SOBAN SINGH JEENA UNIVERSITY, ALMORA

Three Year Undergraduate Programme

MATHEMATICS SYLLABUS

DEPARTMENT OF MATHEMATICS

Three Year Undergraduate Programme in Mathematics					
Year	Semester	Course	Paper Title		Credits
FIRST YEAR	I	DSC Maths1	Fundamental Mathematics-I	Theory	4
	II	DSC Maths2	Fundamental Mathematics-II	Theory	4
SECOND YEAR	III	DSC Maths3	Differential Calculus	Theory	4
		DSE Maths1	Geometry	Theory	4
	IV	DSC Maths4	Integral Calculus	Theory	4
		DSE Maths2	Group Theory	Theory	4
THIRD YEAR	V	DSC Maths5	Analysis	Theory	4
		DSE Maths3	Ring Theory	Theory	4
	VI	DSC Maths6	Vector spaces and linear transformations	Theory	4
		DSE Maths4	Differential Equations	Theory	4

Abbreviations-
DSC-Discipline Specific Course; DSE- Discipline Specific Electives; GE-Generic Electives.

Program Outcomes (POs)	
After this programme:	
PO 1.	Students will have a firm foundation in the fundamentals and applications of Mathematics and scientific theories.
PO 2.	Students will develop skills in problem solving, critical thinking and analytical reasoning as applied to scientific problems.
PO 3.	Students will be able to explore new directions to pursue higher studies in science subjects.
PO 4.	Students will be able to contest and qualify different competitive exams where graduation degree is one of the essential qualifications.
PO 5.	Students will be able to function as a member of an interdisciplinary problem-solving team.

PROGRAM SPECIFIC OUTCOMES (PSOS)

First Year	Certificate in Science (Mathematics as one of the major Subject)
	Certificate in Science will give students a basic knowledge of mathematics. Two other major subjects needed for the study of other courses in forthcoming years. It will enable students to join the diploma course (semester III and IV) in any University or College of Higher education in Uttarakhand.
Second Year	Diploma in Science (Mathematics as one of the major Subject).
	Diploma will enable students to join the Bachelor of Science course (semester V and VI) in any University or College of Higher education in Uttarakhand.
Third Year	Bachelor of Science (Mathematics as one of the major Subject)
	Upon completion of a degree, students will be eligible for Master Degree in any of the major subject in any of the higher institutions of India. It will give students an ability of critical thinking and scientific study of any discipline. Students after getting Bachelor degree will be eligible for all the competitive examinations where graduation is an essential qualification.

Department of Mathematics

Semester-I

Certificate in Science (Mathematics as one of the major Subjects)

DISCIPLINE SPECIFIC COURSE (DSC Maths1)- Fundamental Mathematics-I

No. of Hours: 50-60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC Maths1: Fundamental Mathematics-I	4	3	2	0	Passed Class XII with Mathematics	Nil

Certificate in Science (Mathematics as one of the major Subjects)			
Programme:	*Certificate in Science (Mathematics as one of the major Subjects)*	Year: I	Semester: I Paper: DSC Maths1
Subject: Mathematics			
Course: DSC Maths1	Course Title: Fundamental Mathematics-I		
Course Outcomes: This paper is a fundamental course for intermediate pass students who are going to study mathematics as one of the major subjects for their graduation degree. It gives basic knowledge and background to understand other courses either in mathematics or physics.			
Credits: 4		Discipline Specific Course	
Max. Marks: As per Univ. rules		Min. Passing Marks: As per Univ. rules	
Unit	Content		Number of Hours
Unit I	**Theory of Equations:** Relations between roots and coefficients of algebraic equations, Transformation of equations, Descartes rule of signs, Solutions of cubic and bi-quadratic equations.		10-15
Unit II	**Matrices:** Basic concepts of matrices, Types of matrices, Transpose, trace and determinant of a matrix, Elementary operations, Row reduced echelon form, Rank and inverse of a matrix, Normal form of a matrix, Solutions of a system of linear equations, Characteristic equation of a matrix, Eigenvalues, Eigenvectors, Cayley-Hamilton		12-15

	theorem.	
Unit III	**Trigonometry:** Complex numbers with elementary properties, De-Moivre's theorem, Exponential functions, Euler's theorem, Circular and hyperbolic functions of complex variables together with their inverses, Logarithmic functions, Gregory's series, Summation of trigonometric series.	10-15
Unit IV	**Elements of number theory:** Review of number system, Divisibility, The division algorithm, Greatest common divisor, The Euclid algorithm, Prime numbers, The fundamental theorem of Arithmetic, The theory of congruences: Introduction and basic properties.	12-15

Books Recommended:
C. C. MacDuffee: *Theory of Equations,* John Wiley & Sons, 1954.
Burton, D. M. *Elementary number theory*. McGraw-Hill Education, 2011.
R. K. Sharma, S. K. Shah and A. G. Shankar: *Complex Numbers and the Theory of Equations,* Anthem Press, 2011.
Shanti Narayan and P.K. Mittal: A Textbook of Matrices, S. Chand Publishing, 2010.
S. L. Loney: Plane Trigonometry Part-I (Geometrical Trigonometry), Cambridge University Press, 1893.
S. L. Loney: Plane Trigonometry Part-II (Analytical Trigonometry), Cambridge University Press, 1893.
Further Readings:
William Snow Burnside and Arthur William Panton: *The Theory of Equations Vol. I,* Nabu Press, 2011.
Leonard E. Dickson: *First Course in the Theory of Equations*, Merchant Books, 2009.
Fuzhen Zhang: *Matrix Theory- Basic Results and Techniques,* Springer, 1999.
K. B. Dutta: *Matrix and Linear Algebra,* Prentice Hall of India*,* 2004.
Digital Platform: NPTEL/SWAYAM/MOOCs.

Semester-II

Certificate in Science (Mathematics as one of the major Subjects)

DISCIPLINE SPECIFIC COURSE (DSC Maths2)- Fundamental Mathematics -II

No. of Hours: 50-60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC Maths2: Fundamental Mathematics-II	4	3	2	0	Passed Class XII with Mathematics	Nil

Certificate in Science (Mathematics as one of the major Subjects)			
Programme:	*Certificate in Science (Mathematics as one of the major Subjects)*	Year: I	Semester: II Paper: DSC Maths2
Subject: Mathematics			
Course: DSC Maths2	Course Title: Fundamental Mathematics-II		
Course Outcomes: This paper is a fundamental course for intermediate pass students who are going to study mathematics as one of the major subjects for their graduation degree. It gives basic knowledge and background to understand other courses either in mathematics or physics.			
Credits: 4			Discipline Specific Course
Max. Marks: As per Univ. rules			Min. Passing Marks: As per Univ. rules
Unit	Content		Number of Hours
Unit I	**Preliminaries:** Sets, Operations on sets, Index set and family of sets, Relations, Equivalence relations and partitions, Functions, Composition of functions, Infinite sets and cardinality, Cantor set, Principle of mathematical induction.		10-15
Unit II	**Numerical Sequence and Series:** Real Sequences, theorems on limit of sequences, Infinite series, series of non-negative terms, Various tests for convergence, Alternating series, Leibnitz's theorem, Absolute convergence, Conditional convergence.		12-15

Unit III	**Partial Derivatives:** Functions of more than one variable, Partial Derivatives, Euler's Theorem for Homogeneous Functions, Jacobians and their applications, Chain rule.	12-15
Unit IV	**Polar Geometry:** Polar coordinate system, Polar equation of a conic, Chords, Tangent and Normal to a conic, Tracing of conics.	10-15

Books Recommended:

Kenneth H. Rosen: *Discrete Mathematics and Its Applications*, McGraw Hill Education, 7th Edition, 2012.

Paul R. Halmos: *Naive Set Theory*, Springer, Undergraduate Texts in Mathematics, Reprint Edition, 1974.

Walter Rudin: *Principles of Mathematical Analysis*, McGraw Hill Education, 3rd Edition, 1976.

H.S. Hall and S.R. Knight: *Higher Algebra*, Arihant Publications, Reprint Edition, 2019.

George B. Thomas and Ross L. Finney: *Calculus and Analytic Geometry*, Pearson Education, 9th Edition, 1996.

S.L. Loney: *The Elements of Trigonometry*, Cambridge University Press, Reprint Edition, 2016.

Digital Platform: NPTEL/SWAYAM/MOOCs.

Semester-III
Diploma in Science (Mathematics as one of the major Subjects)

DISCIPLINE SPECIFIC COURSE (DSC Maths3)- Differential Calculus

No. of Hours: 50-60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC Maths3: **Differential Calculus**	4	3	2	0	Passed Class XII with Mathematics	Completed DSC Maths1 and DSC Maths2

Diploma in Science (Mathematics as one of the major Subjects)			
Programme:	*Diploma in Science (Mathematics as one of the major Subjects)*	Year: II	Semester: III Paper: DSC Maths3
Subject: Mathematics			
Course: DSC Maths3	Course Title: Differential Calculus		
Course Outcomes: This paper provides detailed knowledge of differentiation and integration of various classes of functions. It relates and gives an analytical aptitude for various mathematical problems. After completing this course students will be able to understand basic concepts of calculus and able to apply these concepts in other areas of study especially physics and engineering.			
Credits: 4			Discipline Specific Course
Max. Marks: As per Univ. rules			Min. Passing Marks: As per Univ. rules
Unit	Content		Number of Hours
Unit I	**Limit, Continuity and Differentiability**: Functions of one variable, Limit and Continuity of a function, sequential definition of continuity, Properties of continuous functions, Classification of Discontinuities, Differentiability of a function, Rolle's Theorem, Mean value theorems and their geometrical interpretations, Applications of mean value theorems. Successive Differentiation, n^{th} Differential coefficient of functions, Leibnitz Theorem; Taylor's Theorem, Maclaurin's Theorem, Taylor's and Maclaurin's series expansions, Indeterminate forms.		10-15

Unit II	**Tangents and Normals**: Geometrical meaning of dy/dx, Definition and equation of Tangent and Normal, Tangent at origin, Angle of intersection of two curves, Subtangent and Subnormal, Tangents and Normals of polar curves, Angle between radius vector and tangent, Perpendicular from pole to tangent, Pedal equation of curve, Polar subtangent and polar subnormal, Intrinsic equations.	12-15
Unit III	**Curvature and Asymptotes**: Curvature, Radius of curvature; Cartesian, Polar and pedal formula for radius of curvature, Tangential polar form, Centre of curvature, Asymptotes of algebraic curves, Methods of finding asymptotes, Parallel asymptotes.	12-15
Unit IV	**Singular Points and Curve Tracing**: Existence and classification of singular points, points of inflexion, Double Points, Cusp, Node and conjugate points, Curve tracing.	10-15

Books Recommended:
T. M. Apostol: *Calculus Vol. I*, John Willey & Sons, 1999.
Gorakh Prasad: *Differential Calculus*, Pothishala publication, Allahabad, 2016.
M. Ray, H. S. Sharma and S. S. Seth: *Differential Calculus*, Shiva Lal Agarwal & Company, Agra.
Further Readings:
S. Lang: *A First Course in Calculus*, Springer-Verlag New York Inc.,1986.
H. Anton, I. Birens and S. Davis: *Calculus*, John Wiley & Sons, 2007.
G. B. Thomas and R. L. Finney: *Calculus and Analytical Geometry*, Addison-Wesley, 2010.
S. Balachandra Rao and C. K. Shantha: *Differential Calculus*, New Age Publication, 1992.
Frank Ayres and Elliott Mendelson: *Calculus,* Schaum's Outline Series, McGraw Hill Edition, 2009.
Digital Platform: NPTEL/SWAYAM/MOOCs.

Semester-III

Diploma in Science (Mathematics as one of the major Subjects)

DISCIPLINE SPECIFIC ELECTIVE (DSE Maths1)- Geometry

No. of Hours: 50-60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSE Maths 1: **Geometry**	4	3	2	0	Passed Class XII with Mathematics	Nil

Certificate in Science (Mathematics as one of the major Subjects)			
Programme:	*Certificate in Science (Mathematics as one of the major Subjects)*	Year: II	Semester: III Paper: DSE Maths1
Subject: Mathematics			
Course: DSE Maths 3	Course Title: Geometry		
Course Outcomes: This course will enhance the understanding of mathematical concepts with geometrical/graphical interpretations. After studying this course students will be able to visualize mathematical concepts geometrically.			
Credits: 4		Discipline Specific Elective	
Max. Marks: As per Univ. rules		Min. Passing Marks: As per Univ. rules	
Unit	Content		Number of Hours
Unit I	**Direction Cosines and the Plane:** Cartesian co-ordinates in three-dimension, Direction cosines, direction ratios and their properties, Equation of a Plane in various forms, Two sides of a plane, Length of perpendicular from a point to a plane, Angle between two planes, System of planes, Transformation of coordinates.		10-15
Unit II	**Straight Lines and the Sphere:** Equation of a line in different forms, Angle between a line and a plane, Co-planar lines, shortest distance, Length of perpendicular from a point to a line, Intersection of three planes, Definition and equation of a sphere, Plane section of a sphere, Intersection of two spheres, Sphere through a		12-15

	given circle, Intersection of a sphere and a line, Power of a point, Tangent plane, Plane of contact, Polar plane and polar lines, Pole of a plane, Conjugate points and conjugate planes, Angle of Intersection of two spheres. Radical axis and centre.	
Unit III	**Cone and Cylinder:** Definition and equation of a cone with various properties, Three mutually perpendicular generators, Intersection of a line with a cone, Tangent line and tangent plane, Reciprocal cone, right circular cone, Definition and equation of a cylinder, right circular cylinder, Enveloping cylinder, General equation of second degree.	12-15
Unit IV	**The Conicoids:** Central conicoids, Tangent plane, Director sphere, Normal, Plane of contact, Polar plane, Conjugate points, conjugate planes and conjugate lines, enveloping cone, Paraboloids, Plane sections of conicoids.	10-15

Books Recommended:
S.L. Loney: *The Elements of Coordinate Geometry,* McMillan and Company, London, 2018.
Shanti Narayan and P. K. Mittal: *Analytical Solid Geometry*, S. Chand & company, 2007.
P. K. Jain: *A Textbook of Analytical Geometry*, New Age Publication, 2014.
Jyoti Das: *Analytical Geometry,* Academic Publisher, 2011.
J. G. Chakravorty and P. R. Ghosh: *Analytical Geometry and Vector Analysis,* U. N. Dhur & Sons Pvt. Ltd, 1973.
Further Readings:
Henry B. Fine and H. D. Thompson: *Coordinate Geometry,* The Macmillan company, 1909.
G. B. Thomas and R. L. Finney: *Calculus and Analytical Geometry*, Addison-Wesley, 2010.
Robert J. T. Bell: *An Elementary Treatise on Coordinate Geometry of three dimensions,* Macmillan India Ltd., 1923.
P. R. Vittal: *Analytical Geometry-2D & 3D,* Pearson Education, 2013.
Manicavachagom T.K. Pillay: *A Textbook of Analytical Geometry (Part:1 & 2),* Viswanathan, S., Printers & Publishers Pvt Ltd, 2009.
Digital Platform: NPTEL/SWAYAM/MOOCs.

Semester-IV

Diploma in Science (Mathematics as one of the major Subjects)

DISCIPLINE SPECIFIC COURSE (DSC Maths4)- Integral Calculus

No. of Hours: 50-60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC Maths4: Integral Calculus	4	3	2	0	Passed Class XII with Mathematics	Completed DSC Maths2 and DSC Maths3

Diploma in Science (Mathematics as one of the major Subjects)			
Programme:	*Diploma in Science (Mathematics as one of the major Subjects)*	Year: II	Semester: IV Paper: DSC Maths4
Subject: Mathematics			
Course: DSC Maths4	Course Title: Integral Calculus		
Course Outcomes: This paper provides detailed knowledge of differentiation and integration of various classes of functions. It relates and gives an analytical aptitude for various mathematical problems. After completing this course students will be able to understand basic concepts of calculus and able to apply these concepts in other areas of study especially physics and engineering.			
Credits: 4			Discipline Specific Course
Max. Marks: As per Univ. rules			Min. Passing Marks: As per Univ. rules

Unit	Content	Number of Hours
Unit I	**Definite Integrals:** Integral as a limit of sum, Properties of Definite integrals, Summation of series by integration, Differentiation and integration under the integral sign, Beta and Gamma function.	10-15
Unit II	**Multiple Integrals:** Double integrals, Evaluation of Double integrals, Double integral in polar coordinates, Change of order of integration in Double integrals, Triple integrals, Evaluation of Triple integrals, Dirichlet's theorem and its Liouville's extension.	12-15

Unit III	**Geometrical Applications of Definite Integrals:** Area bounded by curves (quadrature), Rectification (length of curves), Volumes and Surfaces of Solids of revolution.	10-15
Unit IV	**Vector Calculus:** Vectors, The dot product cross product and their geometric interpretation, Triple products, Reciprocal vectors, Gradient, Divergence, Curl and Laplacian, Differentiation of vectors, Line, surface and volume integrals, Simple applications of Green's theorem, Gauss divergence theorem and Stoke's theorem.	12-15

Books Recommended:
T. M. Apostol: *Calculus Vol. I*, John Willey & Sons, 1999.
G. B. Thomas and R.L. Finney; Calculus and Analytical Geometry, Addison Wesley, 2010.
M. Ray, H. S. Sharma and S. S. Seth: *Differential Calculus*, Shiva Lal Agarwal & Company, Agra.
M. Ray, H. S. Sharma and S. S. Seth: *Integral Calculus*, Shiva Lal Agarwal & Company, Agra.
G. Prasad: Integral Calculus, Banaras Mathematical Society.
Shanti Narayan and P. K. Mittal: A Text Book of Vector Calculus, S. Chand & Company, 1987.
J. G. Chakravorty and P. R. Ghosh: *Analytical Geometry and Vector Analysis,* U. N. Dhur & Sons Pvt. Ltd, 1973.
Further Readings:
S. Lang: *A First Course in Calculus*, Springer-Verlag New York Inc.,1986.
H. Anton, I. Birens and S. Davis: *Calculus*, John Wiley & Sons, 2007.
S. Balachandra Rao and C. K. Shantha: *Differential Calculus*, New Age Publication, 1992.
Frank Ayres and Elliott Mendelson: *Calculus,* Schaum's Outline Series, McGraw Hill Edition*,* 2009.
Murray Spiegel, Seymour Lipschutz and Dennis Spellman: *Vector Analysis,* Schaum's Outline Series, McGraw Hill Edition*,* 2017.

Digital Platform: NPTEL/SWAYAM/MOOCs.

Semester-IV

Diploma in Science (Mathematics as one of the major Subjects)

DISCIPLINE SPECIFIC ELECTIVE (DSE Maths2)- Group Theory

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSE Maths2: **Group Theory**	4	3	2	0	Passed Class XII with Mathematics	Completed DSC Maths1 and DSC Maths2

Diploma in Science (Mathematics as one of the major Subjects)		
Programme: *Diploma in Science (Mathematics as one of the major Subjects)*	Year: II	Semester: III Paper: DSE Maths2
Subject: Mathematics		
Course: DSE Maths2	Course Title: Group Theory	
Course Outcomes: This course is useful to understand the concepts of algebraic structures and their properties. It will help the students for better understanding of other subjects, especially atomic structures in chemistry and certain concepts of physics.		
Credits: 4		Discipline Specific Elective
Max. Marks: As per Univ. rules		Min. Passing Marks: As per Univ. rules
Unit	Content	Number of Hours
Unit I	**Groups:** Binary operation and Algebraic structure, Groups, Modulo Group ($\mathbb{Z}_n$), Klein group, Quaternion group, Dihedral Group, $GL(n, \mathbb{R})$, $SL(n, \mathbb{R})$, Abelian groups, group of symmetries, Alternating group, Noncommutative groups.	10-15
Unit II	Subgroups, Finite groups, Lagrange theorem and its consequences, Permutation groups, Cyclic groups, Coset decomposition.	10-15
Unit III	Normal subgroups, Quotient group, Simple Group, Centre of Group, Class equation of Group, Homomorphism and Isomorphism, Fundamental theorems of homomorphism,	12-15

	Cayley's theorem.	
Unit IV	Automorphism and inner automorphism, Automorphism groups and their computation, Normalizer and Centralizer of group, Commutator subgroups.	12-15

Books recommended:

I. N. Herstein: *Topics in Algebra*, John Wiley & Sons, 2006.
Joseph A. Gallian: *Contemporary Abstract Algebra,* Narosa Publishing House, 2016.
David S. Dummit and Richard M. Foote: *Abstract Algebra*, John Wiley & Sons, 2011.
Surjeet Singh and Qazi Zameeruddin: *Modern Algebra*, Vikas Publishing House, India, 2021.
Further Readings:
Michael Artin: *Algebra,* Pearson Education, 2015.
N. Jacobson: Lectures in Abstract Algebra-*Vol. I, II & III,* Springer, 2013.
N. Jacobson: Basic Algebra-*Vol. I & II,* Dover Publications Inc., 2009.
R. S. Aggarwal: *A Textbook on Modern Algebra,* S Chand & Company, 1973.
R. Lal; Algebra1, Groups, Rings, Fields and Arithmetic, Springer.
Digital Platform: NPTEL/SWAYAM/MOOCs.

Semester-V

Bachelor of Science (Mathematics as one of the major Subjects)

DISCIPLINE SPECIFIC COURSE (DSC Maths5)- Analysis

No. of Hours: 50-60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC Maths5: Analysis	4	3	2	0	Passed diploma in Science with Mathematics	Completed DSC Maths3 and DSC Maths4

Bachelor of Science (Mathematics as one of the major Subjects)			
Programme:	*Bachelor of Science (Mathematics as one of the major Subjects)*	Year: III	Semester: V Paper: DSC Maths5
Subject: Mathematics			
Course: DSC Maths5	Course Title: Analysis		
Course Outcomes: The core concepts of Real analysis have been included in this course with a view that students can understand the behavior of real numbers and real valued functions in a critical way.			
Credits: 4		Discipline Specific Course	
Max. Marks: As per Univ. rules		Min. Passing Marks: As per Univ. rules	
Unit	Content		Number of Hours
Unit I	**Topology of Real line**: Complete ordered field, Archimedean Property, Supremum, infimum, Neighbourhood of a point, Interior of a set, open set, closed set, Derived set, Closure of a set, Bolzano-Weierstrass Theorem, Brief introduction of compactness and connectedness.		10-15
Unit II	Integration: Riemann integral-definition and properties, Integrability of continuous and monotonic functions, Fundamental theorem of Calculus, Improper integrals and their convergence.		12-15

Unit III	Limit, continuity and differentiability of functions of a complex variable, Cauchy-Riemann equations, Analytic functions, Harmonic functions and Harmonic conjugates.	12-15
Unit IV	Line Integration, Cauchy's theorem, Morera's theorem, Cauchy's integral formula, Taylor's series, Laurent's series, Maximum modulus principle, Poles and singularities. Residues, The Residue theorem, Evaluation of Improper integrals.	12-15

Books Recommended:

Walter Rudin: *Principle of Mathematical Analysis,* McGraw Hill Edition, 1976.

R. G. Bartle and D. R. Sherbert: *Introduction to Real Analysis*, John Wiley & Sons, 1999.

T. M. Apostol: *Mathematical Analysis*, Narosa Publishing House, New Delhi, 1985.

J. W. Brown and R. V. Churchill: Complex variable and Applications, McGraw-Hill, 2004.

A. R. Shastri: Basic Complex Analysis of One Variable, Laxmi Publication, 2010.

Further Readings:

Richard R. Goldberg: *Methods of Real Analysis*, John Wiley & Sons, 1976.

James R. Munkres: *Analysis on Manifolds*, Addison-Wesley Publishing Company, Advanced Book Program, Redwood City, CA, 1991.

H. L. Royden: *Real Analysis,* Macmillan Publishing Company, New York, 1988.

G. F. Simmons: Introduction to Topology and Modern Analysis, McGraw Hill Edition, 2011.

Digital Platform: NPTEL/SWAYAM/MOOCs.

Semester-V

Bachelor of Science (Mathematics as one of the major Subjects)

DISCIPLINE SPECIFIC ELECTIVE (DSE Maths3)- Ring Theory

No. of Hours: 50-60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSE Maths3: Ring Theory	4	3	2	0	Passed Class XII with Mathematics	Completed DSE Maths1

Bachelor of Science (Mathematics as one of the major Subjects)			
Programme:	*Bachelor of Science (Mathematics as one of the major Subjects)*	Year: III	Semester: V Paper: DSE Maths3
Subject: Mathematics			
Course: DSE Maths3	Course Title: Ring Theory		
Course Outcomes: This course is useful to understand the concepts of algebraic structures and their properties. It will help the students for better understanding of other subjects, especially atomic structures in chemistry and certain concepts of physics.			
Credits: 4		Discipline Specific Elective	
Max. Marks: As per Univ. rules		Min. Passing Marks: As per Univ. rules	

Unit	Content	Number of Hours
Unit I	Rings and their examples, Sub rings, Commutative rings, Divisors of zero, Integral domain, Inverse of an element in a ring.	10-15
Unit II	Skew field, Field, Ideals, Characteristic of a ring, Ring Homomorphism, Quotient rings.	12-15
Unit III	Principal ideals, Maximal ideals, Prime ideals, Principal ideal domains, Unique Factorization Domain, Polynomial rings and irreducibility.	12-15
Unit IV	Field of quotients of an integral domain, Embedding of an integral domain in a field, Factorization in an integral domain.	12-15

Books recommended:

I. N. Herstein: *Topics in Algebra*, John Wiley & Sons, 2006.

Joseph A. Gallian: *Contemporary Abstract Algebra,* Narosa Publishing House, 2016.

David S. Dummit and Richard M. Foote: *Abstract Algebra*, John Wiley & Sons, 2011.

Surjeet Singh and Qazi Zameeruddin: *Modern Algebra*, Vikas Publishing House, India, 2021.

Further Readings:

Michael Artin: *Algebra,* Pearson Education, 2015.

N. Jacobson: Lectures in Abstract Algebra-*Vol. I, II & III,* Springer, 2013.

N. Jacobson: Basic Algebra-*Vol. I & II,* Dover Publications Inc., 2009.

R. S. Aggarwal: *A Textbook on Modern Algebra,* S Chand & Company, 1973.

Digital Platform: NPTEL/SWAYAM/MOOCs.

Semester-VI

Bachelor of Science (Mathematics as one of the major Subjects)

DISCIPLINE SPECIFIC COURSE (DSC Maths6)- Vector spaces and linear transformations

No. of Hours: 50-60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC Maths6: **Vector spaces and linear transformations**	4	3	2	0	Passed diploma in Science with Mathematics	Completed DSC Maths5

Bachelor of Science (Mathematics as one of the major Subjects)			
Programme:	*Bachelor of Science (Mathematics as one of the major Subjects)*	Year: III	Semester: VI Paper: DSC Maths6
Subject: Mathematics			
Course: DSC Maths6	Course Title: Vector spaces and linear transformations		
Course Outcomes: Upon successful completion of this course, the students will be able to understand the theory used to solve the mathematical problems. It also helps to enhance the critical thinking of the students.			
Credits: 4		Discipline Specific Course	
Max. Marks: As per Univ. rules		Min. Passing Marks: As per Univ. rules	

Unit	Content	Number of Hours
Unit I	Vector space, subspaces, Linear combinations, linear spans, Sums and direct sums, Linear dependence and independence, Bases and dimensions, Dimensions and subspaces, Coordinates and change of bases.	12-15
Unit II	Linear transformations, rank-nullity theorem, Linear operators, Invertible linear transformations, Matrix representation of a linear transformation, Transpose of a linear transformation, Similarity of Matrices, Linear functional, Dual space and dual basis, second dual space, hyperspace.	12-15

Unit III	Eigen values and Eigen vectors, Algebraic and Geometrical Multiplicity, Characteristic and Minimal Polynomials, Annihilators, Cayley-Hamilton theorem, Similar Matrices, Diagonalizable operator.	10-15
Unit IV	Invariant Subspaces, Direct sum decomposition, Projection on a vector space, Primary decomposition theorem, Canonical Forms, Diagonal forms, Triangular forms, Jordan forms.	10-15

Books Recommended:
K. Hoffman and R. Kunze: *Linear Algebra*, Prentice Hall of India, 1972.
K. B. Dutta: *Matrix and Linear Algebra*, Prentice Hall of India, 2004.
Seymour Lipschutz and Marc L. Lipson*: Linear Algebra,* Schaum's Outline Series, McGraw Hill Edition, 2017.
S. H. Friedberg, A. J. Insel and L. E. Spence: *Linear Algebra,* Pearson Education, 2015.
Further Readings:
G. Hadley: *Linear Algebra,* Narosa Publishing House, 2002.
H. Helson: *Linear Algebra*, Hindustan Book Agency, New Delhi, 1994.
Gilbert Strang: *Linear Algebra and its Applications,* Cengage Learning India, 2005.
Digital Platform: NPTEL/SWAYAM/MOOCs.

Semester-VI
Bachelor of Science (Mathematics as one of the major Subjects)

DISCIPLINE SPECIFIC ELECTIVE (DSE Maths4)- Differential Equations

No. of Hours: 50-60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSE Maths4: **Differential Equations**	4	3	2	0	Passed diploma in Science with Mathematics	Completed DSC Maths3 and DSC Maths4

Bachelor of Science (Mathematics as one of the major Subjects)			
Programme:	*Bachelor of Science (Mathematics as one of the major Subjects)*	Year: III	Semester: VI Paper: DSE Maths4
Subject: Mathematics			
Course: DSE Maths4	Course Title: Differential Equations		
Course Outcomes: This paper provides detailed knowledge of differential equations and their solutions. This course is useful for the students to solve not only mathematical problems in daily life but also helps to understand typical problems of physics and other related areas.			
Credits: 4		Discipline Specific Elective	
Max. Marks: As per Univ. rules		Min. Passing Marks: As per Univ. rules	

Unit	Content	Number of Hours
Unit I	Order and Degree of Differential Equation, Complete primitive (general solution, particular solution and singular solutions), Existence and uniqueness of the solution dy/dx = f(x,y). Differential equations of first order and first degree, Separation of variables, Homogeneous Equations, Linear Differential Equations, Exact Differential Equations, Integrating Factor, Equation of First order but not of first degree, variation of parameters, Clairaut's form, Singular solutions, Trajectory, Orthogonal Trajectory, Self-Orthogonal family of curves.	12-15
Unit II	**Linear Differential Equations**: Linear differential	12-15

	equations with constant coefficients, Complementary function, Particular integral, working rule for finding solution, Homogeneous linear equations. Linear differential equations of second order with variable coefficients.	
Unit III	**Miscellaneous Equations**: Simultaneous differential equations, Differential equations of the form dx/P= dy/Q= dz/R where P, Q, R are functions of x, y and z, Exact differential equations, Total differential equations, Series solutions of differential equations.	12-15
Unit IV	Laplace Transformation, Inverse Laplace Transformation, Applications of Laplace Transformation to solve Differential equations.	10-15

Books Recommended:

G. F. Simmons: *Differential Equations with Application and Historical Notes*, McGraw Hill Edition, 2002.

Shepley L. Ross: *Differential Equations*, John Wiley & Sons, 1984.

M. D. Raisinghania: *Ordinary & Partial Differential Equation,* S. Chand & Co. Ltd, 2017.

B. Rai, D. P. Choudhary and H. J. Freedman: *A Course of Ordinary Differential Equations,* Narosa, 2002.

Further Readings:

Earl A. Coddington and Norman Levinson: *Theory of Ordinary Differential Equations*, McGraw-Hill Edition, 1998.

Ravi P. Agarwal and Donal O'Regan: *Ordinary and Partial Differential Equations,* Springer, 2009.

Martin Braun: *Differential Equations and Their Applications*, Sringer, 1993.

Erwin Kreyszig: *Advanced Engineering Mathematics,* John Wiley & Sons, 2011.

Ian N. Snedden: *Elements of Partial Differential Equations*, Dover Publication, 2013.

Digital Platform: NPTEL/SWAYAM/MOOCs.

Pattern of Examination Theory Papers

1. Theory

Each theory paper shall consist of two sections A and B.

Section A (Short answers type with reasoning): 45 marks, eight questions of nine marks each, any five have to be attempted.

Section B (Long answers type): 30 marks, two questions of fifteen marks each, and both questions are compulsory with internal choice.

2. Internal assessment

For each theory paper internal assessment shall be conducted periodically (in the form of class tests and/or assignments/ group discussion/ oral presentation/ overall performance) during the semester period. Total marks allotted to internal assessment shall be 25. The evaluated answer sheets/assignments have to be retained by the Professor In-Charge for the period of six months and can be shown to the students if students want to see the evaluated answer sheets. The marks obtained by the students shall be submitted to the Head of concerned department/ the Principal of the College for uploading onto the University examination portal.