HAVERI UNIVERSITY , HAVERI.

B.Sc. (MATHEMATICS)

SYLLABUS

WITH EFFECT FROM 2024 - 25

DISCIPLINE SPECIFIC CORE COURSE (DSCC) FOR SEM

III, IV, V & VI

AND OPEN ELECTIVE COURSES (OEC) FOR III, IV AND
SKILL ENHANCEMENT COURSE (SEC) FOR V SEM

AS PER (REVISED) NEP: 2024

HAVERI UNIVERSITY , HAVERI.

Sem.	Type of Course	Theory/ Practical	Course Code	Course Title	Instruction hour/ week	Total hours / sem	Duration of Exam	Marks			Credits
								Formative	Summative	Total	
III	DSCC - 5	Theory	033MAT011	Ordinary Differential Equations and Real Analysis – I	04hrs	56	02 hrs	40	60	100	04
	DSCC - 6	Practical	033MAT012	Practicals on Ordinary Differential Equations and Real Analysis – I	04 hrs	52	03 hrs	25	25	50	02
IV	DSCC - 7	Theory	034MAT011	Partial differential Equations and Integral Transforms	04hrs	56	02 hrs	40	60	100	04
	DSCC - 8	Practical	034MAT012	Practicals on Partial differential Equations and Integral Transforms	04 hrs	52	03 hrs	25	25	50	02
V	DSCC-9	Theory	035 MAT 011	Real Analysis-II and Complex Analysis	04hrs	56	02 hrs	40	60	100	04
	DSCC-10	Practical	035 MAT 012	Practicals on Real Analysis-II and Complex Analysis	04 hrs	56	03 hrs	25	25	50	02
	DSCC-11	Theory	035 MAT 013	Vector Calculus and Analytical Geometry	04hrs	56	02 hrs	40	60	100	04
	DSCC-12	Practical	035 MAT 014	Practicals on Vector Calculus and Analytical Geometry	04 hrs	56	03 hrs	25	25	50	02
	SEC-3	Practical	035 MAT 061	Programming with Python							
VI	DSCC-13	Theory	036 MAT 011	Algebra-III and Special Functions	04hrs	56	02 hrs	40	60	100	04
	DSCC-14	Practical	036 MAT 012	Practicals on Algebra-III and Special Functions and Special Functions	04 hrs	56	03 hrs	25	25	50	02
	DSCC-15	Theory	036 MAT 013	Numerical Analysis	04hrs	56	02 hrs	40	60	100	04
	DSCC-16	Practical	036 MAT 014	Practicals on Numerical Analysis	04 hrs	56	03 hrs	25	25	50	02
	Internship-1		036 MAT 091	Internship				50	0	50	02

B.Sc. in MATHEMATICS

Effective from 2024 - 25

Semester	Type of Course	Theory /Practical	Course Code	Course Title	Instruction hours / week	Total hours of syllabus / Sem	Duration of Sem End Exam	Marks			Credits
								Formative Assessment	Summative Assessment	Total	
I	**DSC – 1**	**Theory**	**C1 MAT 1 T1**	Algebra – I and Calculus – I	04	60	03	20	80	100	**04**
	DSC – 2	**Practical**	**C1 MAT 1 P1**	Practical on Algebra – I and Calculus – I	04	56	03	10	40	50	**02**
II	**DSC – 3**	**Theory**	**C2 MAT 1 T1**	Number Theory and Calculus – II	04	60	03	20	80	100	**04**
	DSC - 4	**Practical**	**C2 MAT 1 P1**	Practical on Number Theory and Calculus – II	04	56	03	10	40	50	**02**
III	**DSC – 5**	**Theory**	**C3 MAT 1 T1**	Algebra – II and Real Analysis – I	04	60	03	20	80	100	**04**
	DSC – 6	**Practical**	**C3 MAT 1 P1**	Practical on Algebra – II and Real Analysis – I	04	56	03	10	40	50	**02**
IV	**DSC – 7**	**Theory**	**C4 MAT 1 T1**	Differential Equations and Integral Transforms	04	60	03	20	80	100	**04**
	DSC – 8	**Practical**	**C4 MAT 1 P1**	Practical on Differential Equations and Integral Transforms	04	56	03	10	40	50	**02**
***V**	**DSC – 9A**	**Theory**	**C5 MAT 2 T1**	Real Analysis – II and Topology	04	60	03	20	80	100	**04**
	DSC – 10A	**Practical**	**C5 MAT 2 P1**	Practical on Real Analysis – II and Topology	04	56	03	10	40	50	**02**
	DSC – 9B	**Theory**	**C5 MAT 2 T2**	Mechanics and Mathematical Modelling	04	60	03	20	80	100	**04**
	DSC – 10B	**Practical**	**C5 MAT 2 P2**	Practical on Mechanics and Mathematical Modelling	04	56	03	10	40	50	**02**
***VI**	**DSC – 11A**	**Theory**	**C6 MAT 2 T1**	Numerical Analysis	04	60	03	20	80	100	**04**
	DSC – 12A	**Practical**	**C6 MAT 2 P1**	Practical on Numerical Analysis	04	56	03	10	40	50	**02**
	DSC – 11B	**Theory**	**C6 MAT 2 T2**	Geometry and Complex Analysis	04	60	03	20	80	100	**04**
	DSC – 12B	**Practical**	**C6 MAT 2 P2**	Practical on Geometry and Complex Analysis	04	56	03	10	40	50	**02**
V	**EC – 1**	**Theory**	**C5 MAT 5 T1**	Quantitative Mathematics – I	03	45	03	20	80	100	**03**
VI	**EC – 2**	**Theory**	**C6 MAT 5 T1**	Quantitative Mathematics – II	03	45	03	20	80	100	**03**
****IV/ V/VI**	**SEC**	**Practical**	**C0 MAT 6 P1**	Programming with GNU Octave	04	56	03	10	40	50	**02**

*Student shall study either DSC-9A and DSC-10A or DSC-9B and DSC-10B in 5^{th} semester. Similarly, DSC-11A and DSC-12A or DSC-11B and DSC-12B in 6^{th} semester.

** Student shall study this Skill Enhancement Course (SEC) either in 4^{th} / 5^{th} / 6^{th} but not in all the semester.

HAVERI UNIVERSITY , HAVERI.

B.Sc. in MATHEMATICS

Programme Specific Outcomes (PSOs):

On completion of the 03 years Degree in Mathematics, students will be able to:

PSO 1	Demonstrate, solve and understand the major concepts in all the disciplines of Mathematics.
PSO 2	Understand practical skills so that they can understand and assess risks and work safely and competently in the laboratory.
PSO 3	To apply standard methodology to the solutions of problems in Mathematics.
PSO 4	Provide students with the ability to plan and carry out experiments independently and assess the significance of outcomes.
PSO 5	Develop in students the ability to adapt and apply methodology to the solution of unfamiliar types of problems.
PSO 6	Employ critical thinking and the scientific knowledge to design, carry out, record and analyse the results of various problems in Mathematics.
PSO 7	To build confidence in the candidate to be able to work on his own in industry and institution of higher education.
PSO 8	To develop an independent and responsible work ethics.
PSO 9	Gain proficiency in mathematical modelling techniques to analyse and solve complex problems across various disciplines such as physics, economics, engineering, and computer science.
PSO 10	Develop the ability to think abstractly and logically, and to construct rigorous mathematical proofs to support assertions and theorems.

B.Sc. Semester – I

Subject: MATHEMATICS

Discipline Specific Core Course (DSC)

Course Title: Algebra - I and Calculus – I

Course Code: C1 MAT 1 T1 (Theory)

Type of Course	Theory /Practical	Credits	Instruction hours per week	Total No. of Lectures / Hours per Semester	Duration of Sem End Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC – 1	Theory	04	04	60 Hrs.	03 Hrs.	20	80	100

Course Outcomes (COs):

After completion of course (Theory), students will be able to:

CO 1: Learn to solve the system of homogeneous and non-homogeneous linear equations in *m* variables by using concept of rank of matrix, finding eigenvalues and eigenvectors.

CO 2: Thoroughly understand the concepts of continuity and uniform continuity.

CO 3: Solve examples related to indeterminate forms.

CO 4: Sketch curves in Cartesian, polar and pedal equations.

CO 5: Learn geometrical representation of mean value theorem and Rolle's theorem.

CO 6: Identify and apply the intermediate value theorem and solve Maclaurin's expansions.

CO 7: Trace curves in Cartesian and polar coordinates.

Unit	**Title:** Algebra - I and Calculus – I	60 Hours / Sem
Unit - I	**Matrices:**	**15 Hrs.**
	Rank of a matrix based on row reduction to echelon form, Reduction to normal form, Solution of system of linear equations: Criterion for existence of non-trivial solutions of homogeneous system of linear equations, Solution of system of non-linear equations: Criterion for existence of non-trivial solutions of non-homogeneous system of linear equations, Characteristic equation of matrices, Eigenvalues and Eigenvectors of square matrices, Cayley-Hamilton theorem, Inverse of matrices by Cayley-Hamilton theorem.	
Unit - II	**Limits and Continuity:**	**15 Hrs.**
	Definition of limit and continuity of a function in ε - δ form. Algebra of limits (with proof) and continuity. Definition of boundedness of continuous function. Properties of continuous function. Intermediate value theorem and its examples, Uniform continuity – definition. Theorems - i) Uniform continuity implies continuity and ii) Continuity on closed interval implies uniform continuity,	

	Differentiability: Definition and problems on differentiability of a function, Indeterminate forms, Evaluation of limits using L-Hospital rule.	
Unit - III	**Polar Coordinates:**	**15 Hrs.**
	Polar coordinates, Angle between the radius vector and tangent, Angle of intersection of curves (polar forms), Length of perpendicular from pole to the tangent, Pedal equations, Derivative of an arc length in Cartesian, parametric and polar forms, Concavity, Convexity and points of inflexion, Curvature of plane curve, radius of curvature - Cartesian, Parametric, Polar, Pedal forms. Centre of curvature of plane curves. Asymptotes, Tracing of curves in Cartesian form (standard curves).	
Unit - IV	**Successive Differentiation and Mean Value Theorems:**	**15 Hrs.**
	The n^{th} derivatives of standard functions: e^{ax+b}, $(ax + b)^n$, $\log(ax + b)$, $\sin(ax + b)$, $\cos(ax + b)$, $e^{ax}\sin(bx + c)$, $e^{ax}\cos(bx + c)$ with examples, Leibnitz theorem and its applications. Rolle's theorem, Lagrange's mean value theorem, Cauchy's mean value theorem and related problems(Only statement and geometrical interpretation). Taylor's theorem with Schlomitch and Roche form of remainder, Taylor's series, Maclaurin's expansions.	

Recommended Books:

1. Theory of Matrices, B. S. Vatsa and S. Vatsa, New Age International (P) Ltd., 2010.
2. Matrices, A. R. Vasista and A. K. Vasista, Krishna Prakashan Media (P) Ltd., 2013.
3. Principles of Mathematical Analysis, W. Rudin, McGraw Hill Edu., 2023.
4. Mathematical Analysis, S. C. Malik and Savita Arora, New Age International (P) Ltd., 2021.
5. Introduction to Real Analysis, S. K. Mapa, Leveant Book Publishers, 2022.
6. Differential Calculus, Shanti Narayan and P. K. Mittal, S. Chand & Co., 2022.
7. The Elements of Calculus, D. C. Pavate and G. V. Bhagwat, Popular Prakashan, 1956.
8. Schaum's Outlines of Calculus, E. Mendelson, McGraw Hill, 2021.
9. Objective Mathematics – Differential Calculus and Integral Calculus, K. B. Pandey, A. K. Singh and V. Yadav, Pragati Prakashan, 2020.

Formative Assessment for Theory	
Assessment Occasion / Type	**Marks**
Internal Assessment Test 1	05
Internal Assessment Test 2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester – I

Subject: MATHEMATICS

Discipline Specific Core Course (DSC)

Course Title: Practical on Algebra – I and Calculus – I

Course Code: C1 MAT 1 P1 (Practical)

Type of Course	Theory /Practical	Credits	Instruction hours per week	Total No. of Lectures / Hours per Semester	Duration of Sem End Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC – 2	Practical	02	04	56 Hrs.	03 Hrs.	10	40	50

Course Outcomes (COs):

After completion of course (Practical), students will be able to:

CO 1: Learn Scilab software, which is free and open source software for computer programming.

CO 2: Solve problem on algebra and calculus using Scilab software.

CO 3: Acquire knowledge of applications of algebra and calculus through Scilab software.

CO 4: Calculate rank and row reduced echelon forms.

CO 5: Sketch curves in Cartesian, polar and pedal equations.

CO 6: Solve Taylor and Maclaurin's expansions.

List of Experiments

[Each will have 4 hrs. / Week (Minimum 12 experiments)]

1. Program to compute addition and subtraction of matrices.
2. Program to compute multiplication of matrices.
3. Program to compute rank of matrix and row reduced echelon form.
4. Program to solve the system of non-homogeneous linear equations.
5. Program to check whether the given function is continuous at a point or not.
6. Program to solve examples based on intermediate value theorem.
7. Program to find the angle between the radius vector and tangent.
8. Program to find the curvatures of the given curves.
9. Program to find the n^{th} derivative of e^{ax}, and trigonometric functions.
10. Program to find the n^{th} derivative of $e^{ax}\sin(bx + c)$ and $e^{ax}\cos(bx + c)$.
11. Program to find the Taylor's and Maclaurin's expansions of the given functions.
12. Program on tracing of standard curves in Cartesian form.

Recommended Books:

1. Scilab by Example, M. Affouf, Create Space Independent Publishing Platform, 2012.
2. Scilab (A free software to Matlab), H. Ramchandran and A. S. Nair, S. Chand & Co., 2018.
3. Scilab – A Beginner's Approach, A. K. Verma, Cengage Learning India Pvt. Ltd., 2018.
4. Programming in Scilab, R. Goyal and M. Dhingra, Narosa Publishing, 2019.
5. Computing in Scilab, C. Jain, Cambridge University Press, 2022.
6. University Algebra, N. S. Gopalakrishnan, New Age International (P) Limited, 2018.
7. Theory of Matrices, B. S. Vatsa and S. Vatsa, New Age International (P) Ltd., 2010.
8. Matrices, A. R. Vasista and A. K. Vasista, Krishna Prakashan Media (P) Ltd., 2013.
9. Principles of Mathematical Analysis, W. Rudin, McGraw Hill Edu., 2023.
10. Mathematical Analysis, S. C. Malik and Savita Arora, New Age International (P) Ltd., 2021.

General Instructions

Software to be used: Scilab

Scheme of Practical Examination (Distribution of Marks)

Formative Assessment for Practical	
Assessment Occasion / Type	**Marks**
Program writing and problem solving (1 Program)	03
Program Execution	03
Viva	02
Journal	02
Total	**10 Marks**
Formative Assessment as per guidelines.	

Summative Assessment for Practical	
Assessment Occasion / Type	**Marks**
Program writing and problem solving (2 Programs)	(5+5)*2 = 20
Program Execution (Any 1 Program)	10
Viva	05
Journal	05
Total	**40 Marks**
Summative Assessment as per guidelines.	

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B.Sc. Semester – II

Subject: MATHEMATICS

Discipline Specific Core Course (DSC)

Course Title: Number Theory and Calculus – II

Course Code: C2 MAT 1 T1 (Theory)

Type of Course	Theory /Practical	Credits	Instruction hours per week	Total No. of Lectures / Hours per Semester	Duration of Sem End Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC – 3	Theory	04	04	60 Hrs.	03 Hrs.	20	80	100

Course Outcomes (COs):

After completion of course (Theory), students will be able to:

CO 1: Understand the concepts of divisibility and congruence.

CO 2: Analyse the applications of Fermat's and Wilson's theorems.

CO 3: Study the applications of definite integrals to areas, volumes and surface of revolution.

CO 4: Learn maxima and minima of the functions of two variables.

CO 5: Find the extreme values of the functions.

CO 6: Solve dot and cross product of vectors.

CO 7: Understand the concepts of gradient, divergence and curl.

Unit	**Title:** Number Theory and Calculus – II	60 Hours / Sem
Unit – I	**Number Theory:**	**15 Hrs.**
	Divisibility. Properties of divisibility. Division algorithm. GCD. Euclid's algorithm. Relatively prime numbers. Fundamental theorem of arithmetic. The number of positive divisors and sum of all the positive divisors of a number. The theory of congruence. Basic properties of congruence. Euler's theorem, Fermat's theorem. Wilson's theorem.	
Unit – II	**Integral Calculus:**	**15 Hrs.**
	Reduction Formulae, application of definite integrals to areas, volumes and surface of revolution. Length of plane curves.	
Unit – III	**Multivariate Calculus:**	**15 Hrs.**
	Functions of two or more variables, Partial derivatives of implicit and composite functions, Euler's theorem and its extension, Total differentials, Jacobians and standard properties and illustrative examples. Taylor's and Maclaurin's series for functions of two variables, Maxima-Minima of functions of two variables, Lagrange's method of undetermined multipliers.	

Unit – IV	**Vector Calculus:**	**15 Hrs.**
	Dot and cross product of vectors. Ordinary derivatives of vectors. Continuity and differentiability of a vector function. Derivatives of sum, dot product. Cross product and triple products of vectors. Differential of vectors. The vector differential operator del, gradient, divergence and curl. Solenoidal and irrational vectors.	

Recommended Books:

1. Elementary Number Theory, D. M. Button, McGraw Hill, 2023.
2. Number Theory, G. E. Andrews, Dover Publications, 1994.
3. Integral Calculus, Shanti Narayan and P. K. Mittal, S. Chand and Co. Pvt. Ltd., 2005.
4. Integral Calculus, S. K. Pundir and B. Singh, Pragati Prakahsan, 2020.
5. Differential Calculus, Shanti Narayan and P. K. Mittal, S. Chand & Company, New Delhi, 2022.
6. Schaum's Outlines of Calculus, E. Mendelson, McGraw Hill, 2021.
7. Vector Calculus, J. N. Sharma and A. R. Vasishtha, Krishna Prakashan, 2020.
8. A Textbook of Vector Calculus, Shanti Narayan and P. K. Mittal, Visionias, 2023.
9. Vector Calculus, R. K. Pandey, Oxford Publications, 2012.
10. A Text Book of B.Sc. Mathematics, G. K. Ranganath, S. Chand Publications, 2009.
11. Mathematical Methods, S. K. Pundir and B. Singh, Pragati Prakashan, 2020.
12. Objective Mathematics – Differential Calculus and Integral Calculus, K. B. Pandey, A. K. Singh and V. Yadav, Pragati Prakashan, 2020.

Formative Assessment for Theory	
Assessment Occasion / Type	**Marks**
Internal Assessment Test 1	05
Internal Assessment Test 2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester – II

Subject: MATHEMATICS

Discipline Specific Core Course (DSC)

Course Title: Practical on Number Theory and Calculus – II

Course Code: C2 MAT 1 P1 (Practical)

Type of Course	Theory /Practical	Credits	Instruction hours per week	Total No. of Lectures / Hours per Semester	Duration of Sem End Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC – 4	Practical	02	04	56 Hrs.	03 Hrs.	10	40	50

Course Outcomes (COs):

After completion of course (Practical), students will be able to:

CO 1: Learn Scilab software, which is free and open source software for computer programming.

CO 2: Solve problems on Number Theory using Scilab language.

CO 3: Acquire the knowledge of applications on the concepts of Number Theory.

CO 4: Solve reduction formulas.

CO 5: Verify Euler's theorem and its extension.

CO 6: Analyse dot and cross products.

List of Experiments

[Each will have 4rs / Week (Minimum 12 experiments)]

1. Program to solve examples using Euler's theorem.
2. Program to solve examples using Fermat's theorem.
3. Program to solve examples using Wilson's theorem.
4. Program on reduction formulas for $\int sin^n x\ dx$ and $\int cos^n x\ dx$ (for all positive values of *n*) with suitable examples.
5. Program on reduction formulas $\int_0^{\pi/2} sin^n x\ dx$ and $\int_0^{\pi/2} cos^n x\ dx$ (for all positive odd and even integral values of *n*) with suitable examples.
6. Program on reduction formulas for $\int tan^n x\ dx$ and $\int cot^n x\ dx$ (for all positive values of *n*) with suitable examples.
7. Program on reduction formulas for $\int sec^n x\ dx$ and $\int cosec^n x\ dx$ (for all positive values of *n*) with suitable examples.

8. Program on reduction formulas for $\int x^m (\log x)^n \ dx$ and $\int x^n e^{ax} \ dx$ (for all positive values of *m* and *n*) with suitable examples.
9. Program on reduction formulas for $\int sin^m x \ cos^n x \ dx$ and $\int_0^{\pi/2} sin^m x \ cos^n x \ dx$ (for all positive values of *m* and *n*) with suitable examples.
10. Program to verify the Euler's theorem and its extension.
11. Programs to construct series using Maclaurin's expansion for functions of two variables.
12. Program to find gradient, divergence and curl.

Recommended Books:

1. Scilab by Example, M. Affouf, Create Space Independent Publishing Platform, 2012.
2. Scilab (A free software to Matlab), H. Ramchandran and A. S. Nair, S. Chand & Co., 2018.
3. Scilab – A Beginner's Approach, A. K. Verma, Cengage Learning India Pvt. Ltd., 2018.
4. Programming in Scilab, R. Goyal and M. Dhingra, Narosa Publishing, 2019.
5. Computing in Scilab, C. Jain, Cambridge University Press, 2022.
6. Vector Calculus, J. N. Sharma and A. R. Vasishtha, Krishna Prakashan, 2020.
7. Integral Calculus, Shanti Narayan and P. K. Mittal, S. Chand and Co. Pvt. Ltd., 2005.
8. Differential Calculus, Shanti Narayan and P. K. Mittal, S. Chand & Co., New Delhi, 2022.
9. Schaum's Outlines of Calculus, E. Mendelson, McGraw Hill, 2021.
10. A Text Book of B.Sc. Mathematics, G. K. Ranganath, S. Chand Publications, 2009.

General Instructions

Software to be used: Scilab

Scheme of Practical Examination (Distribution of Marks)

Formative Assessment for Practical	
Assessment Occasion / Type	**Marks**
Program writing and problem solving (1 Program)	03
Program Execution	03
Viva	02
Journal	02
Total	**10 Marks**
Formative Assessment as per guidelines.	

Summative Assessment for Practical	
Assessment Occasion / Type	**Marks**
Program writing and problem solving (2 Programs)	(5+5)*2 = 20
Program Execution (Any 1 Program)	10
Viva	05
Journal	05
Total	**40 Marks**
Summative Assessment as per guidelines.	

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B.Sc. Semester – III

Subject: MATHEMATICS

Discipline Specific Core Course (DSC)

Course Title: Algebra - II and Real Analysis – I

Course Code: C3 MAT 1 T1 (Theory)

Type of Course	Theory /Practical	Credits	Instruction hours per week	Total No. of Lectures / Hours per Semester	Duration of Sem End Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC – 5	Theory	04	04	60 Hrs.	03 Hrs.	20	80	100

Course Outcomes (COs):

After completion of course (Theory), students will be able to:

CO 1: Interpret the fundamental concepts of groups.

CO 2: Explain the significance of the notions of cosets, normal subgroups and factor groups.

CO 3: Learn countable and uncountable sets.

CO 4: Understand the concepts of open set, closed set, etc.

CO 5: Learn the concept of convergence and divergence of a sequence.

CO 6: Understand limits and their use in sequence, series, differentiation, and integration.

CO 7: Analyse the ratio test, root test, alternating series, limit comparison tests for convergence and absolute convergence of an infinite series.

Unit	**Title:** Algebra - II and Real Analysis – I	60 Hours / Sem
Unit – I	**Groups:**	15 Hrs.
	Groups, Abelian group, Standard examples of groups, Properties of groups, Subgroup, Permutation group, Cyclic groups, Cosets, Lagrange's theorem, Normal sub-groups, Quotient groups, Homomorphism and Isomorphism of groups.	
Unit – II	**Introduction to Real Analysis:**	15 Hrs.
	Real line, Field and order axioms, Existence of $\sqrt{2}$, Intervals, Bounded and unbounded sets, Supremum and infimum of a set, Completeness property of $\mathbb{R}$, Archimedean property of $\mathbb{R}$. Absolute value of $\mathbb{R}$ – Standard theorems, Neighbourhood of a point, Interior point of a set, Open set, Closed set, Limit points of a set, Bolzano-Weierstrass theorem (statement only), Countable and uncountable sets - Standard theorems.	
Unit – III	**Sequences:**	15 Hrs.
	Sequences of real numbers, Bounded sequences, Limit of a sequence, Convergent, Divergent, and Oscillatory sequences, Monotonic sequences,	

	Algebra of convergent sequences, Limit points of a sequence, Bolzano - Weierstrass theorem for sequence, limit superior and limit inferior, Cauchy's first and second theorem on limits of a sequence, Cauchy's general principle for convergence of a sequence (Statement).	
Unit – IV	**Infinite Series:**	**15 Hrs.**
	Definition of convergent, divergent, and oscillatory series, Geometric series, Cauchy's general principle of convergence of series, p-series, Comparison tests for positive term series (Statements) with examples. D'Alembert's ratio test, Raabe's test, Cauchy's Root test and Cauchy's integral test, Alternating series, Leibnitz's theorem, Absolute convergence and conditional convergence of a series.	

Recommended Books:

1. Topics in Algebra, I. N. Herstein, Wiley Eastern Ltd., New Delhi, 2006.
2. Modern Algebra – Surjeet Singh and Q. Zameeruddin, Vikas Publishing House Pvt. Ltd., 2006.
3. Modern College Algebra, D. C. Pavate, Macmillan Publications, 1968.
4. Algebra, S. K. Pundir and B. Singh, Pragati Prakashan, 2020.
5. Principles of Mathematical Analysis, W. Rudin, McGraw Hill Education, 2023.
6. Mathematical Analysis, S. C. Malik and Savita Arora, New Age International (P) Ltd., 2021.
7. Real Analysis, N. P. Bali , New Age International Publishers, 2023.
8. Real Analysis, M. L. Khanna and S. K. Pundir, Jai Prakash Nath & Co. Meerut, 2014.
9. Introduction to Real Analysis, R. G. Bartle and D. R. Sherbert, Wiley, 2021.
10. Mathematical Analysis, T. M. Apostol, Narosa Publishing House, 2002.
11. Advanced Engineering Mathematics, E. Kreyszig, Wiley, 2006.
12. Real Analysis- Hari Kishen, Pragati Publications.

Formative Assessment for Theory	
Assessment Occasion / Type	**Marks**
Internal Assessment Test 1	05
Internal Assessment Test 2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester – III

Subject: MATHEMATICS

Discipline Specific Core Course (DSC)

Course Title: Practical on Algebra-II and Real Analysis – I

Course Code: C3 MAT 1 P1 (Practical)

Type of Course	Theory /Practical	Credits	Instruction hours per week	Total No. of Lectures / Hours per Semester	Duration of Sem End Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC – 6	Practical	02	04	56 Hrs.	03 Hrs.	10	40	50

Course Outcomes (COs):

After completion of course (Practical), students will be able to:

CO 1: Learn Maxima software, which is free and open source software for computer programming.

CO 2: Explain the significance of the notions of groups.

CO 3: Recognize the countable set and groups.

CO 4: Acquire knowledge of applications of real analysis through Maxima software.

CO 5: Attain the information of applications of sequences.

CO 6: Verify the convergence/divergence of different types of series.

List of Experiments

[Each will have 4rs / Week (Minimum 12 experiments)]

1. Program to construct Cayley table and test abelian for given finite set.
2. Program to find generators and corresponding possible subgroups of a cyclic group.
3. Program to verify Lagrange's theorem with suitable example.
4. Program to find infimum and supremum of a set by suitable examples.
5. Program to verify Cauchy's first and second theorems on limits by suitable examples.
6. Program to verify geometric series with suitable examples.
7. Program to verify p-series with suitable examples.
8. Program to verify D'Alembert's test with suitable examples.
9. Program to verify Raabe's test with suitable examples.
10. Program to verify Cauchy's root test with suitable examples.
11. Program to verify Cauchy's integral test with suitable examples.
12. Program to verify alternating series using Leibnitz's theorem with suitable examples.

Recommended Books:

1. Mathematics using Maxima Software, A. S. Pandhari and S. S. Jadhav, Vision, 2019.
2. Computational Mathematics using Maxima Software, K. Takale & Others, Nirali Prakashan, 2020.
3. Introduction to Maxima for Scientific Computers, M. Kanagasabapathy, BPB Publishers, 2018.
4. Maxima: The Computer Algebra System, Vaisakh, Notion Press, 2022.
5. Scientific Programming, J. A. Calvo, Cambridge Scholars Publishing, 2018.
6. Modern College Algebra, D. C. Pavate, Macmillan Publications, 1968.
7. Real Analysis, N. P. Bali , New Age International Publishers, 2023.
8. Real Analysis, M. L. Khanna and S. K. Pundir, Jai Prakash Nath & Co. Meerut, 2014.
9. Introduction to Real Analysis, R. G. Bartle and D. R. Sherbert, Wiley, 2021.
10. Mathematical Analysis, T. M. Apostol, Narosa Publishing House, 2002.

General Instructions

Software to be used: Maxima

Scheme of Practical Examination (Distribution of Marks)

Formative Assessment for Practical	
Assessment Occasion / Type	**Marks**
Program writing and problem solving (1 Program)	03
Program Execution	03
Viva	02
Journal	02
Total	**10 Marks**
Formative Assessment as per guidelines.	
Summative Assessment for Practical	
Assessment Occasion / Type	**Marks**
Program writing and problem solving (2 Programs)	(5+5)*2 = 20
Program Execution (Any 1 Program)	10
Viva	05
Journal	05
Total	**40 Marks**
Summative Assessment as per guidelines.	

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B.Sc. Semester – IV

Subject: MATHEMATICS

Discipline Specific Core Course (DSC)

Course Title: Differential Equations and Integral Transforms

Course Code: C4 MAT 1 T1 (Theory)

Type of Course	Theory /Practical	Credits	Instruction hours per week	Total No. of Lectures / Hours per Semester	Duration of Sem End Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC – 7	Theory	04	04	60 Hrs.	03 Hrs.	20	80	100

Course Outcomes (COs):

After completion of the course (Theory), students will be able to:

CO 1: Get the knowledge of exact differential equations.

CO 2: Solve Complimentary Function and Particular Integrals of given differential equations.

CO 3: Formulate, classify and transform partial differential equations into canonical form.

CO 4: Solve linear and non-linear partial differential equations.

CO 5: Understand convolution theorem and its consequences.

CO 6: Interpret Fourier series and transforms.

CO 7: Solve differential equations by Laplace transforms and Fourier transforms.

Unit	**Title:** Differential Equations and Integral Transforms	60 Hours / Sem
Unit – I	**Ordinary Differential Equations:**	**15 Hrs.**
	Bernoulli's differential equations. Exact differential equations: Necessary and sufficient condition for the equations to be exact, Reducible to the exact differential equations. Differential equations of the first order and higher degree: Equations solvable for p, x, y. Clairaut's equation, Linear differential equations of the n^{th} order with constant coefficients. Particular Integrals when the RHS is of the form e^{ax}, sin(ax+b), cos(ax+b), x^n, e^{ax}.V and x.V (with proofs), where V is a function of *x*.	
Unit – II	**Partial Differential Equations:**	**15 Hrs.**
	Formation of partial differential equations by elimination of arbitrary constants and functions, Condition of integrability of Pdx+Qdy+Rdz=0, Solution of partial differential equations of first order, Lagrange's linear equations of the form Pp + Qq = R, Standard types of first order non-linear partial differential equations. The integrals of the non-linear equation by Charpit's method. Homogeneous linear partial differential equations with constant coefficients.	

Unit – III	**Laplace Transforms:**	**15 Hrs.**
	Definition**,** Basic Properties, Laplace transforms of some standard functions, Laplace transform of Periodic functions, Laplace transform of derivative and integral of a function, Heaviside function, Dirac-delta function, Convolution theorem, Inverse Laplace transforms and its properties, Solution of differential equations by using Laplace transforms.	
Unit – IV	**Fourier Series and Transforms:**	**15 Hrs.**
	Periodic functions, Fourier coefficients, Fourier series of functions with period 2π and period 2L. Fourier series of even and odd functions, Half range cosine and sine series, Fourier Transforms: Finite Fourier cosine and sine transforms, Transforms of derivatives**.** Applications of Fourier Transformation.	

Recommended Books:

1. Ordinary Differential Equations and Partial Differential Equations, M. D. Raisinghania, S. Chand & Company, New Delhi, 2020.
2. A First Course in Ordinary Differential Equations, S. K. Tumuluri, CRC Press, 2021.
3. Introductory Course in Differential Equations, D. A. Murray, Khosla Publishing, 2021.
4. Ordinary Differential Equations, M. Tenenbaum and H. Pollard, Dover Publications, 1986.
5. Differential Equations, B. Singh and S. K. Pundir, Pragati Prakashan, 2020.
6. An Elementary Treatise on Differential Equations and their Applications, H. T. H. Piaggio, Alpha Edition, 2019.
7. Elements of Partial differential equations, I. N. Sneddon, Dover Publications, 2006.
8. Differential Equations with Applications and Historical Notes, G. F. Simmons, Tata McGraw Hill, 2023.
9. Laplace Transforms, M. R. Spiegel (Schaum's Series), McGraw-Hill International Ed.
10. Integral Transform Methods in Science & Engineering, S. K. Pundir, CBS Engineering Series, 2017.
11. Fourier Series and Integral Transforms, S. Sreenadh and Others, S. Chand & Company, 2014.
12. Mathematical Methods, S. K. Pundir and B. Singh, Pragati Prakashan, 2020.
13. Higher Engineering Mathematics- B. S. Grewal, S.Chand Publications

Formative Assessment for Theory	
Assessment Occasion / Type	**Marks**
Internal Assessment Test 1	05
Internal Assessment Test 2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester – IV

Subject: MATHEMATICS

Discipline Specific Core Course (DSC)

Course Title: Practical on Differential Equations and Integral Transforms

Course Code: C4 MAT 1 P1 (Practical)

Type of Course	Theory /Practical	Credits	Instruction hours per week	Total No. of Lectures / Hours per Semester	Duration of Sem End Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC – 8	Practical	02	04	56 Hrs.	03 Hrs.	10	40	50

Course Outcomes (COs):

After completion of course (Practical), students will be able to:

CO 1: Solve exact differential equations.

CO 2: Find complementary functions and particular integral of linear and homogeneous differential equations.

CO 3: Solve total differential equation.

CO 4: Analyse Laplace transforms and inverse Laplace transforms.

CO 5: Solve problems related to Convolution theorem.

CO 6: Solve differential equations by Laplace Transforms and Fourier Transforms.

List of Experiments

[Each will have 4rs / Week (Minimum 12 experiments)]

1. Program to verify the exactness of a differential equation.
2. Program to get the solutions of differential equations that are solvable for x, y, p.
3. Program to find the Complementary Function and Particular Integral of linear differential equations with constant coefficients.
4. Program to get solutions of linear partial differential equations of type1 to type 4 and Lagrange's method.
5. Program to find the solution of total differential equation.
6. Program to get solutions of the partial differential equation using Charpit's method.
7. Program to find the Laplace transforms of some standard and periodic functions.
8. Program to verify Convolution theorem.
9. Program to solve ordinary linear differential equations using Laplace transforms.

10. Program to find full range Fourier series of some simple functions with period 2π and 2L.
11. Program to find half range sine and cosine series of some simple functions.
12. Program to find sine and cosine Fourier transforms.

Recommended Books:

1. Mathematics using Maxima Software, A. S. Pandhari and S. S. Jadhav, Vision, 2019.
2. Computational Mathematics using Maxima Software, K. Takale & Others, Nirali Prakashan, 2020.
3. Introduction to Maxima for Scientific Computers, M. Kanagasabapathy, BPB Publishers, 2018.
4. Maxima: The Computer Algebra System, Vaisakh, Notion Press, 2022.
5. Scientific Programming, J. A. Calvo, Cambridge Scholars Publishing, 2018.
6. Ordinary Differential Equations and Partial Differential Equations, M. D. Raisinghania, S. Chand & Company, New Delhi, 2020.
7. Ordinary Differential Equations, A. K. Nandkumaran, P. S. Datti and R. K. George, IISc Press, 2017.
8. Introductory Course in Differential Equations, D. A. Murray, Khosla Publishing House, 2021.
9. Laplace Transforms, M. R. Spiegel (Schaum's Series), McGraw-Hill Int. Ed., 2005.
10. Fourier Series and Integral Transforms, S. Sreenadh & Others, S. Chand & Company, 2014.

General Instructions

Software to be used: Maxima

Scheme of Practical Examination (Distribution of Marks)

Formative Assessment for Practical	
Assessment Occasion / Type	**Marks**
Program writing and problem solving (1 Program)	03
Program Execution	03
Viva	02
Journal	02
Total	**10 Marks**
Formative Assessment as per guidelines.	

Summative Assessment for Practical	
Assessment Occasion / Type	**Marks**
Program writing and problem solving (2 Programs)	(5+5)*2 = 20
Program Execution (Any 1 Program)	10
Viva	05
Journal	05
Total	**40 Marks**
Summative Assessment as per guidelines.	

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B.Sc. Semester – V

Subject: MATHEMATICS

Discipline Specific Core Course (DSC)

Course Title: Real Analysis – II and Topology

Course Code: C5 MAT 2 T1 (Theory)

SPECIALIZATION – I

(Student shall select DSC - 9A & 10A OR 9B & 10B for 06 credits only)

Type of Course	Theory /Practical	Credits	Instruction hours per week	Total No. of Lectures / Hours per Semester	Duration of Sem End Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC – 9A	Theory	04	04	60 Hrs.	03 Hrs.	20	80	100

Course Outcomes (COs):

After completion of the course (Theory), students will be able to:

CO 1: Compute upper and lower Riemann sums as well as integrals.

CO 2: Describe various criteria for the integrability of functions.

CO 3: Analyse double and triple integrals.

CO 4: Understand the concepts of Beta and Gamma functions.

CO 5: Learn the concepts of closure, interior and boundary of a set.

CO 6: Understand the concepts of basis and sub-basis.

CO 7: Analyse T_0, T_1 and T_2 spaces.

Unit	**Title:** Real Analysis – II and Topology	60 Hours / Sem
Unit - I	**Riemann Integration-I:**	**15 Hrs.**
	Definition and examples for partition of an interval, Refinement of a partition and common refinement, Upper and lower Darboux sums, Upper and lower integrals, Riemann integral, Criterion for integrability, Integrability of sum, difference, product, quotient and modulus of integrable functions. Integral as a limit of sum (Riemann sum) – Problems. Integrability of continuous functions, Monotonic functions, Bounded functions with finite number of discontinuity.	
Unit – II	**Riemann Integration-II and Improper Integrals:**	**15 Hrs.**
	Fundamental theorem of Calculus – related problems, Change of variables, Integration by parts, First and second mean value theorems of integral calculus. **Improper Integrals -** Improper integrals of the first, second and third kind with examples, Improper integral as the limit of proper integral, Comparison	

	test, Abel's test and Dirichlet's test for the convergence of the integral of a product of two functions.	
Unit – III	**Multiple Integrals and Beta-Gamma Functions:**	**15 Hrs.**
	Double integral: Definition and evaluation, Double integrals by changing the order of integration and change of variables, Computation of plane surface areas. **Triple integral:** Definition and evaluation, Triple integrals by change of variables, Volume as triple integral. **Beta-Gamma Functions**: Definitions, Properties and examples, Relations between Beta and Gamma functions, Standard theorems, Duplication formula and related problems. Differentiation under Integral Sign(Statement and Simple Problems).	
Unit - IV	**Topology:**	**15 Hrs.**
	Definition of topological space, Closure, Neighbourhood, Limit points and Derived sets, Interior, Exterior and Boundary, Bases and sub-bases, Sub-spaces, T_0, T_1 and T_2 spaces.	

Recommended Books:

1. Principles of Real Analysis, S. C. Malik, New Age International Publishers, 2021.
2. Mathematical Analysis, S. C. Malik and Savita Arora, New Age International (P) Ltd., 2021.
3. Real Analysis, N. P. Bali (Golden Maths Series), New Age International Publishers, 2023.
4. Integral Calculus, Shanti Narayan and P. K. Mittal, S. Chand Publications, 2005.
5. Integral Calculus, A. R. Vasishtha, R. Dangwal and R. Sharma, Krishna Prakashan, 2020.
6. Topology, J. R. Munkres, Pearson, 2021.
7. Topology, J. N. Sharma and J. P. Chauhan, Krishna Prakashan, Meerut, 2014.
8. General Topology, S. Lipschutz, Schaum's Outlines Series, 1965.
9. Elements of Modern Algebra and Topology, E. Sampathkumar and K. S. Amur, Vidya Vikas Publications, 1969.
10. General Topology, S. R. Malghan, Serial Publication, 2013.

Formative Assessment for Theory	
Assessment Occasion / Type	**Marks**
Internal Assessment Test 1	05
Internal Assessment Test 2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester – V

Subject: MATHEMATICS

Discipline Specific Core Course (DSC)

Course Title: Practical on Real Analysis – II and Topology

Course Code: C5 MAT 2 P1 (Practical)

SPECIALIZATION – I

(Student shall select DSC - 9A & 10A OR 9B & 10B for 06 credits only)

Type of Course	Theory /Practical	Credits	Instruction hours per week	Total No. of Lectures / Hours per Semester	Duration of Sem End Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC – 10A	Practical	02	04	56 Hrs.	03 Hrs.	10	40	50

Course Outcomes (COs):

After completion of course (Practical), students will be able to:

CO 1: Learn Python Software (FOSS) for computer programming.

CO 2: Solve problems on Real Analysis and Topology by using Python software.

CO 3: Acquire knowledge of applications of Real Analysis and Topology through Python.

CO 4: Interpret Riemann integrable functions.

CO 5: Understand the applications of multiple integrals and Beta-Gamma functions.

CO 6: Analyse T_0, T_1 and T_2 spaces.

List of Experiments

[Each will have 4rs / Week (Minimum 12 experiments)]

1. Program to check whether a given set of real numbers attains supremum or infimum.
2. Program to find upper and lower Riemann sums with respect to a given partition.
3. Program to test Riemann integrability of a function.
4. Program to evaluate Riemann integral as a limit of sum.
5. Program to verify the convergence of an improper integral of first kind.
6. Program to verify the convergence of an improper integral of second kind.
7. Program to illustrate Dirichlet's test with suitable example.
8. Double and Triple integrals with constant and variable limits.

9. Program on solutions of Beta-Gamma functions.
10. Program to Solve the problems on Differentiation under Integral Sign.
11. Program to illustrate closure with suitable example.
12. Program to illustrate T_0, T_1 and T_2 spaces with suitable examples.

Recommended Books:

1. Automate the Boring Stuff with Python, A. Sweigart, No Starch Press, 2019.
2. Python Cookbook, D. Beazley and B. K. Jones, Shroff O'Reilly, 2013.
3. Basic Python Programming for Beginners, K. V. Rajkumar, M. Krishna, and J. Prakash, Bluerose Publishers Pvt. Ltd., 2021.
4. Python, J. Shovic and A. Simpson, For Dummies, 2024.
5. Learning Python, M. Lutz, Shroff O'Reilly, 2017.
6. Mathematical Analysis, S. C. Malik and Savita Arora, New Age International (P) Ltd., 2021.
7. Real Analysis, N. P. Bali , New Age International Publishers, 2023.
8. Integral Calculus, Shanti Narayan and P. K. Mittal, S. Chand Publications, 2005.
9. Topology, J. N. Sharma and J. P. Chauhan, Krishna Prakashan, Meerut, 2014.
10. General Topology, S. R. Malghan, Serial Publication, 2013.

General Instructions

Software to be used: Python

Scheme of Practical Examination (Distribution of Marks)

Formative Assessment for Practical	
Assessment Occasion / Type	**Marks**
Program writing and problem solving (1 Program)	03
Program Execution	03
Viva	02
Journal	02
Total	**10 Marks**
Formative Assessment as per guidelines.	

Summative Assessment for Practical	
Assessment Occasion / Type	**Marks**
Program writing and problem solving (2 Programs)	(5+5)*2 = 20
Program Execution (Any 1 Program)	10
Viva	05
Journal	05
Total	**40 Marks**
Summative Assessment as per guidelines.	

B.Sc. Semester – V

Subject: MATHEMATICS

Discipline Specific Core Course (DSC)

Course Title: Mechanics and Mathematical Modelling

Course Code: C5 MAT 2 T2 (Theory)

SPECIALIZATION – II

(Student shall select DSC - 9A & 10A OR 9B & 10B for 06 credits only)

Type of Course	Theory /Practical	Credits	Instruction hours per week	Total No. of Lectures / Hours per Semester	Duration of Sem End Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC – 9B	Theory	04	04	60 Hrs.	03 Hrs.	20	80	100

Course Outcomes (COs):

After completion of the course (Theory), students will be able to:

CO 1: Analyse the concepts of couple and moment of couple.

CO 2: Solve problems on Radial and Transverse velocity as well as acceleration.

CO 3: Understand the concepts of direct and oblique impacts.

CO 4: Evaluate problems related to Tangential and Normal components of acceleration.

CO 5: Understand the need of mathematical modelling.

CO 6: Model problems in Algebra, Geometry, etc.

CO 7: Prepare variety of growth and decay models.

Unit	**Title:** Mechanics and Mathematical Modelling	60 Hours / Sem
Unit – I	**Statics:**	**15 Hrs.**
	Couples, moment of a couple, Varignon's theorem. Resultant of coplanar couples. Resultant of a force and a couple. Resultant of a system of coplanar forces acting at different points of a rigid body. Catenary and common catenary.	
Unit – II	**Dynamics – I:**	**15 Hrs.**
	Velocity and acceleration of a particle along a plane curve. Radial and transverse components of velocity and acceleration. Tangential and Normal components of velocity and acceleration.	
Unit – III	**Dynamics – II:**	**15 Hrs.**
	Motion of a projectile in a non-resisting medium under gravity. Motion of a particle under a central force. Use of polar co-ordinates and pedal coordinates. Elastic impact-Direct and oblique impact of elastic bodies.	

Unit – IV	**Mathematical Modelling:**	**15 Hrs.**
	Need for mathematical modelling, Brachistochrone problem with historical developments. Techniques and classification of mathematical models. Mathematical modelling through Geometry, Algebra (Compound Interest Model), Trigonometry and Calculus. Mathematical modelling through differential equations of first order. Growth and Decay models (linear and non-linear). Prey and predator model.	

Recommended Books:

1. Statics, B. C. Das and B. N. Mukherjee, U. N. Dhar & Sons Pvt. Ltd., 2018.
2. Statics, H. Kishan, Atlantic Publishers, 2023.
3. Engineering Mechanics Statics, J. L. Meriam, L. G. Kraige and J. N. Bolton, Wiley, 2017.
4. The Elements of Statics and Dynamics, S. L. Loney, Arihant Publication, 2023.
5. Dynamics, H. Kishan, Atlantic Publishers, 2023.
6. Engineering Dynamics, M. R. Islam, A. K. M. Mazumder and M. Ahmed, CRC Press, 2022.
7. Engineering Mechanics, I. H. Shames and G. K. Mohana Rao, Pearson, 2005.
8. A Textbook on Dynamics, M. Ray and G. C. Sharma, S. Chand & Company, 2005.
9. Mechanics, B. Singh and S. K. Pundir, Pragati Prakashan, 2020.
10. Engineering Mechanics, A. Nelson, McGraw Hill Edu., 2017.
11. Mathematical Modelling, J. N. Kapur, New Age International Publishers, 2023.
12. Mathematical Modelling Techniques, R. Aris, Dover Publications, 2003.
13. Fundamental Mathematical Modelling, S. Jana, S. Rayachaudhuri and B. Pal, Santra Publication Pvt. Ltd., 2022.

Formative Assessment for Theory	
Assessment Occasion / Type	**Marks**
Internal Assessment Test 1	05
Internal Assessment Test 2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester – V

Subject: MATHEMATICS

Discipline Specific Core Course (DSC)

Course Title: Practical on Mechanics and Mathematical Modelling

Course Code: C5 MAT 2 P2 (Practical)

SPECIALIZATION – II

(Student shall select DSC - 9A & 10A OR 9B & 10B for 06 credits only)

Type of Course	Theory /Practical	Credits	Instruction hours per week	Total No. of Lectures / Hours per Semester	Duration of Sem End Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC – 10B	Practical	02	04	56 Hrs.	03 Hrs.	10	40	50

Course Outcomes (COs):

After completion of course (Practical), students will be able to:

CO 1: Understand the advantage of python software in solving various problems of mechanics.

CO 2: Solve Transverse velocity and acceleration components.

CO 3: Solve problems on Tangential and Normal acceleration.

CO 4: Calculate time of flight and horizontal range.

CO 5: Prepare various mathematical models.

CO 6: Analyse mathematical models through python software.

List of Experiments

[Each will have 4rs / Week (Minimum 12 experiments)]

1. Program to find magnitude and direction of the resultant, when some forces are provided, which act at one of the angular points of a regular hexagon towards the five others in order.
2. Program to find the least possible sag in the middle of a uniform chain of length *l*, if the maximum tension is *n* times its weight (Chain is stretched between two points in the same horizontal line).
3. Program to find radial velocity and acceleration.
4. Program to find transverse velocity and acceleration.
5. Program to find tangential velocity.
6. Program to find tangential acceleration.

7. Program to find normal acceleration.
8. Program to find time of flight and horizontal range.
9. Program to find the time taken by a projectile to reach maximum height and maximum horizontal range.
10. Program to find greatest height reached by a projectile.
11. Program on mathematical modelling of growth and decay population model.
12. Program on prey – predator mathematical model.

Recommended Books:

1. Automate the Boring Stuff with Python, A. Sweigart, No Starch Press, 2019.
2. Python Cookbook, D. Beazley and B. K. Jones, Shroff O'Reilly, 2013.
3. Basic Python Programming for Beginners, K. V. Rajkumar, M. Krishna, and J. Prakash, Bluerose Publishers Pvt. Ltd., 2021.
4. Python, J. Shovic and A. Simpson, For Dummies, 2024.
5. Learning Python, M. Lutz, Shroff O'Reilly, 2017.
6. Statics, H. Kishan, Atlantic Publishers, 2023.
7. The Elements of Statics and Dynamics, S. L. Loney, Arihant Publication, 2023.
8. Dynamics, H. Kishan, Atlantic Publishers, 2023.
9. A Textbook on Dynamics, M. Ray and G. C. Sharma, S. Chand & Company, 2005.
10. Mathematical Modelling, J. N. Kapur, New Age International Publishers, 2023.

General Instructions

Software to be used: Python

Scheme of Practical Examination (Distribution of Marks)

Formative Assessment for Practical	
Assessment Occasion / Type	**Marks**
Program writing and problem solving (1 Program)	03
Program Execution	03
Viva	02
Journal	02
Total	**10 Marks**
Formative Assessment as per guidelines.	

Summative Assessment for Practical	
Assessment Occasion / Type	**Marks**
Program writing and problem solving (2 Programs)	(5+5)*2 = 20
Program Execution (Any 1 Program)	10
Viva	05
Journal	05
Total	**40 Marks**
Summative Assessment as per guidelines.	

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B.Sc. Semester – VI

Subject: MATHEMATICS

Discipline Specific Core Course (DSC)

Course Title: Numerical Analysis

Course Code: C6 MAT 2 T1 (Theory)

SPECIALIZATION – I

(Student shall select DSC - 11A & 12A OR 11B & 12B for 06 credits only)

Type of Course	Theory /Practical	Credits	Instruction hours per week	Total No. of Lectures / Hours per Semester	Duration of Sem End Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC – 11A	Theory	04	04	60 Hrs.	03 Hrs.	20	80	100

Course Outcomes (COs):

After completion of the course (Theory), students will be able to:

CO 1: Understand the concept of errors.

CO 2: Find roots of equations using various iterative methods.

CO 3: Analyse system of linear equations using direct and iterative methods.

CO 4: Describe various operators such as difference operators, shift operators and so on.

CO 5: Apply numerical techniques in other areas of mathematics.

CO 6: Understand the application of finite differences in finding derivatives.

CO 7: Find the value of definite integrals using numerical schemes.

Unit	**Title:** Numerical Analysis	60 Hours / Sem
Unit - I	**Algebraic and Transcendental Equations:**	**15 Hrs.**
	Errors: Significant digits, Absolute, Relative, Percentage errors, Rounding off and Truncation errors, Solutions of algebraic and transcendental equations: Bisection method, Regula-falsi method, Secant method, Newton-Raphson method and Fixed-point iterative method.	
Unit - II	**System of Linear Algebraic Equations:**	**15 Hrs.**
	Direct Methods: Gauss elimination method, Gauss-Jordan method and Tringularization method. Iterative methods: Gauss-Jacobi method, Gauss-Seidel method, Successive – Over Relaxation (SOR) method.	
Unit – III	**Finite Differences:**	**15 Hrs.**
	Finite differences, Forward, Backward and Central differences, Shift Operators: Definitions, Properties and Problems; Polynomial Interpolation: Newton – Gregory forward and backward interpolation formulas, Lagrange	

	interpolation polynomial, Divided differences and Newton's general interpolation formula.	
Unit - IV	**Numerical Differentiation and Integration:**	**15 Hrs.**
	Formula for derivatives (first and second order) based on Newton-Gregory forward and backward interpolations, General quadrature formula, Trapezoidal rule, Simpson's $(1/3)^{rd}$ rule, Simpson's $(3/8)^{th}$ rule and Weddle's rule, Romberg integration and their applications.	

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Recommended Books:

1. Analysis of Numerical Methods, E. Isaacson and H. B. Keller, Dover Publications, 2012.
2. Introductory Methods of Numerical Analysis, S. S. Sastry, PHI Learning Pvt. Ltd., 2012.
3. Advanced Engineering Mathematics, E. Kreyszig, Wiley, 2006.
4. Numerical Methods for Scientists and Engineers, K. Sankara Rao, PHI Learning, 2018.
5. Numerical Methods for Scientists and Engineers, R. W. Hamming, Dover Publications, 1987.
6. Numerical Methods for Scientists and Engineers, J. D. Hoffman, CRC Press, 2001.
7. Numerical Methods in Engineering and Science, B. S. Grewal, Khanna Publishers, 2013.
8. Numerical Methods for Scientific and Engineering Computation, M. K. Jain, S. R. K. Iyengar and R. K. Jain, New Age International Publishers, 2022.
9. Finite Differences and Numerical Analysis, H. C. Saxena, S. Chand Publication, 2010.
10. Numerical Analysis, B. D. Gupta, Konark Publishers Pvt. Ltd., 1990.

Formative Assessment for Theory	
Assessment Occasion / Type	**Marks**
Internal Assessment Test 1	05
Internal Assessment Test 2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester – VI

Subject: MATHEMATICS

Discipline Specific Core Course (DSC)

Course Title: Practical on Numerical Analysis

Course Code: C6 MAT 2 P1 (Practical)

SPECIALIZATION – I

(Student shall select DSC - 11A & 12A OR 11B & 12B for 06 credits only)

Type of Course	Theory /Practical	Credits	Instruction hours per week	Total No. of Lectures / Hours per Semester	Duration of Sem End Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC – 12A	Practical	02	04	56 Hrs.	03 Hrs.	10	40	50

Course Outcomes (COs):

After completion of course (Practical), students will be able to:

CO 1: Learn Free and Open Source software (FOSS) tools for computer programming.

CO 2: Solve problems on Numerical Analysis using Python language.

CO 3: Acquire knowledge of applications of numerical analysis.

CO 4: Find roots of equations using various numerical techniques.

CO 5: Solve system of equations using direct and iterative methods.

CO 6: Find the derivative and integral of a function using numerical methods.

List of Experiments

[Each will have 4rs / Week (Minimum 12 experiments)]

1. Program to find the root of an equation using Bisection and Regula-Falsi methods.
2. Program to find the root of an equation using Newton-Raphson and Secant methods.
3. Program to solve the system of algebraic equations using the Gauss-elimination method.
4. Program to solve the system of algebraic equations using the Gauss-Jordan method.
5. Program to solve the system of algebraic equations using the Gauss-Jacobi method.
6. Program to solve the system of algebraic equations using the Gauss-Seidel method.
7. Program to solve the system of algebraic equations using the SOR method.
8. Program to evaluate integral using Trapezoidal and Simpson's 1/3 rules.
9. Program to evaluate integral using Simpson's 3/8 and Weddle rules.

10. Program to find the value of $y = f(x)$ for the given data using Newton – Gregory technique.
11. Program to find derivative of $y = f(x)$ at specified point using the Newton-Gregory interpolation method.
12. Program to find the polynomial equation from the given data using the Lagrange's formula for unequal intervals.

Recommended Books:

1. Automate the Boring Stuff with Python, A. Sweigart, No Starch Press, 2019.
2. Python Cookbook, D. Beazley and B. K. Jones, Shroff O'Reilly, 2013.
3. Basic Python Programming for Beginners, K. V. Rajkumar, M. Krishna, and J. Prakash, Bluerose Publishers Pvt. Ltd., 2021.
4. Python, J. Shovic and A. Simpson, For Dummies, 2024.
5. Learning Python, M. Lutz, Shroff O'Reilly, 2017.
6. Analysis of Numerical Methods, E. Isaacson and H. B. Keller, Dover Publications, 2012.
7. Introductory Methods of Numerical Analysis, S. S. Sastry, PHI Learning Pvt. Ltd., 2012.
8. Advanced Engineering Mathematics, E. Kreyszig, Wiley, 2006.
9. Numerical Methods for Scientists and Engineers, K. Sankara Rao, PHI Learning, 2018.
10. Finite Differences and Numerical Analysis, H. C. Saxena, S. Chand Publication, 2010.

General Instructions

Software to be used: Python

Scheme of Practical Examination (Distribution of Marks)

Formative Assessment for Practical	
Assessment Occasion / Type	**Marks**
Program writing and problem solving (1 Program)	03
Program Execution	03
Viva	02
Journal	02
Total	**10 Marks**
Formative Assessment as per guidelines.	

Summative Assessment for Practical	
Assessment Occasion / Type	**Marks**
Program writing and problem solving (2 Programs)	(5+5)*2 = 20
Program Execution (Any 1 Program)	10
Viva	05
Journal	05
Total	**40 Marks**
Summative Assessment as per guidelines.	

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B.Sc. Semester – VI

Subject: MATHEMATICS

Discipline Specific Core Course (DSC)

Course Title: Geometry and Complex Analysis

Course Code: C6 MAT 2 T2 (Theory)

SPECIALIZATION – II

(Student shall select DSC - 11A & 12A OR 11B & 12B for 06 credits only)

Type of Course	Theory /Practical	Credits	Instruction hours per week	Total No. of Lectures / Hours per Semester	Duration of Sem End Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC – 11B	Theory	04	04	60 Hrs.	03 Hrs.	20	80	100

Course Outcomes (COs):

After completion of the course (Theory), students will be able to:

CO 1: Interpret the concepts of sphere, cone and cylinder.

CO 2: Realise the importance of complex numbers with examples.

CO 3: Expand various trigonometric functions.

CO 4: Construct analytic functions using Milne-Thomson's method.

CO 5: Learn Cauchy-Riemann equations in Cartesian and polar forms.

CO 6: Analyse linear and bilinear transformations.

CO 7: Understand the concepts of analytic, harmonic and integral functions.

Unit	**Title:** Geometry and Complex Analysis	60 Hours / Sem
Unit – I	**Geometry:**	**15 Hrs.**
	Sphere: Equation of a sphere, Section of a sphere by a plane, Equation of a sphere through a circle, Equation of a sphere with two given points as the ends of diameter, Tangent planes, Orthogonal spheres. **Cone:** Equation of a cone, Quadric cone, Enveloping cone of a sphere, Right circular cone. **Cylinder:** Equation of a cylinder, Enveloping cylinder of a sphere, Right circular cylinder.	
Unit – II	**Complex Numbers:**	**15 Hrs.**
	Complex numbers in terms of polar form, Euler's Formula: $e^{i z} = \cos z + i \sin z$, D'Moivre's theorem (statement). n^{th} roots of a complex number. Expansion of $\sin n\theta$, $\cos n\theta$, $\tan n\theta$ in terms of $\sin \theta$, $\cos \theta$, $\tan \theta$,	

	respectively. Expansion of $\sin^n\theta$, $\cos^n\theta$ and $\sin^m\theta\cos^n\theta$ in a series of sines or cosines multiple of θ. Exponential and circular function of complex variable. Hyperbolic function and its identities. Problems on real and imaginary parts of circular and hyperbolic function.	
Unit – III	**Functions of Complex Variables:**	**15 Hrs.**
	Functions of a complex variable: limit, continuity and differentiability of a complex function. Analytic function, Cauchy- Riemann equations in Cartesian and Polar forms, Sufficient conditions for analyticity (Cartesian form), Harmonic function: Standard properties of analytic functions, Construction of analytic function using Milne – Thomson's method.	
Unit – IV	**Transformations and Complex Integration:**	**15 Hrs.**
	Transformations: Definition, Jacobian of a transformation, Identity transformation, Reflection, Translation, Rotation, Stretching, Inversion, Linear transformation, Bilinear transformations, Cross-ratio of four points, Cross-ratio preserving property, Preservation of the family of straight lines and circles, Conformal mappings: Discussion of the transformations: $w = z^2$, $w = \sin z$, $w = e^z$, $w = \frac{1}{2}\left(z + \frac{1}{z}\right)$. **Complex integration**: Definition, Line integral, Properties and problems, Cauchy's theorem: Proof using Green's theorem, Direct consequences, Cauchy's Integral formula with proof, Cauchy's generalized formula for the derivatives and applications for evaluation of simple line integrals.	

Recommended Books:

1. Elements of Analytical Solid Geometry, Shanti Narayan and P. K. Mittal, S. Chand & Co., 2007.
2. Analytical Geometry, A. R. Vasishtha and D. C. Agarwal, Krishna Prakashan Media, 2014.
3. Analytical Solid Geometry, B. P. Singh, Venus Books, 2015.
4. Complex Variables, J. N. Sharma, Krishna Prakashan, 2014.
5. Complex Analysis, Goyal, Gupta and Pundir, Anu Books, 2019.
6. Complex Variables, Spiegel and Others, Schaum's Outline Series, 2009.
7. Complex Analysis, L. V. Ahlfors, McGraw Hill Education, 2017.
8. Complex Analysis, S. Lang, Springer, 2003.
9. Theory of Functions of a Complex Variable, Shanthi Narayan and P. K. Mittal, S. Chand Publishers, 2005.
10. Foundations of Complex Analysis, S. Ponnusamy, Narosa Publications, 2011.

Formative Assessment for Theory	
Assessment Occasion / Type	**Marks**
Internal Assessment Test 1	05
Internal Assessment Test 2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

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B.Sc. Semester – VI

Subject: MATHEMATICS

Discipline Specific Core Course (DSC)

Course Title: Practical on Geometry and Complex Analysis

Course Code: C6 MAT 2 P2 (Practical)

SPECIALIZATION – II

(Student shall select DSC - 11A & 12A OR 11B & 12B for 06 credits only)

Type of Course	Theory /Practical	Credits	Instruction hours per week	Total No. of Lectures / Hours per Semester	Duration of Sem End Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC – 12B	Practical	02	04	56 Hrs.	03 Hrs.	10	40	50

Course Outcomes (COs):

After completion of course (Practical), students will be able to:

CO 1: Learn Free and Open Source software (FOSS) tools for computer programming.

CO 2: Solve various problems related to geometries such as sphere, cone and cylinder.

CO 3: Expand various trigonometric functions.

CO 4: Solve problems related to complex integration.

CO 5: Verify Cauchy-Riemann equations in Cartesian and polar forms.

CO 6: Calculate cross ratio of points.

List of Experiments

[Each will have 4rs / Week (Minimum 12 experiments)]

1. Program on sphere with suitable example.
2. Program on cone with suitable example.
3. Program on cylinder with suitable example.
4. Program on expansion of sin $n\theta$ and cos $n\theta$ with suitable examples.
5. Program on expansion of $\sin^n \theta$ and $\cos^n \theta$ with suitable examples.
6. Program on expansion of $\sin^m \theta \cos^n \theta$ with suitable examples.
7. Program on verification of Cauchy–Riemann equations in Cartesian form.
8. Program on verification of Cauchy–Riemann equations in polar form.
9. Program to check whether a function is harmonic or not.

10. Program to construct analytic functions through Milne–Thompson method.
11. Program to find cross-ratio of points.
12. Program to find fixed points of bilinear transformations.

Recommended Books:

1. Automate the Boring Stuff with Python, A. Sweigart, No Starch Press, 2019.
2. Python Cookbook, D. Beazley and B. K. Jones, Shroff O'Reilly, 2013.
3. Basic Python Programming for Beginners, K. V. Rajkumar, M. Krishna, and J. Prakash, Bluerose Publishers Pvt. Ltd., 2021.
4. Python, J. Shovic and A. Simpson, For Dummies, 2024.
5. Learning Python, M. Lutz, Shroff O'Reilly, 2017.
6. Elements of Analytical Solid Geometry, Shanti Narayan and P. K. Mittal, S. Chand & Co., 2007.
7. Complex Variables, J. N. Sharma, Krishna Prakashan, 2014.
8. Complex Analysis, L. V. Ahlfors, McGraw Hill Edu., 2017.
9. Complex Analysis, S. Lang, Springer, 2003.
10. Foundations of Complex Analysis, S. Ponnusamy, Narosa Publications, 2011.

General Instructions

Software to be used: Python

Scheme of Practical Examination (Distribution of Marks)

Formative Assessment for Practical	
Assessment Occasion / Type	**Marks**
Program writing and problem solving (1 Program)	03
Program Execution	03
Viva	02
Journal	02
Total	**10 Marks**
Formative Assessment as per guidelines.	

Summative Assessment for Practical	
Assessment Occasion / Type	**Marks**
Program writing and problem solving (2 Programs)	(5+5)*2 = 20
Program Execution (Any 1 Program)	10
Viva	05
Journal	05
Total	**40 Marks**
Summative Assessment as per guidelines.	

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B.Sc. Semester – V

Subject: MATHEMATICS

Elective Course (EC) - 1

(It is for other combination students only)

Course Title: Quantitative Mathematics - I

Course Code: C5 MAT 5 T1 (Theory)

Type of Course	Theory /Practical	Credits	Instruction hours per week	Total No. of Lectures / Hours per Semester	Duration of Sem End Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
EC – 1	Theory	03	03	45 Hrs.	03 Hrs.	20	80	100

Course Outcomes (COs):

After completion of the course (Theory), students will be able to:

CO 1: Apply sets, relations, functions in business.

CO 2: Use permutations and combinations.

CO 3: Learn HCF and LCM of numbers.

CO 4: Understand the problem of ages and other quantitative aptitude problems.

CO 5: Calculate mean, median and mode for various problems.

CO 6: Find out arithmetic, geometric and harmonic means.

CO 7: Draw histogram and ogive curves for given statistical data.

Unit	**Title:** Quantitative Mathematics – I	45 Hours / Sem
Unit - I	**Algebra:**	15 Hrs.
	Basics of Sets, Relations, Functions, Surds and Indices, Logarithms, Permutations and combinations.	
Unit - II	**Quantitative Aptitude – I:**	15 Hrs.
	Numbers, HCF and LCM of numbers. Decimal Fractions, Simplification, Square roots and cube roots, Averages, Problems on numbers, Problems on ages, Percentage.	
Unit - III	**Measures of Central Tendency:**	15 Hrs.
	Frequency distribution: Raw data, Classification of data, frequency distribution, cumulative frequency distribution, Histogram and ogive curves. Measures of central tendency: Arithmetic Mean, Median and Mode for ungrouped and grouped data. Merits and demerits of measures of central tendency. Geometric mean: definition, merits and demerits, Harmonic mean: definition, merits and demerits.	

Recommended Books:

1. Quantitative Aptitude, R. S. Aggarwal, S. Chand Publications, 2017.
2. Objective Arithmetic, R. Verma, Arihant Publications (India) Ltd., 2022.
3. Basic Mathematics, J. K. Sharma, Wiley, 2019.
4. Complete Book on Objective Arithmetic, S. L. Gulati, Heed Publications Pvt. Ltd., 2019.
5. Quantitative Aptitude, A. Guha, McGraw Hill Publications, 2020.
6. Statistical Methods, S. P. Gupta, S. Chand & Sons, 2023.
7. Applied Statistics, P. Mukhopadhya, Books & Allied Ltd., 2005.
8. Fundamentals of Statistics, A. M. Gun, M. K. Gupta, and B. Dasgupta, World Press, 2013.
9. Fundamentals of Applied Statistics, S. C. Gupta and V. K. Kapoor, S. Chand & Sons, 2018.
10. Business Mathematics and Statistics, N. G. Das and J. K. Das, McGraw Education, 2020.

Formative Assessment for Theory	
Assessment Occasion / Type	**Marks**
Internal Assessment Test 1	05
Internal Assessment Test 2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

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B.Sc. Semester – VI

Subject: MATHEMATICS

Elective Course (EC) - 2

(It is for other combination students only)

Course Title: Quantitative Mathematics - II

Course Code: C6 MAT 5 T1 (Theory)

Type of Course	Theory /Practical	Credits	Instruction hours per week	Total No. of Lectures / Hours per Semester	Duration of Sem End Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
EC – 2	Theory	03	03	45 Hrs.	03 Hrs.	20	80	100

Course Outcomes (COs):

After completion of the course (Theory), students will be able to:

CO 1: Understand the concepts such as profit and loss, ratio and proportion.

CO 2: Solve the problems based on simple and compound interest.

CO 3: Analyse clock and calendar related problems.

CO 4: Learn matrices and determinants.

CO 5: Solve the system of linear equations.

CO 6: Understand various measures of depression.

CO 7: Interpret the concept and types of correlation.

Unit	**Title:** Quantitative Mathematics – II	45 Hours / Sem
Unit – I	**Quantitative Aptitude – II:**	**15 Hrs.**
	Profit and loss, Ratio and proportion, Partnership, Time and Work, Time and distance, Simple interest, Compound interest, Area, Volume and surface area, Calendar and clocks.	
Unit – II	**Matrices:**	**15 Hrs.**
	Definition of a matrix; types of matrices; Algebra of matrices, Determinants, Properties of determinants; calculations of values of determinants up to third order. Adjoint of a matrix, Elementary row and column operations; Solution of a system of linear equations involving not more than three variables.	
Unit – III	**Dispersion and Correlation:**	**15 Hrs.**
	Measures of dispersion: Range, Variance, Standard deviation (SD) for grouped and ungrouped data, Measures of relative dispersion: Coefficient of range, coefficient of variation. Examples and problems. Correlation, Scatter diagram,	

	Interpretation with respect to magnitude and direction of relationship. Karl Pearson's coefficient of correlation for ungrouped data.	

Recommended Books:

1. Quantitative Aptitude, R. S. Aggarwal, S. Chand Publications, 2017.
2. Objective Arithmetic, R. Verma, Arihant Publications (India) Ltd., 2022.
3. Quantitative Aptitude, A. Guha, McGraw Hill Publications, 2020.
4. Complete Book on Objective Arithmetic, S. L. Gulati, Heed Publications Pvt. Ltd., 2019.
5. Matrices, A. R. Vasista and A. K. Vasista, Krishna Prakashan Media (P) Ltd., 2013.
6. Statistical Methods, S. P. Gupta, S. Chand & Sons, 2023.
7. Applied Statistics, P. Mukhopadhya, Books & Allied Ltd., 2005.
8. Fundamentals of Statistics, A. M. Gun, M. K. Gupta, and B. Dasgupta, World Press, 2013.
9. Fundamentals of Applied Statistics, S. C. Gupta and V. K. Kapoor, S. Chand & Sons, 2018.
10. Business Mathematics and Statistics, N. G. Das and J. K. Das, McGraw Education, 2020.

Formative Assessment for Theory	
Assessment Occasion / Type	**Marks**
Internal Assessment Test 1	05
Internal Assessment Test 2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

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B.Sc. Semesters – IV/V/VI

Subject: MATHEMATICS

SKILL ENHANCEMENT COURSE (SEC)

(Student shall study this SEC in any one of the Semesters either in IV or V or VI semester and College shall decide to allot the students)

Course Title: Programming with GNU Octave

Course Code: C0 MAT 6 T1 (Practical)

Type of Course	Theory /Practical	Credits	Instruction hours per week	Total No. of Lectures / Hours per Semester	Duration of Sem End Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
SEC	Practical	02	04	56 Hrs.	03 Hrs.	10	40	50

Course Outcomes (COs):

After completion of course (Practical), students will be able to:

CO 1: Learn GNU Octave Software (FOSS) for computer programming.

CO 2: Solve problems on Algebra, Calculus, Differential Equations, Laplace Transforms and Fourier series by using Octave software.

CO 3: Acquire knowledge of applications of above mentioned topics through Octave.

CO 4: Find angle between radius vector and tangent using FOSS.

CO 5: Verify the exactness of a differential equation.

CO 6: Calculate double integral with constant and variable limits.

List of Experiments

[Each will have 4rs / Week (Minimum 12 experiments)]

1. Program to compute addition and subtraction of matrices
2. Program to compute rank of matrix and row reduced echelon form.
3. Program to find the angle between the radius vector and tangent.
4. Program to find the n^{th} derivative of e^{ax} and trigonometric functions.
5. Program to construct Cayley table and test abelian for given finite set.
6. Programs to verify Lagrange's theorem (groups) with suitable example.
7. Program to evaluate the double and triple integrals with constant limits.
8. Program to verify the exactness of a differential equation.

9. Program to find the Complementary Function and Particular Integral of linear differential equations with constant coefficients.
10. Program to verify D'Alembert's and Raabe's tests with suitable examples.
11. Program to find the Laplace transforms of some standard and periodic functions.
12. Program to find sine and cosine Fourier transforms.

Recommended Books:

1. Introduction to Octave, N. Sandeep, APress, 2017.
2. Scientific Computing with Matlab and Octave, A. Quarteroni, Springer, 2010.
3. Essential Matlab and Octave, J. Rogel-Salazar, CRC Press, 2018.
4. GNU Octave by Example, A. Pajankar, APress, 2020.
5. Octave and Matlab for Engineering Applications, A. Stahel, Springer, 2022.
6. Differential Calculus, Shanti Narayan and P. K. Mittal, S. Chand & Company, New Delhi, 2022.
7. Modern Algebra, S. Singh and Q. Zameeruddin, Vikas Publishing House Pvt. Ltd., 2006.
8. Ordinary Differential Equations and Partial Differential Equations, M. D. Raisinghania, S. Chand & Company, New Delhi, 2020.
9. Laplace Transforms, M. R. Spiegel (Schaum's Series), McGraw-Hill International Ed., 2005.
10. Fourier Series and Integral Transforms, S. Sreenadh & Others, S. Chand & Company, 2014.

General Instructions

Software to be used: GNU Octave

Scheme of Practical Examination (Distribution of Marks)

Formative Assessment for Practical	
Assessment Occasion / Type	**Marks**
Program writing and problem solving (1 Program)	03
Program Execution	03
Viva	02
Journal	02
Total	**10 Marks**
Formative Assessment as per guidelines.	

Summative Assessment for Practical	
Assessment Occasion / Type	**Marks**
Program writing and problem solving (2 Programs)	(5+5)*2 = 20
Program Execution (Any 1 Program)	10
Viva	05
Journal	05
Total	**40 Marks**
Summative Assessment as per guidelines.	

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GENERAL PATTERN OF THEORY QUESTION COURSE FOR DSC/ EC

(80 Marks for Semester End Examination with 3 Hrs Duration)

Part-A

I. Question number 1 - 10 carries 2 marks each. Answer all questions: **20 marks**

(Minimum 2 questions from each unit)

Part-B

II. Question number 11 - 18 carries 05 marks each. Answer any 06 questions: **30 marks**

(Minimum 2 questions from each unit)

Part-C

III. Question number 19 - 22 carries 10 marks each. Answer any 03 questions: **30 marks**

(Minimum 1 question from each unit and each 10 marks question may have sub-questions for 7+3 or 6+4 or 5+5, if necessary)

Total: 80 Marks

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

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