NTU NUMBERS & MATRICES
(Prof-In-Charge: Prof Ling San, http://www.ntu.edu.sg/home/lingsan/)

NTU NUMBERS & MATRICES offers students who have a strong aptitude for, and are passionate about mathematics, an opportunity to further develop their mathematical reasoning skills and enhance their understanding and appreciation of fundamental mathematical tools like number theory and matrix algebra as well as their relevance in modern applications.

The topics covered include: basic number theory (divisibility and modular arithmetic), matrix algebra (solutions of systems of linear equations, properties of matrices, connection with geometry) and vector spaces (basic properties, basis, rank and nullity).

Several applications of these tools are also discussed, including: cryptography (symmetric-key cryptosystems, Hill cipher, RSA cryptosystem), optimization problems (linear programming, simplex algorithm, Travelling Salesman Problem), coding theory (check digits, error-detecting and error-correcting codes), Internet search engines, genetic and population growth, etc.

There are ample opportunities for students to learn to appreciate and understand the importance of mathematical definitions, to read and write mathematical proofs, to be familiar with useful algorithmic techniques, as well as to explore and appreciate the relevance of mathematical tools in modern technology and applications.

Pre-requisites: H2 Mathematics (particularly Functions and Graphs (especially Equations) and Vectors)

Assessment:
Students are assessed based on the following components:
- One 2-hour written Final Examination (70%)
- Two 1-hour written Mid-Term Tests (20% - each test 10%)
- Assignments (10%)

Please contact your school representative if you have any query.
Application starts from 11 Sept to 29 Sept 2006

Host JCs: 1. National Junior College (NJC) / Hwa Chong Institution (HCI)
2. Temasek Junior College (TJC)
NTU CONTEMPORARY PHYSICS
(Prof-In-Charge: Prof Alfred Huan, http://www1.spms.ntu.edu.sg/~alfred/index.htm)

NTU CONTEMPORARY PHYSICS is a fresh look at some topics in contemporary physics research. The course will outline the physical principles that lead to a direct discussion of the prevailing ideas and thought. The course will be taught by NTU professors who themselves are actively engaged in the respective research areas.

The following topics will be covered:

1. Nanoscale Physics – Starting with basic quantum physics and progressing to ideas of quantum confinement, this topic will examine the physical structure and properties of low-dimensional systems and quantum dots. Methods of fabrication (molecular beam epitaxy, chemical vapour deposition) and analytical techniques (microscopy and diffraction) will be discussed in sufficient detail for a strong appreciation of the topic. Finally it takes a look at current research ideas in molecular electronics and photonics.

2. Semiconductor physics – While semiconductors have been known for almost a century, this topic looks at why modern technology is so reliant on this class of material, particularly in logic devices (CMOS transistors) and opto-electronic components (LEDs, photovoltaics). The topic closes with a look at an impending technology involving the property of electron spin in logic and storage devices – an area called spin electronics.

3. Biophysics – This topic begins with a look at the forces at play in the world of biomolecules (proteins, DNA) and the mechanisms of their motion. This is followed by a discussion on the transmission of electrical signals in nerves and ending with the response of plants and animals to electrical and magnetic stimuli.

The course will be conducted through lectures, tutorials and laboratory work, and assessment will be based on the following components:

- Final Exam
- Term tests
- Laboratory work

This course cannot be offered together with the MOE H3 Physics course.

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Host JCs:
1. Hwa Chong Institution (HCI) / National Junior College (NJC)
2. Victoria Junior College (VJC) / Temasek Junior College (TJC)