Technology Enhanced Learning For Delivering Mechanical Engineering Courses at Florida Atlantic University

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ABSTRACT

Technology enhanced learning is used in the Ocean and Mechanical Engineering Department at Florida Atlantic University to optimize and enhance students learning. Florida Engineering Education Delivery System (FEEDS) is used for delivering graduate and undergraduate courses to student over the internet. The lectures can be viewed by students any where and at any time through the streaming videos posted in blackboard. Web-based simulation and visualization or interactive modules are used to complement student learning achieved through physical laboratories and conventional class room. Citrix System, blackboard and digital writing pad are used for delivering information technology (IT) solutions that enhance and expand the educational experience for engineering students. The integration of education and information technology into academic environment will be discussed in this paper.

Keywords: Technology enhanced learning, Florida engineering education delivery system, web-based simulation and visualization, black board, digital writing pad,

1. INTRODUCTION

The goal of the higher education institution is to improve the efficiency and cost-effectiveness of learning, for individuals and organization, independent of time and place. Innovative technologies and methods are needed to reach this goal. Technology Enhanced Learning (TEL) integrates education and information and communication technologies into academic environment [1-2]. TEL is used to optimize and enhance students learning in all aspects of education. It allows for interactive environment that maximize learning by challenging the students to be creative. TEL helps faculty and staff to explore and implement technologies for delivering courses on campus and distance learning. The demand of new web-based courses for distance learning and the evolution and the development of new technology for education will encourage faculties to adopt new Technology Enhanced Learning for distance education [3-4]. The evolving student population, the development of innovative technology, and the change in the climate for higher education are the key dynamic factors affecting the support or the expansion of the use of technology enhanced learning in higher education [5]. The use of TEL will help higher education institutions to reach out students with different learning styles, skills and different needs [5]. Technology enhanced learning can provide convenient and flexible learning opportunities to students wishing to develop new skills and knowledge, and improve communication among students, and between students and instructors.

The Mechanical Engineering Department at Florida Atlantic University is using new Technology Enhanced Learning for delivering courses to engineering students. Florida Engineering Education Delivery System (FEEDS) is us used for delivering graduate and undergraduate engineering courses such as Dynamics, Statics, Thermodynamics, Fluid Mechanics, Computation Fluid Dynamics, and Applied Combustion to students over the Internet. Lectures can be viewed by streaming video after the on-campus lecture has finished. Interactive modules

that use Web-based simulation and visualization are also used to enhance the student learning. The web based simulation and visualization are used in Dynamics, Fluid Mechanics and Computational Fluid Dynamics courses to complement student learning achieved through physical laboratories and conventional classroom instruction. Citrix system is used for visualization and remote access software for delivering applications over a network and the internet. Through Citrix system, students on and off campus can remotely access and run software without having the software loaded onto their personal computers. Blackboard is used by students to access course information, participate in online discussions with their professor and classmates, obtain homework assignments and self-assessment quizzes, as well as track their academic schedule and grades.

2. TECHNOLOGY ENHANCED LEARNING

2.1 TEL – Florida Engineering Education Delivery System

Florida Engineering Education Delivery System (FEEDS) is a distance education program. It is a statewide system in Florida providing access to university courses at corporate sites, government agencies, and individuals, regardless of location. The FEEDS system has been developed to deliver engineering and computer science programs to students any place, and at any time. The FEEDS system is a cooperative effort between engineering colleges within the State of Florida and private industry throughout Florida. The FEEDS system has been created at the beginning for the expressed need of Florida's technological industry to access quality graduate continuing education programs in engineering. Several Florida's Universities (Florida Atlantic University, Florida International University, University of Central Florida, University of Florida, University of South Florida) are using this system to deliver engineering courses on and off campuses. The College of Engineering and Computer Science at Florida Atlantic University offers engineering students and professional with work and/or family responsibility to take courses around the busy schedule. FEEDS course is suitable for students living fare away from the engineering college and professional with physical handicaps that prevent them for attending classes. Undergraduate and graduate engineering credits courses are offered during the fall, spring and summer semesters in mechanical, civil, ocean, electrical, computer engineering and computer science. The engineering course lectures are recorded daily from live lecture classroom. The course lectures or streaming videos are posted the same day in blackboard. Graduate and undergraduate mechanical engineering courses (dynamics, statics, thermodynamics, heat transfer, fluid mechanics, computational fluid dynamics, applied combustion) are delivered to students over the internet. The lectures can be viewed by streaming video after the on-campus lecture has finished. With streaming video, students have the convenience of accessing their course anywhere (Work, Home, while traveling) with a computer that has Windows Media Player 10 and a high-speed Internet connection. The lectures will be available for students for the entire semester. The lecture is recorded in one of the three studios (see Fig. 1) in the computer center. The lecture is posted in blackboard just after the end of the session.

For the registration, the students can enroll in one or more courses in six different engineering disciplines each semester. Students follow the same admissions and registration policies as students who take courses on campus. For each course, students can register in one of the three sections for the specific course. Section 1 is for students attending live class (face to face students). Section 2 is for students at FAU campus that are taking another course during the same timeframe, so there is a time conflict (distance learning). Section 3 is for students who are not present at FAU campus and can not attend live class (distance learning). Students register for section 2 and 3 (distance learning) need to provide the name of person to proctor the exam. The exam is sent to other campus locations/ industry proctor/ FEEDS office to proctor the tests.

Figure 1 Tele classroom for hybrid or fully online courses

2.2 TEL – Web-based simulation and visualization

Interactive modules that use web-based simulation and visualization (WBSV) are also used for engineering courses to enhance the student learning. WBSV are used in mechanical engineering courses such as dynamics, fluid mechanics and computational fluid dynamics to complement student learning achieved through physical laboratories and conventional classroom instruction. For example, for dynamics course (undergraduate level course) is designed to introduce students to the concepts and applications of engineering dynamics of moving bodies. After finishing the course, the student will be able to relate the forces and moments acting on a body to the resulting motion, and to develop solution procedures using basic principles of mechanics (force, mass and acceleration; work and energy; and impulse and momentum). The lectures are based on a sequence of chapters from the Beer and Johnston textbook [6] and supplemented with additional materials. Class interactivities are used for Dynamics course to complement the topics covered in the class (kinematics, kinetics, work and energy and impulse and momentum for single particle, and rigid bodies). For example, for problem of the motion of a brick on a frictional inclined plane, the force applet (see Fig. 2) was designed to give student an opportunity to develop computational skills and examine the forces on inclined plane. For projectile motion (see Figures 2 and 3), different games for students to play in an effort to develop an understating of how objects move when projected through the air. The circular motion applet (Fig. 2) is designed for students to examine the basic ideas of kinematics (study the motion of an abject without taking into account the forces applied on it) and for objects whose motion is circular. The student will be able to examine the impact of mass and velocity on force and acceleration both graphically and numerically. The banked curve applet (Fig. 2) is designed to simulate a race car traveling around a track in order to study inertia, centripetal force, and the impact of such variables as the incline of the track, velocity of the car, and friction. The students can manipulate all of these variables in order to better understand their relationships. The students will have fun trying different combinations and seeing if they can avoid a crash. The roller coaster applet (Fig. 2) is designed to give the students an entertaining way of examining the principle of conservation of energy. The students can build their own roller coaster, and watch the interplay between potential and kinetic energy. The pool table applet (Fig. 2) is designed for students to examine the principle of conservation of linear momentum. The students can select and place balls of mass and initial velocity on the table to investigate the principle of linear momentum. Before and after displays will give students a visual of how the forces change during a collision. The students can put the newfound knowledge of this game to practical use against their friends.

Figure 2 Interactivities – Dynamics Course

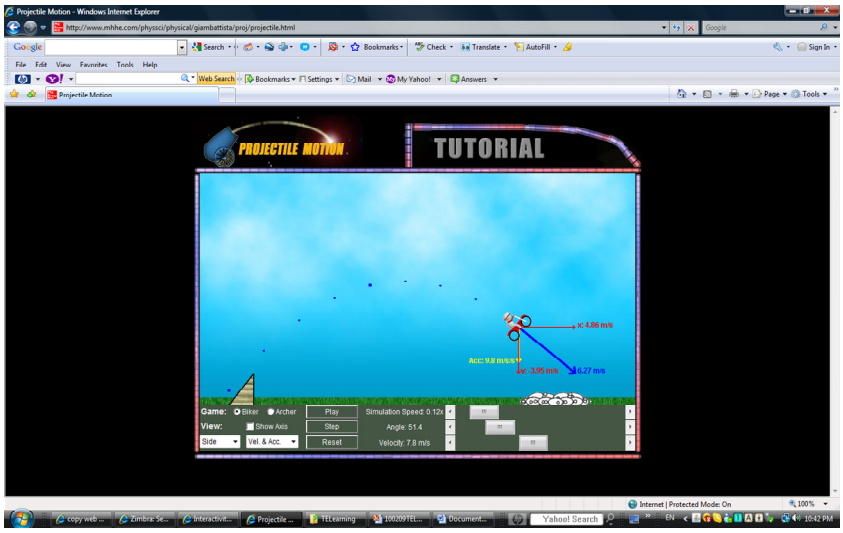


Figure 3 Projectile motion: Example of Course Interactivities

2.3 TEL – Citrix System

Citrix System is used for delivering information technology (IT) solutions that enhance and expand the educational experience for mechanical engineering students. Citrix Systems is used for visualization and remote access software for delivering applications over a network and the internet. Software such as Matlab, Ansys, Fluent, Visual Studio, Solid Works, Labview, and Maple (See Fig. 4) are available through Citrix system. Citrix System is also used by students on campus (laptop classroom) and off campus to remotely access and run software. Citrix is also used for online courses that feature two-way audio and video interactions between students and the instructor (go to meeting). Another advantage is the ability for students to remotely access and run professional software without having the software loaded onto their personal computers. The software product that permits this type of operation is citrix's presentation server. The Citrix system will allow the students to access the software they need for their home works and projects from home and offices at any time. For example, students taking the computer application course (undergraduate level course) can access Matlab to perform computation to solve engineering problems. Figure 5 shows the program developed by students using matlab to compute the position, velocity, and acceleration of a piston for internal combustion engines. Figure 6 shows the results of the computational fluid dynamics analysis (mixing elbow) performed by students using fluent software through citrix system. Fluent is used by students for fluid and heat transfer analysis for heat transfer, fluid mechanics and advanced computational fluid dynamics courses.

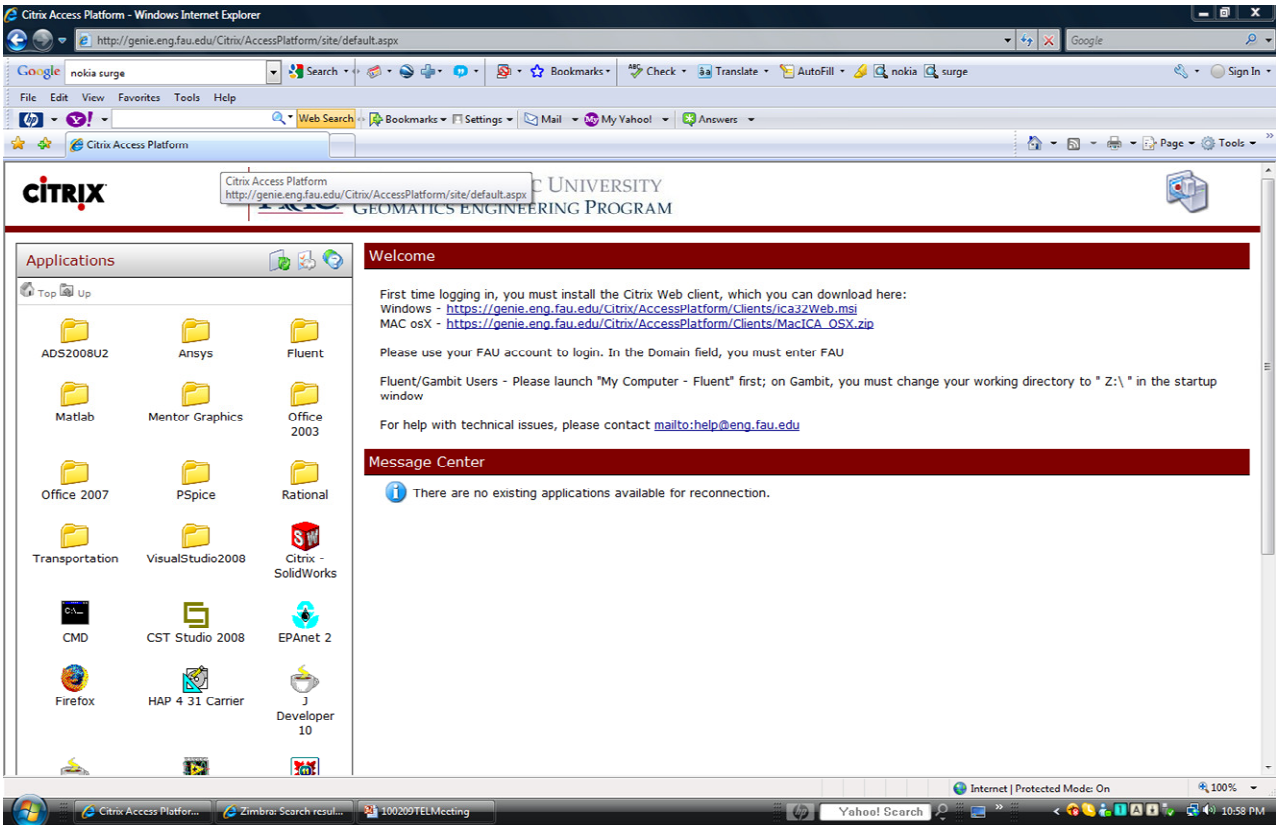


Figure 4 Citrix System

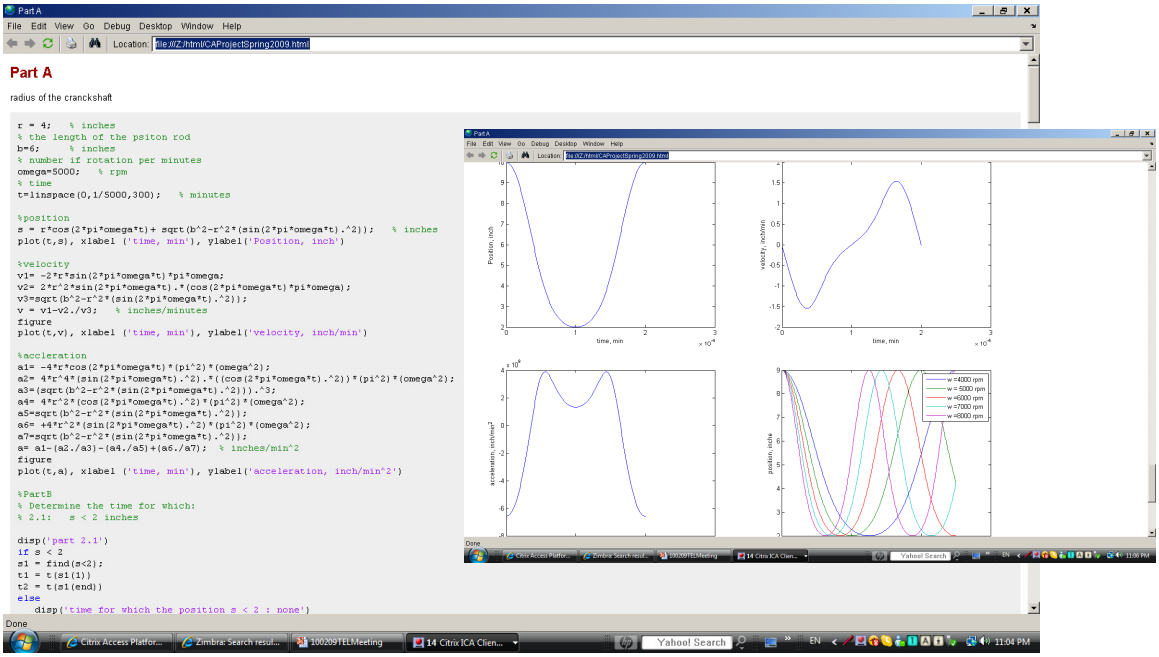
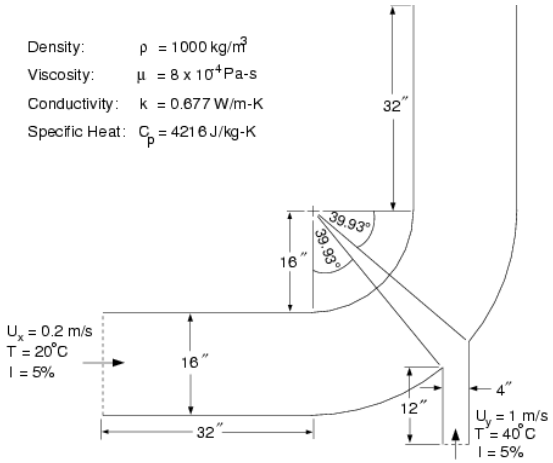


Figure 5 Matlab program for computer application course - Citrix System



Velocity contours **Temperature contours**

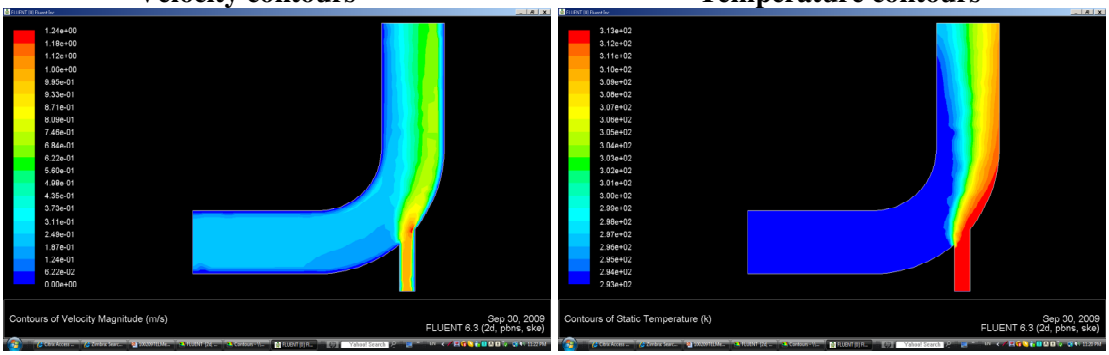


Figure 6 CFD Analysis using Fluent - Citrix System

2.4 TEL – Blackboard

Blackboard is a web-based course-management system that allows instructors to put their syllabi, lecture notes, homework assignments, quizzes, and grades online for students to access at anytime. It also includes interactive features, such as discussion boards and virtual chat rooms, which enhance communication between students and faculty. Instructors can use blackboard as the sole means of delivering their course or as a way to augment a traditional face-to-face class. Blackboard (see Fig. 7) is the primary vehicle that supports online classes.

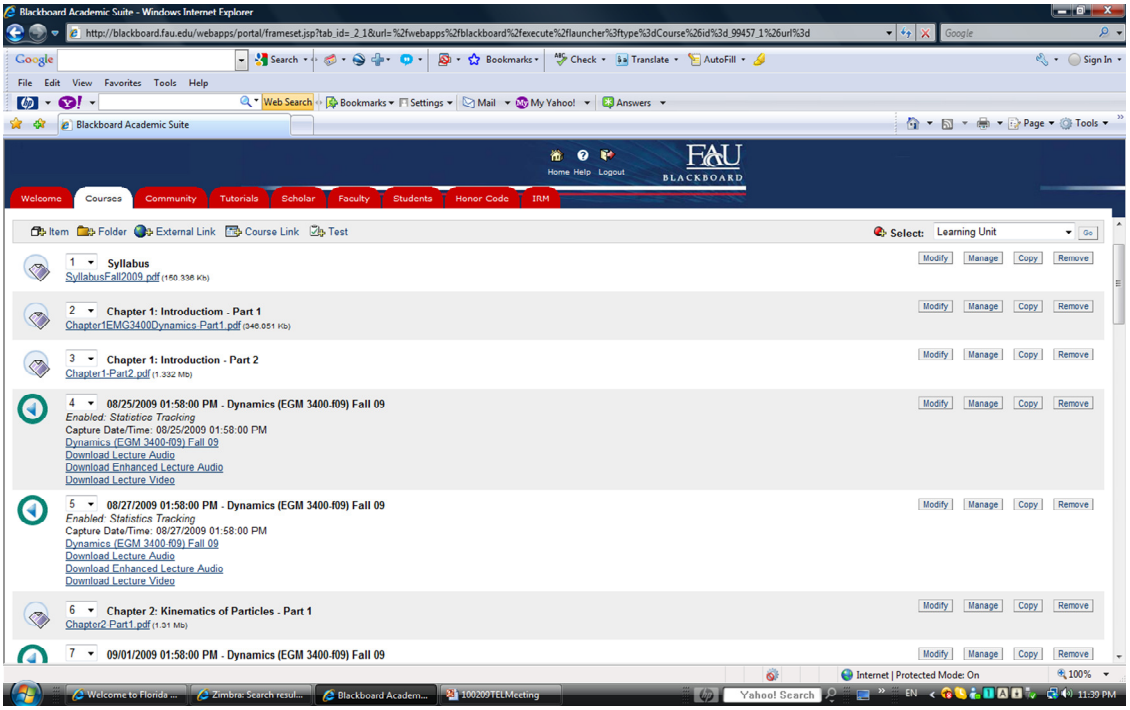


Figure 7 Blackboard for face to face, hybrid and fully online courses

2.5 TEL – Digital writing pad

The portable digital writing pad (See Fig. 8) is a device with storage capabilities that digitally capture and store everything you write or draw on ordinary paper. The instructor can view, edit, and share the hand written notes with students. A digital ink pen is used to write notes, home work assignments, solve engineering problems on the paper clipped into the digital pad. All you write is automatically saved into the memory, so the instructor can transfer the digital copy to his computer to edit, organize, e-mail and share with his students (see Fig. 8). The pad has a 32 MB internal memory, uses A4 size paper and you can stack up to 135 sheets of paper. A USB cable is used to plug the digital pad into the PC. Figure 8 shows an example of lecture notes using the digital pad from the fluid mechanics course (undergraduate level course). The notes from the digital pad are posted in blackboard for student to review online.

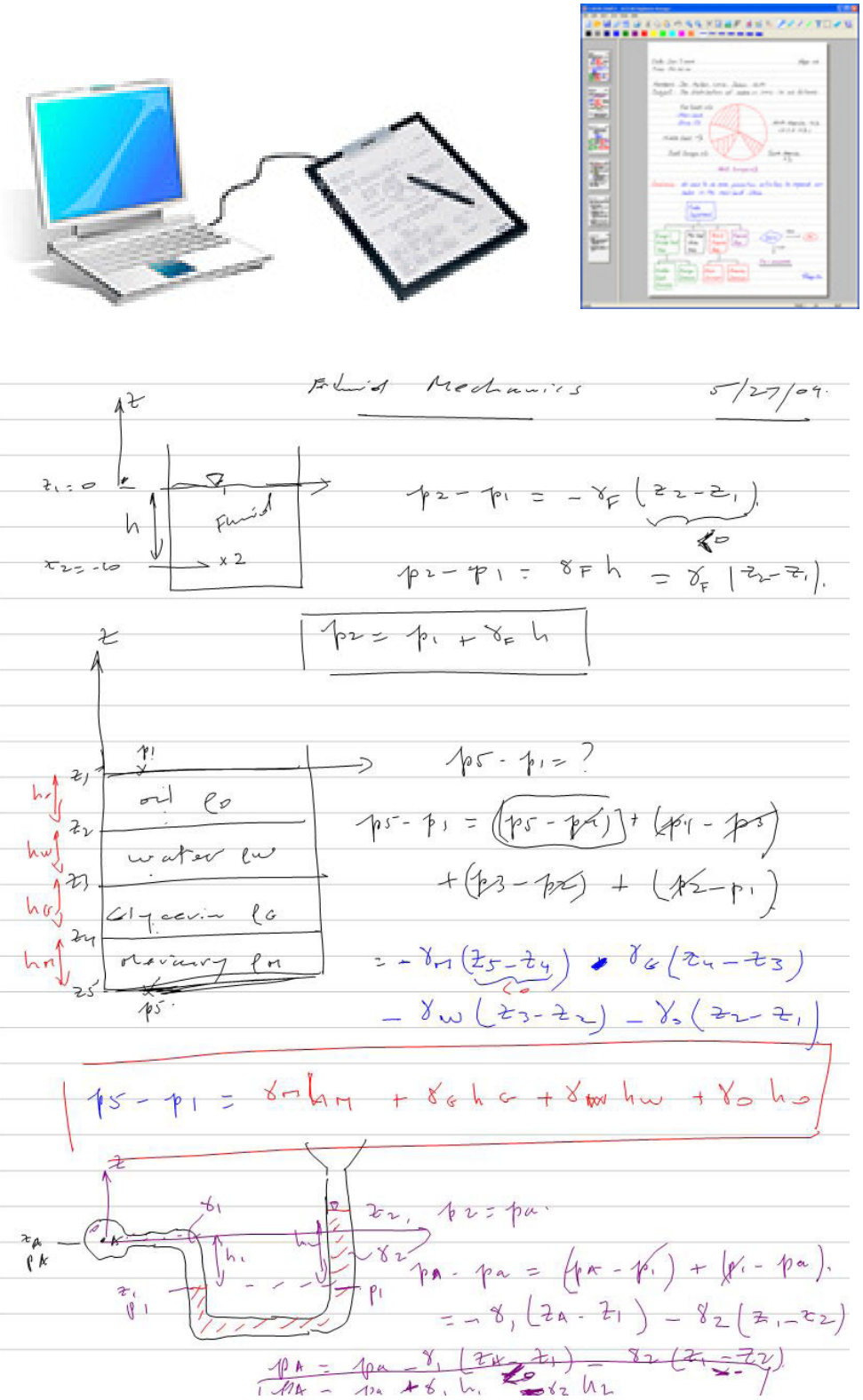


Figure 8 Digital writing pad and lecture notes (fluid mechanics course)

3. CONCLUSIONS

Technology enhanced learning for delivering graduate and undergraduate courses to student over the internet, web based simulation and visualization, and citrix system, black board and digital writing pad for delivering information technology solutions that enhance and expand the educational experience for engineering students are used in the Ocean/Mechanical Engineering Department, College of engineering and compute Science at Florida Atlantic University. The benefits of integrating these information technologies and education into academic environment are:

- Feeds course: For hybrid and fully online courses (distance learning), the recorded lectures are posted in black board and the students have the convenience of accessing their course anywhere and at any time with a computer. The students can download the streaming video and review the lecture notes any time they want for the hall semester.
- Web-based simulation and visualization: used to complement student learning achieved through physical laboratories and conventional classroom instruction.
- Citrix system: used for visualization and remote access software for delivering applications over a network and the internet. Engineering students are able access to software used in engineering courses online and to work on their home works, projects and other assignments from any place and at any time.
- Black board: used by students to access course information, participate in online discussions with their professor and classmates, obtain homework assignments and self-assessment quizzes, as well as track their academic schedule and grades.
- Digital writing pad: The instructor can view, edit, and share the hand written notes with students. The students will focus less on note-taking and more on class discussion, so they can listen more and participate in the class.

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