Final Exam
Academic Year 1443 Hijri- Second Semester

Exam Information معلومات الامتحان			
Course name	**Mathematical Physics I**		اسم المقرر
Course Code	**PHYS 201**		رمز المقرر
Exam Date	**Sunday 05/06/2022**	**06/11/1443H** الأحد	تاريخ الامتحان
Exam Time	**1:00-04:00 pm**		وقت الامتحان
Exam Duration	**3 Hours**	3 ساعات	مدة الامتحان
Classroom No.	موحد بين شطري الطالبات والطلاب		رقم قاعة الاختبار
Instructor Name	د. أبوعزة المحمدي(مقرر) - د.عبير المدلج - د. وفاء المجممي - د.حامد السويدان – د. عبد الحي صلاح		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 2 PAGES (except this paper)
- Keep your mobile and smart watch out of the classroom.
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تعليمات عامة:

- عدد صفحات الامتحان 2 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	Methods to solve system of linear equations	Qs 1	7	40
2	Basic operations on matrices, inverse, elementary matrices and determinants	Qs 2 & 3	12	
3	- Vector Spaces: Properties and calculations - Inner product Spaces: Properties and calculations	Qs 4 & 5	14	
4	Eigenpairs problem and Diagonalization	Qs 6	7	
				40

يمنع استعمال الالة الحاسبة بكافة أنواعها

Answer all the six questions.

Q.1. (7 marks)

1. Determine whether the following equations are ***Linear*** or ***Non-Linear*** in x, y and z:

a- π x - $\sqrt{2}$ y + $\frac{1}{3}$ z = $5^{1/2}$

b- y = $\frac{1}{3}$ z+e^2 + $\sin(\pi/3)$

c- $\frac{1}{x}$ + 4z = 20

2. Solve the following system of linear equations using ***Gauss-Jordan*** elimination method.

$$\begin{aligned} \boldsymbol{x + 2\,y - 3z} &= \boldsymbol{6} \\ \boldsymbol{2x - y + 4z} &= \boldsymbol{2} \\ \boldsymbol{4x + 3y - 2z} &= \boldsymbol{14} \end{aligned}$$

Q.2. (6 marks)

Use the following matrices to compute the indicated expressions:

$$A = \begin{pmatrix} 3 & 0 \\ -1 & 2 \\ 1 & 1 \end{pmatrix}, \; B = \begin{pmatrix} 1 & 4 & 2 \\ 3 & 1 & 5 \end{pmatrix}, \; C = \begin{pmatrix} 1 & 5 & 2 \\ -1 & 0 & 1 \\ 3 & 2 & 4 \end{pmatrix}$$

a- **$(-AB)^T$** and **$5C^T$**

b- Deduce then the quantity **Tr{$(-AB)^T + 5C^T$}**

Q.3. (6 marks)

Let ***A*** be the matrix:

$$A = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ -1 & 0 & 1 \end{bmatrix}$$

a- find the determinant of the matrix ***A*** using ***expansion method*** along the first column

b- find the inverse of the matrix ***A*** by the ***adjoint*** method

Q.4. (7 marks)

1. Determine whether the vectors **U_1**(1, 2, 4), **U_2**(2, -3, 1), **U_3**(2, 1,-1) are basis for **R^3** or not (provide detailed answer).

2. Determine whether the following set of vectors **S={(1, a, b);** with **a** and **b** are real numbers**}**, with standard operations, is a subspace of **R^3** or not.

Q.5. (7 marks)

Consider the inner product space ***P_n*** of polynomials with inner product defined as:

$$\langle f, g \rangle = \int_0^1 f(x)g(x)dx$$

and consider two vectors of the space: ***$f(x) = 5x^2$*** and ***$g(x) = 3x$***

a- compute the norms of the vectors ***f(x)*** and ***g(x),*** then deduce the **cosine** of the angle between them.

b- determine which of the vectors ***$h(x) = 5x^2 - 3x + 5$*** or ***$k(x) = 5x^2 + 4$*** is the closest to ***f(x)***

(hint: compare their relative distances)

Q.6. (7 marks)

Consider the following matrix in $\mathbf{M}_{2\times2}$: $A = \begin{bmatrix} 1 & 1 \\ -2 & 4 \end{bmatrix}$

a- find the eigenvalues of ***A***.

b- find the associated eigenvectors and deduce the dimensions of the corresponding eigenspaces.

c- find a nonsingular matrix ***P*** such that ***$P^{-1}AP$*** is diagonal.

بالتوفيق