**University of Asia Pacific (UAP)**

**Department of Basic Sciences and Humanities**

**Course Title: Multivariable Calculus (MTH 201)**

**Program: B.Sc. Engineering (CSE)**

**2nd Year / 1st Semester**

**Teacher: Sk. Reza-E-Rabbi (Lecturer)**

**Lecture-01**

Introductory Class

**Lecture- 02**

1. Define limit and continuity of a function.
2. Discuss the limit of the function  along
3. x-axis (b) y-axis (c) the line y= x

(d) the line y= -x (e) the parabola y= x2

1. Does the following limit exist? If so find its value.



1. Evaluating limits by converting to polar coordinates,



**Lecture- 03**

1. Find , and use those partial derivatives to compute .
2. Find if .
3. If 

(a) Find the slope of the surface z= f(x,y) in the x direction at the point (1, -2).

(b) Find the slope of the surface z= f(x,y) in the y direction at the point (1, -2).

1. Let, 

(a) Show that exist at all points (x, y).

(b) Explain why f is not continuous at (0,0)

**Lecture- 04**

1. What is chain rule?
2. Suppose that z= x2y, x= t2, y= t3. Use the chain rule to find dz/dt.
3. Suppose that . Use the chain rule to find .
4. If z= x2y+3xy4, where, x=sin2t and y= cost, find dz/dt when t=0.
5. Given that, use appropriate forms of the chain rule to find .
6. Given that, use appropriate forms of the chain rule to find .
7. If use appropriate forms of the chain rule to find .
8. If find the value of when r= 2, s=1, t= 0.
9. If and f is differentiable, show that g satisfies the equation .

**Lecture- 05**

1. Define directional derivative.
2. If f is a differentiable function of x and y, then prove that f has a directional derivative in the direction of any unit vector **u**= <a, b> and D**u** f(x,y)= fx(x, y) a+ fy(x,y) b.
3. Find the directional derivative D**u** f(x,y) of f at the given point in the direction indicated by the angle θ.



1. Find the directional derivative of the function at the point (2, -1) in the direction of the vector **v**= 2**i**+5**j**.
2. If f(x, y, z)= x sinyz, (a) find the gradient of f and (b) find the directional derivative of f at (1, 3, 0) in the direction of **v**= **i**+2**j**-**k**.
3. Find the equation of (a) tangent plane and (b) normal line to the given surface at the specified point.



**Lecture- 06**

1. Evaluate where, dA indicates small area in xy-plane.
2. Evaluate R is the region bounded by x= 0, x= 2, y= x, y=x+2.
3. Evaluate where, R is the quadrant of the circle x2+y2= a2 where x≥ 0 and y≥ 0.
4. Evaluate by converting into polar coordinates.
5. Evaluate by changing to polar coordinates.
6. Find the area between the parabolas y2= 4ax and x2= 4ay.
7. Find by double integration the area enclosed by the pair of curves y= 2-x and y2= 2(2-x).
8. Find by double integration, the area lying inside the cardioid r= a (1+cosθ) and outside the circle r= a.
9. Find by double integration, the area lying inside the circle r= a sinθ and outside the cardioid r= a (1-cosθ).
10. Evaluate 
11. Evaluate the integral taken over the volume enclosed by the sphere x2+y2+z2= 1.
12. Evaluate throughout the volume of the sphere x2+y2+z2= a2.