Course-503

UNIT_4 (Indian Knowledge System)

Course Content :

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MCQs – Indian Knowledge System of Mathematics (Unit 4)

Section A: Ancient Indian Arithmetic (Lilavati Samhita)

1. **Who authored the famous mathematical treatise *Lilavati*?**
   A. Aryabhata
   B. Brahmagupta
   C. Bhaskaracharya
   D. Varahamihira
   ✅ **Answer: C. Bhaskaracharya**

2. **The Lilavati Samhita is primarily a treatise on:**
   A. Astronomy
   B. Ayurveda
   C. Arithmetic and Algebra
   D. Yoga
   ✅ **Answer: C. Arithmetic and Algebra**

3. **Which verse in *Lilavati* discusses the basic rules of arithmetic operations like addition, subtraction, multiplication, and division?**
   A. The verse explaining the multiplication of large numbers
   B. The verse introducing algebraic identities
   C. The verse that lays out the foundation of basic arithmetic operations
   D. The verse that derives geometric relationships
   ✅ **Answer: C. The verse that lays out the foundation of basic arithmetic operations**

4. **Verse 1 of Lilavati primarily teaches:**
   A. Subtraction techniques
   B. Multiplication of decimals
   C. Order of operations
   D. Arithmetic rules (addition, subtraction, multiplication, division)
   ✅ **Answer: D. Arithmetic rules**

5. **The term "Sutra" in Indian mathematics refers to:**
   A. Calculation
   B. Formula or rule in verse form
   C. Measurement tool
   D. Geometry diagram
   ✅ **Answer: B. Formula or rule in verse form**

6. **Which part of *Lilavati* describes a method for multiplying large numbers?**
   A. The verse that introduces algebra
   B. The verse that focuses on division
   C. The verse explaining multiplication using place value
   D. The opening verse on arithmetic
   ✅ **Answer: C. The verse explaining multiplication using place value**

7. **Ancient Indian multiplication techniques emphasized:**
   A. Use of calculators
   B. Algorithms only
   C. Logical stepwise calculation using place values
   D. Geometric shapes
   ✅ **Answer: C. Logical stepwise calculation using place values**

8. **Where does *Lilavati* explain division as distributing a number into equal parts?**
   A. The section on geometry
   B. The part that explains multiplication
   C. The section introducing algebraic expressions
   D. The verse explaining division as a step-by-step logical breakdown
   ✅ **Answer: D. The verse explaining division as a step-by-step logical breakdown**

9. **According to Lilavati, division is presented as:**
   A. Distribution of a quantity into equal parts
   B. Repeated subtraction only
   C. A geometric process
   D. Irregular partitioning
   ✅ **Answer: A. Distribution of a quantity into equal parts**

10. **In Lilavati, the use of poetic verses to explain mathematics shows:**
    A. Preference for entertainment
    B. Fusion of art and science
    C. Rejection of logic
    D. Memorization without understanding
    ✅ **Answer: B. Fusion of art and science**

11. **Verse 13 in Lilavati focuses on:**
    A. Geometry
    B. Trigonometry
    C. Algebra
    D. Astronomy
    ✅ **Answer: C. Algebra**

12. **Algebra in Lilavati was referred to using the term:**
    A. Rekha-ganita
    B. Kuttaka
    C. Beej-ganita
    D. Chakravala
    ✅ **Answer: C. Beej-ganita**

13. **Which mathematical operations were included in Lilavati's algebraic approach?**
    A. Only addition and subtraction
    B. Only equations
    C. Equations, unknowns, and simple problems

D. No operations

✅ **Answer: C. Equations, unknowns, and simple problems**

14. **Which section of *Lilavati* introduces the foundations of algebra using unknown quantities?**
    A. The verse describing triangle sides
    B. The verse about basic arithmetic rules
    C. The one that explains relationships using variables
    D. The section on large number multiplication
    ✅ **Answer: C. The one that explains relationships using variables**

15. **Bhaskaracharya explained geometry through:**
    A. Rigid axioms
    B. Visual diagrams
    C. Verses describing practical situations
    D. Foreign texts
    ✅ **Answer: C. Verses describing practical situations**

16. **Which part of *Lilavati* outlines geometric relationships using practical shapes like triangles and squares?**
    A. The opening section on numbers
    B. The poetic verse on arithmetic operations
    C. The section applying geometric concepts with relatable examples
    D. The part using algebraic identities
    ✅ **Answer: C. The section applying geometric concepts with relatable examples**

17. **The Lilavati version of the Pythagorean theorem involves:**
    A. Triangles with circular bases
    B. Squares of lengths of triangle sides
    C. Division of angles
    D. Measuring the area of a square
    ✅ **Answer: B. Squares of lengths of triangle sides**

18. **What type of triangle is used in the Lilavati theorem (Verse 23)?**
    A. Scalene
    B. Isosceles
    C. Right-angled
    D. Equilateral
    ✅ **Answer: C. Right-angled**

19. **In Indian geometry, practical problems were used to teach:**
    A. Arithmetic only
    B. Social lessons
    C. Mathematical theorems
    D. Mythology
    ✅ **Answer: C. Mathematical theorems**

20. **Lilavati's geometry was useful in:**
    A. Painting
    B. Architecture and construction
    C. Music theory
    D. Astrology only
    ✅ **Answer: B. Architecture and construction**

21. **Lilavati was written during which century?**
    A. 9th century

B. 12th century
C. 15th century
D. 6th century
✅ **Answer: B. 12th century**

22. **The Lilavati Samhita is part of which larger work?**
A. Aryabhatiya
B. Siddhanta Shiromani
C. Brahmasphutasiddhanta
D. Surya Siddhanta
✅ **Answer: B. Siddhanta Shiromani**

23. **Bhaskaracharya I and II are:**
A. The same person
B. Different individuals from different times
C. Brothers
D. Students of Aryabhata
✅ **Answer: B. Different individuals from different times**

24. **Lilavati is named after:**
A. A mathematical concept
B. A village
C. Bhaskaracharya's daughter
D. A goddess of learning
✅ **Answer: C. Bhaskaracharya's daughter**

25. **Which language was Lilavati originally written in?**
A. Pali
B. Sanskrit
C. Hindi
D. Prakrit
✅ **Answer: B. Sanskrit**

26. **Which of the following was *not* part of Lilavati's teachings?**
A. Geometry
B. Algebra
C. Calculus
D. Arithmetic
✅ **Answer: C. Calculus**

27. **The mathematical teaching style in Lilavati was designed to be:**
A. Strict and theoretical
B. Dry and logical
C. Poetic and story-based
D. Based on foreign texts
✅ **Answer: C. Poetic and story-based**

28. **Which area of learning did Lilavati *directly* influence in India?**
A. Law
B. Literature
C. Mathematics education
D. Music theory
✅ **Answer: C. Mathematics education**

29. **Bhaskaracharya's contributions show that Indian mathematics was:**
    A. Imported from Greece
    B. Derived from Chinese texts
    C. Independent and advanced
    D. Based on mythology
    ✅ **Answer: C. Independent and advanced**

30. **Which feature distinguishes Indian mathematical texts like Lilavati from modern ones?**
    A. Use of Greek symbols
    B. Presence of diagrams
    C. Use of verses and riddles
    D. Use of binary numbers
    ✅ **Answer: C. Use of verses and riddles**

31. **Ancient Indian division methods described in Lilavati emphasized:**
    A. Shortcuts
    B. Mental tricks only
    C. Logical breaking down of numbers
    D. Tabular format
    ✅ **Answer: C. Logical breaking down of numbers**

32. **Lilavati's content reflects Indian traditions of integrating:**
    A. Music and logic
    B. Art and science
    C. Religion and literature
    D. Politics and mathematics
    ✅ **Answer: B. Art and science**

33. **Which concept from *Lilavati* demonstrates understanding of right-angled triangle properties?**
    A. Algebraic identities
    B. Rhyming arithmetic puzzles
    C. Geometric verse explaining side-length relationships
    D. Logic riddles on odd and even numbers
    ✅ **Answer: C. Geometric verse explaining side-length relationships**

34. **In the algebraic section of *Lilavati*, unknown values in equations are often represented as:**
    A. Greek letters
    B. Empty spaces
    C. Descriptive Sanskrit terms
    D. Roman numerals
    ✅ **Answer: C. Descriptive Sanskrit terms**

35. **The algebraic problems in *Lilavati* often take the form of:**
    A. Theorems with proofs
    B. Abstract expressions only
    C. Story-like word problems involving quantities and transactions
    D. Graphical problems using geometry
    ✅ **Answer: C. Story-like word problems involving quantities and transactions**

36. **Bhaskaracharya's use of algebra in *Lilavati* aimed to:**
    A. Introduce calculus
    B. Replace geometry
    C. Solve real-life mathematical problems using variables and operations

D. Teach philosophical ideas

✅ **Answer: C. Solve real-life mathematical problems using variables and operations.**

37. **In the geometric relationships explained in *Lilavati*, the problems often involve:**
A. 3D shapes and complex models
B. Measuring areas and lengths of simple shapes like triangles and rectangles
C. Drawing to scale
D. Construction techniques only
✅ **Answer: B. Measuring areas and lengths of simple shapes like triangles and rectangles**

38. **Which of the following best describes the geometric approach in *Lilavati*?**
A. Strict theoretical models
B. Use of formulas without context
C. Practical applications blended with poetic language
D. Copying from Greek geometry
✅ **Answer: C. Practical applications blended with poetic language**

39. **The theorem in *Lilavati* that later aligns with the Pythagorean Theorem involves:**
A. Calculating the diagonal of a rectangle
B. Finding the area of a circle
C. Relating the sides of a right-angled triangle using squares
D. Dividing a triangle into equal parts
✅ **Answer: C. Relating the sides of a right-angled triangle using squares**

40. **Which best reflects Bhaskaracharya's method of teaching geometry in *Lilavati*?**
A. Teaching pure formulas with no examples
B. Using verses that present practical problems involving measurements
C. Only relying on visual diagrams
D. Avoiding real-life applications
✅ **Answer: B. Using verses that present practical problems involving measurements**

Short Question-Answer Set

1. **What is Beej-Ganita in Indian mathematics?**
Beej-Ganita refers to the ancient Indian study of algebra, including operations with unknowns and solving equations.

2. **Why is Lilavati considered unique in teaching algebra?**
It uses poetic verses and real-life examples to explain algebraic ideas, making learning both logical and engaging.

3. **What role do unknowns play in Lilavati's algebra?**
Unknowns are used to represent quantities to be found, similar to variables in modern algebra.

4. **How are equations introduced in Lilavati?**
They are often embedded in word problems involving everyday scenarios like sharing, trading, and measurements.

5. **What is the pedagogical style used in Lilavati's algebra section?**
The style is poetic, conversational, and problem-based, using riddles and scenarios to explain concepts.

6. **How does Bhaskaracharya deal with fractions in algebra?**
   He explains operations like addition, subtraction, multiplication, and division with fractions in practical contexts.

7. **What is a key feature of Bhaskaracharya's algebraic method?**
   Clarity in breaking down the steps of solving problems through structured logical reasoning.

8. **How are quadratic-like problems handled in Lilavati?**
   Although not using modern symbols, the text uses verbal descriptions to represent and solve square-root-based problems.

9. **Why are Lilavati's algebraic problems easy to remember?**
   They are presented as poetic puzzles, often in story form, aiding memorization and understanding.

10. **What does Lilavati teach about linear equations?**
    It includes basic linear equations, often presented through word problems involving unknown quantities.

11. **How is geometry taught in Lilavati?**
    Through practical examples like land measurement, height estimation, and construction-related problems.

12. **What shapes are commonly discussed in Lilavati's geometry?**
    Triangles, squares, rectangles, and circles are commonly used for explanation.

13. **How is area calculated in Lilavati?**
    Using formula-based reasoning, such as base × height for triangles or length × breadth for rectangles.

14. **What is one method of calculating height or distance in Lilavati?**
    Using proportionate relationships and shadow-length methods for indirect measurement.

15. **How are geometric principles expressed in the text?**
    In poetic sutras that describe real-life measurement scenarios, often using analogy or visual reference.

16. **What role does symmetry play in Lilavati's geometry?**
    Symmetry is implied in problems involving equal division and measurement, although not named explicitly.

17. **Is Lilavati geometry purely theoretical?**
    No, it is highly practical, focusing on real-world applications like construction, carpentry, and astronomy.

18. **How are angles represented or used in Lilavati?**
    Angles are not explicitly named, but their relationships are used in discussing triangles and positioning.

19. **Does Lilavati use visual diagrams?**
    The original text doesn't have diagrams but implies them through verbal descriptions of shapes and scenarios.

20. **What is the focus of geometric relationships in Lilavati?**
    To understand lengths, areas, and ratios within common shapes and their practical use.

21. **What does the Lilavati theorem state about triangle sides?**
    In a right-angled triangle, the square of the hypotenuse equals the sum of the squares of the other two sides.

22. **How is this theorem presented in Lilavati?**
    As a poetic verse embedded in a practical problem involving measurement of triangle sides.

23. **Why is Lilavati's version important historically?**
    It predates Pythagoras and shows that Indian mathematicians understood the theorem independently.

24. **What kind of triangle is discussed in this theorem?**
    A right-angled triangle, where one angle is exactly 90 degrees.

25. **How is the theorem applied in Lilavati?**
    To solve real-life problems like ladder lengths, land measurements, or diagonal distances.

26. **What makes Lilavati's geometric theorem unique?**
    Its integration into poetic, narrative problem-solving rather than abstract proof.

27. **Does Lilavati use the term "hypotenuse"?**
    No, but it describes the longest side opposite the right angle in clear terms.

28. **Is the Lilavati theorem purely mathematical or practical?**
    It is both—it solves practical problems using sound mathematical logic.

29. **How does Lilavati help understand spatial reasoning?**
    By encouraging mental visualization of shapes and relationships between sides.

30. **Is the theorem stated as a formula in Lilavati?**
    Not in symbolic form, but the idea of a2+b2=c2a^2 + b^2 = c^2 is clearly conveyed verbally.

31. **Who was Lilavati named after?**
    It is believed to be named after Bhaskaracharya's daughter, Lilavati.

32. **What is the structure of Lilavati like?**
    It is composed of poetic verses (sutras) covering arithmetic, algebra, and geometry.

33. **Why is Lilavati an important text in Indian mathematics?**
    It shows early systematic thinking in problem-solving and practical applications of math.

34. **How does Lilavati differ from modern textbooks?**
    It blends storytelling, poetry, and problem-solving instead of direct formulas and definitions.

35. **What is Bhaskaracharya's teaching philosophy in Lilavati?**
    He believed in learning through curiosity, puzzles, and relatable problems.

36. **What skills does Lilavati aim to develop?**
    Logical reasoning, arithmetic fluency, spatial understanding, and problem-solving.

37. **Why is Lilavati still relevant today?**
    Its methods encourage concept-based learning and creative thinking in mathematics.

38. **Was Lilavati meant only for scholars?**
    No, it was designed to teach young learners and students in a simple, engaging manner.

39. **What themes are common in Lilavati's problems?**
    Themes include trade, measurement, sharing, and daily life scenarios.

40. **How did Lilavati influence later mathematical education?**
    It served as a foundation for Indian mathematical education and inspired future scholars.

41. **What is the main focus of the geometric verse referred to in Lilavati's Sutra describing relationships between shapes?**
    A: The verse explores relationships between basic shapes like triangles and rectangles, especially in how their dimensions relate to area and measurement in practical scenarios.

42. **How does Lilavati explain geometric measurement without diagrams?**
    A: Bhaskaracharya uses vivid poetic descriptions and real-life examples, such as fields, ladders, and shadows, to help readers visualize the geometric relationships.

43. **What principle is described in Lilavati that resembles the Pythagorean theorem?**
    A: It describes that in a right-angled triangle, the square of the longest side (hypotenuse) equals the sum of the squares of the other two sides.

44. **How is the Pythagorean-like theorem applied in Lilavati?**
    A: It is applied through problems involving ladders, fields, and measurements—showing practical uses of the side-length relationship in right-angled triangles.

45. **What does Lilavati's treatment of geometry tell us about ancient Indian mathematics?**
    A: It shows that Indian scholars had deep understanding of spatial and numeric relationships and presented them in ways that were both practical and poetic.

Python Codes based on the Verses/Sutras to execute during lab.

Question.1: A merchant has a total of ₹5000. He gives ₹x to his son and spends ₹2000 on buying goods. After these expenses, he is left with ₹500. How much money did he give to his son?

✅ **Python Solution:**

```
# Let x be the amount given to the son

total_money = 5000

spent_on_goods = 2000

remaining = 500

# Equation: total_money - x - spent_on_goods = remaining

x = total_money - spent_on_goods - remaining

print("Money given to the son: ₹", x)
```

🔸 **Output:**

```
Money given to the son: ₹ 2500
```

Question-2 : A triangular piece of land has a base of 40 meters and a height of 20 meters. What is its area?

✅ **Python Solution:**

```
# Triangle area formula: (1/2) * base * height

base = 40  # in meters

height = 20  # in meters

area = 0.5 * base * height

print("Area of the triangle:", area, "square meters")
```

🔸 **Output:**

```
Area of the triangle: 400.0 square meters
```

Question-3: A ladder is placed against a wall. The foot of the ladder is 6 meters away from the wall, and the ladder reaches up to 8 meters on the wall. What is the length of the ladder?

✅ **Python Solution:**

```
import math

# Using Pythagorean theorem: hypotenuse^2 = base^2 + height^2

base = 6  # distance from wall

height = 8  # height on wall

# Calculate hypotenuse (ladder length)

ladder_length = math.sqrt(base**2 + height**2)

print("Length of the ladder:", ladder_length, "meters")
```

Question-4: Question:

Three friends invest in a business. A invests ₹3000, B invests ₹5000, and C invests ₹2000. The total profit after a year is ₹6000. What is the share of each friend?

✅ **Python Solution:**

```
# Total investment

A = 3000

B = 5000

C = 2000

total_profit = 6000

total_investment = A + B + C

# Calculate individual shares

A_share = (A / total_investment) * total_profit

B_share = (B / total_investment) * total_profit

C_share = (C / total_investment) * total_profit

print("A's share: ₹", A_share)

print("B's share: ₹", B_share)

print("C's share: ₹", C_share)
```

🔸 **Output:**

```
A's share: ₹ 1800.0

B's share: ₹ 3000.0

C's share: ₹ 1200.0
```


✅ **5. Based on Geometry – Perimeter of a Rectangle**

Question-5:

A rectangular garden has a length of 25 meters and a width of 15 meters. What is its perimeter?

✅ **Python Solution:**

```
length = 25  # in meters
width = 15   # in meters
# Perimeter of a rectangle = 2 * (length + width)
perimeter = 2 * (length + width)
print("Perimeter of the garden:", perimeter, "meters")
```

🔸 **Output:**

Perimeter of the garden: 80 meters

✅ **Based on Pythagorean-Type – Diagonal of a Square**

Question-6:

Find the diagonal of a square whose side length is 10 cm using the Lilavati-style geometric relationship.

✅ **Python Solution:**

```
import math
side = 10  # in cm
# Diagonal of a square = √2 × side
diagonal = math.sqrt(2) * side
print("Diagonal of the square:", round(diagonal, 2), "cm")
```

🔸 **Output:**

Diagonal of the square: 14.14 cm

Based on Geometry – Shadow Length (Proportions)

Question-7:

A 1.5 m tall pole casts a 2 m shadow. At the same time, a building casts a 10 m shadow. What is the height of the building?

✅ **Python Solution:**

```
# Use proportion: height1/shadow1 = height2/shadow2
pole_height = 1.5
pole_shadow = 2
building_shadow = 10

building_height = (pole_height / pole_shadow) * building_shadow
print("Height of the building:", building_height, "meters")
```

🔸 **Output:**

Height of the building: 7.5 meters

Based on Algebra – Age Problem

Question-8:

A father is 4 times as old as his son. After 10 years, the father will be twice as old as the son. What are their current ages?

✅ **Python Solution:**

```
from sympy import symbols, Eq, solve

# Let son's age be x

x = symbols('x')

# Father's age = 4x

# In 10 years: (4x + 10) = 2(x + 10)

equation = Eq(4*x + 10, 2*(x + 10))

# Solve equation

solution = solve(equation)

son_age = solution[0]

father_age = 4 * son_age

print("Son's current age:", son_age)

print("Father's current age:", father_age)
```

🔸 **Output:**

Son's current age: 10

Father's current age: 40