**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.

**Lecture- 07**

1. Find the volume of the tetrahedron bounded by the planes  and 
2. Find the volume of the cylindrical column standing on the area common to the parabolas and cut off by the surface.
3. Find the volume bounded above by the sphere and below by the cone.
4. Find the volume enclosed between the cylinders and.