A. COMPUTERS IN PHYSICS EDUCATION

The potential of the computers in interactive learning, in tutorial modes, in computations and problem solving, in model exploration and simulation of various theoretical and experimental results is well recognized. The development of a tool-kit of hardware and software modules, the functional aspects of which are easy to master, allowed the possibility to convert the microcomputer into a versatile instrument capable of performing a variety of tasks in a large number of laboratory experiments.

It is the goal of the project **"UNESCO FOUNDATION COURSE FOR PHYSICS EDUCATION"**, run by **ROSTAS**, to develop a unified physics learning environment that can play three roles:

a. A means of improving our current teaching.
b. An environment in which innovative approaches can be developed.
c. A basis for a physics course designed for lecture, laboratory, recitation, homework, workshop, or even independent study.

The student's text book is written by Professor R. Kamel Wassef in a completely non-traditional way. A story line is used for the random access teaching method adopted. Contemporary physics, environmental physics, and new frontiers in physics are introduced. The course design in this way was implied by the rapid growth of technology which necessitated that changes should be made in both the way physics is done and the way it can be presented to the student. It is clear that in the near future, students will have important parts of their learning based on a computerized environment.

Technological advances demand a complete reinterpretation and redesign of the state of art in experimentation. Interfacing allows the

microcomputer to become a versatile instrument with which many experiments could be done. Computer-controlled sensor systems usually enhance the quality of measurement. Also, the automatic recording of the data has several advantages. Large amounts of data can be gathered without the trouble of repetitiveness, thus shifting to the search for significance of experimental results. Besides, the time scale of the experiment can range from very short to very large periods.

At present, many programmes for data acquisition and data analysis have been created. The Comprehensive Unified Physics Learning Environment (CUPLE) is one multiasking, windowing, graphic environment for learning physics at college level. It combines hypertext materials, computational physics tools, video from videodisc, videotape. The use of microcomputer-based laboratory interfaces will receive wide application in many educational institutes in the near future.

The software presented in the next section is available on the market and will help the student to understand the material in a better way. Several centers allover the world are engaged in producing such software material suitable for the teaching and learning processes from which we ennumerale the following:

a. **CUPLE**: "Comprehensive Unified Physics Learning Environment". The CUPLE consortium has the support of the American association of physics teachers. It produced the proto-type of new instructional resource for university physics courses.
J.M. Wilson and J.H. Redish, Rensselaer Polytechnic Institute, Troy, New York, USA.

b. **CUPS**: "Consortium for Upper-level Physics Software". This software present lecture demonstrations, and, more importantly, homework excercises.
R. Ehrlich, M. Dworzecka and W.M. MacDonald.

c. **MUPPET:** "Maryland University Project in Physics Education Technology". This project allows the students to take part in programming the introductory physics course. It includes some real problem and introduces contemporary physics.
E.F. Redish, University of Maryland.

B. COMPUTER SOFTWARE AVAILABLE FOR THE UNDERSTANDING OF THE MATERIAL PRESENTED IN THIS BOOK

1. **Ballistics car**: **C\PSP\PHYS DEM\DEMO.EXE.** This software informs the student about projectile motion. It illustrates the relation between different parameters characterizing the three dimensional motion of non-resistive and/or resistive media.

2. **The monkey and the Coconut**: **C\PSP\PHYS DEM\DEMO.EXE.** It illustrates projectile motion and analyze the scheme of velocities, vertical and horizontal components.

3. **Wave speed on a rope**: **C\MUPPET\WAVE.EXE.** This demonstration shows progressive and stationary waves, and the formation of nodes and antinodes on the rope.

4. **Oscilloscope waveforms**: **C\PSP\OSCILLOSCOPE WAVEFORMS.** Sinusoidal and other types of waveforms are shown.

5. **The Doppler effect**: **C\PSP\PH DEM\DEMO.EXE.** This software illustrates with sound the change of frequency of the moving sound source. Also, it shows what happens when the observer is moving and the source is not.

6. **Simple harmonic motion**: **C\CUPLE\MECHANIC\VIBRATE\ PENDULUM.** The student is here informed about the simple harmonic motion and the simple pendulum. The relation between the physical parameters (length and mass) of the pendulum will be stressed at. A graphical representation on the acceleration and velocities will be shown. The basic principle of the conservation of energy will be emphasized as well. Damped harmonic motion is also shown.

7. **Special relativity**: **C\CUPLE\RELATIVI\EINSTEIN.EXE.**
The student is here informed about relativistic motions. Comparison between classical and relativistic motions could be drawn via the change of parameters around the relativistic limits.

8. **Thermodynamical processes**: **C\PSP\THERMO.** The demonstration of adiabatic and isothermal processes. The temperature change in an adiabatic process. Combined isothermal and adiabatic PV plots.

9. **The Carnot cycle**: **C\PSP\CARNOT CYCLE.** It shows the work of an ideal heat engine.

10. **Electrostatic fields and potential**: **C\CUPS\EM\GAUSS** In this section the student is informed about the physics of charge density and its relation with the electric field and potential. The program displays a plot of these three physical quantities based on the choice of the user of either the potential form, charge distribution or electric field.

11. **Electromagnetic waves**: **C\CUPS\EM WAVE** This demonstration shows the animation of electromagnetic waves. The student will be informed about the physics of electromagnetic waves. The program displays the direction of propagation, magnetic and electric field components of the electromagnetic waves.

12. **Physics of geometrical optics**: **C\CUPS\OPTICS\GEOMTRI\ LENSES.** This program gives information about different types of lenses and their powers with the effect of changing refractive index.

13. **Diffraction**: **C\CUPLE\OPTICS\PHYSICAL\DIFFRACT.** The student is here informed about the physics of diffraction due to the existence of various sources of lights. A good display of diffraction is presented.

14. <u>Nuclear decays</u>: C\CUPS\MP\NUCLEI. The student is informed about the nuclear decay of natural and artificial nuclei. Also the program demonstrates a good information for the periodic table of elements from the nuclear activity point of view with a display of the mass and atomic number of atoms studied.

15. <u>G.M. tube</u>: C\CUPS\NP\DECAYS. This program simulates the decays from a source with a constant rate. Arriving counts are modeled via the interval distribution.

16. <u>NP nuclei</u>: C\CUPS\NP\NUCLEI. This program simulates the display of nuclear mass or binding energy per nucleon versus Z, N and A.

17. <u>SS bands</u>: C\CUPS\SS\BANDS. This program simulates the electron energy bands in a periodic crystal.

18. <u>MP laser</u>: C\CUPS\MP\LASER. This program simulates the laser operation.

19. <u>Fiber</u>: C\CUPS\FIBER. This program simulates the variation of path of a ray through a region of varying refractive index. The user has the option of changing the refractive index and the angle of incidence.

20. <u>Chaos - driven pendulum</u>: C\PSP\CHAOS DEM\DRIVEN PENDULUM. This program simulates the damped simple harmonic motion. The user can change the amplitude, damping factor, and the frequency. A display on a space diagram could be made, sinx vs. time, velocity vs. time, phase plot.

21. <u>Diffusion</u>: C\PSP\CHAOS DEM\DIFFUSION. This program simulates diffusion explanation, n particles move randomly by a unit step. The resulting trajectory is a random walk or Brownian motion and is a fractal.

22. **PH-GEM Moonel**: **C\PSP\PH-GEM\MOONEL.** This program displays the flight passage from a planet around its moon and back to the starting point. The orbit is determined by setting the initial values of the starting velocities, mass of the planet moon and the separating distance.

23. **Lorentz attractor**: **C\PSP\CHAOS   DEM\LORENTZ ATTRACTOR.**   This program shows Lorentz model of thermal convection.   It displays Lorentz strange attractor showing the projection of the orbit in each plane and the variation of the variables with time.

About The Author

Raafat Kamel Wassef, D.Sc. Born 6 th of June, 1926. Married and have three children.

Present position: Emeritus Professor of physics, and previous Chairman of physics Department, Cairo University.
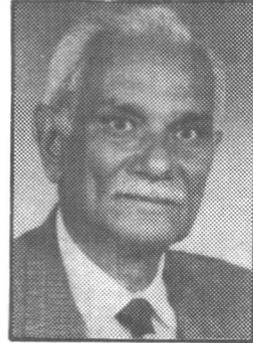
Achievements: More than 130 scientific publications in International Journals. Published for undergraduate students seven text books in Arabic and two in English. Established the Egyptian Society of Solids and acted as Chairman. Established the Egyptian Journal of Solids and acted as Chief Editor. Established the Arab Networh for physics Education, ARAPEN, which involves 16 Arab States, and acted as its Chairman. Established the Arab Journal for Pure and Applied Physics and Education. Member of the Egyptian National Committee for pure and Applied Physics. Elected member of the International Committee for physics Education, ICPE, for four periods since 1981 till 1996. In popular science, he wrote a book and established an annual letter "ARAPEN NEWS".

Appointed by UNESCO in an International Committee to establish a "UNESCO Foundation Course For physics Education for professional Students.

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