



SIR P. T. SARVAJANIK COLLEGE OF SCIENCE (Autonomous)
SURAT-395001
(Affiliated with Veer Narmad South Gujarat University, Surat)



SYLLABUS
FOR
SEM I & II
Program: M. Sc.
Course: Mathematics

From
Academic year
2026-27



PROGRAMME OUTCOMES:

- PO-1: Master Degree Programme in Mathematics will meet the present day needs of academic and Research, Institutions and Industries.
- PO-2: Students may acquire depth knowledge in Algebra, Analysis, Topology, Functional Analysis, Optimization Techniques and Graph Theory which will motivate the students to go for higher studies/research in Mathematics.
- PO-3: Inculcate critical thinking to carry out scientific investigation objectively without being biased with preconceived notions.
- PO-4: Prepare students for pursuing research or careers in mathematical sciences and applied fields.
- PO-5: Equip the student with skills to analyse problems, formulate a hypothesis, evaluate and validate results, and draw reasonable conclusions thereof.

PROGRAMME SPECIFIC OUTCOMES:

- PSO-1: Mastery of Fundamental Mathematical Concepts (Algebra, Analysis, Geometry).
- PSO-2: Will gain the ability to understand and deal with abstract concepts.
- PSO-3: Communicate mathematical concepts effectively.
- PSO-4: Ability to think critically and creatively.
- PSO-5: Analyse and model real world problems based on mathematical principles.
- PSO-6: Ability to solve problems which are modelled.
- PSO-7: Communicate the solutions in rigorous mathematical language.
- PSO-8: Ability to progress independently and ethically.



Content

M. Sc. (Sem-I & II) Mathematics

Sr. No	Semester	Course	Course Number	Course Code	Course Name
1	I	Core Course-I	CC-I	MHMSC-S1P1-4CR26	Advanced Abstract Algebra
2		Core Course-II	CC-II	MHMSC-S1P2-4CR26	Advanced Real Analysis
3		Core Course-III	CC-III	MHMSC-S1P3-4CR26	Advanced Number Theory
4		Skill Enhancement Course-I	SEC-I	MHMSC-S1SEC1-2CR26	Principles of Data Science
			SEC-II	MHMSC-S1SEC2-2CR26	Math with Python [only practical]
			SEC-III	MHMSC-S1SEC3-2CR26	SWAYAM/MOOC etc.
5		Indian Knowledge System	IKS	MHMSC-S1IKS1-2CR26	Introduction to Ancient Mathematics and Astronomy
6		Practical	CCP-I	MHMSC-S1PR1-2CR26	Lab Course-I
			CCP-II	MHMSC-S1PR2-2CR26	Lab Course-II
			CCP-III	MHMSC-S1PR3-2CR26	Lab Course-III
1	II	Core Course - IV	CC-IV	MHMSC-S2P4-4CR26	Complex Analysis
2		Core Course - V	CC-V	MHMSC-S2P5-4CR26	Ordinary Differential Equations
3		Core Course - VI	CC-VI	MHMSC-S2P6-4CR26	Analytic Number Theory
4		Vocational Course-I	VC-I	MHMSC-S2VOC1-2CR26	Applications of Python in Mathematics
5		Practical	CCP-IV	MHMSC-S2PR4-2CR26	Lab Course-IV
			CCP-V	MHMSC-S2PR5-2CR26	Lab Course-V
			CCP-VI	MHMSC-S2PR6-2CR26	Lab Course-VI
			VCP-I	MHMSC-S2VOCPR1-2CR26	Vocational Lab Course-I



M. Sc. (Mathematics) Syllabus

M. Sc. (Mathematics) Syllabus with effect from the Academic year 2026-27

Course	Course Name	Course Number	Credits	Hour	Module	Lectures per module (1 Hr)	Examination		
							Internal Marks	External Marks	Total Marks
SEMESTER I									
Core Courses									
I	Advanced Abstract Algebra	CC-I	4	60	4	15	50	50	100
II	Advanced Real Analysis	CC-II	4	60	4	15	50	50	100
III	Advanced Number Theory	CC-III	4	60	4	15	50	50	100
Skill Enhancement Course									
IV	Principles of Data Science	SEC-I	2	30	2	15	25	25	50
	Math with Python[only practical]	SEC-II	2	60	--	--	25	25	50
IKS									
V	Introduction to Ancient Mathematics and Astronomy	IKS	2	30	2	15	25	25	50
PRACTICAL									
VI	Lab Course-I	CCP-I	2	60	--	--	25	25	50
	Lab Course-II	CCP-II	2	60	--	--	25	25	50
	Lab Course-III	CCP-III	2	60	--	--	25	25	50
SEMESTER II									
Core Courses									
I	Complex Analysis	CC-IV	4	60	4	15	50	50	100
II	Ordinary Differential Equations	CC-V	4	60	4	15	50	50	100
III	Analytical Number Theory	CC-VI	4	60	4	15	50	50	100
Vocational Course									
IV	Applications of Python in Mathematics	VC-I	2	30	2	15	25	25	50
PRACTICAL									
V	Lab Course-IV	CCP-IV	2	60	--	--	25	25	50
	Lab Course-V	CCP-V	2	60	--	--	25	25	50
	Lab Course-VI	CCP-VI	2	60	--	--	25	25	50
	Vocational Lab Course-I	VCP-I	2	60	--	--	25	25	50



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Semester- I



Core Course- I (CC-I)

COURSE NAME: ADVANCED ABSTRACT ALGEBRA

COURSE CODE: MHMSC-S1P1-4CR26 [CREDITS - 04]

Course learning outcome		
At the end of this course, Students will be able to		
1. Understand advanced group theory concepts such as conjugacy, class equations, double cosets, and counting principles. 2. Apply key results like Cauchy's Theorem, Sylow's Theorems, direct products, and the Fundamental Theorem of Finite Abelian Groups to analyse and classify finite groups. 3. Understand polynomial rings, primitive polynomials, and polynomials over commutative rings. 4. Use Gauss's Lemma and the Eisenstein Criterion to study irreducibility of polynomials and unique factorization. 5. Understand field extensions, including finite and algebraic extensions, and study algebraic numbers and roots of polynomials. 6. Understand splitting fields, their uniqueness, and simple and separable extensions.		
Module 1	Groups	[15L]
Learning Objective		
1. To understand advanced group theory concepts including conjugate elements, conjugacy classes, class equations, double cosets, and counting principles, and apply major theorems such as Cauchy's and Sylow's Theorems to study finite groups. 2. To analyse and classify finite abelian groups using direct products and the Fundamental Theorem of Finite Abelian Groups.		
Learning Outcomes:		
At the end of this module the learner will be able to		
1. Understand advanced group theory concepts such as conjugacy, class equations, double cosets, and counting principles. 2. Apply key results like Cauchy's Theorem, Sylow's Theorems, direct products, and the Fundamental Theorem of Finite Abelian Groups to analyse and classify finite groups.		
1.1	Another counting principle, Conjugate of an element, class equation, no. of conjugate classes, Double Cosets, Cauchy theorem	[6L]
1.2	Sylow's theorem, Direct Products, Fundamental Theorem of Finite Abelian Groups.	[9L]
Module 2	Rings	[15L]
Learning Objective		
1. To understand polynomial rings over commutative rings, identify primitive polynomials 2. To apply Gauss's Lemma and Eisenstein's Criterion to study irreducibility and Unique Factorization Domains.		
Learning Outcomes:		
At the end of this module the learner will be able to		



- Understand polynomial rings, primitive polynomials, and polynomials over commutative rings. - Use Gauss's Lemma and the Eisenstein Criterion to study irreducibility of polynomials and unique factorization.		
2.1	Polynomial rings, Primitive polynomials, Gauss' lemma	[6L]
2.2	The Eisenstein criterion, polynomial rings over commutative rings, unique factorization domain	[9L]
Module 3	Fields	[15L]
Learning Objective - To understand finite and algebraic field extensions - Study algebraic numbers along with the roots of polynomials within these extensions.		
Learning Outcomes: At the end of this module the learner will be able to - Understand field extensions, including finite and algebraic extensions - Learn algebraic numbers and roots of polynomials.		
3.1	Extension fields, Finite extension field, Algebraic extension	[9L]
3.2	Algebraic number, Roots of polynomials	[6L]
Module 4	More about Fields	[15L]
Learning Objective - To understand splitting fields and their uniqueness, - To study simple and separable extensions and analyse the properties of polynomial roots in field theory.		
Learning Outcomes: At the end of this module the learner will be able to - Understand splitting fields, their uniqueness. - Learn the concept of more about roots and simple and separable extensions.		
4.1	Splitting fields, Uniqueness of Splitting fields	[8L]
4.2	More about roots, Simple Extension, Separable extension	[7L]

References:

- I. N. Herstein, Topics in Algebra, 3/e, Wiley Eastern Limited, 2016.
- P. B. Bhattacharya, S. K. Jain, S. R. Nagpaul: Basic Abstract Algebra, 2nd edition, Cambridge University Press, 1/e, 1997 (Reprint).
- Vijay K. Khanna and S.K. Bhambri, A Course in Abstract Algebra, 5/e, Vikas Publishing House Pvt Limited, 1993.
- David S. Dummit and Richard M. Foote, Abstract Algebra, 3/e, Wiley Student Edition, 2015.
- John B. Fraleigh and Neal Brand, A First Course in Abstract Algebra, 8/e, Pearson Education Limited, 2020.
- Joseph A. Gallian, Contemporary Abstract Algebra, 4/e, Narosa publishing House, 1999.



7. Shanti Narayan, Text Book of Modern Abstract Algebra, 2/e, S.Chand and Co., New Delhi, 1965 (Reprint).
8. Artin M., Algebra, 2/e, Prentice Hall, Englewood, Cliffs NJ.

Mapping of COs and PSOs

Course Learning Outcomes	Programme Outcomes							
	1	2	3	4	5	6	7	8
Understand advanced group theory concepts such as conjugacy, class equations, double cosets, and counting principles.	X	X	X	X	X	X	X	
Apply key results like Cauchy's Theorem, Sylow's Theorems, direct products, and the Fundamental Theorem of Finite Abelian Groups to analyse and classify finite groups.	X	X	X	X	X	X	X	
Understand polynomial rings, primitive polynomials, and polynomials over commutative rings.	X	X	X	X	X	X	X	
Use Gauss's Lemma and the Eisenstein Criterion to study irreducibility of polynomials and unique factorization.	X	X	X	X		X	X	
Understand field extensions, including finite and algebraic extensions, and study algebraic numbers and roots of polynomials.	X	X	X	X	X	X	X	
Understand splitting fields, their uniqueness, and simple and separable extensions.	X	X	X	X		X	X	



M.Sc. (MATHEMATICS) SEMESTER I

COURSE NAME: LAB COURSE - I

COURSE CODE: MHMSC-S1PR1-2CR26 [Credit- 02]

Course Learning Outcome

After the successful completion of the Course, the learner will be able to:

1. Develop the ability to analyse group theory concepts such as class equations, Sylow theorems, and finite abelian groups, along with polynomial rings and factorization techniques.
2. Apply field theory concepts including extensions, algebraic elements, and splitting fields to study roots of polynomials and advanced algebraic structures.

PRACTICAL: MHMSC-S1PR1-2CR26 (Lab Course - I)

- 1 Examples based on Class equation, no. of conjugate classes, Double Cosets and Cauchy theorem.
- 2 Examples based on Sylow's theorem, Direct Products and Fundamental Theorem of Finite Abelian Groups.
- 3 Examples based on polynomial rings, primitive polynomials and Gauss's lemma
- 4 Examples based on the Eisenstein criterion, polynomial rings over commutative rings and unique factorization domain.
- 5 Examples based on Extension fields, Finite extension field and algebraic extension
- 6 Examples based on algebraic numbers and roots of polynomials.
- 7 Examples based on Splitting fields and Uniqueness of Splitting fields
- 8 Examples based on More about roots, Simple Extension and Separable extension



Core Course- II (CC-II)

COURSE NAME: ADVANCED REAL ANALYSIS

COURSE CODE: MHMSC-S1P2-4CR26 [CREDITS - 04]

Course learning outcome		
At the end of this course, Students will be able to		
1. Explain the concepts of limits on the real line and in metric spaces. 2. Analyse continuity using sequences and identify types of discontinuities. 3. Distinguish between open sets, closed sets, connected sets, and bounded sets. 4. Apply differentiation concepts including Mean Value Theorem, L' Hospital's Rule, and Taylor's Theorem. 5. Analyse point wise and uniform convergence of sequences of functions.		
Module 1	Limits and Metric spaces	[15L]
Learning Objective		
1. To understand the concept of limits of functions on the real line. 2. To define and explain metric spaces and related concepts.		
Learning Outcomes:		
At the end of this module the learner will be able to		
1. Apply the concept of metric spaces to analyse convergence and limits. 2. Identify and differentiate between open and closed sets.		
1.1	Limit of function on the real line, Metric spaces, Limits in metric spaces, Functions continuous at a point on the Real line, Reformulation	[8L]
1.2	Functions continuous on a metric space, Open sets and closed sets, Discontinuous functions on $\mathbb{R}^1$	[7L]
Module 2	Connectedness, completeness and compactness	[15L]
Learning Objective		
1. To understand properties of open sets, connected sets, bounded and totally bounded sets in metric spaces. 2. To study continuous functions on compact spaces, including uniform continuity and continuity of inverse functions.		
Learning Outcomes:		
At the end of this module the learner will be able to		
1. Apply concepts of connectedness, boundedness, and compactness to solve problems in metric spaces. 2. Evaluate properties of continuous functions, including uniform continuity and continuity of inverse functions.		
2.1	More about open sets, connected sets, bounded set and totally bounded sets, Complete metric spaces, Compact metric spaces	[8L]
2.2	Continuous functions on compact metric spaces, continuity of the inverse function, uniform continuity	[7L]
Module 3	Differentiation and Riemann-Stieltjes Integral	[15L]
Learning Objective		
1. To understand concepts of derivatives, including Mean Value Theorem, L' Hospital's Rule, higher-order derivatives and Taylor's Theorem.		



2. To understand the definition and properties of integrals, including the Fundamental Theorem of Calculus and integration of vector-valued functions.		
Learning Outcomes: At the end of this module the learner will be able to 1. Apply differentiation techniques and theorems to analyse real-valued and vector-valued functions. 2. Evaluate definite integrals and apply the Fundamental Theorem of Calculus to solve problems involving integration and differentiation.		
3.1	Derivative of a real function, Mean value theorem, The continuity of derivatives, L' Hospital's Rule, Derivatives of Higher Order, Taylor's Theorem, Differentiation of vector valued functions	[8L]
3.2	Definition and Existence of the Riemann-Stieltjes Integral, Properties of the Riemann-Stieltjes Integral, Integration and Differentiation, fundamental theorem of Calculus, Integration of vector valued functions	[7L]
Module 4	Sequences and Series of a functions	[15L]
Learning Objective 1. To study convergence and uniform convergence of series of functions. 2. To learn the conditions for integration and differentiation of sequences and series of functions.		
Learning Outcomes: At the end of this module the learner will be able to 1. Distinguish between point wise and uniform convergence of sequences and series of functions. 2. Apply results to determine validity of term-wise integration and differentiation of function series.		
4.1	Point wise convergence of a sequences of function, uniform convergence of a sequences of function, consequences of uniform convergence	[8L]
4.2	Convergence and uniform convergence of series of a function, integration and differentiation of a series of a function	[7L]

References:

1. R. R. Goldberg: Methods of Real Analysis, 2/e, Oxford and IBH Publishing Co. (1976).
2. Walter Rudin, Principles of Mathematical Analysis, 3/e, Tata McGraw- Hill, 1985.
3. R. G. Bartle, D. R. Sherbert, Introduction to Real Analysis, 3/e, John Wiley and Sons, New York, 1982.
4. N. L. Carothers, Real Analysis, Cambridge University Press, UK, 2000.
5. K. R. Stromberg, An Introduction to Classical Real Analysis, AMS Chelsea Publishing, 2015.
6. H. L. Royden, Real Analysis, 3/e, Pearson Publishing company, New Delhi, 1988.



Mapping of COs and PSOs

Course Learning Outcomes	Programme Outcomes							
	1	2	3	4	5	6	7	8
Explain the concepts of limits on the real line and in metric spaces.	X	X	X			X		
Analyse continuity using sequences and identify types of discontinuities.	X	X	X	X				
Distinguish between open sets, closed sets, connected sets, and bounded sets.	X	X	X	X				
Apply differentiation concepts including Mean Value Theorem, L' Hospital's Rule, and Taylor's Theorem.	X	X	X				X	
Analyse point wise and uniform convergence of sequences of functions.	X	X	X			X		X



M.Sc. (Mathematics) Semester-I

COURSE NAME: LAB COURSE-II

COURSE CODE: MHMSC-S1PR2-2CR26 [CREDITS- 02]

Course Learning Outcome

After the successful completion of the Course, the learner will be able to:

1. Develop the ability to understand and analyse real and complex fields, metric spaces, sequences, series, limits, continuity, and differentiability.
2. Apply concepts of integration, including Riemann-Stieltjes integrals and vector-valued functions, to study curves and solve advanced analysis problems.

PRACTICAL : MHMSC-S1PR2-2CR26 (Lab Course - II)

Practical-1 Examples based on the real and complex field.

Practical-2 Example related Metric Spaces.

Practical-3 Example related sequences and series.

Practical-4 Example related numerical series.

Practical-5 Example based on limits and continuity.

Practical-6 Example based on the Derivative of a Real Function.

Practical-7 Based on the Integral – Properties of the Integral (Riemann-Stieltjes integral).

Practical-8 Based on Integration and vector valued function – Rectifiable curves.



Core Course- III (CC-III)

COURSE NAME: ADVANCED NUMBER THEORY

COURSE CODE: MHMSC-S1P3-4CR26 [CREDITS - 04]

Course learning outcome		
At the end of this course,		
- Students will learn about Primitive roots and Indices - Students will be able to understand the logic of the Quadratic Reciprocity Law - Students learn about Fibonacci numbers and its various properties. - Students will be able to solve various problems and prove various theorems of number theory		
Module 1	Primitive Roots	[15L]
Learning Objective		
to get knowledge of key concept in number theory, like primitive roots.		
Learning Outcomes:		
At the end of this module the learner will be able to		
Students will learn about Primitive roots		
1.1	Introduction, Congruences, Residues.	[2L]
1.2	The order of an integer modulo n , The exponent of a number mod m , Primitive roots for primes	[4L]
1.3	Primitive roots and reduced residue systems, The nonexistence of primitive roots, The existence of primitive roots mod p for odd primes p , Primitive roots and quadratic residues	[5L]
1.4	The existence of primitive roots mod p^a , The existence of primitive roots mod $2p^a$, The number of primitive roots mod m , Composite numbers having primitive roots	[4L]
Module 2	Indices and Quadratic Congruence	[15L]
Learning Objective		
To get the knowledge of indices theory and Solution of the congruences.		
Learning Outcomes:		
At the end of this module the learner will be able to		
Understand the indices theory and Solution of the congruences, Quadratic Congruence, Euler's criterion and Quadratic residues		
2.1	The theory of indices, The table of Indices, Solution of the congruences of the types $ax^n \equiv b \pmod{p}$ and $x^n \equiv a \pmod{n}$, $\gcd(a, n) = 1$, Decimal representation, Quadratic Congruence	[8L]
2.2	Euler's criterion and examples, Quadratic residues, Legendre symbol, Gauss lemma, Law of quadratic reciprocity, Quadratic residues and primes.	[7L]
Module 3	Quadratic Congruence	[15L]
Learning Objective		
To get the knowledge of Quadratic Congruence		
Learning Outcomes:		
At the end of this module the learner will be able to		
Understand the logic of the Quadratic Congruence		
3.1	Quadratic congruence, Quadratic congruence with composite moduli, Method of solving the congruence $x^2 \equiv a \pmod{2^h}$, The Jacobi symbol	[8L]
3.2	Applications to Diophantine equations, Gauss sums and the quadratic reciprocity law, The reciprocity law for quadratic Gauss sums	[7L]



Module 4 Numbers of special forms		[15L]
Learning Objective 1. to get familiar with numbers of special forms like Perfect numbers, Mersenne primes, Amicable numbers, Fermat numbers, Fibonacci numbers.		
Learning Outcomes: At the end of this module the learner will be able to 1. Students will be able to solve various problems of Numbers of special forms and prove various theorems of number theory		
4.1	Perfect numbers, Mersenne primes, Amicable numbers	[8L]
4.2	Fermat numbers, Pepin's test, Fibonacci numbers	[7L]

References:

1. Tom M. Apostol, Introduction to Analytic Number Theory, Springer, International Student Edition, Reprint 2010.
2. David M. Burton, Elementary Number Theory, 7/e, Tata McGraw Hill Edu. (P) Ltd., New Delhi, 2012
3. G. H. Hardy and et al, An Introduction to the Theory of Numbers, 6/e, Oxford University Press, 2009.
4. S. G. Telang: Number Theory, 4/e, The Tata McGraw Hill Co. Ltd., New Delhi, 2003.

Mapping of COs and PSOs

Course Learning Outcomes	Programme Outcomes							
	1	2	3	4	5	6	7	8
Students will learn about Primitive roots and Indices	X	X	X			X		
Students will be able to understand the logic of the Quadratic Reciprocity Law.	X	X	X					
Students learn about Fibonacci numbers and its various properties.	X	X	X	X	X			
Students will be able to solve various problems and prove various theorems of number theory	X	X	X			X	X	



M.Sc. (Mathematics) Semester-I

COURSE NAME: LAB COURSE-III

COURSE CODE: MHMSC-S1PR3-2CR26 [CREDITS- 02]

Course Learning Outcome

After the successful completion of the Course, the learner will be able to:

1. Develop the ability to solve congruences, analyze primitive roots, and apply concepts of quadratic residues, Legendre symbols, and number-theoretic properties.
2. Apply these concepts to study special numbers such as perfect numbers, Mersenne primes, Fermat numbers, and amicable numbers in problem-solving contexts.

PRACTICAL: MHMSC-S1PR3-2CR26 (Lab Course - III)

Practical-1 Find primitive roots of primes.

Practical-2 Find primitive roots of composite numbers.

Practical-3 Obtain solutions of congruences.

Practical-4 Solve Quadratic Congruence.

Practical-5 Evaluate the Legendre symbol.

Practical-6 Find quadratic residues.

Practical-7 Find perfect numbers.

Practical-8 Based on Mersenne primes, Amicable numbers, Fermat numbers.



Indian Knowledge System- I

COURSE TITLE: INTRODUCTION TO ANCIENT MATHEMATICS AND ASTRONOMY

COURSE CODE: MHMSC-S1IKS1-2CR26 [CREDITS - 02]

Course learning outcome		
At the end of this course, Students will be able to		
1. Understand key features of ancient Indian mathematics and contributions of major mathematicians. 2. Apply basic mathematical concepts such as arithmetic, series, and combinatorics. 3. Study geometric and astronomical ideas from classical Indian texts. 4. Understand the development and unique aspects of Indian astronomy. 5. Explain fundamental concepts of the celestial system and Indian calendar. 6. Interpret the Panchanga and its components in time-reckoning.		
Module 1	Ancient Mathematics	[15L]
Learning Objective		
1. Develop an understanding of the unique features of ancient Indian mathematics and recognize the contributions of major mathematicians in shaping mathematical knowledge. 2. Apply key mathematical concepts such as arithmetic operations, series and progressions, and basic combinatorial ideas including binary numbers and Varasankalita. 3. Study geometric and early astronomical applications from classical sources, including properties of right-angled triangles, approximation of π, and practical problem-solving techniques like shadow problems and magic squares.		
Learning Outcomes:		
At the end of this module the learner will be able to		
1. Understand key features of ancient Indian mathematics and contributions of major mathematicians. 2. Apply basic mathematical concepts such as arithmetic, series, and combinatorics. 3. Study geometric and astronomical ideas from classical Indian texts.		
1.1	Ancient Indians: Tryst with Mathematics, Unique aspects of Indian Mathematics, Great Mathematicians and their contributions	[2L]
1.2	Arithmetic, Square of a number, Square root, Cube root	[3L]
1.3	Series and progressions, Sum of the series of Squares and Cubes, Repeated Summation of Series (Varasankalita)	[2L]
1.4	Geometry-Property of Right-angle Triangle in Sulba-sutras, Shadow Problem- An Astronomy Example	[3L]
1.5	The value of Pi, Binary Mathematics and Combinatorial Problems in Chandah-Sastra of Pingala (300 BCE), Magic Squares in India	[5L]
Module 2	Ancient Astronomy	[15L]
Learning Objective		
1. Develop an understanding of the evolution and distinctive features of Indian astronomy,		



including classical works like Aryabhatiya and the Siddhantic tradition.		
2. Explain key astronomical concepts such as the celestial coordinate system and fundamental elements of the Indian calendar, including solar and lunar months, tithi, and the structure of a year.		
3. Interpret the Panchanga system by identifying and describing its components – tithi, karana, nakshatra, yoga, and vara – and their role in traditional time-reckoning.		
Learning Outcomes: At the end of this module the learner will be able to		
1. Understand the development and unique aspects of Indian astronomy.		
2. Explain fundamental concepts of the celestial system and Indian calendar.		
3. Interpret the Panchanga and its components in time-reckoning.		
2.1	Astronomical Gifts from the King of Benares to the Prince of Wales in 1876, Unique aspects of Indian Astronomy, Historical Development of Astronomy in India.	[3L]
2.2	The Celestial Co-ordinate System	[3L]
2.3	Elements of the Indian Calendar- The notation of a Year, Solar and Lunar Months, The notation of Tithi	[4L]
2.4	Aryabhatiya and the Siddhantic tradition, Panchanga-The Indian Calendar system, Tithi, Karana, Nakshatra, Yoga, Vara	[5L]

References:

1. Prof. B Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R.N., Textbook on Introduction to Indian Knowledge System: Concepts and applications, IIM Bengaluru, PHI publication, New Delhi, 2022.
2. M. C. Bora, Bhartiya Knowledge Systems, 1/e, Khanna Publishing House, 2023.
3. R P Kulkarni, Glimpses of Indian Engineering and Technology (Ancient & Medieval period, Munshiram Manoharlal Publishers Pvt. Ltd. 2018.
4. Subhash Vats, Religion and Dharma, 1/e, Khanna Publishing House, New Delhi, 2025.
5. AK Pathak, Science and Technology in India, Anshika prakashan pratapgarh, 2016.
6. NVP, Unithiri, Indian Scientific Traditions (Professor K.N. Neelakantan Elayath Felicitation Volume), publication division University of Calicut, 2006.
7. Dharmpal, Indian Science and technology in the eighteen century, Rashtrottahana Sahitya, 1983.
8. S Biswal, B L Ray, Vedic Science and Technology, DK Print World, 2009.
9. A Kolachana, Studies in Indian Mathematics and Astronomy, Hindustan Book Agency.
10. S B Rao, Indian Mathematics and Astronomy: Some Landmarks (Revised Third Edition), Bhartiya Vidhya Bhavan, 2012.
11. GG Josheph, Indian Mathematics: Engaging with the World from Ancient to Modern Times, speaking Tiger, 2016.
12. BS Yadav, Ancient Indian Leaps into Mathematics, Brikhausher Publication, 2010.



Mapping of COs and PSOs

Course Learning Outcomes	Programme Outcomes							
	1	2	3	4	5	6	7	8
Understand key features of ancient Indian mathematics and contributions of major mathematicians.	X	X	X	X			X	
Apply basic mathematical concepts such as arithmetic, series, and combinatorics.	X	X	X	X	X	X	X	
Study geometric and astronomical ideas from classical Indian texts.	X	X	X	X	X	X	X	
Understand the development and unique aspects of Indian astronomy.	X	X	X	X			X	
Explain fundamental concepts of the celestial system and Indian calendar.	X	X	X	X	X	X	X	
Interpret the Panchanga and its components in time-reckoning.	X	X	X	X	X	X	X	



Skill Enhancement Course(SEC)

COURSE NAME: Principles of Data Science

COURSE CODE: MHMSC-S1SEC1-2CR26 [CREDITS - 02]

Course learning outcome		
At the end of this course, Students will be able to		
1. Use the tools and techniques used in Data Science process 2. Analyze data analysis techniques for applications handling large data		
Module 1	Introduction to Data Science	[15L]
Learning Objective		
1. Apply scientific techniques to practical problems.		
Learning Outcomes:		
At the end of this module the learner will be able to		
1. The managerial understanding of the tools and techniques used in Data Science process		
1.1	Definition, Benefits and uses of data science and big data, Facts of data, Big Data and Data Science Hype, why data science, Getting Past the Hype, The Current Landscape, who is Data Scientist?	[8L]
1.2	Data Science Process Overview, Defining goals, Retrieving data, Data preparation, Data exploration, Data modelling, Presentation	[7L]
Module 2	Big Data	[15L]
Learning Objective		
1. Provides strong foundation for data science and application area related to information technology		
Learning Outcomes:		
At the end of this module the learner will be able to		
1. Analyze data analysis techniques for applications handling large data		
2.1	Problems when handling large data, General techniques for handling large data, Choosing the right algorithm, Choosing the right data structure, Case study.	[8L]
2.2	Steps in big data, Distributing data storage and processing with Frameworks, Case study.	[7L]



References:

1. D. Cielen, A. D. B. Meysman and M. Ali, Introducing Data Science, Manning Publications Co., 1/e, 2016
2. G. James, D. Witten, T. Hastie and R. Tibshirani, An Introduction to Statistical Learning: with Applications in R, Springer, 1/e, 2013
3. Y. Bengio, A. Courville, Deep Learning, Ian Goodfellow, MIT Press, 1/e, 2016
4. D. J. Patil, H. Mason, M. Loukides, O' Reilly, Ethics and Data Science, 1/e, 2018

Mapping of COs and PSOs

Course Learning Outcomes	Programme Outcomes							
	1	2	3	4	5	6	7	8
Use the tools and techniques used in Data Science process			X	X	X	X		X
Analyze data analysis techniques for applications handling large data			X	X	X	X		X



Skill Enhancement Course (SEC)

COURSE NAME: Math with Python [only Practical]

COURSE CODE: MHMSC-S1SEC2-2CR26 [CREDITS – 02]

Course learning outcome
At the end of this course, Students will be able to 1. Understand and apply basic Python programming concepts, including installation, working with IDEs, variables, data types, input/output operations, and built-in functions. 2. Demonstrate the use of operators, expressions, and mathematical functions to solve computational problems effectively. 3. Utilize popular Python libraries such as NumPy and SymPy for numerical computation and basic data handling. 4. Perform basic data analysis and visualization, including data manipulation, interpretation, and graphical representation using Pandas and Matplotlib. 5. Develop simple Python-based solutions for real-world problems, integrating programming concepts and data analysis techniques.
Introduction to Python, Data Types, Control Structures, Data Analysis & Visualization
Installation, IDE, Variables, Built-in functions, Input and Output, Modules and packages, Data types and data structures, Use of mathematical operators and mathematical functions, Programming Structures (Conditional structure, The for loop, The while loop, nested statements), Introduction to popular Python libraries (e.g., NumPy, SymPy, Matplotlib), Introduction to data analysis and visualization in Python, working with data using Python libraries (e.g., Pandas, Matplotlib).

Practical:

Practical-1	Installation, IDE, and Getting Started.
Practical-2	Program to swap the values of two variables.
Practical-3	Program to calculate the sum and average of a list of numbers using functions.
Practical-4	Program to obtain the length and breadth of a rectangle and calculate its area.
Practical-5	Program to calculate the sum of even and odd integers of first n natural numbers.
Practical-6	Program to check if the input year is a leap year or not.
Practical-7	Program to print Fibonacci series.
Practical-8	Program to calculate the factorial of a number.
Practical-9	Program to input a number and test if it is a prime number.
Practical-10	Program that searches for prime number from 15 through 25.
Practical-11	Program to compute the Taylor series expansion of a function.
Practical-12	Program to find lowest and second lowest number from the 10 numbers input.



Practical-13	Program to implement 'guess the number' game. Python generates a number randomly in the range [10,50]. The user is given five chances to guess a number in the range.
Practical-14	Program to read data from a CSV file using the Pandas library and perform data analysis.
Practical-15	Program to create a class representing a student and calculate their grades based on certain criteria.
Practical-16	Program to create a class representing a graph and perform basic operations like adding nodes, edges

References:

1. H. P. Langtangen, A Primer on Scientific Programming with Python, 2nd ed., Springer, 2016
2. H. Fangohr, Introduction to Python for Computational Science and Engineering (A beginner's guide), University of Southampton, 2015.
(<https://www.southampton.ac.uk/~fangohr/training/python/pdfs/Python-for-Computational-Science-and-Engineering.pdf>)
3. Timothy A Budd, "Exploring Python", Tata McGraw Hill, New Delhi. Michel Dawson, "Python Programming for Absolute Beginners", Third Edition, Course Technology Cengage Learning Publications, 2013.
4. E Balagurusamy, Introduction to Computing & Problem Solving using Python, 1st ed., McGraw Hill Education (India) Private Limited, New Delhi

Mapping of COs and PSOs

Course Learning Outcomes	Programme Outcomes							
	1	2	3	4	5	6	7	8
Understand and apply basic Python programming concepts, including installation, working with IDEs, variables, data types, input/output operations, and built-in functions.				X	X	X		X
Demonstrate the use of operators, expressions, and mathematical functions to solve computational problems effectively.			X	X	X	X		X
Utilize popular Python libraries such as NumPy and SymPy for numerical computation and basic data handling.			X	X	X	X		X
Perform basic data analysis and visualization, including data manipulation, interpretation, and graphical representation using Pandas and Matplotlib.				X	X	X		X
Develop simple Python-based solutions for real-world problems, integrating programming concepts and data analysis techniques.				X	X	X		X