

Open Book/Notes/Internet (90 minutes including scan and email return).

Posted Syllabus Exam Time is 6:00 pm – 7:30 pm.

Exam emailed 5:45 pm and you can start as soon as you get it.

All work and related steps must be explicitly shown for full credit.

[25] 1. Combinatorics. There are 10 students taking a flexible course where 3 of the 10 are attending face to face, another 3 are attending online, and the remaining 4 are attending in a mixed more. How many different ways can this arrangement be realized?

[25] 2. Inverse Matrix. Find the inverse matrix for the Pauli combination

$$M = \sigma_y + \sigma_z = \begin{bmatrix} 0 & -i \\ i & 0 \end{bmatrix} + \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} = \begin{bmatrix} 1 & -i \\ i & -1 \end{bmatrix}.$$

Express your final answer in terms of M .

[25] 3. Matrix as Exponent. Find the simplest form for e^A , where $A = i\theta\sigma_z$ and σ_z is the third Pauli matrix. Simplest form is defined by the least amount of characters needed to express the final answer. As an example, the function $\cos \theta$ consists of 4 characters. A left or right parenthesis counts as one character.

[25] 4. Recurrence Relation. You are given the recurrence relation

$$a_{k+2} = \frac{2(k-n)}{(k+1)(k+2)} a_k \text{ for } f(x) = a_0 + a_1x + a_2x^2 + a_3x^3 + \dots,$$

where $k = 0, 1, 2, 3, \dots$ and $n = 0, 1, 2, 3, \dots$

Find the specific polynomial $f(x)$ where $a_0 = 0$, $a_1 = 1$, and $n = 5$.