Module (Course Syllabus) Catalogue

2022-2023

College/ Institute	**Erbil Technology College**	
Department	**Construction and Materials Technology Engineering Department**	
Module Name	**Calculus 1**	
Module Code	**CAL114**	
Degree	**Technical Diploma** ☒ **Bachelor** ☐ **High Diploma** ☐ **Master** ☐ **PhD** ☐	
Semester	**1**	
Qualification	**MSc.**	
Scientific Title	**Assistant Lecturer**	
ECTS (Credits)	**6**	
Module type	**Prerequisite** ☐ **Core** ☐ **Assist.** ☒	
Weekly hours	**4**	
Weekly hours (Theory)	**(4)hr Class**	**(162)Total hrs Workload**
Weekly hours (Practical)	**( )hr Class**	**( )Total hrs Workload**
Number of Weeks	**12**	
Lecturer (Theory)	**Lawin Dhahir Hayder**	
E-Mail & Mobile NO.	**Lawin.hayder@epu.edu.iq**	
Lecturer (Practical)		
E-Mail & Mobile NO.		
Websites		

Course Book

Course Description	Functions and their graphs, differentiation of polynomial, rational and trigonometric functions. Velocity and acceleration. Geometric applications of the derivative, minimization and maximization problems, the indefinite integral, and an introduction to differential equations. The definite integral and the Fundamental Theorem of Calculus.
Course objectives	Main concepts of calculus are derivatives (rates of change of a function) and integrals (which, in particular, provide a way to recover a function from the knowledge of its derivative). Knowledge and the ability to work with these concepts is essential for further studies of mathematical subjects, as well as for applications of mathematical techniques in other sciences. This course will focus on understanding calculus concepts, analytical reasoning and developing crucial skills in order to calculate, analyze, interpret and communicate the results clearly. Specific course learning objectives are listed below. 1. Learn the general concept of function and its applications to real-world situations. 2. Learn to work with exponential, logarithmic and trigonometric functions and their applications in applied problems. 3. Learn the concepts of the derivative and its underlying concepts such as limits and continuity. 4. Learn to calculate derivative for various type of functions using definition and rules. 5. Apply the concept of derivative to completely analyze graph of a function. 6. Learn about various applications of the derivative in applied problems. 7. Learn about anti-derivative and the Fundamental Theorem of Calculus and its applications.

<table>
<tr><td></td><td colspan="5">8. Learn to use concept of integration to evaluate geometric area and solve other applied problems</td></tr>
<tr><td>Student's obligation</td><td colspan="5">Attending the lecture is a fundamental part of the course. You are responsible for material presented in the lecture whether or not it is discussed in the textbook. You should expect questions on the exams to test your understanding of concepts discussed in the lecture and in the homework assignments.
It can be very helpful to study with a group. This type of cooperative learning is encouraged; however, be sure that you have a thorough understanding of the concepts besides the mathematical steps used to solve a problem. You must be able to work through the problems on your own.</td></tr>
<tr><td>Required Learning Materials</td><td colspan="5">Data Show, Handout lecture notes and white board notes.</td></tr>
<tr><td rowspan="13">Evaluation</td><td colspan="2">Task</td><td>Weight (Marks)</td><td>Due Week</td><td>Relevant Learning Outcome</td></tr>
<tr><td colspan="2">Paper Review</td><td></td><td></td><td></td></tr>
<tr><td rowspan="6">Assignments</td><td>Homework</td><td>10 %</td><td></td><td></td></tr>
<tr><td>Class Activity</td><td>2 %</td><td></td><td></td></tr>
<tr><td>Report</td><td></td><td></td><td></td></tr>
<tr><td>Seminar</td><td>8 %</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td></td><td></td></tr>
<tr><td>Project</td><td>8 %</td><td></td><td></td></tr>
<tr><td colspan="2">Quiz</td><td>8 %</td><td></td><td></td></tr>
<tr><td colspan="2">Lab.</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Midterm Exam</td><td>24 %</td><td></td><td></td></tr>
<tr><td colspan="2">Final Exam</td><td>40%</td><td></td><td></td></tr>
<tr><td colspan="2">Total</td><td>100%</td><td></td><td></td></tr>
<tr><td>Specific learning outcome:</td><td colspan="5">Upon successful completion of this course:
1. interpret a function from an algebraic, numerical, graphical and verbal perspective and extract information relevant to the phenomenon modeled by the function.</td></tr>
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	2. verify the value of the limit of a function at a point using the definition of the limit 3. calculate the limit of a function at a point numerically and algebraically using appropriate techniques including l'Hospital's rule. 4. find points of discontinuity for functions and classify them. 5. understand the consequences of the intermediate value theorem for continuous functions 6. interpret the derivative of a function at a point the as the instantaneous rate of change in the quantity modeled and state its units. 7. interpret the derivative of a function at a point as the slope of the tangent line and estimate its value from the graph of a function 8. sketch the graph of the derivative from the given graph of a function. 9. given a table of function values, approximate the value of the derivative at a point using the forward difference quotient and the centered difference quotient 10. compute the value of the derivative at a point algebraically using the (limit) definition 11. derive the expression for the derivative of elementary functions from the (limit) definition 12. be able to show whether a function is differentiable at a point. 13. compute the expression for the line tangent to a function at a point 14. interpret the tangent line geometrically as the local linearization of a function 15. compute the expression for the derivative of a function using the rules of differentiation Including the power rule, product rule, and quotient rule and chain rule. 16. compute the expression for the derivative of a composite function using the chain rule of differentiation. 17. differentiate a relation implicitly and compute the line tangent to its graph at a point 18. differentiate exponential, logarithmic, and trigonometric and inverse trigonometric functions.

	19. obtain expressions for higher order derivatives of a function using the rules of differentiation 20. interpret the value of the first and second derivative as measures of increase and concavity of a functions. 21. compute the critical points of a function on an interval. 22. identify the extrema of a function on an interval and classify them as minima, maxima or saddles using the first derivative test. 23. use the differential to determine the error of approximations. 24. understand the consequences of Rolle's theorem and the Mean Value theorem for differentiable functions 25. find the anti-derivative of elementary polynomials, exponential, logarithmic and trigonometric functions. 26. interpret the definite integral geometrically as the area under a curve 27. construct a definite integral as the limit of a Riemann sum 28. approximate a definite integral using left sum, right sum, midpoint and trapezoidal rules 29. interpret the indefinite integral as a definite integral with variable limit(s). 30. interpret differentiation and anti-differentiation as inverse operations (Fundamental Theorem of Calculus, part 1) 31. interpret the anti-derivative as a definite integral with variable limit and implement this expression on graphing platforms 32. evaluate a definite integral using an anti-derivative (Fundamental Theorem of Calculus, part 2) 33. use substitution to find the anti-derivative of a composite function. 34. apply basic optimization techniques to selected problems arising in various fields such as physical modelling, economics and population dynamics.
Course References:	1. Stewart, J. (2016). *Single variable calculus: Early transcendentals* (Eight edition.). Boston, MA, USA: Cengage Learning. (Major) 2. Lecture Notes. (Minor)

Course topics (Theory)	**Week**	**Learning Outcome**
Functions	1 and 2	Functions are fundamental to the study of calculus. review what functions are and how they are pictured as graphs, how they are combined and transformed, and ways they can be classified. We review the trigonometric functions, and we discuss misrepresentations that can occur when using calculators and computers to obtain a function's graph. We also discuss inverse, exponential, and logarithmic functions.
Limits and continuity	3 and 4	The concept of a limit is fundamental to finding the velocity of a moving object and the tangent to a curve. In this chapter we develop the limit, first intuitively and then formally. We use limits to describe the way a function varies. Some functions vary *continuously*; small changes in x produce only small changes in $f(x)$. Other functions can have values that jump, vary erratically, or tend to increase or decrease without bound. The notion of limit gives a precise way to distinguish between these behaviors.
Differentiation	5 and 6	In the beginning of we discussed how to determine the slope of a curve at a point and how to measure the rate at which a function changes. Now that we have studied limits, we can define these ideas precisely and see that both are interpretations of the *derivative* of a function at a point. We then extend this concept from a single point to the *derivative function*, and we develop rules for finding this derivative function easily, without having to calculate any limits directly. These rules are used to find derivatives of most of the common functions reviewed in previous lessons 1, as well as various combinations of them. The derivative is one of the key ideas in calculus, and we use it to solve a wide range of problems involving tangents and rates of change.
Application of derivatives	7 and 8	In this lesson we use derivatives to find extreme values of functions, to determine and analyze the shapes of graphs, and to find numerically where a function equals zero. We also introduce the idea of recovering a function from its derivative. The key to many of these applications is the Mean Value Theorem, which paves the way to integral calculus .
Integration	9 and 10	A great achievement of classical geometry was obtaining formulas for the areas and volumes of triangles, spheres, and cones. In this chapter we develop a method to

		calculate the areas and volumes of very general shapes. This method, called *integration*, is a tool for calculating much more than areas and volumes. The *integral* is of fundamental importance in statistics, the sciences, and engineering. We use it to calculate quantities ranging from probabilities and averages to energy consumption and the forces against a dam's floodgates. We study a variety of these applications in the next chapter, but in this chapter we focus on the integral concept and its use in computing areas of various regions with curved boundaries.
Application of definite integrals	11 and 12	In this lesson we extend the applications of definite integrals to finding volumes, lengths of plane curves, and areas of surfaces of revolution. We also use integrals to solve physical problems involving the work done by a force, the fluid force against a planar wall, and the location of an object's center of mass.

Questions Example Design

Q1:

find the domain and range of each function.

$$f(t) = \frac{4}{3 - t}$$

$$g(x) = \sqrt{x^2 - 3x}$$

Q2:

say whether the function is even, odd

$$g(x) = x^3 + x$$

$$h(t) = 2|t| + 1$$

Q3:

If $f(x) = x - 1$ and $g(x) = 1/(x + 1)$, find the following.

a. $f(g(1/2))$ **b.** $g(f(1/2))$

c. $f(g(x))$ **d.** $g(f(x))$

e. $f(f(2))$ **f.** $g(g(2))$

g. $f(f(x))$ **h.** $g(g(x))$

Q4:

A:

Simplify the expressions

$2^{\log_2 3}$

$\pi^{\log_\pi 7}$

B:

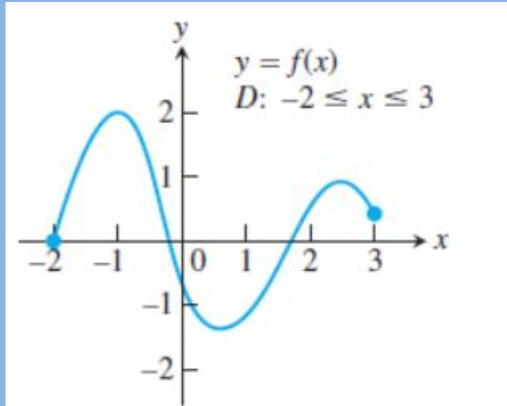
$$\lim_{x \to 2} \frac{x+3}{x+6}$$

$$\lim_{x \to 0} \tan x$$

Q5:

Differentiability and Continuity on an Interval

At what domain points does the function appear to be



a. differentiable?

b. continuous but not differentiable?

c. neither continuous nor differentiable?

Give reasons for your answers.

Extra notes:

External Evaluator

Approved

Dr. Saad Khalis Essa