College of Science.
Department of Mathematics

كلية العلوم
قسم الرياضيات

Second Midterm Exam
Academic Year 1447 Hijri- SecondSemester

Exam Information معلومات الامتحان			
Course name	**Vector Calculus حساب المتجهات**		**اسم المقرر**
Course Code	**202 ريض**		**رمز المقرر**
Exam Date	**2026-04-19**	**1447-10-24**	**تاريخ الامتحان**
Exam Time	**11: 00 AM**		**وقت الامتحان**
Exam Duration	**2 hours**	**ساعتان**	**مدة الامتحان**
Classroom No.			**رقم قاعة الاختبار**
Instructor Name	**هناء السديس**		**اسم استاذ المقرر**

Student Information معلومات الطالب		
Student's Name		**اسم الطالب**
ID number		**الرقم الجامعي**
Section No.		**رقم الشعبة**
Serial Number		**الرقم التسلسلي**

General Instructions:

- Your Exam consists of 5 PAGES (except this paper)
- Keep your mobile and smart watch out of the classroom.
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تعليمات عامة:

- عدد صفحات الامتحان 5 صفحة. (بإستثناء هذه الورقة)
- يجب إبقاء الهواتف والساعات الذكية خارج قاعة الامتحان.
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هذا الجزء خاص بأستاذ المادة
This section is ONLY for instructor

#	**Course Learning Outcomes (CLOs)**	**Related Question (s)**	**Points**	**Final Score**
1	1.1	2A	/1	
2	1.2	2B	/2	
3	1.3	3	/5	
4	2.2	4+5	/9	
5	2.3	1	/3	/20
6				
7				
8				

EXAM COVER PAGE

Question	1	2A	2B	3	4	5	Total
Mark							

Question1:[1.5+1.5= 3points]

A. If a moving particle has velocity $\vec{v}(t) = (\sin t)\, i + t^3\, j + e^t\, k$, and its initial position at $t = 0$, is $\vec{r}(0) = -i$. Find its position vector $\vec{r}(t)$at any moment t.

B. Calculate the arc length of the curve $\vec{r}(t) = \cos^3 t\ \ i + 3\, j - \sin^3 t\, k,\quad 0 \le t \le \frac{\pi}{2}$.

Question2: [1+2=3 point]

A. When do we say that $\vec{r}(t)=r_1(t)i+r_2(t)j+r_3(t)k$ is a smooth parametrization of the curve it defines?

B. Suppose that $s \mapsto \vec{r}(s), 0 \leq s \leq L$, is a smooth parametrization of the curve C. Prove that $\vec{r}$ is the arc length parametrization of C if and only if $\left\|\frac{d\vec{r}}{ds}(s)\right\| = 1$ for all s.

<u>Question 3</u>: [1.5+1.5+2=5 points]

Let $\vec{r}(t) = \langle t, 4 - t^2 \rangle$ be a parametrization of a planar curve

Then answer the following

(i) Sketch the curve and indicate the orientation.

(ii) Find the velocity vector $\vec{v}(t)$, acceleration $\vec{a}(t)$ and speed $v(t)$ of $\vec{r}(t)$.

(iii) Compute the tangential a_T and normal a_N components of acceleration.

Question4: [2.5+1.5+1=5 points]

Let $\vec{r}(t) = \langle 3\cos(t), 3\sin(t), 4t \rangle$ be a parametrization of a space curve.
Then answer the following:

(i) Calculate the curvature $K(t)$ and radius of curvature $\rho(t)$.

(ii) Calculate the unit tangent vector $\vec{T}(t)$ and the principal unit normal $\vec{N}(t)$.

(iii) Find the center of curvature.

<u>Question5:</u> [2+2=4 points]

A. Given the function $f(x, y, z) = z^2\, e^{xy}$. Answer the following:

(i) Calculate the gradient of f, at the point $P(-1, 0, 3)$.

(ii) Calculate the directional derivative of f in the direction $\vec{a} = \langle 3, 1, -5 \rangle$ at the point $P(-1, 0, 3)$.

B. Find the equation of the **<u>tangent plane</u>** and the **<u>normal line</u>** to the graph of the equation

$$x^3 + 2xy + z^3 + 7y + 6 = 0$$

at the point $P(1, 4, -3)$.

Good Luck 😊