SCILAB or other softwares to calculate resultant of forces, acceleration, velocity, coefficient of friction, angle of friction, work done, energy and power.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Internal Assessment Marks	20	10	30
End term Examination Marks	50	20	70
Examination Time	3 Hours	3 Hours	

Max. Marks:100

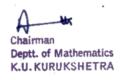
PartB-Contentsofthe Course

Instructions for Paper- Setter

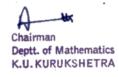
Unit	Topics	Contact Hours
Ι	Composition and resolution of forces, Parallel forces, Moment of force about a point and a line, Couple, Moment of couple about a point and a line.	12
II	Concept of friction, Laws of friction, Concepts of centre of mass and centre of gravity, Centre of gravity of a uniform arc, plane area and solids of revolution.	12



III	Valacity and acceleration of a particle along a survey radial	12
	Velocity and acceleration of a particle along a curve: radial and transverse components, tangential and normal	12
	components, Relative velocity, Angular velocity and	
	acceleration, Simple harmonic motion, Elastic string.	
IV	Newton's laws of motion, Work, Power and Energy.	12
	Practical	
	The practical component of the course has two parts,	30
	Problem Solving and Practical's using MATLAB/SCILAB	
	software. The examiner will set 4 questions at the time of	
	practical examination asking two questions from the part	
	(A) and two questions from the part (B) by taking course	
	learning outcomes (CLOs) into consideration. The	
	examinee will be required to solve one problem from the	
	part (A) and to execute one problem successfully from the	
	part (B). Equal weightage will be given to both the parts.	
	The evaluation will be done on the basis of practical	
	record, viva-voce, write up and execution of the program.	
	(A) Problem Solving- Questions related to the following	
	problems will be worked out and record of those will be	
	maintained in the Practical Notebook:	
	1. Practical problems to find resultant and resolution of	
	forces.	
	2. Practical problems based on Lami's theorem and its	
	converse.	
	3. Practical problems on equilibrium of a number of	
	concurrent forces.	
	4. Practical problems to find moment of couples.	



5. Practical problems on motion of a particle attached to an elastic string. 6. Practical problems on motion of two bodies connected by a string. 7. Practical problems based on principle of conservation of energy. (B) The following practical will be done using MATLAB/SCILAB or other softwares and record of those will be maintained in the practical note book: 1. To find magnitude and resultant of given forces. 2. To find ratio of magnitude of forces using Lami's theorem. 3. To find coefficient of friction, resultant friction, angle of friction. 4. To find limits between which a force lie in order to keep a body in equilibrium on a rough inclined plane. 5. To find magnitude and direction of velocity, acceleration along a plane curve. 6. To find magnitude and direction of radial velocity, transverse velocity, radial acceleration, transverse acceleration along a plane curve. 7. To find magnitude and direction of tangential velocity, normal velocity, tangential acceleration, normal acceleration along a plane curve. 8. To find work done by a constant force, variable force and in stretching an elastic string. 9. To find rate of doing work (power). 10. To find kinetic energy and potential energy of a body.

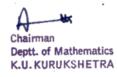


	Suggested Evaluation Methods		
\succ	ernal Assessment: Theory 20 Class Participation 5	End Term Examination:	
• •	Class Participation: 5 Seminar/presentation/assignment/quiz/class test etc.: 5 Mid-Term Exam: 10	Theory 50 Written Examination	
) • •	Practicum 10 Class Participation: Seminar/Demonstration/Viva-voce/Lab records etc.: 10 Mid-Term Exam:	Practical 20 Lab record, viva- voce, write up and execution of the program	

PartC-Learning Resources

Recommended Books:

- Stephan J. Chapman (2020). *MATLAB Programming for Engineers* (6th edition). Cengage Learning.
- William Palm Lii (2017). A concise introduction to MATLAB (2nd edition). Tata Mcgraw-Hill Education.
- 3. RudraPratap (2010). *Getting Started with MATLAB:A quick introduction for scientists and engineers*. Oxford University Press.
- 4. A. S. Ramsey (2009). *Statics*. Cambridge University Press.
- 5. A. S. Ramsey (2009). *Dynamics*. Cambridge University Press.
- 6. S.L. Loney (2006). An Elementary Treatise on the Dynamics of a Particle and of Rigid Bodies. Read Books.
- A.P. Roberts (2003). Statics and Dynamics with Background in Mathematics. Cambridge University Press.
- 8. S.L. Loney (1995). An Elementary Treatise on Statics, Radha Publishing House.
- 9. P.L. Srivastava (1964). *Elementary Dynamics*. Ram NarainLal, Beni Prasad Publishers Allahabad.
- 10. R. S. Varma (1962). A Text Book of Statics. Pothishala Pvt. Ltd.
- 11. J. L. Synge & B. A. Griffith (1949). Principles of Mechanics. McGraw-Hill.



Session: 2023-24 (Scheme), 2024-25 (Syllabus)		
Part A – Introduction		
Subject	Mathematics	
Semester	V	
Name of the Course	Linear Programming	
Course Code	B23-MAT-503	
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE	
Level of the course	300-399	
Pre-requisite for the course (if any)	Mathematics as a subject at level 4.0	
Course Learning Outcomes (CLOs):	 After completing this course, the learner will be able to: Understand the concepts of linear programming problems (LPP) and all other associated concepts. Learn to analyze and solve linear programming problems of real life situations using graphical method. Have the procedural knowledge of Simplex method and attain the skills to apply knowledge of simplex method in solving real life LPP. Learn the techniques of Two-phase method and Big-M method. Understand the concepts of dual problems, duality theorem and to attain skills to solve linear 	

DSE-2 Linear Programming

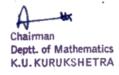


CLO 5 is related to the practical component of the course.	 programming problems by making use of duality theorem. 4. Have the procedural knowledge of Transportation problems and Assignment problems. Acquire the skills to solve these problems by using different LPP methods. 5. Attain cognitive and technical skills required to analyze scientific and social problems as linear programming problems and solving them by 		
	applying lea	arnt techniques.	
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Internal Assessment Marks	20	10	30
End Term Examination Marks	50	20	70
Examination Time	3 Hours	3 Hours	
	Max. Marks: 100		
Part	B- Contents of the	Course	

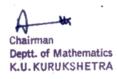
Part B- Contents of the Course

Instructions for Paper- Setter

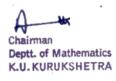
Unit	Topics	Contact Hours
Ι	Linear Programming Problems: Definition, Objective function, Constraints, Canonical and standard forms. Graphical approach for solving some linear programming problems, Limitations of graphical method.	12



	Convex and polyhedral sets, Extreme points, Basic solutions, Basic feasible solutions. Correspondence between basic feasible solutions and extreme points.	
Π	 Theory of simplex method, Concept of initial basic feasible solution, Optimality criterion, Improving a basic feasible solution, Unboundedness. Simplex algorithm and its tableau format, Artificial variables, Two-phase method, Big-M method. Relation between maximization and minimization problems, Solving linear programming problems using simplex algorithm. 	12
III	Formulation of the dual problem, Duality theorems, Unbounded and infeasible solutions in the primal, Solving the primal problem using duality theory.	12
IV	Transportation Problem: Definition and formulation, Methods of finding initial basic feasible solutions, North West corner rule, Least cost method, Vogel's Approximation method. Assignment Problem: Mathematical formulation and Hungarian method of solving.	12
	Practical	
	The practical component of the course has two parts,	30
	Problem Solving and Practical's using MATLAB/SCILAB	
	or other Statistical software. The examiner will set 4	
	questions at the time of practical examination asking two	
	questions from the part (A) and two questions from the part	
	(B) by taking course learning outcomes (CLOs) into	
	consideration. The examinee will be required to solve one	
	problem from the part (A) and to execute one problem	
	successfully from the part (B). Equal weightage will be	
	given to both the parts. The evaluation will be done on the	
	basis of practical record, viva-voce, write up and execution	
	of the program.	
	Part A: Problem Solving-Questions related to the practical	



applications based on following problems will be worked out and record of those will be maintained in the Practical Note Book:	
1. To solve Linear Programming Problems using Graphical method with	
(i) Unbounded solution.(ii) Infeasible solution.(iii) Alternate or multiple solutions.	
2. Solving LPP using Simplex method with(i) Unrestricted variables.(ii) Infeasible solution.	
3. To solve Linear Programming Problem by Simplex method with unique solution or with unbounded solution.	
4. To solve Linear Programming Problem by Two Phase method.	
5. To solve Linear Programming Problem by Big M-Method.	
6. To solve Linear Programming Problem using duality.	
7. To obtain an optimal solution by Dual Simplex Method.	
8. To determine optimal solution of a transportation problem using Vogel's method.	
9. To determine optimal solution of transportation problem using (u v) method.	
10. To determine an initial basic feasible solution of transportation problem by matrix method.	
11. To determine solution of Allocation problems using Assignment model.	
Part B: Implementation of above mentioned problem solving through MATLAB/SCILAB or other Statistical softwares.	



Internal Assessment:	End Term		
 Theory 20 Class Participation: 5 Seminar/presentation/assignment/quiz/class test etc.: 5 Mid-Term Exam: 10 Practicum 10 Class Participation: Seminar/Demonstration/Viva-voce/Lab records etc.: 10 Mid-Term Exam: 	Examination: > Theory 50 Written Examination > Practicum 2 Lab record, viva- voce, write-up and execution of programs		
Part C-Learning Resources			

- F. S. Hillier, G. J. Lieberman, B. Nag and P. Basu (2021). Introduction to Operations Research (11th Edition). McGraw-Hill Education.
- 2. Hamdy A. Taha (2021). *Operations Research: An Introduction* (10th Edition). Pearson.
- M. S. Bazaraa, J.J. Jarvis and H. D. Sherali (2010). *Linear Programming and Network Flows* (4th Edition). John Wiley & Sons Inc.
- P. R. Thie and G. E. Keough (2008). An Introduction to Linear Programming and Game Theory (3rd Edition). Wiley Interscience.
- 5. G. Hadley (2002). *Linear Programming*. Narosa Publishing House.



Session: 2023-24 (Scheme), 2024-25 (Syllabus)				
Part A – Introduction				
Subject	Mathematics			
Semester	V			
Name of the Course	Computer Programming			
Course Code	B23-MAT-504			
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE			
Level of the course	300-399			
Pre-requisite for the course (if any)	Mathematics as a subject at level 5.0			
Course Learning Outcomes (CLOs):	 After completing this course, the learner will be able to: Have a deeper knowledge and understanding of the concept of mathematical problem solving using computer programming, program design, documentation, compilation, debugging, linking and types of errors in programming. Gain the knowledge and familiarize with the concepts of identifiers, constants, variables, data types, operators, input/output functions in C/C++ programming language. Attain the skills to write and execute programs in C/C++ using programming tools. Have a deeper knowledge and understanding of 			

DSE-2 Computer Programming

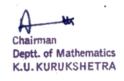


CLO 5 is related to the practical component of the course.	 decision control statements, loops structures, multidimensional arrays and dynamic arrays in C/C++ programming language. 4. Gain the knowledge and deeper understanding of functions, pointers, strings and files in C/C++ language. Attain the programming skills to solve scientific and practical problem using programming tools. 5. Attain skills of writing codes in the C/C++ programming language. Have hands-on experience to run and debug programs in C/C++ for different mathematical and other practical problems of daily or scientific use. 		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Internal Assessment Marks	20	10	30
End Term Examination Marks	50	20	70
Examination Time	3 Hours	3 Hours	
	Max. Marks: 100		
Part B- Contents of the Course			

Instructions for Paper- Setter



Unit	Topics	Contact Hours
I	Planning the Computer Program: Concept of problem solving, Problem definition, Program design, Debugging, Types of errors in programming, Documentation. Techniques of Problem Solving: Flowchart, Algorithms, 	12
Π	of a good programming language. Basic Structure of programming in C/C++, Creating C/C++ source file, Editing, Compiling, Debugging, linking etc., Tokens, Keywords, Identifiers, Constants and Variables in C/C++, Scope and lifetime of variables, Data types in C/C++, Operators and Enum in C/C++, Operators precedence, Arithmetic Expressions, Input/ Output functions in C/C++.	12
III	Decision making using IF statement, Types of IF-ELSE block, Switch case block. Loop structures: While loop, Do-While Loop, For Loop, Continue statement, Break statement. Introduction of Array, Multidimensional Arrays, Dynamic Arrays.	12
IV	Concept of function in C/C++, User defined function, System defined function, Types of parameters passing in function. Implementing string variables, String handling functions in C/C++. Need of Pointers, Types of pointers, Pointers expressions, Arrays of Pointers, Pointers and Functions, File handling	12

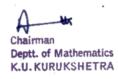


using C/C++	
Practical	
 Practical This course has programs, based on Programming in C/C++. The examiner will set 4 programs at the time of practical examination by taking course learning outcomes (CLOs) into consideration. The examinee will be required to execute two programs. The evaluation will be done on the basis of practical record, viva-voce, write-up and execution of the program. Practicals: The following practicals will be done using the programming language C/C++ and record of those will be maintained in the practical Note Book: Program to find the largest number among n input numbers. Program to find first nPrime Numbers. Program to print hollow pyramid star pattern. Program to generate Fibonacci Triangle. Program to find sum of an AP and GP Series. Program to check whether a two dimensional array 	30
is a Sparse Matrix. 9. Find Norm and Trace of a Square Matrix. 10. Program to find GCD of two Numbers using	
 Recursion. 11. Program to check if input character is a vowel using Switch Case. 12. Program to Check if a given string is Palindrome. 13. Program to Count the number of vowels & consonants in a sentence. 14. Program for dynamic memory allocation using malloc(). 	



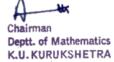
	 15. Program to swap two numbers using Pointers. 16. Program for accessing array elements (Traversing array) by incrementing a Pointer. 17. Program for Pointer to a Function. 18. Program for sorting an array. 19. Program for searching an element in an array. 		
	Suggested Evaluation Methods	I	
λ	al Assessment: Theory 20 Class Participation: 5 Seminar/presentation/assignment/quiz/class test etc.: 5 Mid-Term Exam: 10 Practicum 10 Class Participation: Seminar/Demonstration/Viva-voce/Lab records etc.: 10 Mid-Term Exam:	End Term Examination:	
	Part C-Learning Resources		
1.	nmended Books: E. Balagurusamy (2020). <i>Object Oriented Programming with C+</i> McGraw Hill Education.	+ (8 th Edition).	
	 E. Balagurusamy (2019). <i>Programming in ANSI C</i> (8th Edition). McGraw Hill Education. 		
	 D.S. Malik (2017). C++ Programming: From Problem Analysis to Program Design (8th Edition). Cengage Learning. 		
	5. R. Thareja (2016). <i>Computer Fundamentals and Programming in C</i> (2 nd Edition), Oxford University Press.		
6.	S. Prata (2015). <i>C</i> ++ <i>Primer Plus</i> (6 th Edition). Pearson Education	on India.	
	B.W. Kernighan and D.M Ritchie (2015). <i>The C Programming L</i> Pearson Education India.	anguage (2 nd Edition).	

8. V. Rajaraman (1994). Computer Programming in C. Prentice Hall of India.



Session: 2023-24 (Scheme), 2024-25 (Syllabus)			
PartA – Introduction			
Subject	Mathematics		
Semester	V		
Name of the Course	Number theory and cryptography		
Course Code	B23-MAT-505		
CourseType: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course	300-399		
Pre-requisite for the course (ifany)	Level 200-299		
CourseLearningOutcomes(CLOs):	 After completing this course, the learner will be able to: 1. Understand the notion of divisibility, Euclidean algorithim, congruences and some applications to factoring. 2. Have knowledge of Finite fields, quadratic residues and quadratic reciprocity. 3. Have deeper knowledge and understanding of cryptosystems and enciphering matrices. 4. Understand and solve problems related to Public key cryptography, RSA, discrete log and knapsack problem. 		

DSE-3 Number theory and cryptography



CLO 5 is related to the practical component of the course.	5. Attain cognitive and technical skills required for solving practical problems related to Euclidean algorithim, linear congruences, divisibility, finite field, Deciphering the ciphertext, integer factorization, RSA encryption and decryption functions.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Internal Assessment Marks	20	10	30
End term Examination Marks	50	20	70
Examination Time	3 Hours	3 Hours	

Max. Marks:100

PartB-Contentsofthe Course

Instructions for Paper- Setter

Unit	Topics	Contact Hours
Ι	Numbers in different bases, divisibility and the Euclidean algorithm, congruences, some applications to factoring.	12
II	Finite fields, quadratic residues and quadratic reciprocity.	12
III	Some simple cryptosystems, enciphering matrices.	12



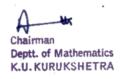
IV	Public key cryptography, RSA cryptosystems, discrete log and knapsack problem.	12
	Practical	
	 The practical component of the course has two parts, Problem Solving and Practical's using MATLAB/SCILAB or other Statistical software. The examiner will set 4 questions at the time of practical examination asking two questions from the part (A) and two questions from the part (B) by taking course learning outcomes (CLOs) into consideration. The examinee will be required to solve one problem from the part (A) and to execute one problem successfully from the part (B). Equal weightage will be given to both the parts. The evaluation will be done on the basis of practical record, viva-voce, write up and execution of the program. Part A: Problem Solving-Questions related to the practical applications based on following problems will be worked out and record of those will be maintained in the Practical Note Book: To find the gcd using Euclidean algorithim. Find common solution of linear congruences using Chinese remainder theorem. Checking the divisibility of an integer by another integer. Find the generator of a finite field. To find the square root of a number in finite field. Check that a given number is quadratic residue or quadratic non residue modulo a prime number. 	
	7. Deciphering the ciphertext.	



1. N. Koblitz, (1994). A Course in Number Theory an Verlag.	nd Cryptography (2 nd edition). Springer-
PartC-Learning R Recommended Books:	esources
	050118005
 Seminar/Demonstration/Viva-voce/Lab record Mid-Term Exam 	ds etc.: 10 execution of the program
Class Participation	voce, write up and execution of the
 Practicum 10 Practicum 10 	Lab record, viva-
 Seminar/presentation/assignment/quiz/class te Mid-Term Exam: 10 	est etc.: 5 Written Examination ➤ Practicum 20
Class Participation: 5	> Theory 50
InternalAssessment: Theory 20	End Term Examination:
Suggested Evaluation	on Methods
solving through MATLAB/SCILAB or c	
Part B: Implementation of above m	-
inverse.	antional making
compute their sum, product, a	and multiplicative
12. Given two elements a and b in	-
functions in a problem.	
11. Implement the RSA encryption	n and decryption
encryption and decryption.	
n and the public and private	e keys for RSA
10. Given two prime number p and c	q find the modulus
contains all the roots of the polyn	omial $X^2 + X + 1$.
9. Find the smallest field extens	ion of F ₅ which

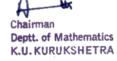
Theory, Cryptography and Codes. Springer Berlin, Heidelberg.

3. W. Stallings, (2017). Cryptography and network security (7th edition). Pearson Education.



Session: 2023-24 (Scheme), 2024-25 (Syllabus)		
Part A – Introduction		
Subject	Mathematics	
Semester	V	
Name of the Course	Integral Transforms and Fourier Analysis	
Course Code	B23-MAT-506	
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE	
Level of the course	300-399	
Pre-requisite for the course (if any)	Mathematics as a subject at level 5.0.	
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to:	
	 Gain the knowledge and understanding of Laplace transforms, Inverse Laplace transforms, their properties and convolution theorem. Have the knowledge of Fourier series, Fourier sine and cosine series, Fourier half range series and absolute and uniform convergence of Fourier series. Learn Parseval's identity and Bessel's inequality. Attain skills to make use of Fourier series in scientific problem solving. Gain the deeper knowledge of Fourier transforms, inverse Fourier transforms, their properties and Convolution theorem. Learn about the concept of finite Fourier transforms, inverse finite Fourier transforms. 	

DSE-3 Integral Transforms and Fourier Analysis



CLO 5 is related to the practical component.	 and attain the skills to apply Fourier transforms techniques to solve mathematical and scientific problems. 4. Have the procedural knowledge and attain the skills to solve differential equations, partial differential equations, boundary value problems and integral equations using Integral transforms. 5. Attain the cognitive and technical skills required for performing and accomplishing complex tasks related to solution of differential equations, boundary value problems and integral equations and integral equations using Laplace transforms and Fourier Transforms. Acquire analytical and numerical skills to solve mathematical and scientific models involving Integral transforms. 		
	Theory	Practical	
Credits	3	1	4
Contact Hours	3	2	5
Internal Assessment Marks	20	10	30
End Term Exam Marks	50	20	70
Examination Time	3Hrs	3Hrs	
Max. Marks: 100 Part B-Contents of the Course			

Tart D-Contents of the Course

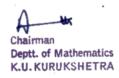
Instructions for Paper- Setter



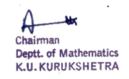
Unit	Topics	Contact Hours
Ι	Introduction to Integral transforms. Laplace transforms: Existence theorem for Laplace transforms, Linearity, change of scale and shifting properties of the Laplace transforms, Laplace transforms of some standard functions, Laplace transforms of derivatives and integrals, Differentiation and integration of Laplace transforms, Laplace transforms of periodic functions and some special functions. Convolution theorem, Inverse Laplace transforms and its properties.	12
Π	Fourier series, Fourier series of even and odd functions, Fourier half-range series, Fourier cosine and sine series, Parseval's identity, Differentiation and integration of Fourier series, Absolute and uniform convergence of Fourier series, Bessel's inequality, the complex form of Fourier series.	12
III	Fourier transforms, Fourier sine and cosine transforms, Linearity, Change of scale and Shifting properties, Fourier transforms of derivatives, Modulation theorem, Relation between Fourier and Laplace transforms, Convolution theorem for Fourier transform, Parseval's identity for Fourier transforms, , Finite Fourier transform, Inversion formula for finite Fourier transforms. Inverse Fourier transforms, Inverse Fourier sine and cosine transforms.	12
IV	Applications of Laplace transform in obtaining solutions of ordinary differential equations and integral equations. Solution of integral equation by Fourier sine and cosine transforms, Applications of infinite and finite Fourier	12



Practical Protectical component of the course has two parts, Problem Solving and Practical's using MATLAB/ SCILB/MAXIMA software. The examiner will set 4 questions at the time of practical examination asking two	20
Problem Solving and Practical's using MATLAB/ SCILB/MAXIMA software. The examiner will set 4	20
 questions from the part (A) and two questions from the part (B) by taking course learning outcomes (CLOs) into consideration. The examinee will be required to solve one problem from the part (A) and to execute one problem successfully from the part (B). Equal weightage will be given to both the parts. The evaluation will be done on the basis of practical record, viva-voce, write up and execution of the program. (A) Problem Solving- Questions related to the following problems will be solved and record of those will be maintained in the Practical Notebook: 1. Practical problems to determine Laplace transform. 2. Practical problems for finding Fourier half-range series. 4. Practical problems for finding finite Fourier transform. 5. Practical problems for finding finite Fourier transform. 6. Practical problems to solve differential equations by Laplace transform method. 7. Practical problems to solve partial differential equations by Fourier transform method. 8. Practical problems to solve integral equations by Fourier 	30



SCILAB/MAXIN maintained in the 1. Practical proble symbolic expre- independent and to 2. Practical proble Dirac and Heavis 3. Practical proble symbolic express 4. Practical proble Fourier transform 5. Practical proble Bessel's function 6. Practical proble using Laplace tra 7. Practical proble	ems for computing Inverse Laplace of ions. ems for computing Fourier and Inverse s of symbolic expressions. ems for computing Fourier transform of ems based on solving differential equations nsform.	
equations using F 8. Practical proble odd and even fun	ems based on computing Fourier series of	
	Suggested Evaluation Methods	
 Seminar/presentation/ Mid-Term Exam: 10 Practicum 10 Class Participation: 	5 assignment/quiz/class test etc.: 5 on/Viva-voce/Lab records etc.: 10	End Term Examination:



Part C-Learning Resources

Recommended Books:

1. W. Rudin (2017). Fourier Analysis on Groups. Dover Publications Inc.

2. J. W. Brown and R.V. Churchill (2011). *Fourier Series and Boundary Value Problems* (8th Edition). McGraw-Hill Higher Education.

3. E. Kreyszig (2011). Advanced Engineering Mathematics (10th Edition). Wiley.

4. M.R. Spiegel (2005). *Laplace Transforms*. Schaum's Outline Series. McGraw Hill Education.

5. A. Zygmund (2003). *Trigonometric Series* (3rd Edition). Cambridge University Press.

6. C. K. Chui (1992). An Introduction to Wavelets. Academic Press.

7. I.N. Sneddon (1974). The Use of Integral Transforms. McGraw Hill Inc., US.



Session: 2023-	-24 (Scheme), 2024-25 (Syllabus)			
Part A – Introduction				
Subject	Mathematics			
Semester	VI			
Name of the Course	Numerical Analysis			
Course Code	B23-MAT-601			
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	CC/MCC			
Level of the course	300-399			
Pre-requisite for the course (if any)	Mathematics as a subject at level 4.5			
Course Learning Outcomes (CLOs):	 Mathematics as a subject at level 4.5 After completing this course, the learner will be able to: Understand the different types of errors, learn techniques to obtain numerical solutions of algebraic and transcendental equations. Have the knowledge and attain numerical skills to find solutions of system of linear equations by different methods. Gain the knowledge to understand the concept of interpolation and extrapolation. Learn various numerical methods to find the value of function and their derivatives using interpolation concept. Have the procedural knowledge and acquire the 			

CC-6/ MCC-11 Numerical Analysis

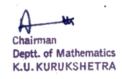


	skills to apply numerical methods for evaluating definite integrals. Learn single step and multi-step methods to solve first order ordinary differential equations.		
CLO 5 is related to the practical component of the course. 5. Attain cognitive and technical solve scientific problems by ap techniques. Learn to write and ex numerical methods based on C la		pplying numerical execute program of	
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Internal Assessment Marks	20	10	30
End Term Examination Marks	50	20	70
Examination Time	3 Hours	3 Hours	
Max. Marks: 100			

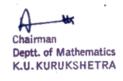
Part B- Contents of the Course

Instructions for Paper- Setter

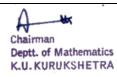
Unit	Topics	Contact Hours
Ι	Round-off error and computer arithmetic, Local and global truncation errors, Algorithms and convergence. Numerical methods for solving algebraic and transcendental equations: Bisection method, False position method, Fixed point iteration method, Newton-Raphson	12



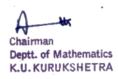
	method and Secant method.	
	Newton's iterative method for finding nth root of a	
	number.	
п		10
II	Numerical methods for solving simultaneous linear	12
	equations: Gauss-elimination method, Gauss-Jordan	
	method, Triangularization method (LU decomposition	
	method), Crout's method, Cholesky decomposition	
	method. Iterative methods: Jacobi's method, Gauss-Seidal	
	method, Relaxation method.	
III	Finite Differences operators and their relations.	12
111	1	12
	Interpolation with equal intervals: Gregory-Newton	
	forward and backward difference interpolations.	
	Interpolation with unequal intervals: Newton's divided	
	difference formulae, Lagrange's Interpolation formulae.	
	Central Differences: Gauss forward and Gauss backward	
	interpolation formulae, Sterling formula, Bessel's formula.	
	Piecewise linear interpolation, Cubic spline interpolation.	
	Numerical Differentiation: First and second derivative of a	
	function using interpolation formulae.	
13.7		12
IV	Numerical Integration: Newton-Cote's Quadrature formula,	12
	Trapezoidal rule, Simpson's one-third and three-eighth rule,	
	Chebychev formula, Gauss Quadrature formula.	
	Numerical solution of ordinary differential equations:	
	Single step methods-Picard's method, Taylor's series	
	method, Euler's method, Runge-Kutta Method.	
	Multiple step methods: Predictor-corrector method,	
	Modified Euler's method, Milne-Simpson's method.	
<u> </u>		



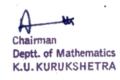
Practical			
related proble: practic (CLOs to exec the ba	course has programs, based on Programming in C, I to Numerical methods to solve mathematical ms. The examiner will set 4 programs at the time of cal examination by taking course learning outcomes s) into consideration. The examinee will be required cute two programs. The evaluation will be done on asis of practical record, viva-voce, write-up and cion of the program.	30	
progra mainta 1. 2. 3.	equations using Newton Raphson method.		
5. 6.	Elimination method. To find solution of system of equations using Gauss Seidal method. To find approximate value of a function by Newton Forward Interpolation formula. To find approximate value of a function by Newton Backward Interpolation formula.		



is: An algorithmic
programs
programs
programs
voce, write-up and execution of
Lab record, viva-
Written Examination
End Term Examination: > Theory 50



- 3. M.K. Jain, S. R. K. Iyengar and R. K. Jain (2012). *Numerical Methods for Scientific and Engineering Computation* (6th Edition). New Age International Publishers.
- 4. B. Bradie (2007). A Friendly Introduction to Numerical Analysis. Pearson India.
- C. F. Gerald and P. O. Wheatley (2007). *Applied Numerical Analysis* (7th Edition). Pearson Education India.
- F.B. Hildebrand (2003). *Introduction to Numerical Analysis* (2nd edition). Dover Publication Inc.
- 7. R. J. Schilling and S. L. Harris (1999). *Applied Numerical Methods for Engineers using MATLAB and C.* S. Chand (G/L) & Company Ltd.



Session: 2023-24 (Scheme), 2024-25 (Syllabus)		
PartA – Introduction		
Subject	Mathematics	
Semester	VI	
Name of the Course	Real Analysis	
Course Code	B23-MAT-602	
CourseType: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	МСС	
Level of the course	300-399	
Pre-requisite for the course (ifany)	Courses on Calculus and Advanced Calculus	
CourseLearningOutcomes(CLO):	 After completing this course, the learner will be able to: Learn basic theory of Riemann integration, and understand fundamental theorem and mean valuetheoremofintegralcalculus. Understand the notion of improper integral and learn to test the convergence of improper integrals. Apply Leibnitz's rule of differentiation under integral sign to compute various integrals. Have knowledge of distance function (metric) and grasp the basic definitions and theorems based on metric and metric space. Apply the knowledge of distance function to check the convergence of sequence in a metric space. Understand the concepts of continuity, compactness, and connectedness in a metric space and analyze the same on real line with usual metric. 	
CLO 5 is related to the practical component of the course.	5. Attain cognitive and technical skill required to trace the open (closed) sphere in a metric space and observe the effect of different metrics on the same space. Apply the technical tool to check the convergence of real sequences.	

MCC-12 Real Analysis



Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Internal Assessment Marks	20	10	30
End Term Examination Marks	50	20	70
Examination Time	3 Hours	3 Hours	

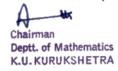
Max. Marks:100

PartB-Contentsofthe Course

Instructions for Paper- Setter

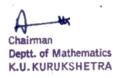
Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will contain 5 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unitand the compulsory question.

Unit	Topics	Contact Hours
Ι	Riemann integral, Integrability of continuous and monotonic functions, The fundamental theorem of integral calculus, Mean value theorems of integral calculus.	12
II	Improper integrals and their convergence, Comparison tests, Abel's and Dirichlet's tests, Frullani's integral, Integral as a function of a parameter. Fourier series: Fourier expansion of piecewise monotonic functions, Properties of Fourier coefficients, Dirichlet's conditions, Parseval's identity for Fourier series, Half range series, Change of intervals.	12
III	Definition and examples of metric spaces, neighborhoods, interior points, limit points, open and closed sets, closure and interior of a set, boundary points, subspace of a metric space, equivalent metrics, Cauchy sequences, completeness, Cantor's intersection theorem, Baire's category theorem, contraction principle.	12
IV	Continuous functions, uniform continuity, compactness for metric spaces, sequential compactness, Bolzano-Weierstrass property, total boundedness, finite intersection property, continuity in relation with compactness, connectedness, components, continuity in relation with connectedness.	12



Practical

The practical component of the course has two parts, Problem	30
Solving and Practical's using Mathematica/	
MATLAB/Maple/SCILAB/ Maxima etc. software. The examiner	
will set 4 questions at the time of practical examination asking two	
questions from the part (A) and two questions from the part (B) by	
taking course learning outcomes (CLO) into consideration. The	
examinee will be required to solve one problem from the part (A)	
and to execute one problem successfully from the part (B). Equal	
weightage will be given to both the parts. The evaluation will be	
done on the basis of practical record, viva-voce, write up and	
execution of the program.	
(A) Problem Solving- Questions related to the following	
problems will be solved and their record will be maintained in the	
Practical Notebook:	
1 Droblem solving to compute upper and lower sums of a	
1. Problem solving to compute upper and lower sums of a	
bounded function for a given partition of a closed interval.	
2. Practical problems to check the Riemann integrability of a	
bounded function.	
3. Problem solving to compute the Riemann integrals of a	
bounded functions using definition.	
4. Practical problems to estimate the value of an integral using mean value theorem.	
5. Problem solving to check the convergence of improper integrals.	
6. Problem solving to compute the integral using Leibnitz's rule	
of differentiation under integral sign.	
8. Problem solving on the Fourier series expansion of periodic	
functions.	
7. By means of an example demonstrate that a subset which is	
(a) Open in a subspace need not be open in the space.	
(b) Closed in a subspace need not be closed in the	
space.	
8. Show by an example that real line with usual metric is not	

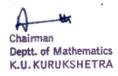


a	B)The following practical's will be done using Mathematica /	
	ATLAB/Maple/SCILAB/Maxima etc.software and their	
	cord will be maintained in the practical note book:	
1 2 3 4	 Trace the open and closed spheres in Euclidean space Rⁿfor n = 2 and n = 3. Trace the open (closed) sphere for same centre and same radius in R² for two different metrics. Problems on convergence of sequences in usual metric space. Problems on definite integral of bounded function on closed interval and verify the same theoretically. Problems on Fourier series expansion of periodic functions. 	
	SuggestedEvaluationMethods	I
 Theo Cla Sen Mi Prace Cla Sen 	Assessment: ory 20 ass Participation: 5 minar/presentation/assignment/quiz/class test etc.: 5 id-Term Exam: 10 eticum 10 ass Participation: minar/Demonstration/Viva-voce/Lab records etc.: 10 id-Term Exam:	End Term Examination: ➤ Theory 50 Written Examination ➤ Practicum 20 Lab record, viva-voce, write up and execution of the program
	PartC-Learning Resources	I
Recomm	nended Books:	
1. T. M. A	apostol (1985). Mathematical Analysis. Narosa Publishing House,	New Delhi.
2. Charala	mbos D. Aliprantis& Owen Burkinshaw (1998). Principles of Rea	al Analysis (3rd edition).
Academic	Press.	
3. Robert	G. Bartle & Donald R. Sherbert (2015). Introduction to Real Analy	ysis (4th edition).Wiley
India.		
1 Canal 1	C Diladare Devel D This θ C E Kanarah (2015) A L (1)	() 1 () () 1

4. Gerald G. Bilodeau, Paul R. Thie& G. E. Keough (2015). *An Introduction to Analysis* (2nd edition), Jones and Bartlett India Pvt. Ltd.

5. E. Hewitt & K. Stromberg (2013). Real and Abstract Analysis. Springer-Verlag.

6. K. A. Ross (2013). Elementary Analysis: The Theory of Calculus (2nd edition). Springer.



7. R. R. Goldberg (1970). Real Analysis. Oxford & I. B. H. Publishing Co., New Delhi.

8. Shanti Narayan & P. K. Mittal (2005). *A Course in Mathematical Analysis* . S. Chand and company, New Delhi.

9. S. C. Malik & S. Arora (2021). *Mathematical Analysis*. Wiley Eastern Ltd., Allahabad.

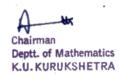
10. E. T. Copson (1988). Metric Spaces. Cambridge University Press.

11. P. K. Jain & Kalil Ahmad (2019). Metric spaces. Narosa Publishing House, New Delhi.

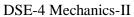
12. S. Kumaresan (2011). *Topology of Metric spaces*(2nd edition). Narosa Publishing House, New Delhi.

13. G. F. Simmons(2004). Introduction to Topology and Modern Analysis. McGraw-Hill.

14. SatishShirali& H. L. Vasudeva (2006). Metric spaces. Springer-Verlag.



Session: 2023-24			
PartA - Introduction			
Subject	Mathematics		
Semester	VI		
Name of the Course	Mechanics-II		
Course Code	B23-MAT-603		
CourseType: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course	300-399		
Pre-requisite for the course (ifany)	Course on Mechanics-I		
CourseLearningOutcomes(CLO):	 After completing this course, the learner will be able to: 1. Gain comprehensive understanding of the necessary conditions for the equilibrium of a body acted upon by forces in plane, and learns the principle of virtual work for a system of coplanar forces acting on a rigid body and central axis. Apply this knowledge to investigate, analyze and solve scientific problems. 2. Have deeper knowledge and understanding of three dimensional force system, central axis, and wrenches and learn about null point, null lines and null planes with respect to a system of forces acting on a rigid body together with the idea of central axis. 		





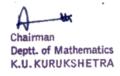
Max. Marks:100 PartB-Contentsofthe Course				
Examination Time	3 Hours	3 Hours		
End term Examination Marks	50	20	70	
Internal Assessment Marks	20	10	30	
Contact Hours	3	2	5	
	3	1	4	
Credits	Theory	Practical	Total	
CLO 5 is related to the practical component of the course.	 4. Understand equation of motion of a body moving under central forces, Kepler's laws of the planetary motions and their relations with Newton's laws of Motion. Solve problems of central orbits and planetary motion using procedural knowledge of these laws. 5. Attain cognitive and technical skills to solve practical problems of virtual work, principle of virtual work, wrenches and central orbits. Have hands on skill to create simple program in SCILAB/MATLAB to find time of flight, horizontal range of projectile motion. 			
 Have knowledge of projectile motion, particle motion on a smooth or rough path in a plane and apply the knowledge for problem solving. 				

Instructions for Paper- Setter

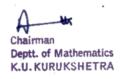
The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will contain 5 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unitand the compulsory question.



Unit	Topics	Contact Hours
Ι	Analytical conditions of equilibrium of coplanar force, Virtual work.	12
II	Forces in three dimensions, Poinsot's central axis, Wrenches, Null lines and Null planes.	12
III	Projectile motion of a particle in a plane, Motion on smooth and rough plane curves.	12
IV	Central Orbit, Kepler's laws of planetary motion and their relation with Newton's laws of motion.	12
	PRACTICAL	
	 The practical component of the course has two parts, Problem Solving and Practical's using SCILAB/MATLAB software. The examiner will set 4 questions at the time of practical examination asking two questions from the part (A) and two questions from the part (B) by taking course learning outcomes (CLO) into consideration. The examinee will be required to solve one problem from the part (A) and to execute one problem successfully from the part (B). Equal weightage will be given to both the parts. The evaluation will be done on the basis of practical record, viva-voce, write up and execution of the program. (A) Problem Solving- Questions related to the following problems will be solved and their record will be maintained in the Practical Notebook: 1. Practical problems to understand principle of virtual work for a system of coplanar forces acting on a 	30



particle.	
Practical problems to determine equilibrium of a body	
under coplanar forces.	
Practical problems to understand wrenches, screw,	
poinsot's central axis and pitch of the system.	
Practical problems to find velocity at any point of the	
trajectory.	
Practical problems to determine range and time of	
flight of a particle on an inclined plane.	
Practical problems to determine central orbits when the	
law of central force is given.	
Practical problems related to elliptic, hyperbolic and	
parabolic orbit.	
Practical problems to establish the equivalence of	
Kepler's laws for planetary motion and Newton's law	
of Gravitation.	
) The following practicals will be done using	
CILAB/MATLAB software and their record will be	
-	
· · ·	
1	
	 Practical problems to determine equilibrium of a body under coplanar forces. Practical problems to understand wrenches, screw, poinsot's central axis and pitch of the system. Practical problems to find velocity at any point of the trajectory. Practical problems to determine range and time of flight of a particle on an inclined plane. Practical problems to determine central orbits when the law of central force is given. Practical problems to establish the equivalence of Kepler's laws for planetary motion and Newton's law of Gravitation. The following practicals will be done using

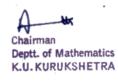


Mid-Term Exam: PartC-Learning Resources	program
 Practicum 10 Class Participation: Seminar/Demonstration/Viva-voce/Lab records etc.: 10 	Lab record, viva- voce, write up and execution of the program
 Class Participation: 5 Seminar/presentation/assignment/quiz/class test etc.: 5 Mid-Term Exam: 10 	 ➢ Theory 50 Written Examination ➢ Practicum 20
InternalAssessment: > Theory 20 Class Destination 5	End Term Examination:
SuggestedEvaluationMethods	
MATLAB/SCILAB.	16
its time of flight, maximum height, and range. Pl these parameters as functions of initial velocity using	
Study how the initial velocity of the projectile affect	
angle on range.	
analytical solutions and explore the effect of laune	ch
angle and initial velocity. Compare the result with	th
horizontal range of a projectile launched at a give	en
Develop MATLAB/SCILAB code to calculate t	he
calculate the corresponding height.	
projectile during its flight using MATLAB/SCILA Plot the trajectory and identify the vertex, the	
Determine the maximum height reached by the projectile during its flight using MATLAR/SCUA	
result by comparing it with analytical solutions.	
initial velocity, neglecting air resistance. Verify t	he
of flight of a projectile launched at a given angle an	nd



Recommended Books/e-resources/LMS:

- Stephan J. Chapman (2020). MATLAB Programming for Engineers (6th edition). Cengage Learning.
- 13. William Palm Lii (2017). *A concise introduction to MATLAB* (2nd edition). Tata Mcgraw-Hill Education.
- 14. RudraPratap (2010). Getting Started with MATLAB:A quick introduction for scientists and engineers. Oxford University Press.
- 15. A. S. Ramsey (2009). Statics. Cambridge University Press.
- 16. A. S. Ramsey (2009). Dynamics. Cambridge University Press.
- 17. S.L. Loney (2006). An Elementary Treatise on the Dynamics of a Particle and of Rigid Bodies. Read Books.
- A.P. Roberts (2003). Statics and Dynamics with Background in Mathematics. Cambridge University Press.
- 19. S.L. Loney (1995). An Elementary Treatise on Statics, Radha Publishing House.
- 20. P.L. Srivastava (1964). *Elementary Dynamics*. Ram NarainLal, Beni Prasad Publishers Allahabad.
- 21. R. S. Varma (1962). A Text Book of Statics. Pothishala Pvt. Ltd.
- 22. J. L. Synge & B. A. Griffith (1949). Principles of Mechanics. McGraw-Hill.



Session: 2023-24 (Scheme), 2024-25 (Syllabus)			
PartA - Introduction			
Subject	Mathematics		
Semester	VI		
Name of the Course	Classical Mechanics		
Course Code	B23-MAT-604		
CourseType: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course	300-399		
Pre-requisite for the course (ifany)	Course on Mechanics-I		
CourseLearningOutcomes(CLO):	After completing this course, the learner will be able to:		
	1. Learn calculus of variation, Brachistochrone problem, isoperimetric problems, and geodesic etc.		
	2. Understand stationary paths of a functional, Euler's equation, variational problems involving functionals depending on multi variables and on higher derivatives with different types of boundary conditions, and solving physical problems based on these cases.		
	3. Understand the concepts of constaints, generalized coordinates, holonomic and non-holonomic systems in classical mechanics, and Lagrangian and, Hamiltonian mechanics.		
	4. Understand D'Alembert's Principle and its application, Poisson bracket, Lagrange's equations, Gyroscopic, potential, dissipative forces and their importance in practical problems of mechanics.		

DSE-4 Classical Mechanics



CLO 5 is related to the practical component of the course.	5. Exploring practical problems of Calculus of variation and Analytical Mechanics inculcate skill to handle real life problems based on these.			
Credits	Theory Practical Total			
	3	1	4	
Contact Hours	3	2	5	
Internal Assessment Marks	20	10	30	
End term Examination Marks	50	20	70	
Examination Time	3 Hours	3 Hours		

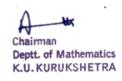
Max. Marks:100

Part B- Contents of the Course

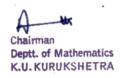
Instructions for Paper- Setter

The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will contain 5 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unitand the compulsory question.

Unit	Topics	Contact Hours
Ι	Motivating problems of calculus of variations: shortest distance, Minimum surface of revolution, Brachistochrone problem, Isoperimetric problem, Geodesic. Fundamental Lemma of calculus of variation.	12
II	Euler's equation for one dependent function of one and several independent variables, and its generalization to (i) Functional depending on 'n' dependent functions, (ii) Functional depending on higher order derivatives. Variational derivative, invariance of Euler's equations, natural boundary conditions and transition conditions,	12



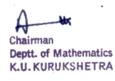
	Conditional extremum under geometric constraints and	
	under integral constraints . Variable end points.	
III	Free and constrained systems, constraints and their classification. Generalized coordinates. Holonomic and Non-Holonomic systems. Scleronomic and Rheonomic systems. Generalized Potential, Possible and virtual displacements, ideal constraints. Lagrange's equations of first kind, Principle of virtual displacements, Hamilton's Principle, Derivation of Lagrange equations from Hamilton's principle. Extension of principle to nonholonomic systems. Conservation theorems and	12
	symmetry properties.	
IV	Routh's procedure and oscillations about steady motion, The Hamiltonian formulation of relativistic mechanics, The Principle of least action.D'Alembert's principle, Holonomic Systems independent coordinates, generalized forces, Lagrange's equations of second kind. Uniqueness of solution. Theorem on variation of total energy. Potential, Gyroscopic and dissipative forces, Lagrange's equations for potential forces equation for conservative fields. The equations of canonical transformation. Examples of canonical transformation. The symplectic approach to canonical transformations. Poisson brackets and other canonical invariants.	12
	PRACTICAL	
	The examiner will set 4 questions at the time of practical examination asking two questions by taking	30



course learning outcomes (CLOs) into consideration. The examinee will be required to solve two problems. The evaluation will be done on the basis of practical record, viva-voce, write up and execution of the program.

Problem Solving: Questions related to the following problems will be worked out and record of those will be maintained in the Practical Notebook:

- 1. Practical problems to find geodesics on a surface.
- 2. Problem solving of isoperimetric problems.
- Formulation and solution of the variational problems with several variables as functions of a single independent variable.
- 4. Formulation and solution of the variational problem in which higher order derivatives are involved in a functional.
- 5. Solve numerical problems related to Lagrange's equation.
- Formulation and solution of real life situations which uses mathematical knowledge and characteristics of D's Alembert's Principle.
- 7. Solution of problems based on Lagrange's equation.
- 8. Solution of problems based on Hamilton's equation.

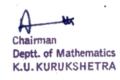


	Suggested Evaluation Methods		
Inte	ernalAssessment: Theory 20 Class Participation: 5 Seminar/presentation/assignment/quiz/class test etc.: 5 Mid-Term Exam: 10	End Term Examination: → Theory 50 Written Examination → Practicum 20	
) • •	Practicum 10 Class Participation: Seminar/Demonstration/Viva-voce/Lab records etc.: 10 Mid-Term Exam:	Lab record, viva- voce, write up and execution of the program	

PartC-Learning Resources

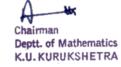
Recommended Books/e-resources/LMS:

- H. Goldstein, C.P. Poole & J.L. Safko (2011). *Classical Mechanics* (3rd edition), Pearson.
- 2. I.M. Gelfand and S.V. Fomin (2012). Calculus of Variations, Dover Publications.
- 3. S.K. Sinha (2009). Classical Mechanics, Alpha Science International Limited.
- 4. Louis N. Hand and Janet D. Finch (2008). *Analytical Mechanics*, Cambridge University Press.
- 5. F. Chorlton (2002). Text Book of Dynamics 2nd Ed, CBS.
- 6. F. Gantmacher (1975). Lectures in Analytic Mechanics, Mir Publishers.
- 7. Francis B. Hilderbrand (1992). Methods of applied mathematics, Dover Publication.
- Narayan Chandra Rana&PramodSharad Chandra Joag (1991). Classical Mechanics, Tata McGraw Hill.



Session: 2023-24 (Scheme), 2024-25 (Syllabus) PartA – Introduction		
Semester	VI	
Name of the Course	Discrete Mathematics	
Course Code	B23-MAT-605	
CourseType: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE	
Level of the course	300-399	
Pre-requisite for the course (ifany)	Courses on Algebra up to the level 299	
CourseLearningOutcomes(CLOs):	 After completing this course, the learner will be able to: 1. Understand the notion of sets, logical connectives, tautologies, theory of inference, permutations, combinations and discrete probability. 2. Have knowledge of relations, lattices, chains and antichains, functions and recursive functions. 3. Have deeper knowledge and understanding of discrete numeric functions, generating functions and recurrence relations. 4. Understand and solve problems related to lattices and algebraic systems, Boolean algebras, Boolean functions and Boolean expressions. 	

DSE-5 Discrete Mathematics



CLO 5 is related to the practical component of the course.	C C	actical problems s, combinations	
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Internal Assessment Marks	20	10	30
End term Examination Marks	50	20	70
Examination Time	3 Hours	3 Hours	

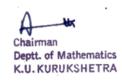
Max. Marks:100

PartB-Contentsofthe Course

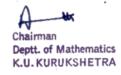
Instructions for Paper- Setter

The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will contain 5 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unitand the compulsory question.

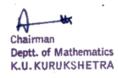
Unit	Topics	Contact Hours
Ι	Sets, countability and cardinality of sets, principle of inclusion and exclusion, multisets, logical connectives, conditional and biconditionals, tautologies, logical equivalences, inference theory, predicate calculus, Euclidean algorithim, permutations, combinations and discrete probability.	12
Π	Relations, equivalence relations, partial ordering relations and lattices, chains and antichains, functions, composition	12



	of functions, invertible functions, recursive functions.	
III	Discrete numeric functions, generating functions,	12
	combinatorial problems, recurrence relations, linear	
	recurrence relations with constant coefficients,	
	homogeneous solutions, particular solutions, total	
	solutions, solution by method of generating functions.	
IV	Lattices and algebraic systems, principle of duality,	12
	distributive and complemented lattices, boolean lattices,	
	boolean algebras, uniqueness of finite boolean functions	
	and boolean expressions.	
	Practical	
	The examiner will set 4 questions at the time of practical	30
	examination asking two questions by taking course	
	learning outcomes (CLOs) into consideration. The	
	examinee will be required to solve two problems. The	
	evaluation will be done on the basis of practical record,	
	viva-voce, write up and execution of the program.	
	Problem Solving: Questions related to the following	
	problems will be worked out and record of those will be	
	maintained in the Practical Notebook:	
	1. Use of principle of inclusion and exclusion.	
	2. Checking of equivalence of two propositions.	
	3. The number of ways to choose three out of seven days	
	with repetitions allowed.	
	4. Practical problem based on Bayes' theorem.	
	5. To check that given relation is equivalence relation or	
	not.	
	I	



· · · · ·		1	
6	. To check that given relation is partial order or not.		
7	. Practical problems based on composition of functions		
	and invertible functions		
8	8. Practical problem to find homogeneous solution of		
	recurrence relations with constant coefficients.		
9	. Find the total solution of the given recurrence relation.		
1	0. To find the generating function of the numeric		
	function.		
1	1. Practical problem based on principle of duality.		
1	2. To check that a given lattice is distributive lattice or		
	not.		
1	3. To check that a given lattice is boolean lattice or not.		
I	Suggested Evaluation Methods		
• Semina		End TermExamination:➤Theory50Written Examination➤Practicum20	
	cum 10	Lab record, viva- voce, write up and	
• Semina	Participation: ar/Demonstration/Viva-voce/Lab records etc.: 10 erm Exam:	execution of the program	
	PartC-Learning Resources	I	
Recommend 1. C. L. Liu a	led Books: and D. P. Mohapatra (2017). <i>Elements of Discrete Mathem</i>	atics (4 th edition).	
McGraw Hill Education.			
McGraw I	Hill Education.		
	979). <i>Graph Theory</i> , Prentice Hall of India Pvt. Ltd.		
2. N. Deo (19		Mathematics (4th	
 N. Deo (19 S. Lipschu 	979). Graph Theory, Prentice Hall of India Pvt. Ltd.	Mathematics (4th	
 N. Deo (19 S. Lipschu edition). N 	979). <i>Graph Theory</i> , Prentice Hall of India Pvt. Ltd. htz and M. L. Lipson (2022). <i>Schaum's Outline of Discrete</i>		



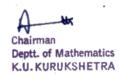
Session: 2023-24 (Scheme), 2024-25 (Syllabus)		
Part A – Introduction		
Subject	Mathematics	
Semester	VI	
Name of the Course	Mathematical Modelling	
Course Code	B23-MAT-606	
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE	
Level of the course	300-399	
Pre-requisite for the course (if any)	Mathematics as a subject at level 5.0	
Course Learning Outcomes (CLOs):	After completing this course, the learner will be able to: 1. Gain the knowledge and understanding of the underlying principles and theories related to mathematical modelling. Have the knowledge about the current and emerging issues and latest development related to mathematical modelling. Learn to apply the fundamental analytical techniques and simulation methods to develop insight into system behavior. 2. Have the procedural knowledge to apply ordinary differential equation concept in solving the real world problems based mathematical models related to population dynamics, epidemic and	

DSE-5 Mathematical Modelling

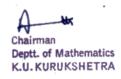


Instructions for Paper- Setter

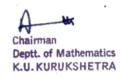
Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will contain 5 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unitand the compulsory question.



Unit	Topics	Contact Hours	
Ι	matical modelling definition, Need, Classification, Simple ons requiring mathematical modelling, Techniques of matical modelling, Classification of mathematical models, cteristics of mathematical models, Latest development in matical Modelling, Merits and Demerits of Mathematical ling, Quantitative and Qualitative approach of modelling, ptual and Physical models, Models in real world problem.	12	
II	ematical modelling through ordinary differential equations rst order, Mathematical modelling in population dynamics, nematical modelling of epidemic and compartment models 1gh system of ordinary differential equations.	12	
III	Mathematical modelling in Economics, Medicines, Arms race, Battle, International trade and dynamics through ordinary differential equations, Mathematical modelling through ordinary differential equation of second order.	12	
IV	Mathematical modelling through difference equation: Need, Basic theory, Economics and Finance, Population dynamics and Genetics, Discrete dynamical systems, Linear models, Growth models, Decay models, Drug delivery problems.	12	
	Practical		
	This course has programs, based on MATLAB/MATHEMATICA/MAPLE Software, related to Mathematical and scientific models. The examiner will set 4 programs at the time of practical examination by taking course learning outcomes (CLOs) into consideration. The examinee will be required to execute two programs. The	30	



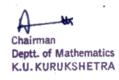
evaluation will be done	e on the basis of practical record,
viva-voce, write-up and	execution of the program.
Practicals: The follow	ng practicals will be done using
the MATLAB/MATH	EMATICA/MAPLE Software and
record of those will be	maintained in the practical Note
Book:	
 pollution concentration) 4. Case of single cold pil 5. Limited growth of harvesting). 6. Predatory-prey model dependence, effect of DE 7. Epidemic model of contagious for life, diseat 8. Battle model (basic range weapons). 9. Drug delivery models. 	htial case only). (with constant/seasonal flow and and a course of cold pills. population (with and without (basic volterra model, with density DT, two prey one predator). influenza (basic epidemic model,
10. Economics Model.	
Sug	gested Evaluation Methods
Internal Assessment: ➤ Theory 20 • Class Participation: 5 • Seminar/presentation/assignr • Mid-Term Exam: 10 > Practical 10 • Class Participation: • • Seminar/Demonstration/Viva Mid-Term Exam:	➢ Practical 20 Lab record, viva- voce, write-up and



Part C-Learning Resources

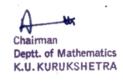
Recommended Books:

- 1. J.N. Kapur (2021). *Mathematical Modelling* (2nd Edition). New Age International Pvt. Ltd.
- 2. B. Barnes and G.R. Fulford (2016). *Mathematical Modelling with Case Studies: Using MAPLE and MATLAB* (3rd Edition). Chapman and Hall/CRC.
- L. Edsberg (2008). Introduction to Computation and Modeling for Differential Equations. Wiley.
- 4. F.R. Marotto (2005). *Introduction to Mathematical Modeling using Discrete Dynamical Systems*. Thomson Brooks/Cole.
- 5. C.L. Dym (2004). *Principles of Mathematical Modeling*(2nd Edition). Academic Press.
- 6. E.A. Bender (2003). An Introduction to Mathematical Modeling. Dover Publications.
- 7. G. Fulford, P. Forrester and A. Jones (1997). *Modelling with Differential and Difference Equations*. Cambridge University Press.



Session: 2023-24 (Scheme), 2024-25 (Syllabus)		
PartA - Introduction		
Subject	Mathematics	
Semester	VI	
Name of the Course	Basic Mathematical Techniques	
Course Code	B23-SEC-406	
CourseType: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	SEC	
Level of the course	200-299	
Pre-requisite for the course (ifany)		

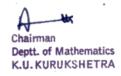
SEC-4 Basic Mathematical Techniques



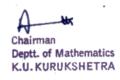
CourseLearningOutcomes(CLO):	After completing this course, the learner will be able to:1. Attain theoretical knowledge of techniques of solving system of linear equations and technical skills to implement these techniques of real world problems.2. Understand theoretical concepts of numerical methods for solving algebraic and transcendental equations and attain practical skills for their implementation.3. Gain deep theoretical knowledge of techniques of solving differential equations and technical skills to implement these techniques of realistic problems which arise in all disciplines.4. Understand theoretical concepts of statistical techniques and attain practical skills for their implement these techniques of solving of statistical techniques and attain practical skills for their implementation.of5.Gain hand on experience of implementation of basic mathematical techniques for solving practical problems on paper and through either of listed softwares.		
CLO 5 is related to practical component of the course.			practical problems
	Theory	Practical	Total
Credits	1	1	2
Contact Hours	1	2	3
Internal Assessment Marks	10	5	15
End Term Examination Marks	20	15	35
Examination Time	3 Hours	3 Hours	
	Max. Marks: 50		
Part B-	Contents of the Cou	irse	

Instructions for Paper- Setter

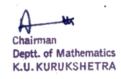
Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will contain 4 parts covering entire syllabus. The examinee will be required to



Unit	Topics	Contact Hours
I	System of Linear Equations:Solution of system of linear equations by Gauss elimination method, LU decomposition method, Crout's method, Cholesky method and House Holder's method for tridiagonal systems.	4
II	Techniques for solving algebraic and transcendental equations:Newton-Raphson, Chebyshev, derivative free, iterative,Bairstow.	4
III	Numerical techniques for solving ODEs: Euler methods, Runge-Kutta methods (2nd and 4 th order), Nystrom method, Adams-Bashforth method.Taylor series method and Runge-Kutta methods for solving system of differential equations.	4
IV	Statistical hypothesis test, t-test for one and two samples, F-test, chi-square test, Statistical methods for data fitting: Linear, multi-linear, non-linear regression.	4
	Practical	
	The practical component of the course involvesproblem solving using MAXIMA/Scilab/SageMath/SPSS software. The examiner will set 4 programs at the time of practical examination by taking course learning outcomes (CLOs) into consideration. The examinee will be required to execute two programs. The evaluation will be done on the basis of practical record, viva-voce, write-up and execution of the program. Practicals related to the following problems will be solved using	30

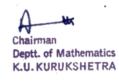


MAXIMA/Scilab/SageMathsoftwares and record of those will	
be maintained in the practical note book:	
 Problems based on analytical techniques to solve system of linear equations. Problems involving numerical techniques to solve simultaneous linear equations. Problems solving by Newton-Raphson method. 	
 Problems solving by Chebyshev and Bairstow methods. Solving differential equations by Euler method . 	
 Problems solving of differential equations by Runge- Kutta methods. 	
7. Problems solving by Adams-Bashforth method.	
8. Problems solving for linear homogeneous system of differential equations.	
9. To apply t -test for testing single mean and difference	
between means and to obtain their confidence intervals.	
10. To apply paired t-test for difference between two means.	
11. To apply Chi- square test for goodness of fit.	
12. To apply Chi- square test for independence of attributes.	
Suggested Evaluation Methods	I
Internal Assessment: ➤ Theory • Class Participation: 4 • Seminar/presentation/assignment/quiz/class test etc.: • Mid-Term Exam: 6 > Practicum • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc.: 5	End Term Examination: → Theory 20 Written Examination → Practicum 15 Lab record, viva- voce, write-up and execution of
• Mid-Term Exam:	programs.
Part C-Learning Resources	



Recommended Books/e-resources/LMS:

- M.K. Jain, S.R.K. Iyengar& R.K. Jain (2020). Numerical Methods: Problems and Solutions (3rd Edition). New Age International Publishers.
- S.S. Sastry (2012). Introductory Methods of Numerical Analysis (5th Edition).Prentice Hall India Learning Private Limited.
- 3. P. Kandasamy, K. Thilagavathy, K. Gunavathi (2006). *Numerical Methods*. S. Chand & Company.
- 4. E.Balagurusamy (2017). Numerical Methods. McGraw Hill Education.



SEC-3 Reasoning			
Session: 2023-24			
Part A - Introduction			
Subject	Mathematics		
Semester	III		
Name of the Course	Reasoning		
Course Code	B23-SEC-327		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/SE C/VAC)	SEC		
Level of the course	100-199		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes(CLO): CLO 5 is related to the practical	 to: Gain the s number seri Understand To find the situations. Familiarize reasoning an Have the kn images and and figures. 5. Attain the 	this course, the lear kill to analyze and es and to pick odd o the concept of coo directions and blood and get acquainte nd venn diagrams. nowledge of obtainin find analogy betwe	d solve letter and ne out. ling and decoding. d relations from the ed with arithmetic ng water and mirror en words, numbers
components of the course.	relationship	and pattern problem	18.
Credits	Theory	Practical	Total
	2	1	3





Part B- Contents of the Course			
Max. Marks:75			
Examination Time	3Hrs	3Hrs	
External Assessment Marks	35	20	55
Internal Assessment Marks	15	5	20
Contact Hours	2	2	4

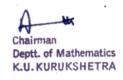
Instructions for Paper- Setter

Theory Paper: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will contain 7 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.

Unit	Topics	Contact Hours			
Ι	Verbal Reasoning: Series Completion, Number series, Letter Series, Alpha numeric series, Wrong Letter Series, Repeat Series, Wrong Number Series, Number Analogy, Word Analogy.	8			
II	Coding and Decoding: Letter Coding, Number coding, Matrix coding, Place arrangement, Direction sense, Family-based puzzles; Blood Relationships.	8			
III	Arithmetic reasoning, Venn diagrams, Logical diagrams, Symbol Substitution.	8			
IV	Non-verbal Reasoning: Choosing the odd figure, Word Analogy, Number Analogy, Water Images, Mirror Images.	8			
	Practical				
	The examiner will set 4 questions at the time of practical examination by taking course learning outcomes (CLOs) into consideration. The examinee will be required to solve 2 questions. The evaluation will be done on the basis of practical	30			



record, viva-voce, written examinatio	
Problem Solving: Questions related	
will be solved and record of those	will be maintained in the
Practical Note Book:	
1. Determination of order of the letter	s or number in the series.
2. Identification of letter or number v	which is wrong or misfit in
the series.	
3. Find out the repeated letter group s	eries.
4. Spotting the odd one out.	
5. Coding with letters of alphabets.	
6. Mixed coding (both alphabetical ar	d numerical).
7. Depicting the correct direction.	
8. Studying the relationship mentione	d between the persons and
selecting the right relationship.	
9. Identification of the most appropr	iate venn diagram for the
given problem.	
10. To obtain the water images of figu	ires.
11. To obtain the mirror images of fig	ures.
12. Finding relationship between wor	ds using analogy.
13. Finding relationship between num	bers using analogy.
14. Finding relationship between	figures using non-verbal
analogy.	
Suggested E	valuation Methods
Internal Assessment:	End Term
➤ Theory :15	Examination:
Class Participation: 4	> Theory 35
• Seminar/presentation/assignment/quiz	V/class test etc.: 4 Written Examination
• Mid-Term Exam: 7	► Practicum 20 Lab record, viva-
➤ Practicum :5	voce, written
Class Participation:	examination.
• Seminar/Demonstration/Viva-voce/La	b records etc.: 5
• Mid-Term Exam:	



Part C-Learning Resources

Recommended Books:

1. Edgor Thorpe (2018). *A course in mental ability and Quantitative aptitude* (4th edition). Tata McGraw Hill Company, New Delhi.

2. Ravi Chopra (2006). *Logical Critical Analytical Reasoning* (1st edition). Galgotia Publications Pvt. Ltd., New Delhi.

3. R.S. Aggarwal (2018). *A Modern approach to Verbal and Non-verbal reasoning* (2nd edition). S.Chand and Company Ltd., New Delhi.

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