# Lesson Plan

**Lesson:**          Double Integrals on a general region for MAT 215, multi-variable calculus II

**Timeframe**:

Pre-class: 1-2 hours

Post-class: 1-2 hours

**Materials needed:**

PowerPoint slides, handouts and textbook

**Learning Objectives:**

*Basic objectives:*

1.  Identify and describe types of region and the bounds of a double integral.

2.  Definition of type 1 and Type 2 region in xy-plane.

3.  Distinguish between the type 1 and Type 2 region.

4.  Draw the region in type 1 or type 2.

*Advanced objectives:*

1.  Set up the bounds of double integral whose region is type 1.
2.  Set up the bounds of double integral whose region is type 2.
3.  Change the order of integration
4.  Determine when the order of integration should be changed.

**Background / Situation:**

- Students are supposed to have basic knowledge about two variable functions and their graphs from MAT 214. They find it difficult to draw the graph of some basic two variable functions.

- Student should be able to evaluate iterated integrals on a rectangular region discussed in the previous section. They forget some basic formulas of integrals or the methods of integration.

**Introduction to Lesson:**

In this section, we will learn how to evaluate a double integral over a general region. To do this we need to identify the region of integration. First, we go over two types of region depends on the order of integration. Then we will discuss what order is useful to evaluate a double integral. This section is very applicable to compute the volume enclosed between two or more surfaces that will be our next section.

**Procedure:**

**Pre-class individual space activities and resources:**

The steps for preparing for the flip lesson are described below. The instructor will provide PowerPoint handouts. Students can also use the textbooks and any relevant online resources.

*Pre-Class Individual Space Activities and Resources:*

| Steps | Purpose | Estimated Time | Learning Objective |
|---|---|---|---|
| **Step 1:** Have a look at the Power-point slides on the section 13.2 to review the bounds and the region of a double integral. Try to find out the difference between the types of regions, type 1 and type 2. | Have an idea of the region of integrals | 20 min | Identify the bounds of double integrals |
| **Step 2:** Review section 13.2 "Double Integral over General Region" from your textbook. Focus on the first two examples. | Setting the bounds of integral and compute it. | 20 min | Evaluate a double integral on a type 1or type 2 region |
| **Step 3:** Work on two practice problems posted on the Blackboard. | Assess yourself | 20 min | Evaluate a double integral on a type 1or type 2 region |

**In-class group space activities and resources:** The total class time is 75 min

| Steps | Purpose | Estimated time | Learning objective |
|---|---|---|---|
| Q/A on the practice problems posted on the blackboard | Finding the students' common mistakes. | 15 min | Basic: LO2, LO3, LO<br>Advanced: LO2 |
| Short lecture by instructor | To clarify how to change the order of integration | 20 min | Advanced LO's |
| Group work of 3-4 people | To work on two worksheet related to the basic LO4 and advanced LO2 and LO3 | 20 min | Basic: LO4<br>Advanced: LO3 |
| Q/A on the Group work | To measure student understanding of lesson materials | 10 min | Basic and advanced LO's |

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|---|---|---|---|
| Summary | To summary the materials of the section. Ask to students to write the steps for evaluating a double integral. | 10 min | Basic through advanced LO's |

**Post-class individual space activities and resources:**

| **Steps** | **Purpose** | **Estimated time** | **Learning objective** |
|---|---|---|---|
| Homework assignment | To complete the students learning. | 1-2 hours | Review the concept of evaluating a double integral over a general region. |

**Evaluation:**

**Analysis:**

Analyzing homework assignments and group works shows that how students are doing in my class. Also, I have a feedback to improve my teaching in the concept of double integrals.

**Connections to future lessons:**

By basic knowledge of double integral, students will be able to compute volume enclosed by two or more surfaces, work done by a force and even to find the area between two curves in xy-plane.