***Differentiation***

**Introduction:**The derivative is a mathematical operator, which measures the rate of change of a quantity relative to another quantity.The process of finding a derivative is called differentiation. There are many phenomena related changing quantities such as speed of a particle, inflation of currency, intensity of an earthquake and voltage of an electrical signal etc. in the world. In this chapter we will discuss about various techniques of derivative.

**Outcomes:**After successful completion of the chapter, the students will be able to:

1. determine the speed, velocity and acceleration of a particle with respect to time.
2. calculate the rate at which the number of bacteria , the population changes with time.
3. measurethe rate at which the length of a metal rod changes with temperature.
4. find out the rate at which production cost changes with the quantity of a product .

**Derivatives of elementary functions:**

1. *where c is a constant.* **2.**
2. **4.**
3. **6.**
4. **8.**
5. **10.**
6. **12.**
7. **14.**
8. **16.**
9. **18.**
10. **20.**
11. **22.**

*where u and v are functions of x.*

* ***Find the differential coefficient*** *(**)****of the following functions with respect to x.***



**Homework:-**Find  of the following functions:

1. Ans: 
2. Ans: 
3. Ans: 
4. Ans: 
5. Ans: 
6. Ans: 
7. Ans: 
8. Ans: 
9. Ans: 
10. Ans: 

**Logarithmic differentiation:**If we have functions that are composed of products, quotients and powers, to differentiate such functions it would be convenient first to take logarithm of the function and then differentiate. Such a technique is called the logarithmic differentiation.



**Homework:-**Find  of the following functions:

1. Ans: 
2. Ans: 
3. Ans: 
4. Ans: 
5. Ans: 
6. Ans: 

**Parametric Equation:**If in the equation of a curve , *x* and *y* are expressed in terms of a third variable known as parameter i.e, then the equations are called a parametric equation.



**Homework:-**

1. Ans: 
2. Ans: 
3. Ans: 
4. Ans: 

**Successive derivative:**If be a function of *x*then the first order derivative of *y*with respect to *x*is denoted by 

Again the derivative of first ordered derivative of *y*with respect to *x*is called second order derivative and is denoted by 

Similarly, the nth derivative of *y*with respect to *x*is denoted by 

* Find the nth derivative of the following functions:



**Leibnitz’s theorem:**If *u* and *v*are two functions of *x*, then the nth derivative of their product is,



wherethe suffixes in *u* and *v* denote the order of differentiations of *u* and *v* with respect to *x*.

* Using Leibnitz’s theorem find of the following functions:



**Homework:-**

1. Find the nth derivative of the following functions:
2. Ans: 
3. Ans: 
4. 
5. 
6. 
7. 