Syllabus for Calculus III, MATH 227

Spring 2021 Room 180. at 11:00-11:50 M-Thur. at UWSP @ Wausau

Instructor: Paul A. Martin Office 087-B, Telephone 261-6272(temporary), e-mail *pmartin@uwsp.edu*

Office Hours: Officially at 10:00–11:00 M, T, Th, F in a virtual room accessed by the link: https://us.bbcollab.com/guest/6907413811a44e868ccab5fff794fb33 I can chat briefly after class each day too in class. I am willing to meet in the virtual room outside these times too, just drop me an email and we can arrange to meet there at a particular time.

Text: *Calculus* 8th ed. by James Stewart. Handouts will be available in class as well as in Canvas (login available from UWSP home page). All lectures are available live in the classroom and via Zoom and recordings will be available in cloud recordings under the Zoom tab in Canvas by 1:00PM each day.

Course Content: In this course we will extend the concepts of rate of change and integration to real functions and vector-valued functions defined on one, two and three dimensional domains, i.e. the function inputs and outputs will be: real #'s, ordered pairs in the plane or, ordered triples in space.

Ch. **12** We start with a review of vectors in the plane and in 3-space. From this we develop equations of lines and planes in 3-space and quadratic surfaces in three-space.

Ch. **13** Next we study parametric curves in the plane or in 3-space where the position on a path is thought of as being at the tip of a **position vector** with its tail at the origin. Here the domain is still only one-variable, but the function output can be a two or three-dimensional vector. The first and second derivatives of this **position** vector function yield **vector** functions representing the velocity and acceleration of an object as it moves along the path.

Ch. **14** This chapter deals with functions which have output that is a real number, but two or three inputs which will be considered as the (x, y) or (x, y, z) coordinates of a point in the domain. For example, we might consider the function which states the temperature at any point in some solid mass, or the altitude of the earth surface defined for the latitude and longitude inputs. We use differentiation to determine how fast the output changes as we move in any direction in the domain, e.g. how fast is the altitude increasing as one travels in a direction 30 degrees east of north from some point on the earth's surface. Max/Minimal outputs are located only at points where the rate of change of a function is zero in all directions in the domain (or the rate of change may not be defined). We also develop analytic geometry to find tangent planes and normal lines to surfaces of three-dimensional objects.

Ch. **15** Integration with respect to more than one variable is defined and used to find volumes, surface areas, centers of mass of 3-D regions or solids, and average values of functions etc. These problems will be dealt with using rectangular, cylindrical, or spherical coordinate systems as appropriate.

Ch. **16** Vector valued functions defined in the plane or in 3-space are useful to describe changing vector quantities, e.g. the wind velocity is a vector defined at any point (x, y, z) in the sky. (Here the inputs **and** outputs of the function are multidimensional.) One can integrate these vector valued functions across surfaces or along curves in space to obtain certain useful results. E.g. if we multiply a small differential surface area, $dA(m^2)$ by a perpendicular velocity $v\left(\frac{m}{s}\right)$, we get the volume rate of flow across that surface area element, i.e. units are $v\left(\frac{m}{x}\right) \cdot dA(m^2) = dQ\left(\frac{m^3}{s}\right)$. We will study Green's, Stoke's and the Divergence Theorems that allow one to interchange integrals over regions to integrals over the boundaries of the regions.

Homework: Homework problems from the text will be listed on class handouts. The assignments are listed for both the 7th and 8th editions. You should attempt all of these to develop understanding of concepts and techniques. You should be spending about 1-2 hours studying the material and working problems after each class meeting. Any problems or concepts that you don't understand should be brought up at the start of the next class for discussion and resolution.

Study Guide: Success in studying almost any subject area in mathematics requires that a student gain good proficiency with each concept as it is covered. This is because as one goes to the next and the next level in the course, those earlier concepts and algorithms must be almost automatic so that your central processing area of your brain can have a robust recall of earlier concepts to focus on the new topic/concept/problem. If the earlier material is poorly understood, your ability to reason and connect the new concepts to old is significantly handicapped. Thus keeping up with assignments is of paramount importance.

Each section in the course covers some main idea, e.g., the first and second derivative of a vector valued path give the velocity and acceleration vector functions. Try to connect this with experience, e.g., for the acceleration vector when going around a curve, with $m\,\vec{a} = \vec{F}$ imagine how the sideways force exerts itself towards the inside of a curve as you are driving your car. At the end of a section or doing problems in a section, reflect in your mind about what it was about. Doing this prior to going to sleep for a few minutes for all of your learning for the day is a good way to strengthen the connections between many different islets of data stored in your brain and also to improve recall efficiency of the new and of older concepts. In this way, you continue to strengthen and hone your skills and ability to recall and utilize recently learned material.

In reviewing for exams, work through from start to finish a selection of problems. Try to do this with problems in a random order so that you can learn to identify which tool or concept applies. Simply looking at your homework notebook or textbook example problems that are worked out does not provide much help with the recalling task. This should help avoid the oft stated "I just blanked when I got to the test".

Exams: There will be three hour-exams. The exams will have a take-home component worth 40 pts and an in-class part worth 60 points. A cumulative final is worth 150 pts.

Grades: The cut-off scores for A, B, C, D, F-grades will be very close to 90, 80, 70, and 60%.

The final exam score will normally count as 150 points out of 450. However, if the score on the final is higher than the lowest of the hour-exam scores, the final exam percentage will replace the lowest of these inputs. (exams missed for less than adequate reason will count as zero.)

Hour-exams	300
Final Exam	150
Total	450

Tentative Schedule for the Semester

Week	Sections	Content
Jan 25	12.1-12.4	Vectors in 2 and 3-space. Dot and Cross product.
Feb 1	12.5-12.6	Lines and Planes, Cylinders and Quadric Surfaces.
Feb 8	13.1-13.3	Vector functions, Derivatives, Integrals, and arc-length of vector paths
Feb 15	13.4, **Exam I**	Velocity, Acceleration.
Feb 22	14.1-14.3	Introduction to functions of several variables, lLimits, continuity, partial derivatives of functions of several variables.
Mar 1	14.4-14.6	Tangent planes to surfaces $z = f(x, y)$. Chain rule, gradient vector and directional derivatives.
Mar 8	14.7-14.8	Max/Min of functions of several variables.Lagrange multipliers,
Mar 15	15.1-15.3	Double integrals over rectangles and of a function over general regions in the plane, double integrals in Polar Coordinates
Spring Break is from March 22-26		
Mar 29	15.4 **Exam II**	Applications of double integrals.
Apr 5	15.5-15.7	Surface area with double integrals, triple integrals in Cartesian and cylindrical coordinates.
April 12	15.8, 15.9	Triple integrals in spherical coordinates and change of Variable for multiple integrals.
April 19	16.1-16.3	Vector Fields and Line integrals, Fundamental Theorem for line Integrals
April 26	16.4 **Ex III**	Green's Theorem,
April 3	16.5-16.8	Parametric surfaces, surface integrals, Stokes' Theorem,
May 10	16.9	Divergence Theorem.
		Final exam is on May 19, 2021 from 8:00-10:00