Module (Course Syllabus) Catalogue

2023-2024

College/ Institute	Erbil Technical Engineering College	
Department	Highway Engineering Department	
Module Name	Mathematics	
Module Code	HE104	
Degree	Technical Diploma ☐ Bachelor ☒ High Diploma ☐ Master ☐ PhD ☐	
Semester	1st	
Qualification	MSc.	
Scientific Title	Assistant lecture	
ECTS (Credits)	6	
Module type	Prerequisite ☐ Core ☒ Assist. ☐	
Weekly hours	4	
Weekly hours (Theory)	(4)hr Class	( )Total hrs Workload
Weekly hours (Practical)	(0)hr Class	( )Total hrs Workload
Number of Weeks	12	
Lecturer (Theory)	Skala H. Mohammed	
E-Mail & Mobile NO.	Skala.mohammed@epu.edu.iq	
Lecturer (Practical)		
E-Mail & Mobile NO.		
Websites		

Course Book

Course Description	Calculus is an introduction to differential and integral calculus: the study of change. The course is designed for students working on a degree in science, mathematics, Engineering, computer science, and those planning on certain types of graduate work. Others are welcome. The prerequisites are motivation and a good working knowledge of high school algebra and trigonometry. Those needing extra background work should consider MATH, Calculus I with Review. Calculus emphasizes skills, theory, and applications. Calculus opens doors to higher mathematics, science, and technology.
Course objectives	1. Demonstrate knowledge of basic pre-calculus concepts and skills 2. Evaluate limits 3. Recognize continuity and use the properties of continuous functions 4.Find derivatives of algebraic and trigonometric functions using the definition or basic rules of differentiation 5. Find rates of change Solve related rate problems Analyse and sketch the graph of curves Find 6. solve related rate problems 7. analyse and sketch the graphs of curves 8. find extreme values in optimization problems
Student's obligation	Please don't miss any class unless absolutely necessary. If you miss a class period, you still responsible for learning the material covered on the day you missed, and also for any work which was assigned on the day you missed.
Required Learning Materials	**White board and presentation slides in power point, lecture notes.**

Evaluation

Task		Weight (Marks)	Due Week	Relevant Learning Outcome
Paper Review				
Assignments	Homework	10		
	Class Activity	2		
	Report	5		
	Seminar	6		
	Essay			
	Project	5		
Quiz		8		
Lab.				
Midterm Exam		24		

	Final Exam	40		
	Total	100		
Specific learning outcome:	1. Apply mathematical concepts and principles to perform computations 2. Apply mathematics to solve problems 3. Create, use and analyze graphical representations of mathematical relationships 4. Communicate mathematical knowledge and understanding 5. Apply technology tools to solve problems Perform abstract mathematical reasoning			
Course References:	Calculus by Thomas, 14th Edition, 2018			

Course topics (Theory)	Week	Learning Outcome
1.Functions	1,2	
2. derivatives	3,4	
3. Methods of derivative	5,6	
4. Application of Derivatives	7	
5. Partial Derivatives	8,9	
6. Space coordinate	10,11	
7. Equation of two or more variables	12	

Questions Example Design

Ministry of Higher Education & Scientific Research	EPU	Class: First (1st)
Erbil Polytechnic University		Subject: Applied Mathematics
Erbil Technical Engineering College		Time: 3 hours
Highway Engineering Department		Date:
Note: Answer All Questions	Final Exam	Code: HE104
		1st Attempt

Q1. A): Evaluate the limit of:

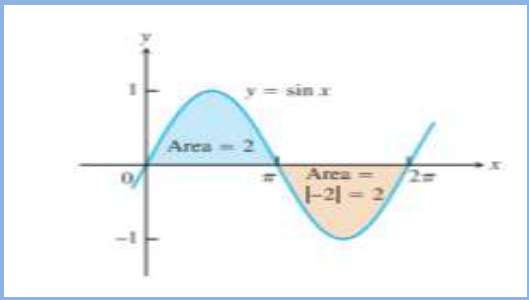
$\lim_{x\to -2} \sqrt{x^2-3}$ **(4 Marks)**

Q2.): On what intervals is f increasing or decreasing? **(6 Marks)**

a. Find $f' = (x+1)(x-7)(x+5)$

b. Find $f'(x) = \frac{x^2(x-1)}{x+2}$

Q3.): Find the areas between the graph of f(x) and the x- axis over (0, 2 $\boldsymbol{\pi}$) **(10 Marks)**



Q4.): Evaluate the following derivatives:

1. Find $\frac{dy}{dx}$ for $y^2 = x^2 + \sin(xy)$ by using implicit differentiation.

2. Find $\frac{dy}{dx}$ for $y = \frac{(x^2+1)(X+3)^{\frac{1}{2}}}{X-1}$

3. Find K if $e^{2k} = 10$ **(20 Marks)**

Q5.): Evaluate the following integrals:

1. $\int sec^2(5t+1)5\,dt$ use integration by parts.

2. $\int_1^{x^2} cost\,dt$

3. $\int_x^5 3t\,sint\,dt$

4.integrate xe^x

(20 Marks)

Best of Luck

Examiner

Answers and solutions

Q1.

$$\lim_{x\to -2}\sqrt{x^2-3} \quad = \sqrt{\lim_{x\to -2}(x^2-3)}$$

$$= \sqrt{\lim_{x\to -2} x^2 - \lim_{x\to -2} 3}$$

$$=\sqrt{4(-2^2)-3}$$

$$\sqrt{13}$$

Q2.

a. Critical points at -1, 7, -5

Increasing on (-5, -1) and (7, ∞) decreasing on (-5, -∞) and (-1, 7)

b. Critical points at 0, 1, -2

Increasing on (-∞, -2) and (1, ∞) decreasing on (-2, 0) and (0, 1)

Q3.

$$\int_0^{\pi} \sin x\,dx = -\cos x\Big]_0^{\pi} = -[\cos\pi - \cos 0] = -[-1-1] = 2$$

$$\int_{\pi}^{2\pi} \sin x\,dx = -\cos x\Big]_{\pi}^{2\pi} = -[\cos 2\pi - \cos\pi] = -[1-(-1)] = -2$$

The second integral gives a negative value. The area between the graph and the axis is obtained by adding the absolute values

$$\text{Area} = |2| + |-2| = 4.$$

Q4.

1.

$$y^2 = x^2 + \sin xy$$

$$\frac{d}{dx}\left(y^2\right) = \frac{d}{dx}\left(x^2\right) + \frac{d}{dx}\left(\sin xy\right)$$

$$2y\frac{dy}{dx} = 2x + (\cos xy)\frac{d}{dx}(xy)$$

$$2y\frac{dy}{dx} = 2x + (\cos xy)\left(y + x\frac{dy}{dx}\right)$$

$$2y\frac{dy}{dx} - (\cos xy)\left(x\frac{dy}{dx}\right) = 2x + (\cos xy)y$$

$$(2y - x\cos xy)\frac{dy}{dx} = 2x + y\cos xy$$

$$\frac{dy}{dx} = \frac{2x + y\cos xy}{2y - x\cos xy}$$

2.

$$\ln y = \ln\frac{(x^2 + 1)(x + 3)^{1/2}}{x - 1}$$

$$= \ln\left((x^2 + 1)(x + 3)^{1/2}\right) - \ln(x - 1) \qquad \text{Rule 2}$$

$$= \ln(x^2 + 1) + \ln(x + 3)^{1/2} - \ln(x - 1) \qquad \text{Rule 1}$$

$$= \ln(x^2 + 1) + \frac{1}{2}\ln(x + 3) - \ln(x - 1). \qquad \text{Rule 3}$$

We then take derivatives of both sides with respect to x, using Equation (1) on the left:

$$\frac{1}{y}\frac{dy}{dx} = \frac{1}{x^2 + 1}\cdot 2x + \frac{1}{2}\cdot\frac{1}{x + 3} - \frac{1}{x - 1}.$$

3.

$$e^{2k} = 10$$

$$\ln e^{2k} = \ln 10$$

$$2k = \ln 10$$

$$k = \frac{1}{2}\ln 10.$$

Q5.

1.

$$y = \int_1^u \cos t\, dt \qquad \text{and} \qquad u = x^2.$$

We must therefore apply the Chain Rule when finding dy/dx.

$$\begin{aligned}\frac{dy}{dx} &= \frac{dy}{du} \cdot \frac{du}{dx} \\ &= \left(\frac{d}{du}\int_1^u \cos t\, dt\right) \cdot \frac{du}{dx} \\ &= \cos u \cdot \frac{du}{dx} \\ &= \cos(x^2) \cdot 2x \\ &= 2x \cos x^2\end{aligned}$$

2.

$$\begin{aligned}\frac{dy}{dx} = \frac{d}{dx}\int_x^5 3t \sin t\, dt &= \frac{d}{dx}\left(-\int_5^x 3t \sin t\, dt\right) \\ &= -\frac{d}{dx}\int_5^x 3t \sin t\, dt \\ &= -3x \sin x\end{aligned}$$

3.

$$\begin{aligned}y^2 &= x^2 + \sin xy \\ \frac{d}{dx}\left(y^2\right) &= \frac{d}{dx}\left(x^2\right) + \frac{d}{dx}\left(\sin xy\right) \\ 2y\frac{dy}{dx} &= 2x + (\cos xy)\frac{d}{dx}(xy) \\ 2y\frac{dy}{dx} &= 2x + (\cos xy)\left(y + x\frac{dy}{dx}\right) \\ 2y\frac{dy}{dx} - (\cos xy)\left(x\frac{dy}{dx}\right) &= 2x + (\cos xy)y \\ (2y - x\cos xy)\frac{dy}{dx} &= 2x + y\cos xy \\ \frac{dy}{dx} &= \frac{2x + y\cos xy}{2y - x\cos xy}\end{aligned}$$

4.

Taking $v = x$ and $\frac{du}{dx} = e^x$

gives $\frac{dv}{dx} = 1$ and $u = e^x$

Then $\int v\frac{du}{dx}dx = uv - \int u\frac{dv}{dx}dx$

gives $\int xe^x dx = (e^x)(x) - \int (e^x)(1)dx$

$= xe^x - e^x + K$

Extra notes:

External Evaluator

As an Assistant lecturer at Bridges and Highway Engineering Department, I have reviewed the catalogue of the subject of Mathematics for 1st stage/2nd semester, Department of Highway Engineering, Erbil Technical Engineering College/ Erbil Polytechnic University. I confirm that the catalogue has well designed to achieve the aim and objectives of the subject. Furthermore, it almost covers all the required syllabus and contents of the course and describes satisfactorily the aspects related to the course.

Hana Sherzad Aziz
10/10/2023