Syllabus for Calculus III, MATH 227

Spring 2022, Room 194 Wausau, 409 MSF, at 11:00-11:50 M-Thur.

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

Office Hours: 10:00 –10:50 on M, T, Th, F **These will be either in person at my office or before or after class or remotely through my personal zoom meeting room with pass-code 3.14 at** https://wisconsin-edu.zoom.us/j/6721469784?pwd=TzNONExrZnN0UEJwS2RIMG9kbTVmQT09 **.** I am also happy to meet at other times; Just send me an email or leave a phone message requesting a meeting. For non-synchronous students at a distance I have tentatively set up a weekly discussion meeting at 1:55-2:40 on Mondays using this room.

DUO and TLC Labs are also available for extra help. DUO in rooms 224WAU and 107MSF, TLC tutoring lab in the library at Wausau.

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. There is also a link in Canvas to a pdf of the textbook until you get a hard-copy.

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 in variables x, y & z of lines and planes in 3-space and quadratic surfaces in three-space. E.g., any first-degree polynomial equation, $2x - 3y + 2z = 12$ represents a plane of points in 3-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 $v\left(\frac{m}{s}\right) \cdot dA(m^2) = dQ\left(\frac{m^3}{s}\right)$. 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 regularly spending at least 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.

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 24	12.1-12.4	Vectors in 2 and 3-space. Dot and Cross product.
Jan 31	12.5-12.6	Lines and Planes, Cylinders and Quadric Surfaces.
Feb 7	13.1-13.3	Vector functions, Derivatives, Integrals, and arc-length of vector paths
Feb 14	13.4, **Exam I**	Velocity, Acceleration.
Feb 21	14.1-14.3	Introduction to functions of several variables, lLimits, continuity, partial derivatives of functions of several variables.
Feb 28	14.4-14.6	Tangent planes to surfaces $z = f(x, y)$. Chain rule, gradient vector and directional derivatives.
Mar 7	14.7-14.8	Max/Min of functions of several variables.Lagrange multipliers,
Mar 14	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 21-25		
Mar 28	15.4 **Exam II**	Applications of double integrals.
Apr 4	15.5-15.7	Surface area with double integrals, triple integrals in Cartesian and cylindrical coordinates.
April 11	15.8, 15.9	Triple integrals in spherical coordinates and change of Variable for multiple integrals.
April 18	16.1-16.3	Vector Fields and Line integrals, Fundamental Theorem for line Integrals
April 25	16.4 **Ex III**	Green's Theorem,
May 2	16.5-16.8	Parametric surfaces, surface integrals, Stokes' Theorem,
May 9	16.9	Divergence Theorem.
		Final exam is on May 16, 2021 from 12:30-2:30PM

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. Sooo, 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".

UWSP Statement on COVID19 Safety Precautions:

Face Coverings:

- At all UW-Stevens Point campus locations, the wearing of face coverings is mandatory in all buildings, including classrooms, laboratories, studios, and other instructional spaces. Any student with a condition that impacts their use of a face covering should contact the Disability and Assistive Technology Center to discuss accommodations in classes. Please note that unless everyone is wearing a face covering, in-person classes cannot take place. This is university policy and not up to the discretion of individual instructors. Failure to adhere to this requirement could result in formal withdrawal from the course.

Other Guidance:

- Please monitor your own health each day using this screening tool. If you are not feeling well or believe you have been exposed to COVID-19, do not come to class; email your instructor and contact Student Health Service (715-346-4646).
    - As with any type of absence, students are expected to communicate their need to be absent and complete the course requirements as outlined in the syllabus.
- Maintain a minimum of 6 feet of physical distance from others whenever possible.
- Do not congregate in groups before or after class; stagger your arrival and departure from the classroom, lab, or meeting room.
- Wash your hands or use appropriate hand sanitizer regularly and avoid touching your face.
- Please maintain these same healthy practices outside the classroom.