

MTH165

# Mathematics for Engineers

## #Zero Lecture



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# Books Required

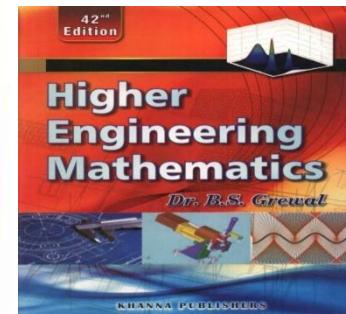
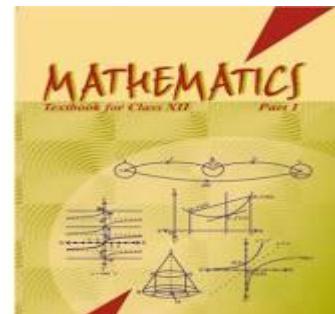
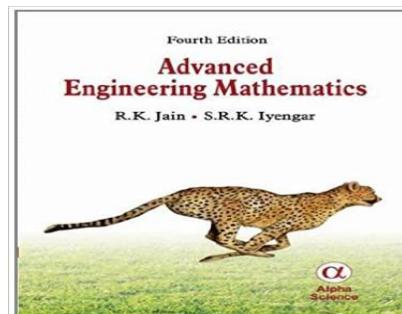
## Text Book:

ADVANCED ENGINEERING MATHEMATICS BY JAIN AND IYENGAR

## References Books:

MATHEMATICS FOR CLASS 12 PART 1-2 BY NCERT

HIGHER ENGINEERING MATHEMATICS BY B.S GREWAL



# Course Assessment Model

## Teaching Model:

L-T-P: 3-1-0 (3 Lectures, 1 Tutorial, 0 Practical)

## Marks Breakup:

Attendance	5
CA (2 best out of 3 online Tests)	30
MTE (MCQ/Viva based)	25
ETE (MCQ)	40
<b>Total</b>	<b>100</b>

# Course Outcomes

**Through this course students should be able to**

- 1.** Recall the concepts of matrices and its application to solve the system of linear equations.
- 2.** Review the basic concept of calculus of one variable.
- 3.** Apply the concept of calculus to evaluate extreme values of functions.
- 4.** Describe calculus of multivariate functions and their applications.
- 5.** Evaluate surface and volume integral using multiple integral.
- 6.** Describe the concept of Fourier series and its application.

# Syllabus Distribution:

## Unit-1

### Linear Algebra

- Review of matrices
- Elementary operations of matrices
- Rank of a matrix
- Linear dependence and independence of vectors
- Solution of Linear system of equations
- Inverse of matrices
- Eigen values and Eigen vectors
- Properties of Eigen values
- Cayley-Hamilton theorem

# Unit-2

## Differential and Integral Calculus

- Differential coefficient
- General rules of differentiation
- Derivatives of standard functions
- Derivatives of Parametric forms
- Derivatives of implicit functions
- Logarithmic differentiation

# Unit-3

## Applications of Derivatives

- Rolles' Theorem
- Mean Value Theorems
- Taylors' theorem with remainders
- Maclaurins' theorem with remainders
- Indeterminate Forms
- L-Hospital rule
- Maxima and Minima

# Unit-4



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## Multivariate Functions

- Functions of two variables
- Limits and Continuity
- Partial derivatives
- Total derivative and differentiability
- Chain rule
- Euler's theorem for Homogeneous functions
- Maxima and Minima
- Lagrange method of multiplier

# Unit-5



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## Multivariate Integrals

- Double integrals
- Change of order of integration
- Triple integrals
- Change of variables
- Application of double integrals to calculate area and volume
- Application of triple integrals to calculate volume

# **Unit-6**

## **Fourier Series**

- Euler Coefficients
- Fourier Series
- Fourier Series for Even and Odd functions
- Half range Fourier Series
- Parseval's Formula
- Complex form of Fourier Series



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# What Do You Think?

What could be considered the greatest achievements of the human mind ?



# It's the Greatest!

- Consider that all these things emerged because of technological advances
- Those advances relied on CALCULUS !
- Calculus has made it possible to:
  - Build giant bridges
  - Travel to the moon
  - Predict patterns of population change



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# Use of Matrices:

Use in Cryptography



Use in Geology

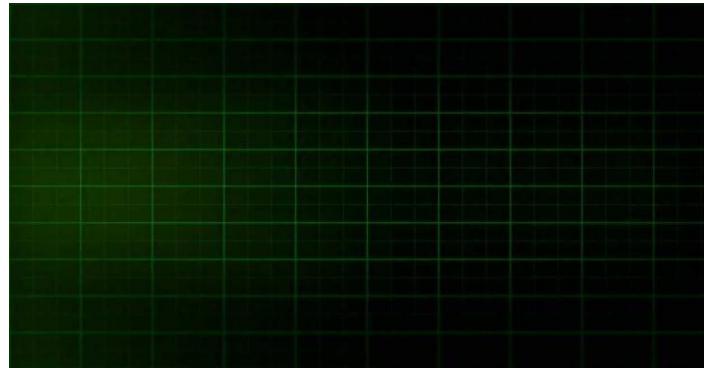


Use in Robotics

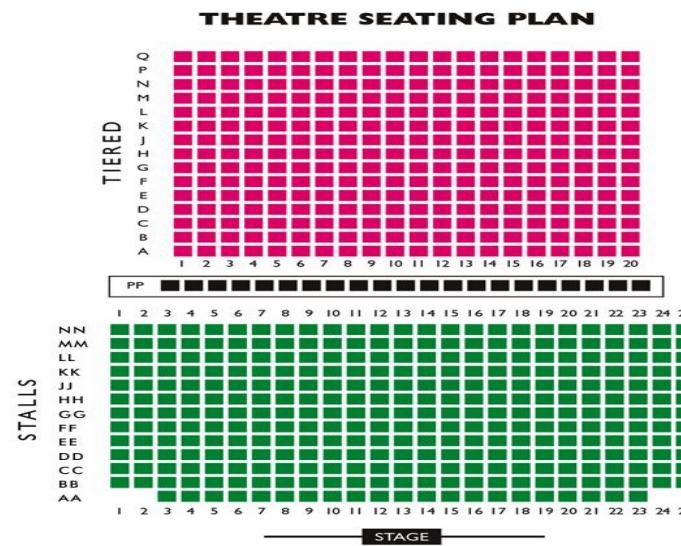


**You might have observed in use of matrices in routine:**

Grid of Computer Screen



Online Booking of Cinema Hall



**You might have observed in use of matrices in routine:**

Republic Day Parade



Matrix Movie



## Uses of Matrices in Various Fields:

**Encryption**

**Games especially 3D**

**Economics and business**

**Construction**

**Dance – contra dance**

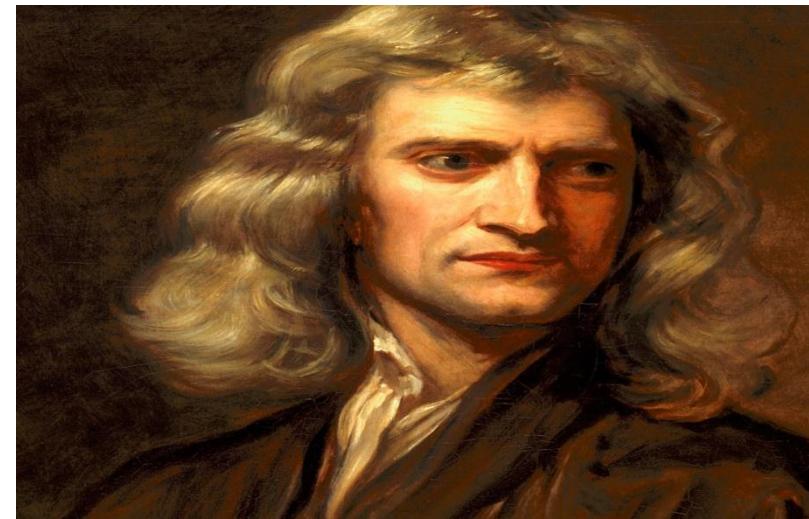
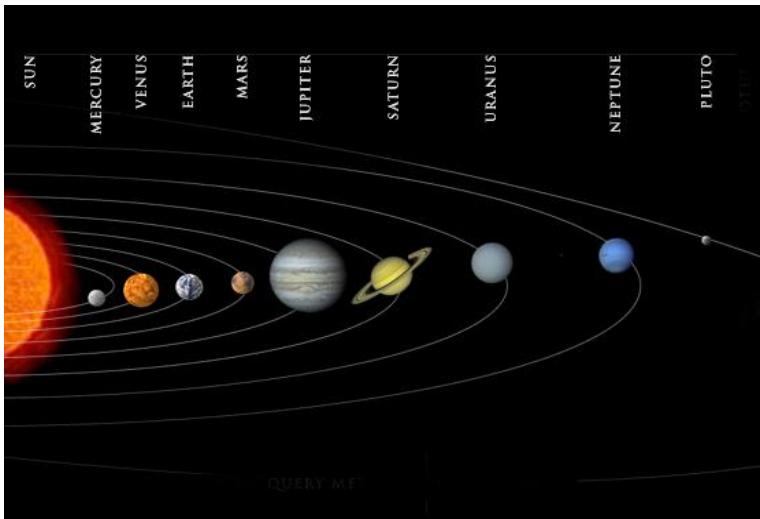
**Animation**

**Physics**

**Geology**

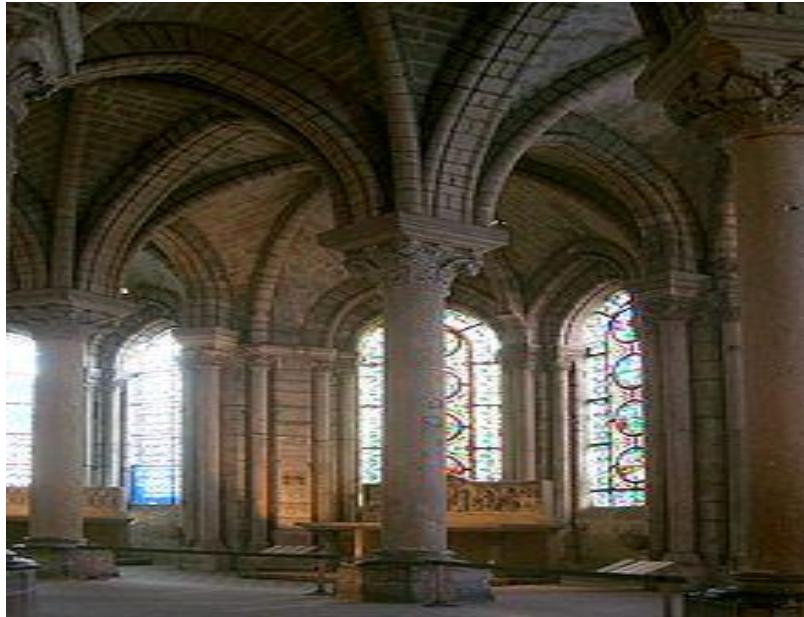
# Uses of Calculus:

Sir Isaac Newton used calculus to solve many physics problems such as the problem of planetary motion, shape of the surface of a rotating fluid etc. – recorded in Principia Mathematica

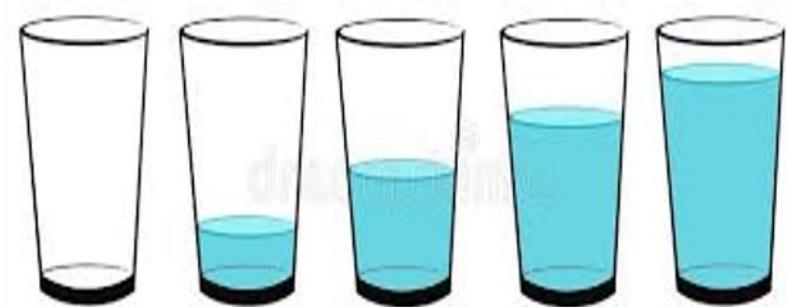


# Uses of Calculus:

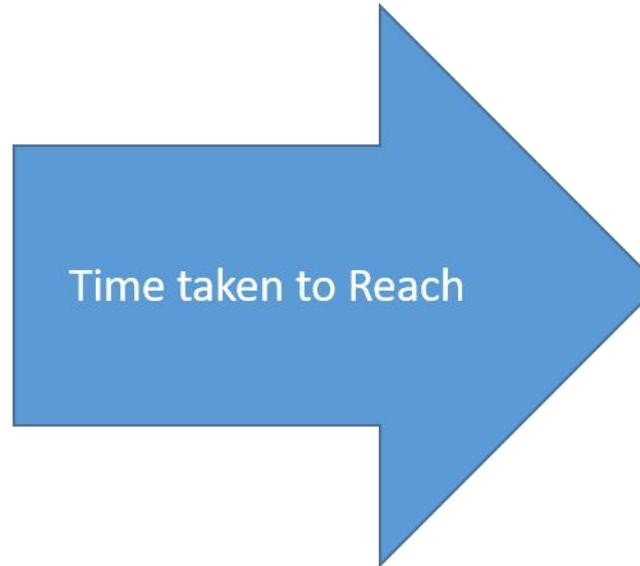
Gottfried Leibniz developed calculus to find area under curves



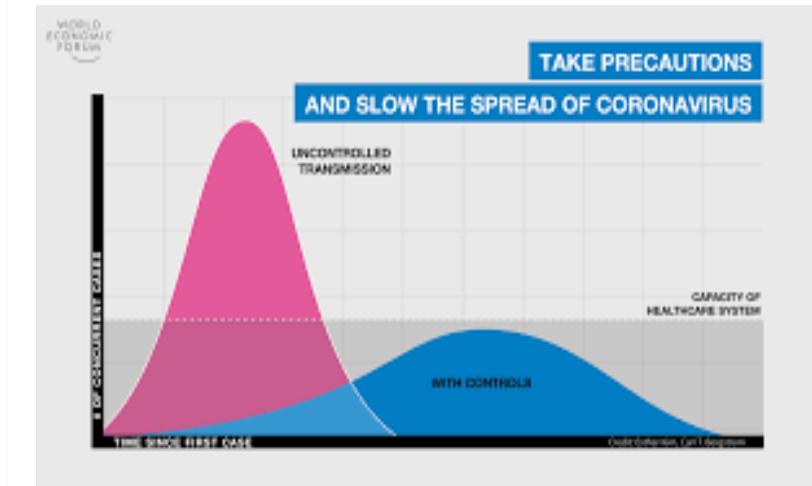
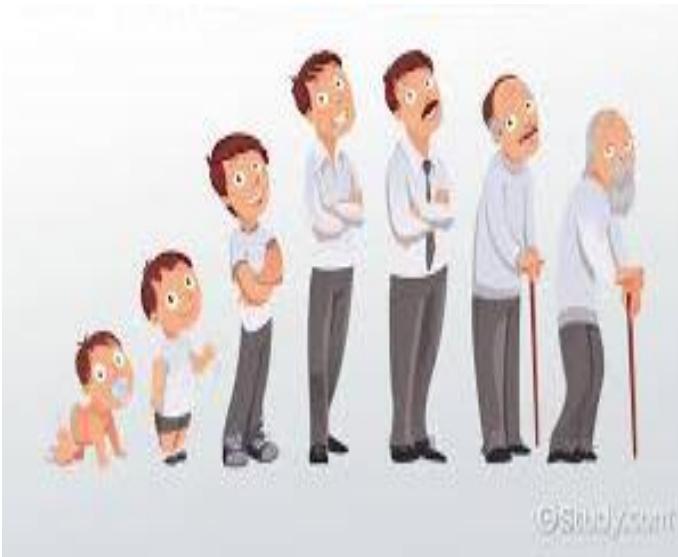
# Rate of change is everywhere....



# Rate of change is everywhere....



# Rate of change is everywhere....



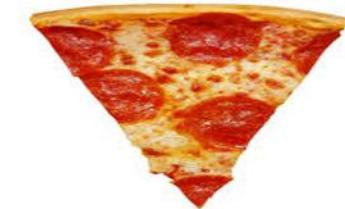


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# Differentiation and Integration are Inverse of each other...

$$\frac{d}{d(Pizza)} = Pizza\ Slices$$





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# Differentiation and Integration are Inverse of each other...

$$\int^8 Slices = 1$$

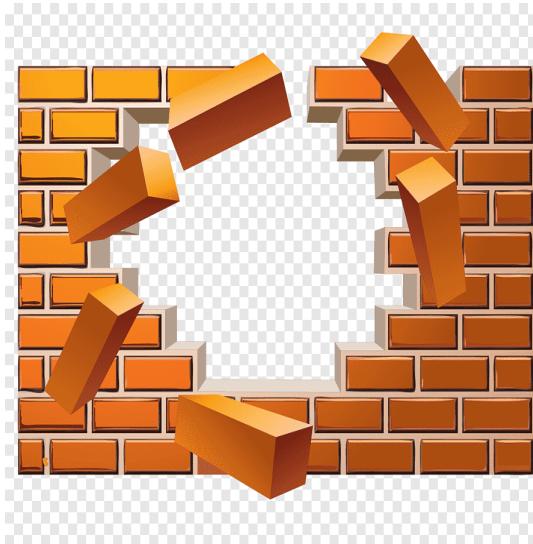





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# Differentiation and Integration are Inverse of each other...



# Calculus in Civil Engineering





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Derivatives are used to determine the maximum and minimum values of the functions like cost, strength, amount of material used in a building, profit loss etc.

**For Construction a Building Five Mathematical Concepts are required**

- Differentiation
- Integration
- Algebra
- Vectors
- Trigonometry





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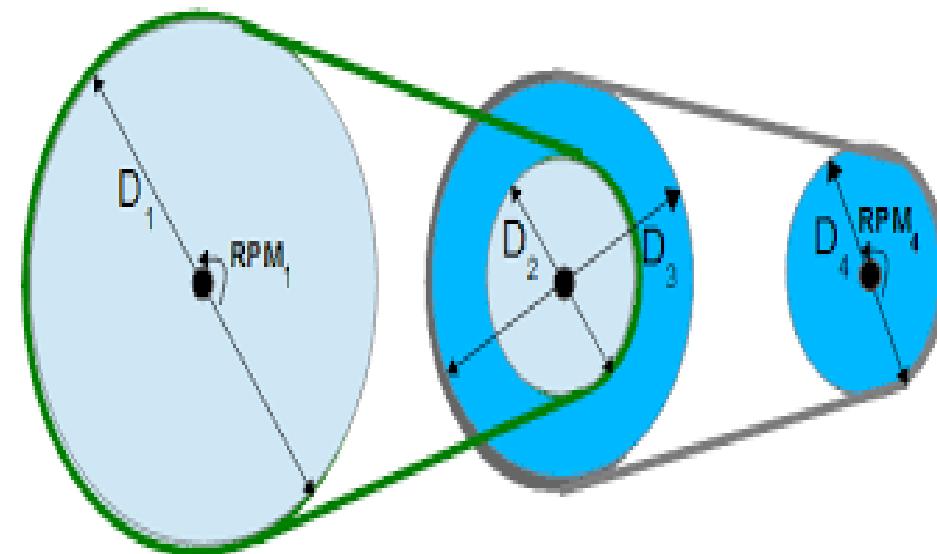
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# CALCULUS AND MECHANICAL ENGINEERING TECHNOLOGY

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The best example of use of chain rule in differentiation, is the working of pulleys of different sizes with same belt to reduce the effort and optimize the output.





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# Calculus and Electronics Engineering





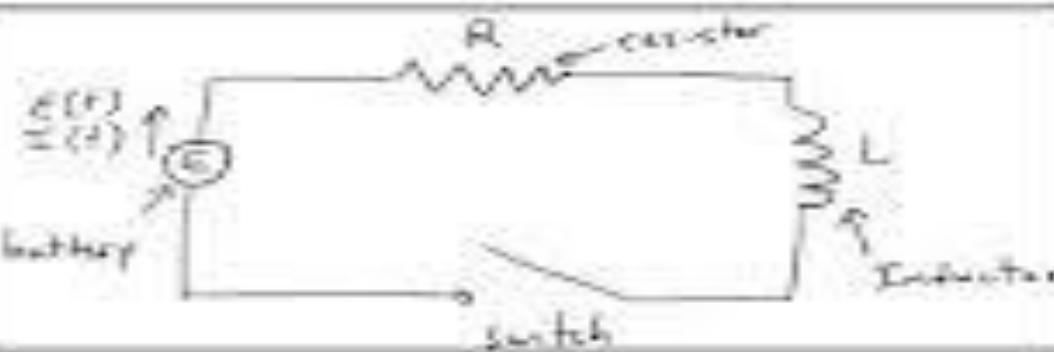
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The various kinds of LCR circuits can not be solved without differential equations and Ohm's law which is dependent on derivative of voltage.

## Differential Equations: Electric Circuits

$$L \cdot \frac{dI}{dt} + R \cdot I = E (+)$$





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# Uses of Calculus in Computer Science/Programming

By Amber Barnett

Development of different kinds of computer languages such as C, C++, Java, Linux, Python and development of various mobile apps has a great reliance on Calculus.





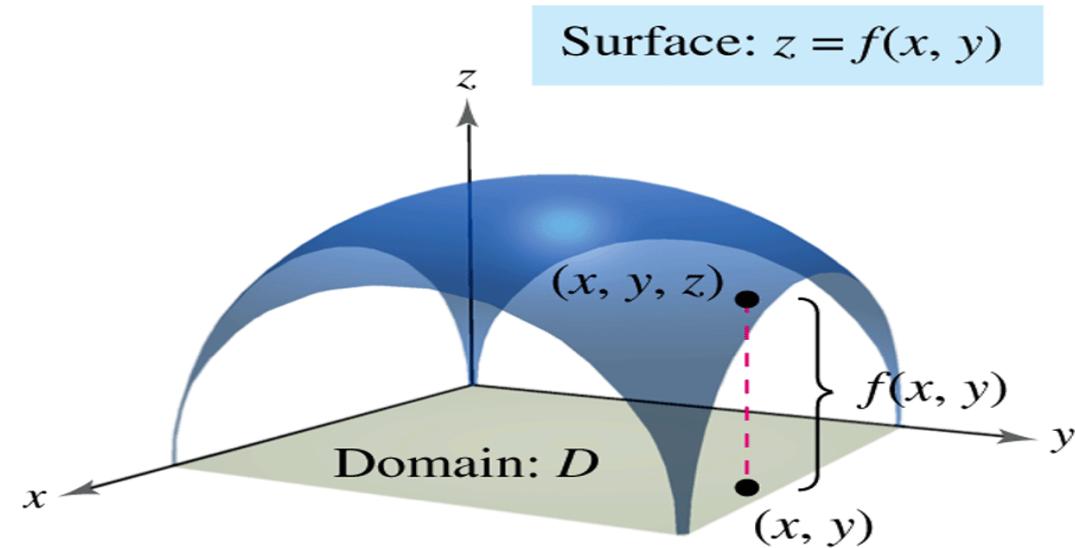
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# Multivariate Calculus

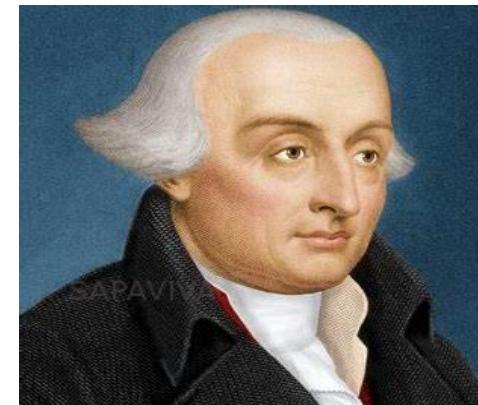
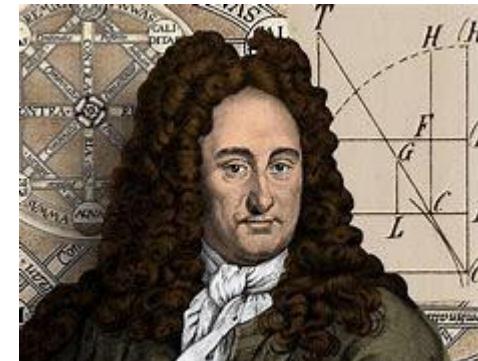
## Definition of a Function of Two Variables

Let  $D$  be a set of ordered pairs of real numbers. If to each ordered pair  $(x, y)$  in  $D$  there corresponds a unique real number  $f(x, y)$ , then  $f$  is called a **function of  $x$  and  $y$** . The set  $D$  is the **domain** of  $f$ , and the corresponding set of values for  $f(x, y)$  is the **range** of  $f$ .



# Multivariate Calculus

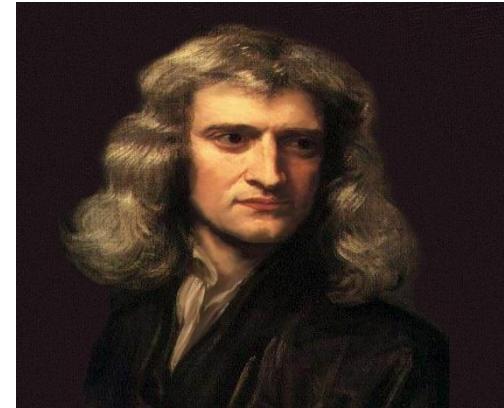
**Major Contributors are:**



# Multivariate Calculus

**Major Contributors are:**

Newton



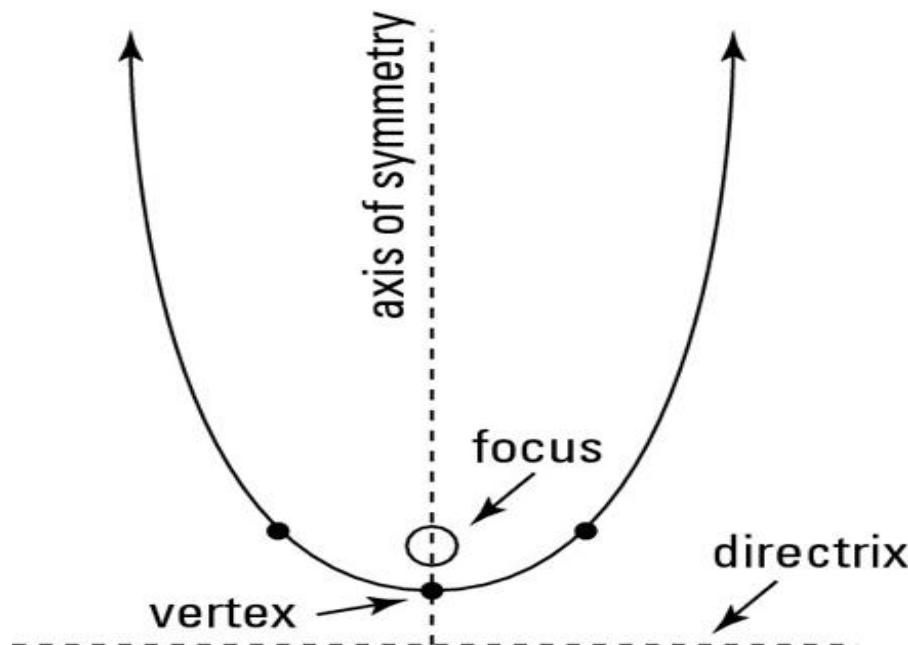
Newton



# Difference:

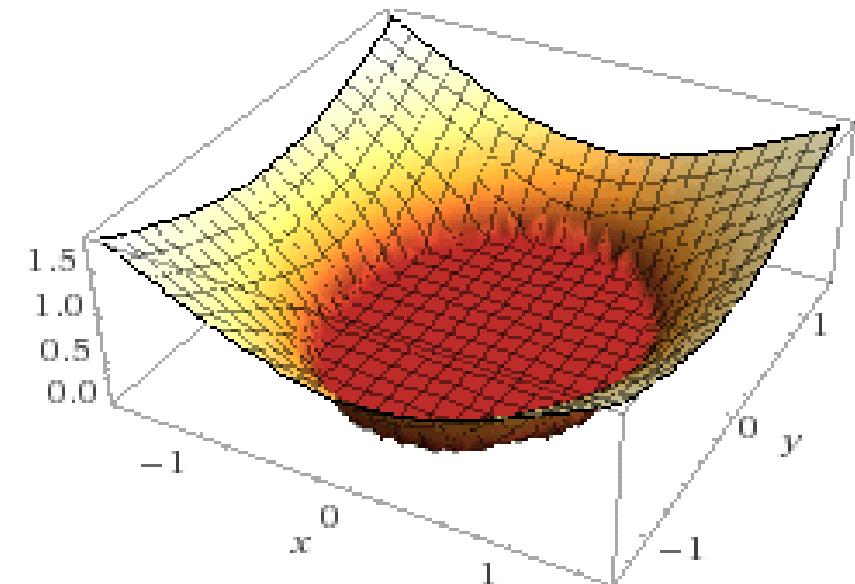
## Single variable calculus

$$y = x^2$$



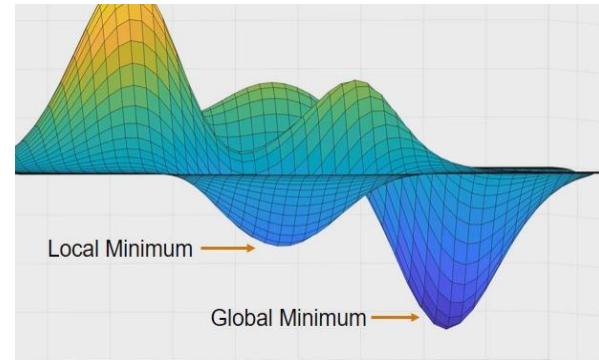
## Multivariable Calculus

$$z = x^2 + y^2$$

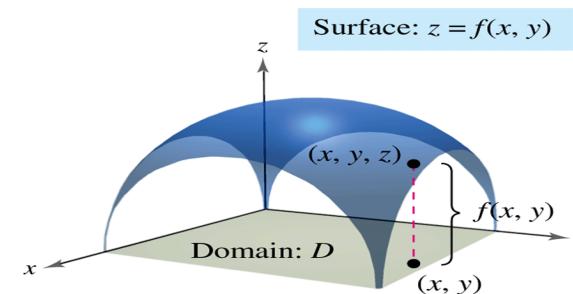


# Uses of Multivariate Calculus:

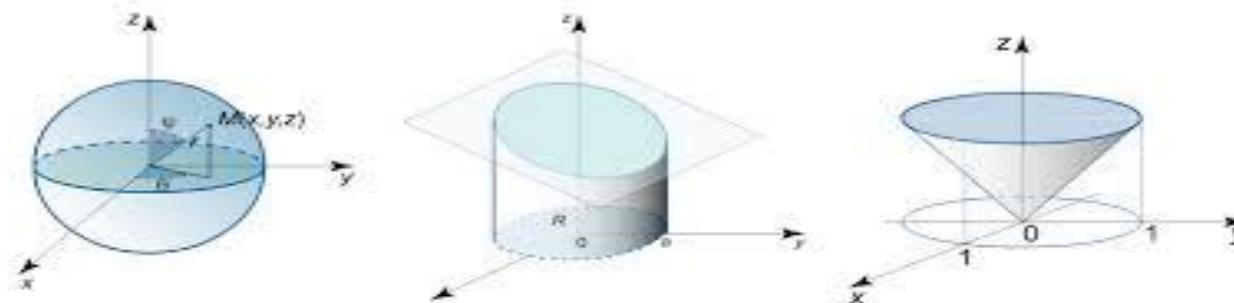
Maxima and Minima



Area under curve



Volume



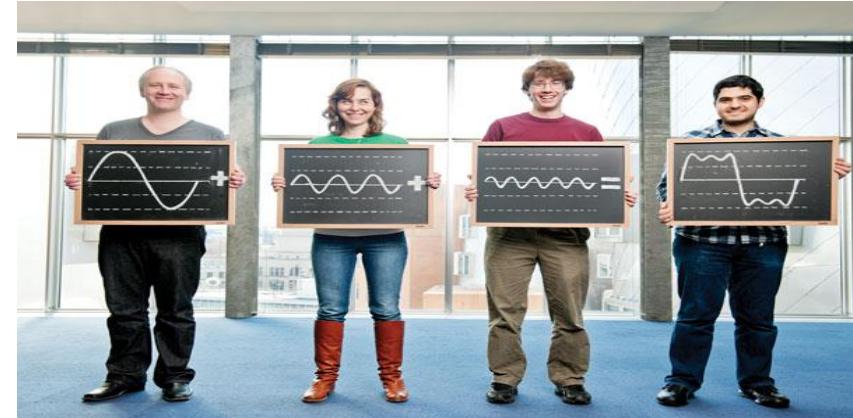
# Uses of Fourier Series:



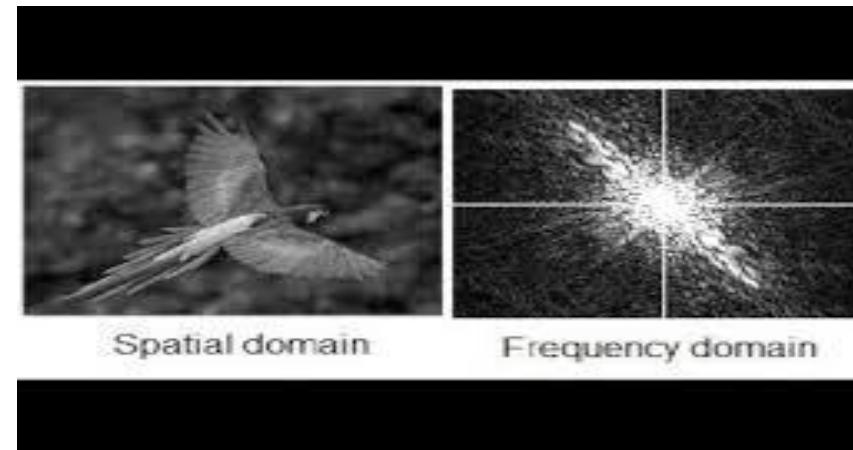
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In Signal Processing



In Image Processing





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## Next Class: LINEAR ALGEBRA



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# Thanks!

