- Define the domain and range of a function and define and plot simple inverse trigonometric and hyperbolic functions.
- Sketch curves using properties such as symmetry, intercepts, discontinuities, turning points and asymptotic behaviour.
- Sum arithmetic, geometric and telescoping series; test series for convergence; find the Maclaurin series of a function; manipulate power series; use lHopitals rule.
- Integrate standard functions using substitution and parts; Apply to calculation of areas and volumes.
- Integrate numerically using Simpsons rule.
- Find partial derivatives of functions of two variables as well as higher partial derivatives; apply to analysis of small errors.

1 Week 3 Fundamentals and Functions

1. Exponentials and Powers
2. Logarithms
3. Factorizations
4. Number Types (natural numbers, real numbers, integers, rational numbers)

2 Week 4 Functions

1. Domain, Codomain and Range
2. One to One and Onto Functions (using Arrow Diagrams)
3. Special Functions
4. Inverting a Function
5. hyperbolic Functions
   show that
$$cosh^2(x) - sinh^2(x) = 1$$
$$cosh(x + y) = cosh(x)cosh(y) + sinh(x)sinh(y)$$

1 Find $f^{-1}(x)$ the inverse of the function
$$f(x) = \frac{1}{2x - 5}$$

2 Check whether the following functions are even, odd or neither.

(i)
$$f(x) = \frac{4}{x2 + 1}$$

(ii) $f(x) = sin(4x)$

(iii) $f(x) = -cos(3x)$

(iv)
$$f(x) = \frac{3x + 2}{4x + 3}$$

3 Week 6 Sequences and Series

1. Three consecutive terms of an arithmetic series are

$$4x + 11, 2x + 11, 3x + 17$$

. Find the value of x.

2. Find the sum of the first 10 numbers of this arithmetic series: $1, 11, 21, 31, \ldots$

3. Find the sum of the following geometric series:

$$3 + 6 + 12 + 24 + \ldots + 3072$$

4. Answer the following Questions

   (i) Show that , where $r \neq \pm 1$.

   $$\frac{2}{r^2 + 1} = \frac{1}{r + 1} + \frac{1}{r - 1}$$

   (ii) Hence, find the following summation

   $$\sum_{r=2}^{n} \frac{2}{r^2 + 1}$$

   (iii) Hence, evaluate the following summation

   $$\sum_{r=2}^{n} \frac{2}{r^2 + 1}$$

Consider the function $y = f(x) = x^4 - 6x^2 + 10$

4 Week 6 Curve Sketching

Ex. 1 (i) Find the y intercept of the function $y = f(x)$.

(ii) Show that $(\sqrt{3}, 1)$ is a stationary point of the function. Find the other two stationary points and classify all three points as local maxima or minima.

(iii) Find the two inflection pints of $f(x)$.

(iv) Find the x values for which is $y = f(x)$ is concave up/down.

(v) Determine the behaviour of y as $x \to +\infty$ and as $x \to -\infty$

(vi) Sketch the graph of $y = f(x)$ indicating clearly the features of the curve obtained in aprts (i) to (v) of this quesiton.

Ex. 2 Find α and β so that the function

$$f(x) = \alpha x^3 + \beta x^2 + 1$$

has a point of inflection at $(-1, 2)$

5 Week 9 Integration

(i) Evaluate the following indefinite integral:

$$\int 3x^2 + 2e^x - 1dx$$

(ii) Evaluate the following definite integral:

$$\int_4^9 \frac{1}{\sqrt{x}}dx$$

(iii) Find

$$\int (4x + 3 + \frac{1}{x^2}dx$$

(iv) The area enclosed between the curve $y = cos(x)$ and the x-axis between $x = 0$ and $x = \frac{\pi}{3}$

Week 10 Integration and Numerical Integration

1. **Integrations by Parts**
   Evaluate the following expression, using the Integration by Parts" technique

   (i)
   $$\int x\sqrt{x+1}dx$$

   (ii)
   $$\int x^5\sqrt{x^3+1}dx$$

   (ii)
   $$\int e^x cos(x)dx$$

2. **Trapezoidal Rule**

3. **Simpson's Rule**

6 Week 11 Partial Derivatives

1. Revision of Differentiation

2.

7 Week 12 Partial Derivatives