**CORE (Mathematics) COURSE 14**

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| --- | --- | --- | --- |
| **Course Code** | **Course Name** | **L-T-P** | **Credits** |
| **MTH4212** | **Foundation Course in Ancient Indian****Mathematics** | **3-1-0** | **4** |

**Course Description**

This course is offered as a Core Course for B.Sc. B.Ed Mathematics students. It focuses on developing a historical perspective and context of ancient Indian mathematics to the present day. It intends to discuss the inter-disciplinary nature of mathematics learning in IKS, make connections with different subjects like computer science, art, music, astronomy, through the applications of mathematics. The course also introduces non-routine computational techniques in basic arithmetic operations.

**Course Introduction**

This is a foundational course in history of Indian mathematics. The course is exploratory in nature. Apart from developing a historical perspective and context of ancient Indian mathematics to the present day, the course intends to dive deep into understanding and applying them. It discusses topics like Pythagorean Triplets, Brahmaguptan Tetrads, Cyclic Quadrilaterals, Linear Indeterminate Equations, Quadratic Indeterminate Equations and Magic Squares highlighting the interplay between Algebra, Geometry and Arithmetic.

**Course Objective**

On the completion of the Course, the student teacher will be able to

1. Appreciate the history of Indian mathematics
2. Analyse the inter-disciplinary nature of mathematics in IKS
3. Make connections with different subjects like computer science, art, music, astronomy,

 through the applications of mathematics

1. Apply the techniques of arithmetic from Vedic mathematics
2. Apply the knowledge of Indian mathematics in relevant classroom instructions as a

 mathematics teacher

**Course Outcome**

On completion of the course the student teacher will be able to:

1. Appreciate the history of Indian mathematics
2. Analyse the inter-disciplinary nature of mathematics in IKS
3. Apply Indian mathematics to develop connections with different subjects like computer

 science, art, music and astronomy

1. Apply the techniques of arithmetic from Vedic mathematics in solving problems
2. Critically compare the concepts and approaches from ancient Indian mathematics with those

 in contemporary mathematics as well as how it developed in other ancient civilisations

1. Apply the knowledge of Indian mathematics in relevant classroom instructions as a mathematics Teacher.

**PO-CO Mapping**

**PO-CO Mapping Matrix**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CO/PO Mapping | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
| CO1 | ✓ |  |  |  | ✓ | ✓ | ✓ |  |
| CO2 | ✓ |  |  |  | ✓ | ✓ | ✓ |  |
| CO3 | ✓ | ✓ | ✓ |  |  |  |  |  |
| CO4 | ✓ |  | ✓ |  |  | ✓ |  |  |

**Prerequisites and other constraints**

There are no prerequisites for taking the course.

**Pedagogy**

This course employs classroom interactive lectures, talks by experts and in-class discussions,

practical explorations and discussions. It will also have quizzes, case discussions and student

 presentations.

**Suggested Reading:**

1. Saraswati Amma - Geomety in Ancient and Medieval India (2ed 1999)
2. Seshadri (ed) - Studies in the History of Indian Mathematics (2010)
3. Srinivasiengar - The History of Ancient Indian mathematics (1967)
4. Plofker - Mathematics in India (2010)
5. Datta and Singh - History of Hindu Mathematics (1935, 1938, 1962)
6. Emch\_Sridharan\_Srinivas - Contributions of the History of Indian Mathematics (2005)
7. Er. Venugopal Heroor - Brahmaguptaganitam (2014)
8. Swami Bharati Krishna Tirtha - Vedic Mathematics
9. Triples: Application of Pythagorean triples- Kenneth Williams (1984)
10. Datta\_Singh\_Shukla - Hindu Geometry (1979)
11. Datta\_Singh\_Shukla - Magic Squares in India (1992)
12. Datta\_Singh\_Shukla - Permutations and Combinations
13. K. R. S. Sastry - Brahmagupta Quadrilaterals
14. Sreeramula Rajeswara Sarma - The Katapayadi system of numerical notation
15. NPTEL, Mathematics in India - From Vedic Period to Modern Times

 https://youtube.com/playlist?list=PLbMVogVj5nJThf31TNSQzuN7zqxe7HdRN

**Extra reading:**

1. Joseph - The Crest of the Peacock (3ed 2011)
2. Parameswaran - The Golden Age of Indian Mathematics (1998)
3. History of Hindu mathematics (Volume 1 and 2): Bibhutibhushan Datta, Avdhesh Narayan

 Singh

1. A Primer to Bharatiya Ganitam Part 1, Samskrit Promotion Foundation

**Evaluation Pattern**

 **Evaluation Pattern Matrix**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Continuous****Internal****Assessment (CIA) Components** | **Component Type** | **Weightage Percentage** | **Total****Marks** | **Tentative Dates** | **Course Outcome Mapping** |
| Mid-term Exam | 50 % 0f CIA Marks | 15 | Around 9th week | 1, 2  |
| Assignment | 25% of CIA | 7.5 | End of each module | 1, 2, 3, 4 |
| Quizzes/ Problem Solving | 17% of CIA | 5 | Every two weeks | 1, 2, 3, 4 |
|  | Presentations | 8% of CIA | 2.5 | End of two modules | 1, 2, 3, 4 |
|  | CIA Marks | 30% | 30 |  |  |
| ESE | 70% | 70 | End of the Semester | End of the semester |

**Module Sessions**

**Module I: History of Indian mathematics (15 Hours)**

* + Appearance of mathematical ideas in India as well as in other cultures. Ancient explorations compared to their known counterparts. Cultural heritage behind the development of rich legacy of mathematics.
	+ Historical timeline of history and development of Mathematics in ancient India in comparison to history and development of Mathematics in the West.
	+ Sulba Sutras (With practical constructions on the ground): Construction of various shapes, Pythagorean Theorem, Transformation of different shapes, Derivation of Root 2.
	+ History and development of zero and number system in different civilisations
	+ Introduction to Kerala school of mathematics. Birth of calculus - Bhaskara’s sine approximation formula.
	+ Various aspects of coding and decoding systems that were prevalent in India - Katapayadi and Bhuta Sankhya.

**Readings:**

1. Saraswati Amma - Geomety in Ancient and Medieval India (2ed 1999)
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4. Plofker - Mathematics in India (2010)
5. Datta and Singh - History of Hindu Mathematics (1935, 1938, 1962)
6. Emch\_Sridharan\_Srinivas - Contributions of the History of Indian Mathematics (2005)
7. Er. Venugopal Heroor - Brahmaguptaganitam (2014)
8. Parameswaran - The Golden Age of Indian Mathematics (1998)

**Activities:**

1. Group/Individual presentation: Compare and contrast the notion of zero in different civilisations
2. Activities: Physical constructions of Sulba sutra on the ground
3. Quizzes
4. Assignments

**Module II: Vedic Mathematics (12 Hours)**

Vedic Mathematics – Understanding and applications of sutras

1. Techniques in multiplication
2. Digital Root
3. Compound Multiplication
4. Divisibility Rules

**Readings:**

* 1. Swami Bharati Krishna Tirtha - Vedic Mathematics

**Activities:**

1. Design a pool of puzzles based on Vedic Mathematics that can be used by teachers in a classroom which they can use to build higher order thinking skills.
2. Quizzes & Assignments
3. Problem solving

**Module III: Mathematics & Algorithms in Poetry & Music (15 Hours)**

Introduction to algorithms and mathematics in literature on Chandas and Music

1. Algorithms in Poetry & Music
	1. Listing
	2. Finding rth row in an array
	3. Finding the row number based on a string
	4. Computing 2^n using an optimal algorithm
2. Counting
	1. Techniques in counting
	2. Varna Meru (Pascal’s Triangle)
	3. Matra Meru

3. Binary mathematics

4. Iterations and Recursions

**Readings:**

1. Seshadri (ed) - Studies in the History of Indian Mathematics (2010)
2. Datta and Singh - History of Hindu Mathematics (1935, 1938, 1962)
3. NPTEL, Mathematics in India - From Vedic Period to Modern Times

https://youtube.com/playlist?list=PLbMVogVj5nJThf31TNSQzuN7zqxe7HdRN

**Activities:**

1. Presentations/Seminars on using inter-disciplinary study of mathematics and music, algorithms in music and computer science, mathematics and computer science, through the lens of IKS
2. Assignments/Quizzes on Problem solving

**Module IV: Interplay between Geometry,Algebra and Arithmetic (18 Hours)**

De compartmentalized approach to learning mathematics through

1. Pythagorean Triplets
2. Brahmagupta Tetrads
3. Cyclic Quadrilaterals
4. Linear Indeterminate Equations
5. Quadratic Indeterminate Equations
6. Magic Squares

**Readings:**

1. Saraswati Amma - Geomety in Ancient and Medieval India (2ed 1999)
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6. Emch\_Sridharan\_Srinivas - Contributions of the History of Indian Mathematics (2005)
7. Er. Venugopal Heroor - Brahmaguptaganitam (2014)
8. Triples: Application of Pythagorean triples- Kenneth Williams (1984)

**Activities:**

1. Create physical or digital interactive (using software like GeoGebra) models of

 all three possible cyclic quadrilaterals for a given Tetrad, OR

1. Write a code to generate Pythagorean Triplets & Tetrads using two variables

 as explained by Brahmagupta.

1. Write codes to create Magic squares of different orders.
2. Problem Solving Assignments & Quizzes