Scheme of B. Sc. Mathematics

Year	Course Code	Subject Name	Theory/ Practical	Total Credit	Total Marks	
					Max	Min
First year	MATH-1T	Calculus	Theory	4	50	33
	MATH-2T	Algebra	Theory	4	50	
	MATH-1P **(Any One)**	Lab 1 : Calculus and Algebra	Practical	2	50	17
		Project 1 : History of Mathematicians	Project	2	50	17
Second year	MATH-3T	Differential Equations	Theory	4	50	33
	MATH-4T	Real Analysis	Theory	4	50	
	MATH-2P **(Any One)**	Lab 2 : Differential Equations and Real Analysis	Practical	2	50	17
		Project 2 : History of Mathematicians	Project	2	50	17
Third year	MATH-5T **Optional I (Any One)**	Mechanics	Theory	4	50	33
		Numerical Methods	Theory	4	50	
		Linear Algebra	Theory	4	50	
		Integral Transforms and Fourier Analysis	Theory	4	50	
	MATH-6T **Optional II (Any One)**	Discrete Mathematics	Theory	4	50	
		Tensors and Differential Geometry	Theory	4	50	
		Number Theory	Theory	4	50	
		Probability and Statistics	Theory	4	50	
	MATH-3P **(Any One)**	Lab 3 : Mathematics Paper 1 and Paper 2	Practical	2	50	17
		Project 3 : History of Mathematicians	Project	2	50	17

Note: There shall be four extra credits in all the years of under graduation for internship/apprenticeship. The certificate of extra credits would be provided by the concern university and is not mandatory.

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Part A: Introduction				
Program: **Certificate Course**		Class: **B.A./ B.Sc. I Year**	Year: **2022**	Session: **2022-2023**
1	Course Code	**MATH-1P (I)**		
2	Course Title	I - Lab 01 - Calculus and Algebra		
3	Course Type	**Practical**		
4	Pre-requisite (if any)	No		
5	Course Learning Outcomes (CLO)	At the end of course, Students will be able to • Learn Free and Open Source Software (FOSS) tools for computer programming • Solve problems on Calculus and Algebra theories studied in Mathematics Paper 1and 2 by using FOSS softwares. • Acquire knowledge of applications of Calculus and Algebra through FOSS.		
6	**Credit Value**	**2**		
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks : 17**	

Part B: Content of the Course	
	Total Periods: 30
Tentative Practical List	Mathematics practical with Free and Open Source Software (FOSS) tools forcomputer programs, such as GeoGebra/Maxima/Scilab/ Octave /Python/R. **Course Objectives:** • To learn Free and Open Source Software (FOSS) tools for computerprogramming • Acquire knowledge of applications of algebra and calculus through FOSS **List of Practicals**: (At least 15 practicals) • Programs to illustrate left hand and right hand limits for discontinuous functions. • Program to illustrate continuity of a function • Program to illustrate differentiability of a function • Program to verify Rolle's theorem • Program to verify Lagrange's theorem • Programs to verify Cauchy's mean value theorem and finding Taylor's theorem for a given function. • Program to illustrate nth derivative without Leibnitz rule.

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	• Program to construct series using Maclaurin's expansion for functions of two variables. • Program to finding the asymptotes of curves. • Program to finding radius of curvature of cycloid. • Program to finding partial derivative of a given function. • Program to calculating the area under two curves. • Obtaining partial derivatives of some standard functions. • Evaluation of the line integral with constant limits. • Evaluation of the line integral with variable limits. • Evaluation of the double integral with constant limits. • Evaluation of the double integral with variable limits. • Evaluation of the triple integral with constant limits. • Evaluation of the triple integral with variable limits. • Programs for area and volume. • Verifying whether given operator is binary or not • To find identity element of a group • To find inverse element of a group. • To construct Cayley's table • Verification of a subgroup of a given subset of a group • Finding all possible subgroups of a finite group. • Examples to verify Lagrange's theorem. • To find the left and right cosets and index of a subgroup • To find all the cyclic subgroups of a given group • Verification of normality of a given subgroup of a group • Illustrating homomorphism and isomorphism of groups • Examples on different types of rings.

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	• Examples on integral domains and fields. • Examples on subrings, ideals and subrings which are not ideals. • Homomorphism and isomorphism of rings- illustrative examples. • Solving polynomial equations. • Finding G.C.D of polynomials. • Finding product of two matrices • To test linear independency of a given set of a vectors in a vector space.

Part C - Learning Resource		
Text Books, Reference Books, Other Resources		
SUPPORT FROM THE GOVT FOR STUDENTS AND TEACHERS IN UNDERSTANDING AND LEARNING FOSS TOOLS: As a national level initiative towards learning FOSS tools, IIT Bombay for MHRD, government of India is giving free training to teachers interested in learning open source software's like scilab, maxima, octave, geogebra and others. (Website: http://spoken-tutorial.org;) (email: info@spokentutorial.org; contact@spoken-tutorial.org)		
Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: Maximum Marks: 50 Continuous Comprehensive Evaluation (CCE): Not Applicable University Exam(UE): 50 Marks		
Internal Assessment: Continuous Comprehensive Evaluation (CCE)	Class Test/Assignment/Presentation	Not Applicable

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Part A: Introduction				
Program: **Certificate Course**		Class: **B.A./B.Sc. I Year**	Year: **2022**	Session: **2022-2023**
1	Course Code	**MATH-1P (II)**		
2	Course Title	II - Project 01 - History of Mathematician		
3	Course Type	**Project**		
4	Pre-requisite (if any)	NIL		
5	Course Learning Outcomes (CLO)	Studying history of mathematicians help students: • Develop a deeper understanding of the mathematics they hare already studied by seeing how it was developed over time and in various places. • Know the rich intellectual heritage of the country. • Develop an appreciation of mathematics and build positive attitude towards mathematics increasing student's motivation decreasing anxiety related the subject. • To acquire knowledge about development of mathematics in ancient , medieval and modern period of history.		
6	**Credit Value**	**2**		
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks : 17**	

Part B: Content of the Course	
Total Periods: 30	
Project List	**Course Objectives:** An elective course designed to acquire special / advance knowledge, such as supplement study / support study to a project work and a candidate will study such a course on his own with an advisory support a teacher / faculty member. **Project** Contributions and biographies of Indian Mathematicians- Bodhayan, Apasthambh, Katyayan and Mahaveeracharya, Brahmagupta, and Bhaskaracharya in special context of Leelavati and contributions of mathematicians involved in context of the paper of calculus and algebra. (10 Mathematicians)

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Part C - Learning Resource		
Text Books, Reference Books, Other Resources		
Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: Maximum Marks: 50 Continuous Comprehensive Evaluation (CCE): Not Applicable University Exam(UE): 50 Marks		
Internal Assessment: Continuous Comprehensive Evaluation (CCE)	Class Test/Assignment/Presentation	Not Applicable

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Part A: Introduction				
Program: Certificate Course		Class: B. A. / B.Sc. Part I	Year: 2022	Session:2022-2023
1	Course Code	Paper – MATH- 1T		
2	Course Title	Calculus		
3	Course Type	Theory		
4	Pre-requisite (if any)	No		
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** • Calculate the limit and examine the continuity and understand the geometrical interpretation of differentiability. • Understand the consequences of various mean value theorems. • Draw curves in cartesian and polar coordinate systems. • Understand conceptual variations while advancing from one variable to severalvariables in calculus. • Inter-relationship amongst the line integral, double and triple integral formulations. • Realize importance of Green, Gauss and Stokes' theorems in other branches ofmathematics.		
6	Credit Value	4		
7	Total Marks	Maximum Marks : 50	Minimum Passing Marks : …..	

Part B: Content of the Course Total Periods: 60		
Unit	Topics	No. of Periods
I	**Sequences, Continuity and Differentiability:** Notion of convergence of sequences and series of real numbers, ϵ-δ definition of limit and continuity of a real valued function; Differentiability and its geometrical interpretation; Rolle's theorem, Lagrange's mean value theorem, Cauchy's mean value theorem and their geometrical interpretations, Darboux's theorem.	12
II	**Expansion of Functions:** Successive differentiation and Leibnitz theorem, Maclaurin's and Taylor's theorems for expansion of a function, Taylor's theorem in finite form with Lagrange, Cauchy and Roche–Schlömilch forms of remainder.	12
III	**Curvature, Asymptotes and Curve Tracing:** Curvature; Asymptotes of general algebraic curves, parallel asymptotes, Asymptotes parallel to axes; symmetry, concavity and convexity, points of inflexion, Tangents at origin, Multiple points, Position and nature of double points; Tracing of	12

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	cartesian, polar and parametric curves; Envelopes and Evolutes.	
IV	**Functions of Several Variables:** Limit, continuity and first order partial derivatives, Higher order partial derivatives, Change of variables, Euler's theorem for homogeneous functions, Taylor's theorem, Total differentiation and Jacobians.	12
V	**Double and Triple Integrals:** Double integration over rectangular and non-rectangular regions, Double integrals in polar co-ordinates, Triple integral over a parallelepiped and solid regions, Volume by triple integrals, Line integrals, Green's theorem, Area as a line integral, Surface integrals, Stokes' theorem, The Gauss divergence theorem.	12

Part C - Learning Resource

Text Books and Reference Books:

1. Howard Anton, I. Bivens & Stephan Davis. Calculus (10th edition). Wiley India. 2016
2. Gabriel Klambauer. Aspects of Calculus. Springer-Verlag. 1986
3. Wieslaw Krawcewicz & Bindhyachal Rai. Calculus with Maple Labs. Narosa. 2003
4. Gorakh Prasad Differential Calculus (19th edition). Pothishala Pvt. Ltd. 2016
5. George B. Thomas Jr., Joel Hass, Christopher Heil & Maurice D. Weir. Thomas' Calculus (14th edition). Pearson Education 2018
6. Jerrold Marsden, Anthony J. Tromba & Alan Weinstein. Basic Multivariable Calculus, Springer India Pvt. Limited.2009
7. James Stewart. Multivariable Calculus (7th edition). Brooks/Cole. Cengage 2012.
8. Monty J. Strauss, Gerald L. Bradley & Karl J. Smith. Calculus (3rd edition). Pearson Education. Dorling Kindersley (India) Pvt. Ltd. 2011

E- Resources :

1. Suggested Equivalent **online courses:** Web link NPTEL/ SWAYAM/ MOOCs
2. https://www.youtube.com/watch?v=tffrrtzUhmw&list=PL7oBzLzHZ1wXBSiJEgqz_iwVoLiY8qhbv
3. https://www.youtube.com/watch?v=XzaeYnZdK5o&list=PLtKWB-wrvn4nA2h8TFxzWL2zy8O9th_fy
4. https://www.youtube.com/watch?v=zxbHsPB8m-M&list=PLBCEh9iawVM75FaeqS-z7olBKTSLfAC4A

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Part D: Assessment and Evaluation	
Suggested Continuous Evaluation Methods: Maximum Marks:	50 Marks

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Part A: Introduction				
Program: **Diploma Course**		Class: **B.A/ B.Sc. II Year**	Year: **2022**	Session: **2023-2024**
1	Course Code	**MATH-2P (I)**		
2	Course Title	I - Lab 02 - Differential Equations and Real Analysis		
3	Course Type	**Practical**		
4	Pre-requisite (if any)	No		
5	Course Learning Outcomes (CLO)	This course will enable the students to • Learn Free and Open Source Software (FOSS) tools for computer programming • Solve problem on differential equations and real analysis theory studied in Mathematics Paper 1 and 2 by using FOSS software's. • Acquire knowledge of applications of Differential Equations and Real Analysisthrough FOSS.		
6	**Credit Value**	**2**		
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks : 17**	

Part B: Content of the Course	
	Total Periods: 30
Tentative Practical List	Mathematics practical with Free and Open Source Software (FOSS) tools for computer programs, such as GeoGebra/Maxima/Scilab/ Octave /Python/R. **Course Objectives:** • To learn Free and Open Source Software (FOSS) tool for computerprogramming • Acquire knowledge of applications of differential equations and real analysisthrough FOSS **List of Practicals**: (At least 10 practicals) • Solution of differential equation and plotting the graph of the solution:Variable separable. • Solution of differential equation and plotting the graph of the solutionHomogeneous equations. • Solution of differential equation and plotting the graph of the solution:Linear differential equations.

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	• Solution of differential equation and plotting the solution: Bernoulli'sequations • Solution of second and higher order ordinary differential equations withconstant coefficients • Solution of second order ordinary differential equations with variable coefficients by i) Method of variation of parameters ii) When the equationis exact. • Finding complementary function and particular integral of constantcoefficient second and higher order ordinary differential equations. • Solving second order linear partial differential equations in two variableswith constant coefficient. • Solutions to the problems on total and simultaneous differential equations. • Solutions to the problems on different types of Partial differentialequations. • Illustration of convergent, divergent and oscillatory sequences. • Using Cauchy's criterion to determine convergence of a sequence(simple examples). • Illustration of convergent, divergent and oscillatory series. • Programs to find the sum of the series and its radius of convergence. • Using Cauchy's criterion on the sequence of partial sums of the series todetermine convergence of series. • Testing the convergence of binomial, exponential and logarithmic seriesand finding the sum. • To verify the given function is Riemann integrable or not over arbitraryclosed interval [a, b].

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Part C - Learning Resource		
Text Books, Reference Books, Other Resources		
SUPPORT FROM THE GOVT FOR STUDENTS AND TEACHERS IN UNDERSTANDING AND LEARNING FOSS TOOLS: As a national level initiative towards learning FOSS tools, IIT Bombay for MHRD, government of India is giving free training to teachers interested in learning open source software's like scilab, maxima, octave, geogebra and others. (Website: http://spoken-tutorial.org;) (email: info@spokentutorial.org; contact@spoken-tutorial.org)		
Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: Maximum Marks: 50 Continuous Comprehensive Evaluation (CCE): Not Applicable University Exam(UE): 50 Marks		
Internal Assessment: Continuous Comprehensive Evaluation (CCE)	Class Test/Assignment/Presentation	Not Applicable

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Part A: Introduction				
Program: **Diploma Course**		Class: **B.A./ B.Sc. II Year**	Year: **2022**	Session: **2023-2024**
1	Course Code	**MATH-2P (II)**		
2	Course Title	II - Project 02 - History of Mathematician		
3	Course Type	**Project**		
4	Pre-requisite (if any)	No		
5	Course Learning Outcomes (CLO)	Studying history of mathematicians help students: • Develop a deeper understanding of the mathematics they hare already studied by seeing how it was developed over time and in various places. • Know the rich intellectual heritage of the country. • Develop an appreciation of mathematics and build positive attitude towards mathematics increasing student's motivation decreasing anxiety related the subject. • To acquire knowledge about development of mathematics in ancient , medieval and modern period of history.		
6	**Credit Value**	**2**		
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks : 17**	

Part B: Content of the Course	
Total Periods: 30	
Project List	**Course Objectives:** An elective course designed to acquire special / advance knowledge, such as supplement study / support study to a project work and a candidate study such a course on his own with an advisory support by a teacher / faculty member. **Project** Contributions and biographies of Indian Mathematicians Aryabhatta , Varahmihir , and Bhaskar I ,Shreedharacharya , Shreepati and Parmeshwar and contribution involved in contents of the paper of Differential Equations and Real Analysis. (Any 10 Mathematicians)

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Part C - Learning Resource		
Text Books, Reference Books, Other Resources		
Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: Maximum Marks: 50 Continuous Comprehensive Evaluation (CCE): Not Applicable University Exam(UE): 50 Marks		
Internal Assessment: Continuous Comprehensive Evaluation (CCE)	Class Test/Assignment/Presentation	Not Applicable

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Part A: Introduction				
Program: Certificate Course		Class: B. A. / B.Sc. Part I	Year: 2022	Session:2022-2023
1	Course Code	Paper – MATH-2T		
2	Course Title	Algebra		
3	Course Type	Theory		
4	Pre-requisite (if any)	No		
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** • Employ De Moivre's theorem in a number of applications to solve numerical problems. • Learn about the fundamental concepts of groups, subgroups, normal subgroups, isomorphism theorems, cyclic and permutation groups. • Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix, using rank. • Find eigen values and corresponding eigen vectors for a square matrix. • Understand real vector spaces, subspaces, basis, dimension and their properties.		
6	Credit Value	4		
7	Total Marks	Maximum Marks : 50	Minimum Passing Marks :	

Part B: Content of the Course Total Periods: 60		
Unit	Topics	No. of Periods
I	**Set Theory and Theory of Equations:** Sets, Relations, Equivalence relations, Equivalence classes; Finite, countable and uncountable sets; The division algorithm, Divisibility and the Euclidean algorithm, Modular arithmetic and basic properties of congruence's; Elementary theorems on the roots of polynomial equations, Imaginary roots, The fundamental theorem of algebra (statement only); The nth roots of unity, De Moivre's theorem for integer and rational indices and its applications.	12
II	**Groups, Subgroups, Normal Subgroups and Isomorphism Theorems :** Definition and properties of a group, Abelian groups, Examples of groups including D_n (dihedral groups), Q_8	12

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	(quarternian group), $GL(n, \mathbb{R})$ (general linear groups) and $SL(n, \mathbb{R})$ (special linear groups); Subgroups and examples, Cosets and their properties, Lagrange's theorem and its applications, Normal subgroups and their properties, Simple groups, Factors groups; Group homomorphisms and isomorphisms with properties; First, second and third isomorphism theorems for groups.	
III	**Cyclic and Permutation Groups:** Cyclic groups and properties, Classifications of subgroup of cyclic groups, Cauchy theorem for finite abelian groups; Centralizer, Normalizer, Center of a group, Product of two subgroups, Permutation group and properties, Even and odd permutations, Cayley's theorem.	12
IV	**Row Echelon Form of Matrices and Applications:** Systems of linear equations, Row reduction and echelon forms, The rank of a matrix and its applications in solving system of linear equations; Matrix operations, Symmetric, skew- symmetric, self-adjoint, orthogonal, Hermition, skew-Hermition and unitary matrices; Determinant of a square matrix, The inverse of a square matrix, Eigen vectors and eigen values, The characteristic equation and the Cayley□Hamilton theorem, Applications of matrices to computer graphics and search engines.	12
V	**Vector Spaces and Linear Transformations:** Definitions of field and vector space with examples, Subspaces, Linear span, Quotient space and direct sum, Linearly independent and dependent sets, Bases and dimension, Linear transformation and matrix of a linear transformation, Change of coordinates, Rank and nullity of linear transformation, Rank-nullity theorem.	12

Part C - Learning Resource

Text Books and Reference Books

1. Michael Artin *Algebra* (2nd edition). Pearson 2014.
2. John B. Fraleigh. *A First Course in Abstract Algebra* (7th edition). Pearson 2007.
3. Stephen H. Friedberg, Arnold J.Insel& Lawrence E. Spence. *Linear Algebra* (4thedition). Prentice-Hall of India Pvt. Ltd. 2003
4. Joseph A. Gallian. *Contemporary Abstract Algebra* (9th edition). Cengage. 2017
5. Kenneth Hoffman & Ray Kunze. *Linear Algebra* (2nd edition). Prentice-Hall. 2015

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6. I. N. Herstein. *Topics in Algebra* (2nd edition). Wiley India. 2006
7. Nathan Jacobson. *Basic Algebra* I (2nd edition). Dover Publications. 2009
8. Ramji Lal. *Algebra 1: Groups, Rings, Fields and Arithmetic*. Springer. 2017
9. I.S. Luthar & I.B.S. Passi. *Algebra: Volume 1: Groups*. Narosa. 2013

E- Resources

1. Suggested Equivalent **online courses:** Web link NPTEL/ SWAYAM/ MOOCs
2. Linear Algebra
   https://www.youtube.com/watch?v=9h_Q-R6sXbM&list=PL7oBzLzHZ1wXQvQ938Wg1-soq09GywgOw
3. Group theory
   https://www.youtube.com/watch?v=pMzcLG6s3z0&list=PLEAYkSg4uSQ1Yhxu2U-BxtRjZElrfVVcO

Part D: Assessment and Evaluation	
Suggested Continuous Evaluation Methods:	
Maximum Marks:	50 Marks

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Part A: Introduction				
Program: Degree Course		Class: **B.A. /B.Sc. III Year**	Year: **2022**	Session: **2024-2025**
1	Course Code	**MATH-3P (I)**		
2	Course Title	I - Lab 03 - Mathematics Paper 1 and Paper 2		
3	Course Type	**Practical**		
4	Pre-requisite (if any)	No		
5	Course Learning Outcomes (CLO)	This course will enable the students to • Learn Free and Open Source Software (FOSS) tools for computer programming • Solve problem on mathematical theory studied in Mathematics Paper 1 and 2 byusing FOSS software's. • Acquire knowledge of applications of Mathematics through FOSS.		
6	**Credit Value**	**2**		
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks : 17**	

Part B: Content of the Course	
	Total Periods: 30
Tentative Practical List	Mathematics practical with Free and open Source Software (FOSS) tools for computer programs, such as GeoGebra/Maxima/Scilab/ Octave /Phython/R. **List of Practical's**: (At least 10 practical's from Paper 1 and Paper 2) • **Note**: Additional practical may be included in the list at the college level as perchoice of optional papers **Mechanics: Suggested book:** Scilab Textbook Companion for Engineering Mechanics by A. K. Tayal 1. Using the Principle of Virtual Work find the force to hold the system ofpulleys in equilibrium. 2. Using the Principle of Virtual Work to determine vertical and horizontal components of reactions of end points of a frame made up with hinge joints. 3. Displacement time relationship for a traveling car. 4. Displacement time relationship for a stone dropped from top of a tower.

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5. Distance travelled by a particle in the nth second.

Numerical Methods: Suggested book: Scilab Textbook Companion forNumerical Methods by B. Ram

1. Program to find solution of nonlinear equations using Bisection method.
2. Program to find smallest positive root of a cubic equation using Newton'smethod.
3. Program to find solution of linear systemof equations usingTriangularization Method.
4. Program to find solution of linear system of equations using Gauss JacobiMethod.
5. Program to find solution of linear system of equations using Gauss SeidelMethod.
6. Program for value of a function at given point using Newton forwarddifference interpolation.
7. Program for value of a function at given point using Newton backwarddifference interpolation.
8. Program to find first and second order approximation of first derivative ofa function.
9. Program to find integral approximation by Simpson three eight rule.
10. Program to solve initial value problem using Euler's method.

Linear Algebra: Suggested book: Scilab Textbook Companion for LinearAlgebra by K. Hoffman and R. Kunze

1. Progam to find matrix of differential operator with respect to standard basis on the vector space of polynomial functions of degree three or less.
2. Progam to find GCD to two polynomials.
3. Program to find Characteristic Polynomial of a matrix of order 2.
4. Program to find Characteristic and minimal polynomial of a matrix.

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5. Program to find Orthogonal projection in R3.

6. Program to find Unitary matrix.

Integral Transforms and Fourier analysis: Suggested book: Scilab Textbook Companion for Higher Engineering Mathematics by B. S. Grewal

1. Find Fourier sine integral.

2. Find Fourier transform of given function.

3. Find Fourier sine transform.

4. Find Fourier cosine transform.

Discrete Mathematics: Suggested book: Scilab Textbook Companion for Discrete Mathematics by S. Lipschutz, M. Lipson And V. H. Patil, Scilab Textbook Companion for Discrete Mathematics And Its Applications by K. H. Rosen

1. Use of Adjacency matrix

2. Use of Path matrix

Probability and Statistics: Suggested book: Scilab Textbook Companion for Probability And Statistics For Engineers And Scientists by S. M. Ross

1. Program for application of Bye's theorem.

2. Program to obtain probability of union of events.

3. Program for probability of equality likely events

4. Program for applications of Bionomial distribution.

5. Program to obtain probability using Poison distribution.

6. Program for probabilities of a uniform random variable.

7. Program to make scatter plot of two sets of data.

8. Program to fit a linear curve to a given set of data and to determine the sum of squares of the residuals.

Number Theory: Suggested book: Scilab Textbook Companion for Discrete Mathematics And Its Applications by K. H. Rosen

1. To find the quotient and reminder when an integer is divided by

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	anotherinteger. 2. To find prime factorization of a given integer. 3. Test that a given integer is prime or not. 4. To find the greatest common divisor of two integers using recursion. 5. To find the greatest common divisor of two integers using Euclideanalgorithm.

Part C - Learning Resource		
Text Books, Reference Books, Other Resources		
SUPPORT FROMTHE GOVTFOR STUDENTS AND TEACHERS IN UNDERSTANDING AND LEARNING FOSS TOOLS: As a national level initiative towards learning FOSS tools, IIT Bombay for MHRD, government of India is giving free training to teachers interested in learningopen source software's like scilab, maxima, octave, geogebra and others. (Website: http://spoken-tutorial.org;)		
Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: Maximum Marks: 50 Continuous Comprehensive Evaluation (CCE): Not Applicable University Exam(UE): 50 Marks		
Internal Assessment: Continuous Comprehensive Evaluation (CCE)	Class Test/Assignment/Presentation	Not Applicable



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Part A: Introduction				
Program: Degree Course		Class: **B.A./ B.Sc. III Year**	Year: **2022**	Session: **2024-2025**
1	Course Code	**MATH-3P (II)**		
2	Course Title	II - Project 03 - History of Mathematician		
3	Course Type	**Project**		
4	Pre-requisite (if any)	No		
5	Course Learning Outcomes (CLO)	Studying history of mathematicians help students: • Develop a deeper understanding of the mathematics they hare already studied by seeing how it was developed over time and in various places. • Know the rich intellectual heritage of the country. • Develop an appreciation of mathematics and build positive attitude towards mathematics increasing student's motivation decreasing anxiety related the subject. • To acquire knowledge about development of mathematics in ancient , medieval and modern period of history.		
6	**Credit Value**	**2**		
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks : 17**	

Part B: Content of the Course	
Total Periods: 30	
Project List	**Course Objectives:** An elective course designed to acquire special / advance knowledge, such as supplement study / support study to a project work and a candidate study such a course on his own with an advisory support by a teacher / faculty member. **Project:** Contributions and biographies of Indian Mathematicians Swami Bharti Krishna Tirth and Ramanujan, Madhav and Neelkanth Somyaji and contribution involved in contents of the paper of opted by student. (Any 10 Mathematicians)

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Part C - Learning Resource		
Text Books, Reference Books, Other Resources		
Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: Maximum Marks: 50 Continuous Comprehensive Evaluation (CCE): Not Applicable University Exam(UE): 50 Marks		
Internal Assessment: Continuous Comprehensive Evaluation (CCE)	Class Test/Assignment/Presentation	Not Applicable



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Part A: Introduction				
Program: Diploma Course		Class: B. A / B.Sc. Part II	Year: 2022	Session:2023-2024
1	Course Code	Paper – MATH-3T		
2	Course Title	Differential Equations		
3	Course Type	Theory		
4	Pre-requisite (if any)	No		
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** • Understand the genesis of ordinary as well as partial differential equations. • Learn various techniques of getting exact solutions of certain solvable first order differential equations and linear differential equations of second order. • Know Picard's method of obtaining successive approximations of solutions of first order ordinary differential equations, passing through a given point in the plane. • Learn about solution of first order linear partial differential equations using Lagrange's method. • Know how to solve second order linear partial differential equations with constant coefficients. • Formulate mathematical models in the form of ordinary and partial differential equations to problems arising in physical, chemical and biological disciplines.		
6	Credit Value	4		
7	Total Marks	Maximum Marks : 50	Minimum Passing Marks :	

Part B: Content of the Course Total Periods: 60		
Unit	Topics	No. of Periods
I	**First Order Differential Equations:** Basic concepts and genesis of ordinary differential equations, Order and degree of a differential equation, Differential equations of first order and first degree, Equations in which variables are separable, Homogeneous equations, Linear differential equations and equations reducible to linear form, Exact differential equations, Integrating factor, First order higher degree equations solvable for x, y and p, Clairaut's form and singular solutions; Picard's	12

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	method of successive approximations and the statement of Picard's theorem for the existence and uniqueness of the solutions of the first order differential equations.	
II	**Second Order Linear Differential Equations:** Statement of existence and uniqueness theorem for the solution of linear differential equations, General theory of linear differential equations of second order with variable coefficients, Solutions of homogeneous linear ordinary differential equations of second order with constant coefficients, Method of variation of parameters and method of undetermined coefficients, Reduction of order, Euler-Cauchy equations, Coupled linear differential equations with constant coefficients.	12
III	**First Order Partial Differential Equations:** Genesis of Partial differential equations (PDE), Concept of linear and non-linear PDEs, Methods of solution of Simultaneous differential equations of the form: $dx/P(x,y,z) = dy/Q(x,y,z) = dz/R(x,y,z)$, Lagrange's method for PDEs of the form: $P(x,y,z)p+Q(x,y,z)q=R(x,y,z)$, where $p=\partial z/\partial x$ and $q=\partial z/\partial y$; Solutions passing through a given curve.	12
IV	**Second order Partial differential equations:** Principle of superposition for homogeneous linear PDEs, Relation between solution sets of non-homogeneous linear PDEs and their corresponding homogeneous equations, Reducible and irreducible homogeneous equations and their solutions in various possible cases, Solution of non-homogeneous reducible equations using Lagrange's method for first order equations.	12
V	**Applications:** Orthogonal trajectories of one-parameter families of curves in a plane, Minimum velocity of escape from Earth's gravitational field, Newton's law of cooling, Malthusian and logistic population models, Radioactive decay, Free and forced mechanical oscillations of a spring suspended vertically carrying a mass at its lowest tip, Phenomena of resonance, LCR circuits, Surfaces orthogonal to a given system of surfaces.	12

Part C - Learning Resource

Text Books and Reference Books:

1. Erwin Kreyszig . *Advanced Engineering Mathematics* (10th edition). J. Wiley &Sons 2011
2. B. Rai & D. P. Choudhury. *Ordinary Differential Equations - An Introduction*.Narosa Publishing House Pvt. Ltd. New Delhi. 2006
3. Shepley L. Ross. *Differential Equations* (3rd edition). Wiley. 2007
4. George F. Simmons. *Differential Equations with Applications and HistoricalNotes* (3rd edition). CRC Press. Taylor & Francis. 2017

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5. Ian N. Sneddon. *Elements of Partial Differential Equations*. Dover Publications. 2006

E-Resources:

1. Suggested Equivalent **online courses:** Web link NPTEL/ SWAYAM/ MOOCs
2. Differential equation
   https://www.youtube.com/watch?v=NBcGLLU90fM&list=PLbMVogVj5nJSGlf9sluucwobyr_zz6glD
3. Partial Differential equation
   https://www.youtube.com/watch?v=Kk5SEzASkZU&list=PL9m2Lkh6odgKbfY03TFRhwjOqW79UdzK8

Part D: Assessment and Evaluation	
Suggested Continuous Evaluation Methods:	
Maximum Marks:	50 Marks

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Part A: Introduction				
Program: Diploma Course		Class: B. A. / B.Sc. Part II	Year: 2022	Session:2023-2024
1	Course Code	Paper – MATH-4T		
2	Course Title	Real Analysis		
3	Course Type	Theory		
4	Pre-requisite (if any)	No		
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** • Understand basic properties of real number system such as least upper bound propertyand order property. • Realize importance of bounded, convergent, Cauchy and monotonic sequences of real l numbers, find their limit superior and limit inferior. • Apply various tests to determine convergence and absolute convergence of a series of real numbers. • Learn about Riemann integrability of bounded functions and algebra of R- integrable functions. • Determine various applications of the fundamental theorem of integral calculus. • Relate concepts of uniform continuity, differentiation, integration and uniformconvergence.		
6	Credit Value	4		
7	Total Marks	Maximum Marks : 50	Minimum Passing Marks :	

Part B: Content of the Course Total Periods: 60		
Unit	Topics	No. of Periods
I	**Real Numbers:** The set of real numbers $\mathbb{R}$ as an ordered field, Least upper bound properties of $\mathbb{R}$, Metric property and completeness of $\mathbb{R}$, Archimedean property of $\mathbb{R}$, Dense subsets of $\mathbb{R}$, Nested intervals property; Neighbourhood of a point in $\mathbb{R}$, Open sets, limit point of a set, closed and perfect sets in $\mathbb{R}$, connected and compact subsets of $\mathbb{R}$, Heine-Borel theorem.	12
II	**Convergence of Sequences in $\mathbb{R}$:** Bounded and monotonic sequences, Convergent sequence and its limit, Limit theorems, Monotone convergence	12

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	theorem, Subsequences, Bolzano-Weierstrass theorem, Limit superior and limit inferior, Cauchy sequence, Cauchy's convergence criterion.	
III	**Infinite Series:** Convergence of a series of positive real numbers, Necessary condition for convergence, Cauchy criterion for convergence; Tests for convergence: Comparison test, Limit comparison test, D'Alembert's ratio test, Cauchy's n^{th} root test, Abel's test, Integral test; Alternating series, Absolute and conditional convergence, Leibniz theorem, Rearrangements of series, Riemann's rearrangement theorem.	12
IV	**Riemann Integration:** Riemann integrability of bounded functions, Examples of R-integrable and non-integrable functions, Algebra of Riemann integrable functions, Integrability of continuous and monotonic functions, Darboux theorems, Fundamental theorem of integral calculus, First mean value theorem and second mean value theorems (Bonnet and Weierstrass forms). Necessary and sufficient condition for Riemann integrable function (Statement only).	12
V	**Uniform Convergence, Continuity and Improper Integrals:** Pointwise and uniform convergence of sequence and series of functions, Uniform continuity, Weierstrass's M-test, Uniform convergence and continuity, Uniform convergence and differentiability, Improper integrals and tests for improper integrals, Beta and Gamma functions.	12

Part C - Learning Resource

Text Books, Reference Books:

1. T. M. Apostol. *Mathematical Analysis: A Modern Approach to AdvancedCalculus*. Pearson Education. 2008
2. Charalambos D. Aliprantis &) Owen Burkinshaw. *Principles of Real Analysis* (3rd edition). Academic Press. 1998
3. Robert G. Bartle & Donald R. Sherbert. *Introduction to Real Analysis* (4thedition).Wiley India. 2015
4. Gerald G. Bilodeau, Paul R. Thie & G. E. Keough. *An Introduction to Analysis* (2nd edition), Jones and Bartlett India Pvt. Ltd. 2015
5. E. Hewitt & K. Stromberg (2013). *Real and Abstract Analysis.* Springer-Verlag.
6. K. A. Ross. *Elementary Analysis*: *The Theory of Calculus* (2nd edition).Springer. 2013

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

E-Resources:

1. Suggested Equivalent **online courses:** Web link NPTEL/ SWAYAM/ MOOCs
2. https://www.youtube.com/watch?v=Bef8QjIjCy0&list=PLbMVogVj5nJQ1UXrOm7KqTg9UKk6eXRp_
3. https://www.youtube.com/watch?v=C2qIoHkhEuM&list=PLOzRYVm0a65cpVtcdj_5SBEh6VQvC_BvR

Part D: Assessment and Evaluation	
Suggested Continuous Evaluation Methods:	
Maximum Marks:	50 Marks

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Part A: Introduction				
Program: Degree Course		Class: B. A. / B.Sc. Part III	Year: 2022	Session:2024-2025
1	Course Code	Paper – MATH – 5T(I)		
2	Course Title	Mechanics		
3	Course Type	Theory		
4	Pre-requisite (if any)	No		
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** • Familiarize with subject matter, which has been the single centre, to which were drawn mathematicians, physicists, astronomers and engineers together. • Understand necessary conditions for the equilibrium of particles acted upon by various forces and learn the principle of virtual work for a system of coplanar forces acting on a particle. • Determine the centre of gravity of materialistic systems and discuss the equilibrium of a uniform cable hanging freely under its own weight. • Deal with the kinematics and kinetics of the rectilinear and planar motions of a particle including the constrained oscillatory motions of particle. • Learn that a particle moving under a central force describes a plane curve and know the Kepler's laws of the planetary motions, which were deduced by him long beforethe mathematical theory given by Newton.		
6	Credit Value	4		
7	Total Marks	Maximum Marks : 50	Minimum Passing Marks : 17	

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Part B: Content of the Course Total Periods: 60		
Unit	Topics	No. of Periods
I	**Statics:** Coplanar forces, Couples, Moment of force and a couple about a point and a line, Equilibrium of a particle and of a system of particles; Work and potential energy, Principle of virtual work for a system of coplanar forces acting on a particle, Forces which can be omitted in forming the equations of virtual work.	12
II	**Centre of Gravity and Common Catenary:** Concepts of Centre of mass and Centre of gravity, Centre of gravity of an uniform arc, plane area and solids of revolution; Common catenary, Approximations of a catenary.	12
III	**Rectilinear Motion:** Simple harmonic motion and its geometrical representation, Motion under inverse square law, Motion in resisting media, Concept of terminal velocity, Motion of varying mass.	12
IV	**Motion in a Plane:** Kinematics and kinetics of motion, Expressions for velocity and acceleration in cartesian, polar and intrinsic coordinates; Motion in a vertical circle, projectile and cycloidal motion.	12
V	**Central Orbits:** Equation of motion under a central force, Differential equation of an orbit, (p, r) equation of an orbit, Apses and apsidal distances, Areal velocity, Characteristics of central orbits, Kepler's laws of planetary motion.	12

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Part C - Learning Resource

Text Books, Reference Books:

1. R. S. Varma (1962). *A Text Book of Statics*. Pothishala Pvt. Ltd.
2. P.L. Srivastava (1964). *Elementary Dynamics*. Ram Narain Lal, Beni PrasadPublishers Allahabad.
3. J. L. Synge & B. A. Griffith (1949). *Principles of Mechanics*. McGraw-Hill.
4. S.L. Loney (2006). *An Elementary Treatise on the Dynamics of a Particle and ofRigid Bodies*. Read Books.
5. A. S. Ramsey (2009). *Statics*. Cambridge University Press.
6. A. S. Ramsey (2009). *Dynamics*. Cambridge University Press.

E-Resources

1. Suggested Equivalent **online courses:** Web link NPTEL/ SWAYAM/ MOOCs
2. https://www.youtube.com/playlist?list=PLwdnzlV3ogoXUbQmP-T2gPhYXeEcxP6U8

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

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Part A: Introduction				
Program: Degree Course		Class: B. A. / B.Sc. Part III	Year: 2022	Session:2024-2025
1	Course Code	Paper – MATH – 5T(II)		
2	Course Title	Numerical Methods		
3	Course Type	Theory		
4	Pre-requisite (if any)	No		
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** • Obtain numerical solutions of algebraic and transcendental equations. • Find numerical solutions of system of linear equations and to check the accuracy ofthe solutions. • Learn about various interpolating and extrapolating methods to find numericalsolutions. • Solve initial and boundary value problems in differential equations using numericalmethods. • Apply various numerical methods in real life problems.		
6	Credit Value	4		
7	Total Marks	Maximum Marks : 50	Minimum Passing Marks : …	

Part B: Content of the Course Total Periods: 60		
Unit	Topics	No. of Periods
I	**Numerical methods for solving algebraic and transcendental equations:** Round-off error and computer arithmetic, Local and global truncation errors, Algorithms and convergence; Bisection method, false position method, fixed point iteration method, Newton's method and secant method for solving equations.	12
II	**Numerical Methods for Solving Linear Systems:** Partial and scaled partial pivoting, LU decomposition and its applications, Thomas method for tridiagonal systems; Gauss-Jacobi, Gauss-Seidel and successive over-relaxation (SOR) methods.	12
III	**Interpolation**: Lagrange and Newton interpolations, Piecewise linear interpolation, Cubic spline interpolation, Finite difference	12

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	operators, Gregory-Newton forward and backward difference interpolations.	
IV	**Numerical Differentiation and Integration:** First order and higher order approximation for first derivative, Approximation for second derivative; Numerical integration: Trapezoidal rule, Simpson's rule and its error analysis, Bulirsch-Stoer extrapolation methods, Richardson extrapolation.	12
V	**Initial and Boundary Value Problems of Differential Equations:** Euler's method, Runge-Kuttamethods, Higher order one step method, Multi-step methods; Finite difference method, Shooting method, Real life examples: Google search engine, 1D and 2D simulations, Weather forecasting.	12

Part C - Learning Resource

Text Books and Reference Books:

1. Brian Bradie , *A Friendly Introduction to Numerical Analysis.* Pearson. 2006
2. C. F. Gerald & P. O. Wheatley. *Applied Numerical Analysis* (7th edition),Pearson Education, India. 2008
3. M.K. Jain, S. R. K. Iyengar & R. K. Jain. *Numerical Methods for Scientificand Engineering Computation* (6th edition). New Age International Publishers. 2012
4. Robert J. Schilling & Sandra L. Harris. *Applied Numerical Methods forEngineers Using* MATLAB *and C*. Thomson-Brooks/Cole.1999

E- Resources:

1. Suggested Equivalent **online courses:** Web link NPTEL/ SWAYAM/ MOOCs
2. https://www.youtube.com/watch?v=pOtnzAXlXvI&list=PL3pGy4HtqwD0CWdFuygdF-gk0ORk5EFZg

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

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Part A: Introduction				
Program: Degree Course		Class: B. A. / B.Sc. Part III	Year: 2022	Session:2024-2025
1	Course Code	Paper – MATH – 5T(III)		
2	Course Title	Linear Algebra		
3	Course Type	Theory		
4	Pre-requisite (if any)	No		
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** • Learn about properties of linear transformation and isomorphism theorems. • Understand the concept of polynomials and their prime factorization. • Find canonical form of linear transformations. • Obtain various variants of diagonalisation of linear transformations. • Apply Cauchy-Schwarz inequality for deriving metric on inner product spaces and obtain orthonormal basis using Gram-Schmidt orthogonalisation.		
6	Credit Value	4		
7	Total Marks	Maximum Marks : 50	Minimum Passing Marks :	

Part B: Content of the Course Total Periods: 60		
Unit	Topics	No. of Periods
I	**Properties of Linear Transformation:** Vector spaces, Linearly independent and dependent sets, Bases and dimension, Linear transformation, Linear functional, Dual spaces and second dual space, Transpose of linear transformation, Algebra of linear transformations, Isomorphism theorems.	12

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II	**Polynomials:** Algebras, The algebra of polynomials, Lagrange interpolation, Vandermonde matrix, Polynomial ideals, Taylor's formula, The prime factorization of a polynomial, Algebraically closed fields.	12
III	**Elementary Cannonical Forms:** Determinant functions, Characteristic values of a linear transformation, Cayley-Hamilton theorem for linear transformations, Annihilating polynomials, Invariant subspaces, Minimaland characteristic polynomials.	12
IV	**Diagonalisation and Jordan Cannonical Form:** Diagonalisability of linear transformations, Direct sum decomposition, Invariant direct sums, The primary decomposition theorem, Triangular form, Jordan canonical form, trace and transpose.	12
V	**Inner Product Spaces:** Definition and examples of inner product space, orthogonality, Cauchy-Schwarz inequality, Gram-Schmidt orthogonalisation, Diagonalisation of symmetric matrices, Hermitian, Unitaryand normal operators.	12

Part C - Learning Resource

Text Books, Reference Books,

1. I. M. Gel'fand. *Lectures on Linear Algebra*. Dover Publications. 1989
2. Kenneth Hoffman & Ray Kunze. *Linear Algebra* (2nd edition). Prentice-Hall. 2015
3. Nathan Jacobson. *Basic Algebra* I (2nd edition). Dover Publications. 2009
4. Nathan Jacobson *Basic Algebra* II (2nd edition). Dover Publications. 2009.
5. Serge Lang *Introduction to Linear Algebra* (2nd edition). Springer India. 2005.
6. Gilbert Strang. *Linear Algebra and its Applications* (2nd edition). Elsevier. 2014

E- Resources:

1. Suggested Equivalent **online courses:** Web link NPTEL/ SWAYAM/ MOOCs
2. https://www.youtube.com/watch?v=9h_Q-R6sXbM&list=PL7oBzLzHZ1wXQvQ938Wg1-soq09GywgOw

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

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Part A: Introduction				
Program: Degree Course		Class: B. A. / B.Sc. Part III	Year: 2022	Session:2024-2025
1	Course Code	Paper – MATH – 5T(IV)		
2	Course Title	Integral Transforms and Fourier Analysis		
3	Course Type	Theory		
4	Pre-requisite (if any)	No		
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** • Know about piecewise continuous functions, Dirac delta function, Laplace transformsand its properties. • Solve ordinary differential equations using Laplace transforms. • Explain Parseval's identity, Plancherel's theorem and applications of Fourier transforms to boundary value problems. • Learn Fourier series, Bessel's inequality, term by term differentiation and integrationof Fourier series.		
6	Credit Value	4		
7	Total Marks	Maximum Marks : 50	Minimum Passing Marks :	

Part B: Content of the Course Total Periods: 60		
Unit	Topics	No. of Periods
I	**Laplace Transforms:** Integral transform, Kernel of an integral transform, Reduction of integral transform into Laplace transform, Linearity, Existence theorem, Laplace transforms of derivatives and integrals, Shifting theorems, Change of scale property, Laplace transforms of periodic functions, Dirac's delta function.	12
II	**Further Properties of Laplace Transforms and Applications:** Differentiation and integration of transforms, Convolution theorem, Integral equations, Inverse Laplace transform, Lerch's theorem, Linearity property of inverse Laplace transform, Translations theorems of inverse Laplace transform, Inverse	12

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	transform of derivatives, Applications of Laplace transform in obtaining solutions of ordinary differential equations and integral equations.	
III	**Fourier Transforms:** Fourier and inverse Fourier transforms, Fourier sine and cosine transforms, Inverse Fourier sine and cosine transforms, Linearity property, Change of scale property, Shifting property, Modulation theorem, Relation between Fourier and Laplace transforms.	12
IV	**Solution of Equations by Fourier Transforms :** Solution of integral equation by Fourier sine and cosine transforms, Convolution theorem for Fourier transform, Parseval's identity for Fourier transform, Plancherel's theorem, Fourier transform of derivatives, Applications of infinite Fourier transforms to boundary value problems, Finite Fourier transform, Inversion formula for finite Fourier transforms.	12
V	**Fourier Series:** Fourier cosine and sine series, Fourier series, Differentiation and integration of Fourier series, Absolute and uniform convergence of Fourier series, Bessel's inequality, The complex formof Fourier series.	**12**

Part C - Learning Resource

Text Books, Reference Books:

1. James Ward Brown & Ruel V. Churchill. *Fourier Series and Boundary ValueProblems*. McGraw-Hill Education. 2011
2. Charles K. Chui. *An Introduction to Wavelets*. Academic Press 1992
3. Erwin Kreyszig. *Advanced Engineering Mathematics* (10th edition). Wiley. 2011
4. Walter Rudin. *Fourier Analysis on Groups*. Dover Publications. 2017
5. A. Zygmund. *Trigonometric Series* (3rd edition). Cambridge University Press. 2002

Other Resources:

1. Suggested Equivalent **online courses:** Web link NPTEL/ SWAYAM/ MOOCs
2. https://www.youtube.com/watch?v=FGjMZ1uMRrs&list=PLhSp9OSVmeyJ5N-JUEZj7uS6IAT9a79nD

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

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Part A: Introduction				
Program: Degree Course		Class: B. A. / B.Sc. Part III	Year: 2022	Session:2024-2025
1	Course Code	Paper – MATH – 6T(I)		
2	Course Title	Discrete Mathematics		
3	Course Type	Theory		
4	Pre-requisite (if any)	No		
5	Course Learning Outcome (CLO)	• Learn about partially ordered sets, lattices and their types. • Understand Boolean algebra and Boolean functions, logic gates, switching circuitsand their applications. • Solve real-life problems using finite-state and Turing machines. • Assimilate various graph theoretic concepts and familiarize with their applications.		
6	Credit Value	4		
7	Total Marks	Maximum Marks : 50	Minimum Passing Marks :	

Part B: Content of the Course Total Periods: 60		
Unit	Topics	No. of Periods
I	**Partially Ordered Sets:** Definitions, examples and basic properties of partially ordered sets (poset), Order isomorphism, Hasse diagrams, Dual of a poset, Duality principle, Maximal and minimal elements, Least upper bound and greatest upper bound, Building new poset, Maps between posets.	12
II	**Lattices:** Lattices as posets, Lattices as algebraic structures, Sublattices, Products and homomorphisms; Definitions, examples and properties of modular and distributive lattices; Complemented, relatively complemented and sectionally complemented lattices.	12
III	**Boolean Algebras and Switching Circuits:** Boolean algebras, De Morgan's laws, Boolean homomorphism, Representation theorem; Boolean polynomials, Boolean polynomial functions, Disjunctive	12

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	and conjunctive normal forms, Minimal forms of Boolean polynomials, Quine-McCluskeymethod, Karnaugh diagrams, Switching circuits and applications.	
IV	**Finite-State and Turing Machines:** Finite-state machines with outputs, and with no output; Deterministic and nodeterministic finite-state automaton; Turing machines: Definition, examples, and computations.	12
V	**Graphs:** Definition, examples and basic properties of graphs, Königsberg bridge problem; Subgraphs, Pseudographs, Complete graphs, Bipartite graphs, Isomorphism of graphs, Paths and circuits, Eulerian circuits, Hamiltonian cycles, Adjacency matrix, Weighted graph, Travelling- salesman problem, Shortest path, Dijkstra's algorithm.	12

Part C - Learning Resource

Text Books and Reference Books:

1. B. A. Davey & H. A. Priestley . *Introduction to Lattices and Order* (2nd edition). Cambridge University Press. 2002
2. Edgar G. Goodaire& Michael M. Parmenter. *Discrete Mathematics withGraph Theory* (3rd edition). Pearson Education. 2018
3. Rudolf Lidl & Günter Pilz. *Applied Abstract Algebra* (2nd edition). Springer. 1998
4. Kenneth H. Rosen. *Discrete Mathematics and its Applications*: *With Combinatorics and Graph Theory* (7th edition). McGraw-Hill. 2012
5. C. L. Liu *Elements of Discrete Mathematics* (2nd edition). McGraw-Hill. 1985

E-Resources:

1. Suggested Equivalent **online courses:** Web link NPTEL/ SWAYAM/ MOOCs
2. https://www.youtube.com/watch?v=hklHg9oMkGA&list=PLwdnzlV3ogoVxVxCTll45pDVM1aoYoMHf

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

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Part A: Introduction				
Program: Degree Course		Class: B. A. / B.Sc. Part III	Year: 2022	Session:2024-2025
1	Course Code	Paper – MATH – 6T(II)		
2	Course Title	Tensors and Differential Geometry		
3	Course Type	Theory		
4	Pre-requisite (if any)	No		
5	Course Learning Outcome (CLO)	• Explain the basic concepts of tensors. • Understand role of tensors in differential geometry. • Learn various properties of curves including Frenet - Serret formulae and theirapplications. • Know the Interpretation of the curvature tensor, Geodesic curvature, Gauss andWeingarten formulae. • Understand the role of Gauss's Theorema Egregium and its consequences. • Apply problem-solving with differential geometry to diverse situations in physics, engineering and in other mathematical contexts.		
6	Credit Value	4		
7	Total Marks	Maximum Marks : 50	Minimum Passing Marks :	

Part B: Content of the Course Total Periods: 60		
Unit	Topics	No. of Periods
I	**Tensors:** Contravariant and covariant vectors, Transformation formulae, Tensor product of two vectorspaces, Tensor of type (r, s), Symmetric and skew-symmetric properties, Contraction of tensors, Quotient law, Inner product of vectors.	12
II	**Further Properties of Tensors:** Fundamental tensors, Associated covariant and contravariant vectors, Inclination of two vectors and orthogonal vectors, Christoffel symbols, Law of transformation of Christoffel symbols, Covariant derivatives of covariant and contravariant vectors, Covariant differentiat- ion of tensors, Curvature tensor, Ricci tensor, Curvature tensor identities.	12
III	**Curves in $\mathbb{R}^2$ and $\mathbb{R}^3$:** Basic definitions and examples, Arc length, Curvature and the Frenet□Serret formulae, Fundamental existence and uniqueness theorem for curves, Non-unit speed curves.	12

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IV	**Surfaces in $\mathbb{R}^3$:** Basic definitions and examples, The first fundamental form, Arc length of curves on surfaces, Normal curvature, Geodesic curvature, Gauss and Weingarten formulae, Geodesics, Parallelvector fields along a curve and parallelism.	12
V	**Geometry of Surfaces:** The second fundamental form and the Weingarten map; Principal, Gauss and mean curvatures; Isometries of surfaces, Gauss's Theorema Egregium, The fundamental theorem of surfaces, Surfaces of constant Gauss curvature, Exponential map, Gauss lemma, Geodesic coordinates, The Gauss-Bonnet formula and theorem.	12

Part C - Learning Resource

Text Books, Reference Books:

1. Christian Bär. *Elementary Differential Geometry*. Cambridge University Press. 2010
2. Manfredo P. do Carmo. *Differential Geometry of Curves & Surfaces* (Revisedand updated 2nd edition). Dover Publications. 2016
3. Alferd Gray. *Modern Differential Geometry of Curves and Surfaces with Mathematica* (4th edition). Chapman & Hall/CRC Press, Taylor & Francis. 2018
4. Richard S. Millman & George D. Parkar. *Elements of Differential Geometry*.Prentice-Hall. 1977
5. R. S. Mishra. *A Course in Tensors with Applications to Riemannian Geometry*.Pothishala Pvt. Ltd. 1965
6. Sebastián Montiel & Antonio Ross. *Curves and Surfaces*. American Mathematical Society. 2009

E-Resources

1. Suggested Equivalent **online courses:** Web link NPTEL/ SWAYAM/ MOOCs
2. https://www.youtube.com/watch?v=OyQj-RWLuV4

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

MaximumMarks: 50 Marks

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Part A: Introduction				
Program: Degree Course		Class: B. A. / B.Sc. Part III	Year: 2022	Session:2024-2025
1	Course Code	Paper – MATH – 6T(III)		
2	Course Title	Number Theory		
3	Course Type	Theory		
4	Pre-requisite (if any)	No		
5	Course Learning Outcome (CLO)	• Some of the open problems related to prime numbers, viz., Goldbach conjecture etc. • About number theoretic functions and modular arithmetic. • Public crypto systems, in particular, RSA.		
6	Credit Value	4		
7	Total Marks	Maximum Marks : 50	Minimum Passing Marks : 17	

Part B: Content of the Course Total Periods: 60		
Unit	Topics	No. of Periods
I	**Distribution of Primes and Theory of Congruencies:** Linear Diophantine equation, Prime counting function, Prime number theorem, Goldbach conjecture, Fermat and Mersenne primes, Congruence relation and its properties, Linear congruence and Chinese remainder theorem, Fermat's little theorem, Wilson's theorem.	12
II	**Number Theoretic Functions:** Number theoretic functions for sum and number of divisors, Multiplicative function, The Mobius inversion formula, The greatest integer function. Euler's phi-function and properties, Euler's theorem.	12
III	**Primitive Roots:** The order of an integer modulo n, Primitive roots for primes, Composite numbers having primitive roots; Definition of quadratic residue of an odd prime, and Euler's criterion.	12

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IV	**Quadratic Reciprocity Law and Public Key Encryption:** The Legendre symbol and its properties, Quadratic reciprocity, Quadratic congruencies withcomposite moduli.	12
V	**Applications:** Public key encryption, RSA encryption and decryption, Some important application.	12

Part C - Learning Resource

Text Books and Reference Books

1. David M. Burton. *Elementary Number Theory* (7th edition). McGraw-Hill. 2007
2. Gareth A. Jones & J. Mary Jones. *Elementary Number Theory*. Springer. 2005
3. Neville Robbins. *Beginning Number Theory* (2nd edition). Narosa. 2007

E- Resources

1. Suggested Equivalent **online courses:** Web link NPTEL/ SWAYAM/ MOOCs
2. https://www.youtube.com/watch?v=u7cBLb0b7pk&list=PLOzRYVm0a65fuj_5fuj1BLeQNULrM4lrj

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

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Part A: Introduction				
Program: Certificate Course		Class: B. A. / B.Sc. Part III	Year: 2022	Session:2024-2025
1	Course Code	Paper – MATH – 6T(IV)		
2	Course Title	Probability and Statistics		
3	Course Type	Theory		
4	Pre-requisite (if any)	No		
5	Course Learning Outcome (CLO)	• Understand the basic concepts of probability. • Appreciate the importance of probability distribution of random variables and to know the notion of central tendency. • Establish the joint distribution of two random variables in terms their correlation andregression. • Understand Correlation , Regression, Partial and Multiple correlation. • Study Attributes, Chi-square distribution and sampling. • Learn Curve Fitting , Interpolation, Extrapolation and Finite Differences		
6	Credit Value	4		
7	Total Marks	Maximum Marks : 50	Minimum Passing Marks :	

Part B: Content of the Course Total Periods: 60		
Unit	Topics	No. of Periods
I	**Probability and Random Variables:** Axiomatic and empirical definitions of probability, Independent and dependent events, Conditional probability and Baye's theorem; Discrete and continuous random variables andtheir probability distributions, Cumulative distribution function, n^{th} Moments, Moment generating function, Characteristic function.	12

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II	**Univariate Distributions:** Discrete distributions: Bernoulli trials and Bernoulli distribution, Binomial and Poisson distributions; Continuous distributions: Uniform, Geometric, Gamma, Exponential, Beta and normal distributions; Normal approximation to the binomial distribution, Central limit theorem.	12
III	**Curve Fitting , Interpolation, Extrapolation and Finite Differences:** Method of least squares, Normal equation, Fitting of the curve of the type $y = ab^x$ and $y = ax^b$. Methods of Interpolation , Newton's Binomial Method, Lagrange's Interpolation Formula, Gausses forwardand backward formula, Striling formula, Bessel's formula, Everett's formula, Divided difference table, Newton's divided difference formula.	12
IV	**Correlation, Regression, Partial and Multiple Correlation:** Correlation, Karl Pearson's Coefficient of correlation, Correlation of ranks, Correlation coefficient, Regression, Line of regression, Equations to the line of regression, Schwarz's Inequality, Moment of Bivariate Distribution. Multiple Correlation, Partial Correlation, Distribution of two, three and more variable, Regression Coefficient , Residuals, Standard deviation of the residuals, Multiple correlation and Partial correlation coefficient.	12
V	**Attributes, Chi-square distribution and sampling:** Attributes, Positive and Negative Attributes, Testing, Condition for consistence in attributes, Independence , Criterion of Independence, Association, complete association, coefficient of association, degree of association, Chi–square distribution, Origin of sampling, Essentials of sampling, Random sampling, Large samples, simple sampling, comparison of large sample, sample from different populations, level of significance, testing the significance of an observed coefficient of correlation and rank of correlation coefficient, Fisher's z-test, Small samples, t-distribution, Fisher's z-distribution, Snedecore's F-distribution.	12

Part C - Learning Resource

Text Books and Reference Books:

1. David Applebaum. *Probability and Information: An Integrated Approach.* Cambridge University Press. 1996
2. Robert V. Hogg, Joseph W. McKean & Allen T. Craig *Introduction to Mathematical Statistics* (7th edition), Pearson Education. 2013
3. Irwin Miller & Marylees Miller (2014). *John E. Freund's Mathematical Statistics with Applications* (8th edition). Pearson. Dorling Kindersley Pvt. Ltd. India.
4. Jim Pitman (1993). *Probability*, Springer-Verlag.
5. Sheldon M. Ross (2014). *Introduction to Probability Models* (11th edition). Elsevier.
6. A. M. Yaglom and I. M. Yaglom (1983). *Probability and Information*. D. Reidel Publishing Company. Distributed by Hindustan Publishing Corporation (India) Delhi.

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7. M. Ray and Sar Swarup Sharma, (1988);*Mathematical Statistics*, 8th edition Ram Prasad adb Sons Agra

Other Resources:

1. Suggested Equivalent **online courses:** Web link NPTEL/ SWAYAM/ MOOCs
2. https://www.youtube.com/watch?v=COI0BUmNHT8&list=PLyqSpQzTE6M_JcleDbrVyPnE0PixKs2JE

Part D: Assessment and Evaluation	
Suggested Continuous Evaluation Methods:	
Maximum Marks:	50 Marks

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