INTEREST GROUP USING ELECTRONIC MANAGEMENT SYSTEM (i-GEMS)

LEE SEAH FANG

UNIVERSITI TEKNOLOGI MALAYSIA

INTEREST GROUP USING ELECTRONIC MANAGEMENT SYSTEM (i-GEMS)

LEE SEAH FANG

A thesis submitted in partial fulfillment of the requirements for the award of the degree of Master of Science (IT – Management)

Faculty of Computer Science and Information Systems
Universiti Teknologi Malaysia

NOVEMBER 2005

To my beloved mother, father and brother.

ACKNOWLEDGEMENTS

The author would like to express her greatest gratitude to many people who have contributed to the successful completion of this thesis. Most especially, the author would like to thank her project supervisors Associate Professor Wardah Zainal Abidin and Pn. Suzana Abidin for their genuine advising and guiding toward the accomplishment of the project. Their brilliant guidance have led the author to produce the thesis successfully within the specified time frame along with conformance formation.

In the meantime, the author greatly appreciate her colleagues at Tunku Abdul Rahman College namely Mr. Chan Lam Heng (Head of School), Ms. Kathleen Tan Swee Neo (Head of Computer Science Division), Mr. Yong Chan Huang (Course Tutor), Mr. Lee Yik Seng (Head of E-learning Project), Ms. Cheong Pooi Sun (Lecturer), Ms. Chin Chai Ling (Lecturer), Ms. See Hui Hong (Lecturer), Mr. Teo Su Beng (Lecturer), Ms. Kong Hui Ming (Lecturer), Mr. Beh Tian Su (Lecturer) and many others for their information, constructive criticism, cooperation and many valuable suggestions.

Apart from that, the author would like to thank University Teknologi Malaysia (UTM) for giving such a valuable opportunity to exert her knowledge and potential in completing the project. In addition, appreciations go to the reviews, assessments and comments from the Panel of Assessors, which are significant in contributing toward the betterment of the thesis.

Last but not least, the author would like to thank her families for their precious support and understanding throughout the time.

ABSTRACT

This thesis studies and analyzes the existing situation of Tunku Abdul Rahman College (TARC) in relation to academic collaboration and information sharing among its six campuses, as well as the status and limitations of TARC's existing electronic learning application. Based on the study, an Interest Group Using Electronic Management System (i-GEMS) is proposed to serve as a platform solution in supporting the collaboration and academic information sharing that is customized to TARC's circumstances.

The i-GEMS is a web-based application that developed using ASP.NET programming language, while Unified Approach (UA) that advocates Object-Oriented Methodology (OOM) in system implementation and Unified Modeling Language (UML) for diagram modeling are selected as a guide in developing the proposed i-GEMS system.

Through the i-GEMS, lecturers from different campuses can collaborate and share academic information with each other. This in turn can lead to delivery of standardized education throughout the six campuses of TARC. In addition, lecturers can broaden their knowledge other than their own fields of teaching through accessing other academic information from the i-GEMS.

In short, i-GEMS is a system that advocates managing academic information through collaboration across the campuses, information sharing and learning throughout different academic modules, as well as promoting higher interaction and information sharing among the students and lecturers.

ABSTRAK

Tesis ini dilaksanakan bagi mengkaji dan menganalisa situasi di Kolej Tunku Abdul Rahman (KTAR) berkenaan kerjasama akademik dan perkongsian informasi di antara enam kampus. Ini termasuk juga status dan kelemahan perisian pembelajaran elektronik sedia ada. *Interest Group Using Electronic Management System (i-GEMS)* dicadangkan sebagai landasan bagi menyokong kerjasama dan perkongsian informasi akademik berdasarkan situasi di KTAR.

I-GEMS adalah perisian yang dibangunkan dengan mengunakan bahasa aturcara *ASP.NET* berdasarkan konsep *Unified Approach* yang menggalakkan penggunaan metodologi berorientasikan objek untuk membina sistem dan *Unified Modeling Language* bagi pemodelan diagram.

Melalui i-GEMS, pensyarah dari kampus yang berlainan dapat berkerjasama dan berkongsi infomasi akademik di antara satu sama lain. Dengan ini, pendidikan yang selaras dan konsisten akan dapat disampaikan di keenam-enam kampus KTAR. Selain itu, para pensyarah dapat memperluaskan pengetahuan dalam bidang lain dengan menggunakan segala informasi yang terdapat di dalam i-GEMS.

Kesimpulannya, i-GEMS adalah sistem yang menggalakkan pengurusan informasi akademik melalui kerjasama antara kampus, perkongsian informasi dan pembelajaran melalui modul akademik yang berlainan serta menggalakkan interaksi dan perkongsian informasi di antara pelajar dengan pensyarah.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

EITF	Estonian Information Technology Foundation
ELCH	E-Learning Consortium Hamburg
ICT	Information and Communication Technologies
IT	Information Technology
i-GEMS	Interest Group Using Electronic Management System
IS/IT	Information System / Information Technology
MCA	Malaysian Chinese Association
OOM	Object-Oriented Methodology
TARC	Tunku Abdul Rahman College
UA	Unified Approach
UML	Unified Modeling Language
UTM	Universiti Teknologi Malysia

LIST OF APPENDICES

CHAPTER 1

PROJECT OVERVIEW

1.1 Introduction

The title for the project is *Interest Group Using Electronic Management System (i-GEMS).* The title i-GEMS symbolizes that the system will serve as an electronic platform to gather a group of people who are having common interest on particular education information which is precious and valuable, just like jewels (gems), to the lecturers and students across campuses of Tunku Abdul Rahman College (TARC). Hence, i-GEMS is selected as the title for the project.

1.2 Background of Problem

Interest Group Using Electronic Management System (i-GEMS) is a proposed project intended for managing academic information through electronic system for tertiary education environment. The system is developed based on the author's working environment – Tunku Abdul Rahman College (TARC).

Currently the college's main campus is located at Setapak, Kuala Lumpur, with five other branches located at five different states (Penang, Perak, Pahang, Johor and Sabah) to provide education to the public. As one of the academic staff for TARC, the author has practical experienced some difficulties in communicating with other academic staff from other branches in sharing academic information. As a result, an initiative to develop an electronic information management system solution, which is custom made based to TARC atmosphere, culture and mission, is duly purposed.

Currently there are 105 courses offered in TARC. For illustration purpose, this project is only concentrating on computer science first year diploma courses.

Fundamentally, as TARC has six campuses within the nation, it is said that lack of communication exists among lecturers from different campuses who are teaching the same subject. This is due to the current environment that does not provide a proper platform to allow different campuses lecturers to communicate with each other in order to share and manage education information effectively and efficiently. As a result, lecturers from different campuses may cover subject scope differently and produce inconsistent teaching materials. The problem is worsen when some campuses students are not able to answer the examination questions due to different scope covered by their lecturer. Consequently, these groups of students may fail the particular examination.

The next section 1.3 – statement of the problem, will serve as a continuous to illustrate an overview of the existing problems.

1.3 Statement of the Problem

As briefed on the previous section, on the whole, the problems faced by the lecturers of TARC can be listed as below:

- Lecturers do not acquaint with lecturers from other branches, including those lecturers who are teaching the same subject.
- A lecturer can only get to know other branches lecturers' contact details through course tutor (course tutor is an academic staff who is in-charge of a small group of lecturers) or human resource personnel, which is quite a tedious task.
- Lack of information sharing and collaboration among the same field lecturers.
- Lack of proper channel that allows lecturers to share their expertise and academic knowledge among themselves.
- Lack of standardization among the teaching materials prepared by the lecturers from different campuses.

On the other hand, the problems faced by students can be short listed as follows:

- Communication between the students and lecturers are mostly restricted to classroom teaching only, which provide very limited time for student to ask question.
- Some students are shy or not confident to voice their question in the classroom, as a result, their enquiries are not handled and subsequently cannot catch up with the syllabus.
- Students may have questions after they have done their revision and wish to send their questions to the lecturer's email account and they have to wait for the replies. However, as some lecturers may not use the e-mail system constantly, students may get the reply within a week, a month or even never get reply from the specific lecturer. As a result, it de-motivate students from asking the lecturer questions.
- Students may not be aware of the important message or announcement made by their lecturer if they are absent from lecture.

- Some students may not receive the complete study materials before a class. For instance, prior to attending tutorial class, some students may not receive the required lecture notes for reference. As a consequence, they come to class without any preparation.

Seeing such problems exist among the lecturers and students, it motivates the author to develop i-GEMS system, which is a customized system solution that developed based on TARC circumstances.

1.4 Project Objectives

The following is a list of objectives for the proposed system – i-GEMS:

- To analyze TARC's existing circumstances in relation to:
  i. Communication and collaboration approach in academic information sharing and management among the lecturers from different campuses.
  ii. Difficulties of students in communicating with lecturers.

- To formulate a framework, to serve as:
  i. Organization strategies in implementing the proposed system, which advocate academic information sharing and collaboration among the campuses of TARC.
  ii. A cheaper and faster mechanism that enable standardization of academic materials among the campuses without the needs of face-to-face meeting.

- To develop a proposed system, that is:
  i. Designed and customized to TARC environment, which can facilitate the communication and cooperation in academic information sharing among the lecturers of different campuses.
  ii. To design a solution that facilitates communication between students and lecturers without restricted by the location boundaries.
  iii. To develop a solution that allows students access to the academic materials, as well as important announcements made by the lecturers.

1.5 Project Scope

The proposed system – i-GEMS, is developed based on Tunku Abdul Rahman College (TARC) context and circumstances. For illustration purpose, the project is only focusing on computer science first year diploma courses.

On the whole, the major functionality of i-GEMS is to serve as a platform to facilitate communication and cooperation among the lecturers of different campuses through developing and managing a common subject module. In addition, the proposed system allows lecturer to post their academic materials, such as lecture notes, tutorial questions, and assignment that can be accessed by the students. When a lecturer has an important announcement to inform students, he or she can make the announcement through the i-GEMS system that is accessible by the students.

From this system, a lecturer can upload objective questions to test students' understanding. Once a student has finished answering the test questions, the system is capable to process and mark the students' answers automatically and produce summary result to the participant. In addition, to enhance the knowledge of academic staff, a lecturer is allowed to access other first year diploma computer science subjects, other than the subject he or she is currently handling.

From the student perspective, students are allowed to access the lecture notes, tutorial questions, assignment or announcement from the proposed system. Whenever students have uncertainties for a particular subject, they can raise queries on the system. Through the system, students' queries are not only can be answered by their own campus lecturer, but also lecturers from other campuses who are teaching the same particular subject. As student's question and answering session can also be accessed and discussed by other students who are studying the same subject, hence information sharing exist among the student group.

The raw data such as lecture notes, tutorial questions, announcement, students' name and so forth, which is used in developing the i-GEMS system will be the combination of actual data that is based on the author's hands-on working at

TARC, as well as some simulation data that is based on other computer science diploma subjects.

To develop the i-GEMS system, the following list of software will be utilized.

- Operating System – Microsoft Windows XP Professional.

- Internet Information Services (IIS) – The powerful web server, IIS 5.0 is used to provide a highly reliable, manageable, and scalable application infrastructure for the web-based i-GEMS system.

- Web Browser - Internet Explorer 6.0 is used to view and display the contents of the electronic system.

- Microsoft dot Net Framework1.1 – The software is needed to support ASP.NET programming application development. The software can be downloaded free from the Internet (hsttp://www.microsoft.com/downloads/).

- Web Matrix – The software is one of the most powerful ASP.NET compilers. It allows system developer to build and maintain a proposed system. The software can be downloaded free from the Internet (http://www.asp.net/webmatrix/).

- Microsoft Office Suite - Microsoft Office 2000 is required to assist in documentation of the project.

- Microsoft Project – Microsoft Project 2002 is utilized to plan and track the schedule for the i-GEMS system.

- Microsoft Visio - Microsoft Visio 2002 is utilized as a diagramming program that allows the author to visualize the system information effectively through the creation of modeling diagram such as UML diagrams.

- Microsoft Access - Microsoft Access 2000 is required to serve as a database for the i-GEMS system.

- Programming language - ASP.NET programming language is the core programming language that is used in developing the i-GEMS system. As the dot net application is capable to support various types of platform, users are freed from using various types of technologies that drives today's computing marketplace.

As i-GEMS is developed based on web-based approach, the system will be developed using Object-Oriented (OO) methodology and modeled by using Unified Modeling Language (UML), which will be discussed in detail in chapter 3.

Generally, users of the proposed i-GEMS system will be academic staff and students from computer science division of TARC. Once the system is developed, a plan for component test and integration test will be produced. Based on the testing plan, each unit component is tested and then followed by the integration test. For further information on the i-GEMS system development methodology, reader can refer to chapter 3.

1.6 Importance of Project

From the proposed system – i-GEMS, lecturers and students of TARC are the two major groups of people who will benefit from the system.

When compared to the current system, the proposed electronic system solution will provide the easiest, fastest and most efficient way that allows 24-by-7 basis of communication among lecturers from different campuses. Through the proposed system, it enables the different campuses' lecturers who are teaching the same subject to cooperate with each other through the cheapest cost media to produce standardized teaching materials throughout the whole nation. Hence, it helps avoid the problem of covering inconsistent teaching scope among the lecturers from different campuses. As a result, students who are studying the same subject, no matter which branches they are from, their performance can be evaluated fairly and accurately. In addition, through I-GEMS, it enables the knowledge sharing and discussion exists among the lecturers through discussion board provided by the system.

On the other hand, through the proposed electronic system, students and lecturers communications are no more restricted to classroom only. Instead, a student can consult a lecturer from anywhere and at any time. In addition, whenever students have any enquiries, they can refer to their own lecturer, as well as lecturers from other campuses who are teaching the same subject. Through I-GEMS, the system ensures that students would not miss any study materials or important announcement even though they may be absent from the class. Moreover, students can participate in objective test questions from the system whenever they get prepared. They can take the test at any time and any place, provided that they are connected to the electronic system.

In short, the proposed i-GEMS system is significant to TARC as it contributes benefits to the lecturers and students in information collaboration and sharing. As a result, these contributions can then further enhance the college efficiency and effectiveness in delivering the academic education as well as increase the reputation of TARC.

1.7 Chapter Summary

The chapter has provided an overview on the proposed system – i-GEMS, which is a system solution that customized to TARC's existing circumstances. Based on the chapter, a reader can have an understanding on the problem statement, objectives, scope and importance of the proposed project.

On the whole, i-GEMS is a solution that will serve as a channel to allow different campuses' lecturers to get acquainted with each other. It facilitates information sharing and management among the lecturers of different campuses who are teaching the same subjects. For those lecturers who want to broaden their knowledge other than their own field of teaching, they can improve themselves by learning from other academic modules that offered by the proposed system.

In addition, i-GEMS is developed to provide a channel that allows better information communication between the students and lecturers of TARC. Students can access the course materials, announcement, assignment and even a test from the system. The proposed system also will serve as a platform for students to raise their inquiries to lecturers. The answering section is not restricted to the student's lecturer only, instead, other campuses' lecturers who are teaching the same subject can also answer the inquiries. Therefore, a student can receive a reply faster than using e-mail approach, where it is directed to one lecturer only. Moreover, i-GEMS allow the question and answering session to be shared and participated by all those students who are studying the same subject.

In short, the I-GEMS system is served as a platform for communication and collaboration in academic information management among the lecturers and students of TARC.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Over the last few years the use of information and communication technologies (ICT) in all sectors of education has increased dramatically. It is said that the adoption of ICT in education is only at its infancy. Seeing the increasing significance of ICT contribution in education sector, hence the topic of the project – i-GEMS is chosen to further explore the possibilities of ICT contribution under TARC circumstances.

To understand the project better, the chapter will first brief on existing system that is available at TARC (section 2.2). Section 2.3 gives a brief overview on the e-learning system, the e-learning providers as well as the impact of e-learning system. Section 2.4, discusses future development and trend in developing the online education system. Last but not least, section 2.5 will be the summary of this chapter.

2.2 TARC's Existing Application

Globalization and ever developing of e-technology application has tremendously changed the ways services are delivered. Higher education or university is not exception. There are lots of colleges and universities all over the world rushing in implementing the e-learning platform to build competitive advantage in facing the current global environment. TARC is also one of the colleges that have joined the trend.

The idea of establishing an e-learning project in TARC was proposed by the management about 3 years ago. The project began to materialize in the academic year 2002/2003. When TARC embarked on the e-learning, a committee team was set up to look into matters concerning the project. The team comprised of staff from different departments who were invited to join the committee on a voluntary basis based on their interests in the project. One of the first objectives of the committee was to identify a suitable commercial learning management system (LMS) that will enable courses to be delivered online. Finally the team has subscribed with Blackboard Inc. to provide the e-learning services.

Though currently TARC has an e-learning system that is provided by Blackboard Inc, however, as the e-learning system is provided by the third party where the system implementation is not accessible to the author, hence the proposed i-GEMS system is not a modification from the existing system. Instead, the proposed system will be a newly developed system that is customized to TARC existing environment.

2.2.1 TARC's E-Learning System

TARC has chosen Blackboard Inc. in supporting the e-learning project. The Blackboard Inc. has provided the blackboard learning system as the college e-learning system or code-named CeL (http://www.tarc.edu.my).

The Blackboard Learning System™ is a web-based server platform that offers industry-leading course management. It is an open architecture that allows for integration with student information systems and authentication protocols. The system is available for local installation or hosted by Blackboard ASP Solutions (http://www.blackboard.com).

The college e-learning system is essentially deployed to deliver online teaching units or subjects that the academic staff is teaching in a virtual learning environment. Through CeL, a lecturer can post the academic materials into the system and make them available to student on a 24-by-7 basis. From the system, an academic staff can create assignments and add them to assignment content area. The content area can list the title, dateline and details of the assignment. In addition, a lecturer can assess students' performance through test feature offered by the system.

Discussion board is another useful tool that can be used to enhance a course unit. Lecturers can create forums to discuss on topics related to a specific subject in the discussion board. Students can reply and converse about the topics on-line. For instance, a lecturer may create a unit review forum. Users may access the forum by clicking on appropriate link in the discussion board. When a forum is accessed, a page appears which lists the different threads in the forum. A thread is a message that is posted to a forum. Users can post new threads in a forum and reply to threads that have already been posted. In spite of this, based on the author's practical experience with the e-learning system, students' participation and respond to the discussion board was poor. Many of them were not interested in posting or even to view the forum. Even though the discussion board is available for them to discuss on a topic, yet students still prefer to post questions to private email account of the lecturers. In fact some of the answers to the queries were already posted on the discussion board. This scenario may due to the existing e-learning system is still not widely adopted by

the lecturers and students. Although some lecturers have applied for using the e-learning system voluntarily, however as the college does not have policies that encourage or emphasize on the use of e-learning system, hence lecturers do not highlight the usage of the system to students.

Academic staff or lecturers who are interested in delivering their teaching subject through online is required to apply for that subject unit through their respective head of school and department. In other words, the e-learning system is not by default offered to all the academic staff. A lecturer who is interested in delivering the academic unit through the e-learning system is required to fill in the request forms (Appendix A and B), and then send to the head of school to get approval. Once the e-learning application is approved, the online service will be only available at a specified period or which is equivalent to one semester duration. When that teaching semester is ended, the applied academic unit will no longer be available for the students. If the same lecturer intended to use the e-learning system for the next semester, he or she is required to go through the same application process cycle once again.

For those lecturers who do not apply for the e-learning system services, they could not access into the system. Moreover, even for a lecturer who has applied for the e-learning system, he or she is not allowed to access other academic units. The lecturer can only access to his or her own applied academic unit only. Hence, it is said that there is no information or knowledge sharing exist across the academic units.

Current Stage

At the moment, the e-learning system is mainly deployed at main campus of TARC. According to the e-learning committee team, currently the e-learning services are not formally offered at other campuses other than the main campus. Nevertheless, when the project is grown into mature stage, the e-learning system may incorporate into other branches as well.

At the moment, the Blackboard Inc. has provided the e-learning system to TARC as a mechanism to embark on the use of information and communication technologies (ICT) in the process of teaching. However, as the current stage of the system is mainly supporting main campus, hence the system does not really support the collaboration and information sharing among the students and lecturers throughout the different campuses within the whole nation. Instead, the system is mainly deployed to offer the e-learning or Internet environment in providing teaching materials.

At current phase, the system is not meant for promoting the communication and academic information sharing throughout the different campuses. As mentioned in previous chapter (section 1.3), to communicate with other branches' lecturers, such as a branch lecturer who wants to communicate with a subject's unit leader (unit leader is one of the main campus lecturers who is selected as a leader for a unit or subject), the branch lecturer has to first acquire the unit leader's name and contact details through his or her own course tutor (assume that previously the branch's course tutor has collected the related information from main campus' course tutor). Only then the branch lecturer can exchange ideas with the unit leader mainly through email, telephone, fax or mailing approaches.

The figure below illustrates the existing communication approach throughout the campuses of TARC.

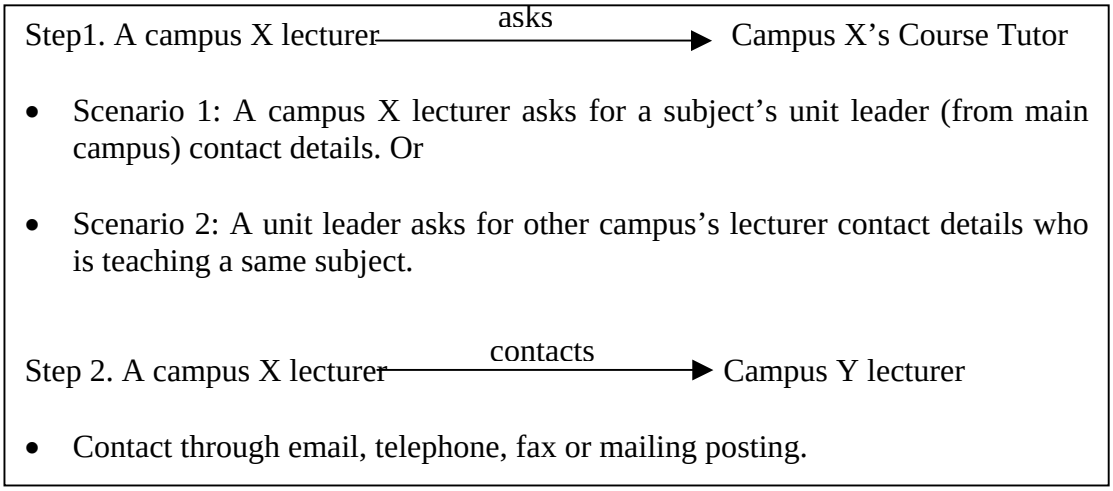


Figure 2.1: Existing Circumstance For Academic Staff To Communicate Across Campuses.

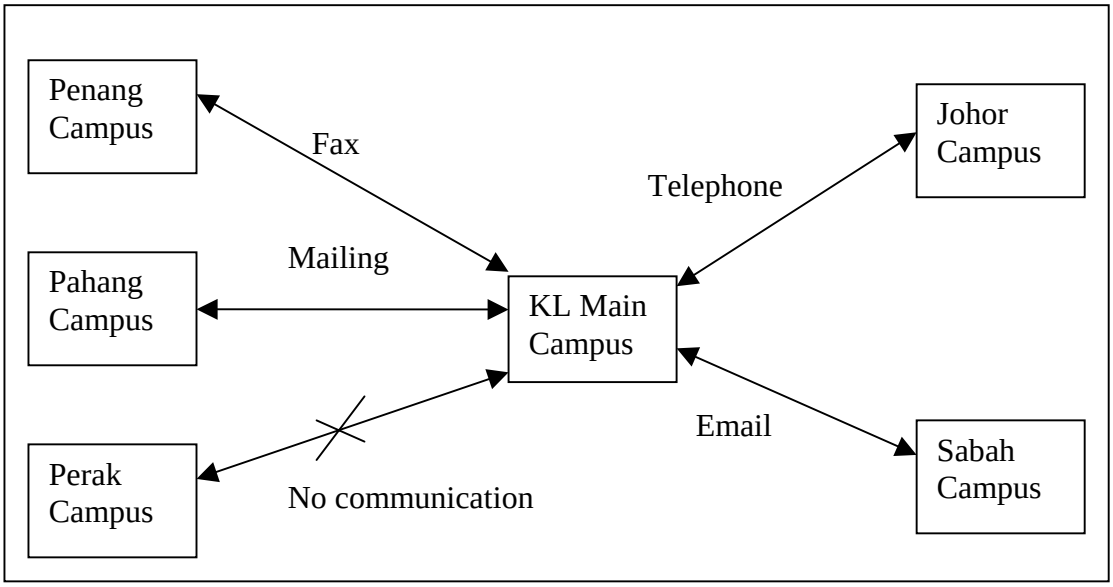


Figure 2.2: Existing Possible Communication Approaches For Academic Staff To Communicate Across Campuses.

In addition, currently TARC does not have a complete framework or policies that advocate communication and collaboration of teaching across the different branches as well as the standardization of teaching materials throughout the whole nation. While TARC is a nation wide college that comprises of six campuses located at various states of Malaysia, collaboration among the campuses is significant in order to be able to provide a standardized and consistent education throughout the nation.

Seeing the problems that were mentioned in chapter 1, discussion with top management was done in relation to the potential issues, especially the inconsistency in preparing academic materials throughout the campuses. However, top management has noted that the issue is not easy to solve. It requires lots of careful planning and considerations since it involves other branches management and policies issues as well. Nonetheless, the top management is moving forward to attend the issues and trying their effort in solving the problems.

2.3 E-Learning System

2.3.1 Overview

Regardless of where one lives, the future of learning cannot be dissociated with information and communication technologies. As technology becomes more and more ubiquitous and affordable, e-learning carries the greatest potential to train masses in the developing world in anything and everything. E-learning can and will finally revolutionize learning in the education sector (Cheick Kante and Vishal Savani, 2003).

What is e-learning? E-learning is the deployment of technology, such as the application of Internet-based technology to facilitate and enhance the traditional processes of education. The goals of deploying the e-learning, or sometimes also called as e-university or e-education are illustrated as following (Maris Treimanis, 2003):

- To improve, diversify and extend university's services.
- To be more effective and efficient in providing education services.
- To increase competitive and attractiveness of a university or college in the local and global market.
- To meet the needs of individual learners by providing technology that support for customized educational programs.
- To apply and aligned with the growing use of the Internet and World Wide Web (WWW) as tools for information access and communication.

The services provided by the e-learning or e-university may vary from university to university. Different university may encompass different scope of services. By and large, the services and functionalities provided by the e-university can be categorized as following:

- E-Teaching and distance learning.
- E-Library.

- E-Enrolment.
- E-Administration.
- E-Commerce.
- E-Publishing.

E-Teaching and distance learning:

E-teaching involves the use of ICT to enhance teaching's core activities. ICT is used to support teaching by offering various services, such as uploading lecture notes and tutorial to the web portal that can be viewed by all the students, online assessment, forum, discussion board, online announcement and so forth. In other hand, distance learning is an option for earning course credit off-campus or takes course at locations remote from the point of instruction. Distance learning may take the form of an instructor-led course delivered via satellite to multiple remote locations. Distance learning may also be training applications delivered via computer networks to students at any network node. Web-based training is one of the distance learning method in that the training application resides on a Web server while students may use the training from any location that can access to the server.

E-Library:

An information resource to support academic programs, including online services support for information literacy and research study. E-library enable users to perform online all the functions of the traditional library, plus many more available in today's digital world. For instance, through online user can access to the circulation services, acquire for a specific book from other library (inter-library transaction) or even access to the latest e-journal, databases or catalogs. Through e-library, it provides users convenience, easy-to-use, and powerful access to library content via the Internet.

E-Enrolment:

Through the web portal, students will receive personalized course information and be able to enroll through online.

E-Administration:

Referring to the use of ICT and Internet, as a tool to achieve better administration. E-administration provides general administrative functions, which include allowing students access to their own records through Internet.

E-Commerce:

In education context, e-commerce is mainly a web portal that provide interface that served as a place for students to pay fees through online or buy books from the education institutions.

E-Publishing:

E-publishing, or electronic publishing is referring to publishing in which information is distributed by means of a computer network or is produced in a format for use with a computer. It is used to provide a service for all kinds of institutional and personal academic publishing, with quality-controlled outputs to enhance university's reputation as a place of innovative research and education.

2.3.2 E-Learning Providers

As the creators and keepers of enormous quantities of valuable information and knowledge content, education institutions today are facing with critical challenges –what is the best approach in controlling and managing all this precious information and knowledge while at the same time makes the content up-to-date, flexible and easy to access through the Internet. Many education institutions have opted for third party or e-learning providers that can supply the services at professional level. Following gives a brief overview of existing prominent e-learning providers (H.M.Deitel, P.J.Deitel and T.R.Nieto, 2001).

Blackboard Inc. (http://www.blackboard.com)

Now Blackboard Inc. is licensed by more than 2,300 client institutions or more than 12 million users in 35 countries. Blackboard is used by over 45% of U.S. postsecondary institutions that use course management systems. In responding to the major challenges facing higher education institutions, the Blackboard Inc. has provided Blackboard Learning System, which is a web based server software application that offers the industry's leading course management system.

The Blackboard Inc. enables instructors to create and manage course content, utilize world-class publisher content, evaluate performance and communicate with students. In addition to provide a robust environment for online teaching and learning, the Blackboard Learning System provides an open architecture for customization and interoperability, and a scalable design that allows for integration with student information systems and authentication protocols. Blackboard Inc. allows teachers and educational organizations to post their courses on the web. Once a company has bought a license for the course-development product, they can begin posting and offering teaching materials and courses over the web.

WebCT (http://www.webct.com)

WebCT is one of the leading providers of e-learning systems for educational institutions. Thousands of colleges and universities in more than 70 countries worldwide are expanding the boundaries of teaching and learning with WebCT.

With WebCT, institutions are implementing successful strategies for engaging learners, increasing enrollment capacity without making major facilities investments, and serving diverse student populations. Hence, it is said the WebCT has successfully provided e-learning system that presents a host of new opportunities for institutions to cost-effectively expand access to education and improve educational outcomes.

WebCT helps educators and students leverage the power of the Web to improve their educational experience. WebCT sells a course development tool that enables educators to quickly build supplementary course materials or full courses to

be offered through the WebCT learning hub. So far, the company has offered courses to more than one million students.

Deitel & Associate, Inc (http://www.deitel.com)

Deitel & Associate Inc teaches instructor-led training courses for many of the world's largest organizations. Deitel publications are used in each of its training courses, and in thousands of colleges and universities worldwide. Deitel & Associates, Inc provides courses pertaining to programming such as Java, C/C++, XML, Internet programming, wireless programming, .NET languages, Perl and Python.

The version 1 Deitel web-based training courses are similar to the Deitel interactive multimedia Cyber Classroom products. The courses include the full content of the textbooks as well as complete auto walkthroughs, "live-code" examples and hundreds of solved problems. The products also include course management, scheduling and assessment features. The version 2 web-based training courses emulate the instructor-led training experience with more extensive lecture and lab features.

Productivity4you (http://www.p4you.com)

Established in 2001, Productivity4you Limited, or P4You is a highly focused e-learning and knowledge management company that utilizes technology and innovative solutions effectively to achieve bottom line improvements for clients. The company has a strong and unique blend of commercial, technological and educational expertise with substantial experience in designing and delivering e-learning and project management plans and solutions. This can be demonstrated across their established client base of FTSE 100 corporations, public sector and educational organizations.

Productivity4you offer wide range of content authoring tools which include Viewlet Presentation Software to Create Online Animated Presentations, Virtual Conferencing and Web Collaboration, Lecture Capture (Presentation, Voice & Whiteboard) and Web Publishing, Content Authoring and Publishing tools, Content and Course Delivery and Management, Assessment Authoring and Management, and

Web Quizzes Authoring. Productivity4you's e-learning and productivity tools are used in many sectors of industry, commerce and the public sector. The prominent clients list include BBC, Shell International, NHS, Citroen, Ford, Volvo, Fujitsu, HP, Novell, Sesame, Nokia, UkeU, Aberdeen University, Oxford University, University of Cambridge, University of Sheffield and so forth.

ScribeStudio™ (http://www.scribestudio.com)

ScribeStudio™ is another provider that allows users to create online versions of offline programs, information, courses, assessments and tests and deliver such materials online to invited students, trainees and other learners. By combining Authoring Tools with a Learning Management System, ScribeStudio™ offers following comprehensive toolset:

- CourseBuilder to create highly engaging online courses. CourseBuilder facilitates learning by unleashing students´ and educators´ creativity to express ideas through rich digital multimedia content.
- SiteBuilder to create password protected learning sites where your students can access their course material and interact with their teacher and classmates.
- TestBuilder to create quizzes, assessments and tests to measure student capabilities.
- Poll/Survey Builder to gain valuable feedback from your students on the course, the material or class in general.
- Learner Management tools to organize and manage students, review report cards, and much more.

Table 2.1 illustrates the comparison between the e-learning providers – Blackboard Inc., WebCT, Deitel & Associate Inc., Productivity4you and ScibeStudio, in offering set of tools to support the e-learning system.

Blackboard	**WebCT**	**Deitel & Associate**	**Productivity4you**	**ScibeStudio**
Content Authoring	Content Authoring	Course Management	Lecture Capture and Web Publishing	CourseBuilder
Syllabus Builder	Presentation Builder	Course Scheduling	Content Authoring	SiteBuilder
Course Cartridge	Communication Management	Course Assessment	Content and Course Delivery and Management	TestBuilder
Discussion Board	Assessment and Survey	Multimedia Cyber Classroom	Assessment Authoring and Management	Poll/Survey Builder
Assessment and Surveys	Personalized Content	Web-based Training	Web Quizzes Authoring	Learner Management Tool
Reporting and Performance Dashboard			*Viewlet* Presentation Software	
			Virtual Conferencing and Web Collaboration	

Table 2.1: Set Of Tools Offered By The Providers In E-Learning System.

2.3.3 Impact of E-learning

With the adoption of e-learning or e-university concept, curriculum approach is tend to focus more on student-centered learning setting, as well as learning environments centered on problem-solving that require students access to a variety of information resources. Traditionally graduates are required to demonstrate generic skills that involve capabilities such as an ability to reason formally, to solve problems, to communicate effectively, to be able to negotiate outcomes, to manage time, project management, along with collaboration and teamwork skills. With today's ICT in higher education or e-university, graduates are required to display more than that. Appropriate levels of information literacy is now required, that is the capabilities to search and identify, locate and compile, as well as to evaluate relevant information in order to engage with it or to solve a problem (James C Taylor, 2002).

In addition, the emerging use of ICT in higher education has changed the roles of educators. Many educators are changing their teaching styles to be more responsive to the characteristics of online environment and emphasize more on students' self-directed learning. The following Table 2.2 demonstrates the changing roles for both educators and students (Zane Berge, 2002).

Changing educators' roles	Changing students' roles
• Educators' role is changing from acting as content experts to serving as coaches and mentors.	• Students' role is changing from acting as passive knowledge recipients to students who are able to construct their own knowledge.
• Educators become expert of questioners, rather that being as providers of answers.	• Students are required to master problem-solving skills rather than merely memorizing facts.
• Educators merely provide structure to student work in order to encourage self-direction.	• Students are more involved in activities that require students define their own questions and search for

	answers.
• From a solitary educator to a member of learning team.	• More emphasize on students' ability as autonomous, independent, and self-motivated.
• From total control of teaching environment to sharing with students as fellow learner. As a result, educator-student hierarchy is broken down.	• Students are required to emphasize more on mastering learning skills, rather than studying just to pass the test.

Table 2.2: Changing Roles For Both Educators And Students.

Moreover, as e-university has introduced the concept of flexibility in delivering place of education programs, ICT applications have provided many options and choices and many institutions are now creating competitive edges for themselves through the choices they are offering to students. With the emerging of ICT, students are allowed to receive their education without restricted to location and time. For those students who are unable to attend campuses courses, they can now opt for off-campus delivery. ICT also provides flexibility in learning time whereby students can receive just-in-time learning. The flexibility provided has offered learning opportunities for more learners who previously were constrained by other commitments (Ron Oliver, 2002).

In spite of this, according to researchers, the current impacts of ICT on educational practice are considered as small. Instead the impacts will grow considerable in years to come and that ICT will become a strong agent for change among many educational practices (Ron Oliver, 2002).

2.4 Future Trend and Development

2.4.1 Overview

The use of ICT in education sector has become a daily part in scientific, teaching and learning processes. In order to survive and succeed in the increasing competitive higher education around the globe, with the use of advanced ICT, universities has looked for collaboration with other institutions in order to consolidate their services in providing the higher education.

According to researchers (Estonia, 2003), the future development of e-learning as well as e-universities will mainly concentrate on the following four main strategies.

Cooperation between universities

The development of cooperation between higher education institutions in the field of e-learning is one of the priorities in the strategic plan. Small population, limited (material and intellectual) resources and international competition have catalyzed the need to strengthen a university's competitiveness with the cooperation with other local higher education institutions. The cooperation may involve in research and development activities, creating and using e-learning infrastructure, developing common curricula, widening learning possibilities and mutual recognition of studies.

Equal possibilities in acquiring quality

One of the major problems revolve around a country's education institutions is unbalanced development. For instance, Malaysia has many universities, including both public and private institutions, are offering inconsistent education services to all those local and foreign students. There are relatively large number of students, including working adult learners are not accessing to equal good opportunities in acquiring quality higher education. The objective of the e-University is to provide high quality education that is accessible to a wider target group, including working

people, people with disabilities, learners in remote areas and also for other students by the means of modern technology and applicable solutions.

Innovation and development of studies

Lecture oriented learning practices will still be widespread in the next few years. The development and training of educators is undertaking first steps. Student's inability to be independent in studying and as an active learners require further attention. Innovative and effective technological and pedagogical solutions will be developed and inculcated in cooperation with higher institutions in order to enhance the learning process. In addition, educators will be offered to a variety of training and support.

International cooperation

Globalization of education and international competition demands greater international and domestic cooperation between higher education institutions. Developing common curricula in cooperation with foreign universities, increasing the number of foreign students and strengthening the quality and competitiveness of university through the international cooperation is the goal of many local universities. The objective of the international cooperation is to provide e-education to the globe, combining and disseminating information on e-learning to local and international students and develop international cooperation in the field of e-university.

2.4.2 The Emerging Approach

According to study (WebCT, 2003), many universities and colleges around the world have embarked on the developing of online learning strategy and investing in the infrastructure required. With the advent of Internet, the course management system has proven to be an essential component for an education institution to compete with others. According to WebCT, having course materials transferred to online mode should not be the final for any e-learning system. Standardization

through single course management and shared service across campuses should be incorporated into the consideration as well.

However, many institutions diminish the standardization approach so as to save cost by allowing each campus to make their own standardization decision. Often this is a result of the perception that a single solution cannot serve the needs of all the different university constituents, or lack of an enterprise-wide strategy view for e-learning. Education institutions that are successfully implementing an enterprise-wide e-learning strategy are typically using a single solution that is flexible enough to allow significant autonomy to different academic schools, departments or campuses.

In fact, having a single standardized course management system could produce an ease-of-use platform to students across campuses, reduce redundant license fees associated with multiple products, lower the costs of technical support for multiple systems, and ensure consistent and standardize course delivery across the campuses. The practice allows the sharing for content, courses, curriculum and even policies across the campuses while maintaining quality standards.

Shared service is another opportunity approach for collaboration. Shared service refers to the joint funding of e-learning infrastructure and the support of common infrastructure to reduce aggregate costs. Shared services collaboration can involve varied members within a consortium of independent institutions, a university system, or multiple campuses of a decentralized university. Before embark on the shared services, standardization on common course management system is a necessary first step toward the success collaboration.

Shared services can come in many forms, such as joint help desks, training programs, or even joint systems implementation. In a shared system implementation, there is just one installation of hardware and software, and often a distributed support staff serving multiple campuses or institutions in an enterprise-wide strategy. The cost savings come from eliminating redundancies in hardware and software or the redeployment of staff. The hardware and software are run from a central source, potentially on the campus with the most technical expertise or specialization. In order

to achieve consensus in support of a shared services environment, a solution must be offered that allows the individual institutions to maintain and control their own brand, pedagogies and teaching approaches, enrollment management, infrastructure integration, and e-learning policies, without affecting the others in sharing the system.

Exemplary Studies:

1. Purdue University

Purdue University is implementing a single academic system to serve all four of its campuses. This is the first time that Purdue has deployed a single standardized technology solution for all of its campuses. In the past, each campus made independent decisions about e-learning as well as other technology platforms. With the advantages provided by the single academic implementation - including the ability to share content and technology resources – it has convinced all of the campuses to participate, including campuses previously deployed on a different e-learning platform. The all four campuses have been now integrating their own student information system into the central e-learning installation to form a single standardized academic platform (WebCT, 2003).

2. ELCH

A six-university consortium in Hamburg, Germany, has begun to develop a new joint e-learning program. The state government and Hamburg Ministry of Science are the sponsors for the program. On the whole, the program is using a single e-learning system to link all six institutions in the E-Learning Consortium Hamburg (ELCH). The state library will also join the program in providing a unified content and technology sharing e-learning environment. The key approach in implementing such program is the interoperability with the school's diversities, proprietary authentication and registration systems, as well as making it easy for universities to participate in the system (WebCT, 2003).

3. Estonian e-University

Estonian e-University was established by 8 institutions – six higher education institutions (University of Tartu, Tallinn Technical University, Tallinn Pedagogical

University, Estonian Agricultural University, Estonian Business School, IT College), Ministry of Education and Research, and Estonian Information Technology Foundation (EITF). The institutions comprised of both public and private universities. The aim of Estonian e-University is to establish an independent legal body within coming years. By and large, Estonian e-University activities are carried out by working groups that consist of representatives from the institutions. There are currently three working groups. Administrative group deals with regulations, procedures, plans, organizational matters, questions about interuniversity cooperation and so on. Technological group concentrates on issues about course and learning object databases, learning environment, technological infrastructure and so forth. The third group called content development group is dealing with staff training and development, initiating thematic networks for joint development of modules and curricula, developing quality assurance measures and so forth (Aune Valk et al.,2004).

4. Nanyang Technological University

(NTU) and UK eUniversities Worldwide (UKeU), a UK government-backed consortium, have signed a Memorandum of Understanding (MOU) to collaborate in the areas of teaching, learning, research and content development. Under the MOU, NTU and UKeU will explore opportunities in:

- Collaboration in teaching activities by the provision of content, facilities and services.
- Co-developing and co-branding course offerings with UKeU member universities and UKeU-related collaborations.
- Conducting research and developmental activities in technological and scientific areas of mutual interest with member universities

Additionally, both parties will:

- Allocate mutually agreed upon resources (funding, manpower, space) necessary to make the partnership significant.
- Collaborate, identify and potentially develop joint and collaborative programs with academic partners worldwide identified with UkeU.

- Allow UKeU to promote NTU's expertise when talking to existing and potential customers, and in conferences (http://www.ntu.edu.sg/).

Table below demonstrates the analyzed exemplary studies based on the four institutions - Purdue University, ELCH, Estonian e-University and Nanyang Technological University.

Approaches	**Purdue University**	**ELCH**	**Estonian e-University**	**Nanyang Technological University**
Single standardized course management system	✓	✓	✓	
Institutions collaboration		✓	✓	✓
Institution’s autonomous control		✓	✓	

Table 2.3: Emerging Approaches Against The Four Exemplary Studies.

2.5 Chapter Summary

The advent of the Internet and ubiquitous of computing has boosted the implementation of e-learning system in education sector. TARC is one of the members who join the trend in the adoption. Nonetheless, as the implementation of e-learning system at TARC is still at the infancy stage, the college still have long way to go prior to reaching a level that is competitive enough to compete with others'.

At the moment, TARC's existing application is mainly intended for transferring the traditional course material approach to online system at main campus only. The system does not handle standardization, shared services or collaboration among the campuses. As the e-learning participation is based on voluntary basis, there are not much volunteer lecturers who offer themselves as the participants. In addition, this chapter indicates that many education institutions lack of enterprise-wide implementation of e-learning platform. Akin to TARC, these institutions diminish standardization in order to save cost by allowing each campus to make their own academic materials. Hence, i-GEMS which advocates collaboration and information sharing among campuses that in turn leads to academic standardization is proposed. Appropriate strategies are also needed to encourage the adoption of e-learning system among the educators in order to increase the competitive advantage of the college.

Besides, the chapter has given brief insights on several related issues such as the e-learning, e-university, existing prominent providers for the learning system, as well as the future trend and development in implementing the online learning system. Bringing courses online is only the initial steps in implementing the e-learning. It was the same cycle as the other sectors when they first embracing the Internet, such as the early days of e-Commerce where businesses simply rushing for putting brochures online. Since then, course management systems like Blackboard Learning System have grown in use and is important to all levels of education in the world. For instance, according to the 2003 Campus Computing Project survey done at

United States, 33.6% of all college courses are using course management tools, which are growing from 26.5% in 2002, 20.6% in 2001 and just 14.7% in 2000.

Based on the chapter, the author realizes that there are growing numbers of education institutions taking further step in implementing the online education system in order to increase their competitive power. Some of these institutions have collaboration and shared services within campuses as well as with other local or oversea education institutions through a single course management platform. Within this paradigm, standardization on common course management system is a necessary step toward the success collaboration. In addition, a system solution that can support the individual institutions to maintain and control their own brand, pedagogies and teaching approaches is essential in order to achieve consensus in supporting the shared services environment.

From the literature review, the chapter has broadened the author's knowledge on the ICT usage and development in higher education sector. It is suggested that TARC can always improve the existing application better by referring to other exemplary approaches and customize them based on its own environment. In the future, perhaps TARC should consider extending the collaboration with other local or oversea education institutions in implementing the e-learning system.

CHAPTER 3

METHODOLOGY

3.1 Introduction

The Interest Group Using Electronic Management System (i-GEMS) is designed and developed mainly based on Unified Approach (UA). The approach advocates elaborating and designing a system by using Unified Modeling Language (UML), and developing a system based on Object-Oriented Methodology (OOM).

As i-GEMS is a web-based system, hence OOM approach is more appropriate to serve as the system development methodology. Seeing that OOM is more suitable for I-GEMS, instead of exploiting Data Flow Diagram (DFD), the UML modeling will be deployed for documenting the system. Compared to other approaches such as Waterfall Model, UA approach or OOM is less rigid and more effective whereby it emphasizes on meeting the user's needs, develops a system iteratively whenever it is needed and promote the concept of objects and reusable components.

On the whole, section 3.2 discusses on UA approach. This is then followed by a system development methodology that is proposed based on the i-GEMS circumstances. At section 3.4, a project schedule is drawn-up. Finally, the last section 3.5 is a summary of the chapter.

3.2 Project Methodology

Unified Approach (UA) or Rational Unified Process (RUP) is based on the best practices that have been proven successful in system development. The approach is produced by three major methodologists - G. Booch, I. Jacobson and J Rumbaugh in their attempt to unify their modeling efforts (Ali Bahrami, 1999). The team was hired by Rational company and has created UML and Rational Unify Process (RUP) in giving pieces of advice around software process.

UA consists of methodology and steps in developing an application, which embodies best practices, processes and guidelines in a system development project. Generally UA advocates six best practices: develop software iteratively, manage requirements, use component-based architectures, visually model software, verify software quality, and control changes to software The approach establishes a unifying and unitary framework by utilizing the UML notations and diagrams for better understanding on object-oriented concepts and system development.

There are four main phases in UA methodology - inception, elaboration, construction and transition. Other software development stages are often divided into five phases: analysis, design, implementation, integration and testing.

As shown in Figure 3.1, the process structure of UA can be viewed based on two viewpoints. The horizontal axis represents time and the dynamic aspects of the UA in terms of the four project phases. While the vertical axis represent the static aspects of the UA in terms of workflow or activities. The balance of effort spent in each workflow varies from phases to phases. Within a phase, there may have more than one iteration, depend on the needs of a system.

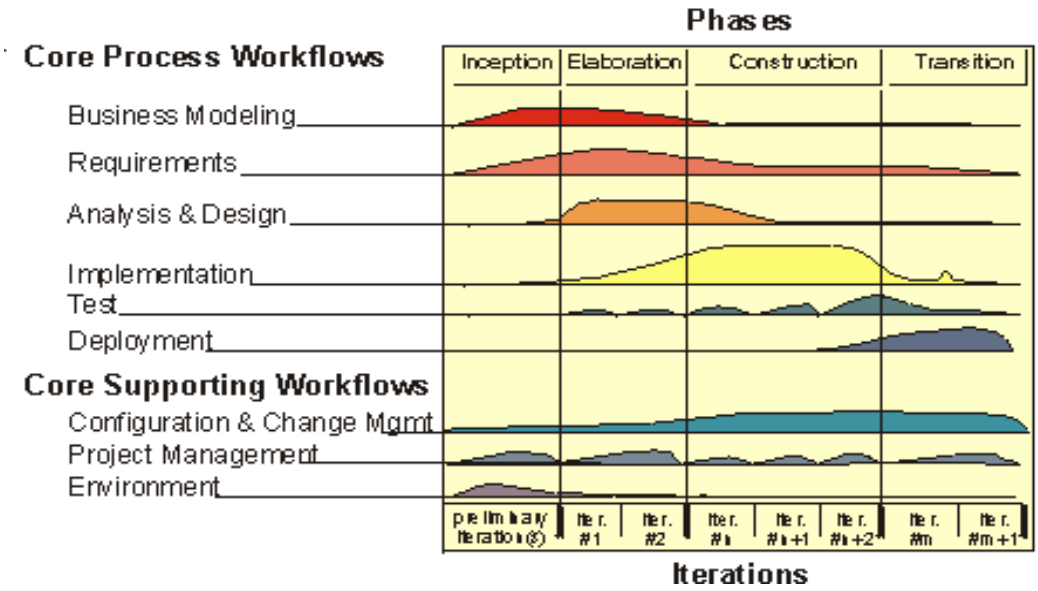


Figure 3.1: The Unified Approach (UA) Process Structure In Iterative Form.

When UA is applied to i-GEMS system, under the inception phase, major process workflow will be collecting user requirements from other academic staff and students who are going to use the system through the author's practical experience, observation and discussion with the users.

In elaboration phase, much effort will be spent on understanding the user requirements, as well as analyzing and designing the proposed system.

Construction phase will focus more on implementing the system by using ASP.NET programming languages, and testing will be performed at the same time.

In short, the unified approach revolves around OOM, UML, and iteration during system development. To implement the i-GEMS system, OOM will serve as the main approach in developing the system. For modeling tool, the UML that consists of nine diagrams will be used to illustrate the proposed system. In addition, the i-GEMS system will be developed iteratively in each phase (according to Figure 3.1) to ensure that the final system is meeting with user requirements and consistent with system design.

The following sections 3.2.1 and 3.2.2, discuss in more details about the OOM and UML approaches.

3.2.1 Object-Oriented Methodology (OOM)

The approach of Object-Oriented Methodology (OOM) is different from traditional development methodologies which are either function or algorithm-centric, or data centric. Instead, OOM has packaged both the data and functions as an object, as demonstrated in Figure 3.2 Each object has its own attributes (data) and methods (functions), and is responsible for itself. OOM applies a single object model that evolves from the analysis and design stage and carries all the way down to the programming level. The interaction between collections of objects that work together to accomplish tasks is viewed as an application.

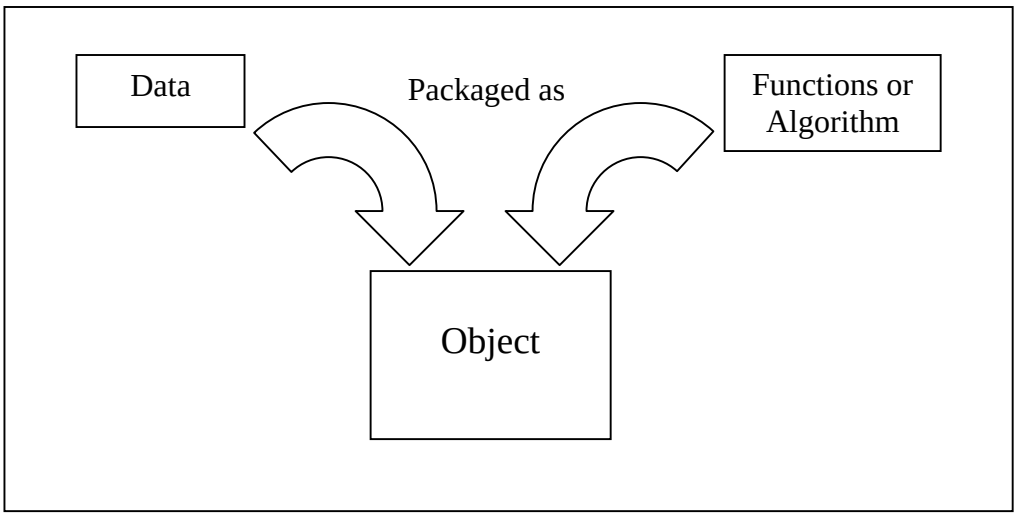


Figure 3.2: Data And Functions Packaged Together As An Object.

An object can only be accessed via the functions it makes publicly available, so that all details of its implementation are hidden from all other objects, which is the concept of encapsulation. Other than encapsulation, inheritance and polymorphism are also the characteristics of OOM. Inheritance refers to specialized objects inheriting the properties and operations of more generalized objects. Polymorphism

on the other hand is referring to the concept, where a single method may operate upon several types of objects.

In addition, OOM is a new system development approach that advocates and facilitates re-use of software components. With OOM, a computer system can be developed on a component basis that enables the effective re-use of existing components and facilitates the sharing of its components by other systems. In addition, OOM allows base concepts of language to be extended to include ideas and terms closer to the primitives of an application.

According to Ali Bahrami (1999), the software development life cycle (SDLC) for OOM is mainly consists of three macro processes: object-oriented analysis, object-oriented design and object-oriented implementation, as shown in Figure 3.3.

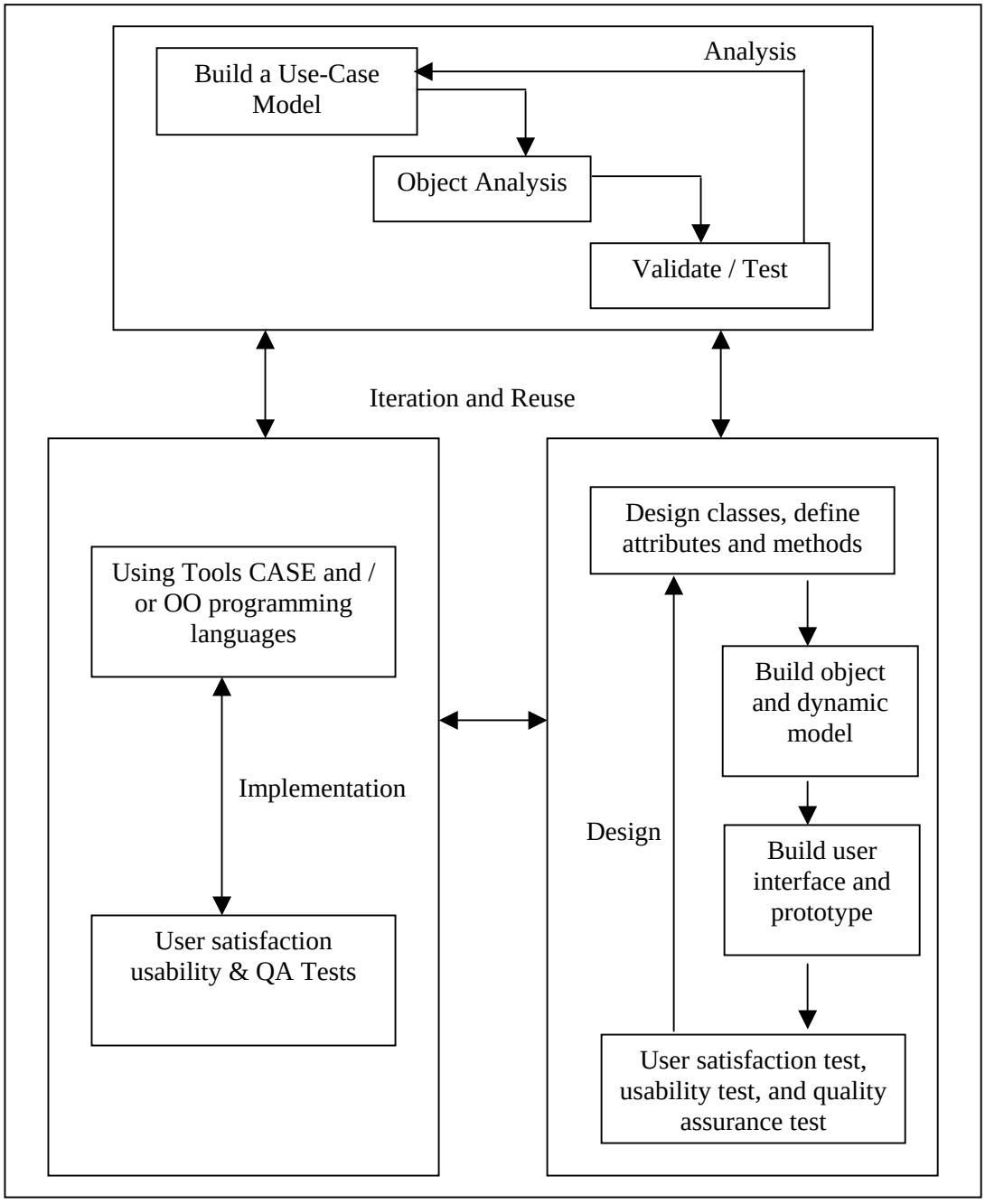


Figure 3.3 Object Oriented Systems Development Approach.

In OOM approach, the use-case model can be employed throughout most of the software development activities and the approach advocates incremental development. Moreover, OOM is basically a bottom up approach that supports viewing system as a set of components or objects that can be combined together to form a system. Hence the OOM inherently makes each software object as stand alone object that can be reused not only within the one problem domain, but also in completely different problem domains. Due to the distinct characteristics supplied by

OOM approach, it is gaining more acceptance as a system development methodology nowadays.

Through the characteristics of OOM, it provides the basis for improvements in traceability, quality, maintainability and extensibility, which are the key features of well-designed Object Oriented systems (Paul Henrik Jorgensen, 1998).

Generally the benefits produced by OOM are listed as follows:

- Improve productivity

Application development is facilitated by the reuse of existing components that can greatly improve the productivity and facilitate rapid delivery.

- Deliver high quality system

The quality of the system can be improved as the system is built up based on components manner with the use of existing components which are well-tested and well-proven.

- Lower maintenance cost

The traceability of OOM enables a system to be extensible and adaptable to changing requirements. As a result, the maintenance cost can be reduced.

- Facilitate reuse

With this approach, a computer system can be developed on a component basis that enables the effective re-use of existing components. Reusable components can be acquired externally or developed internally.

- Manage complexity

By breaking down a complex solution into different components and with each component encapsulated from others, complex development can be better managed.

3.2.2 Unified Modeling Language (UML)

Version 1.0 of the UML was released in January 1997, developed by Grady Booch, James Rumbaugh and Ivar Jacobson who worked for Rational Software Corporation (Hans-Erik Eriksson and Magnus Penker, 1997). Other than Data Flow Diagram (DFD), UML is another approach that is used to model system and make them readable to users. The UML is a language for specifying, constructing, visualizing and documenting the software system and its components. The UML is a graphical language with sets of rules and semantics. UML provides the ability to capture the characteristics of a system by using notations such as actor, use case, action state, class, object and so forth.

On the whole, UML encompasses following nine diagrams, as illustrated below.

- Use-Case Diagram

A use-case diagram is a graph of actors, a set of use cases enclosed by a system boundary, communication associations between the actors and the use cases, and generalization among the use cases. A use case is a description of a functionality that the system provides.

- Class Diagram

A class diagram shows the static structure of classes in the system. The classes represent the “things” that are handled in the system.

- Object Diagram

The object diagram is a variant of a class diagram and uses almost identical notation. The difference between the two is that an object diagram shows a number of object instances of classes. Hence, an object diagram is an example of a class diagram that shows a possible snapshot of the system’s execution.

- State Diagram

A state diagram is typically a complement to the description of a class. It shows all the possible states that objects of the class can have, and which events cause the state to change.

- Sequence Diagram

A sequence diagram shows a dynamic collaboration between a numbers of objects. The diagram demonstrates a sequence of messages sent between the objects, as well as the interaction between objects, something that will happen at one specific point in the execution of the system.

- Collaboration Diagram

A collaboration diagram shows a dynamic collaboration, just like the sequence diagram. In addition to show the exchange of messages, it also shows the objects and their relationships.

- Activity Diagram

An activity diagram shows a sequential flow of activities. The diagram typically describes the activities performed in an operation, though it can also be used to describe other activity flows, such as a use case or an interaction.

- Component Diagram

A component diagram shows the physical structure of the code in terms of code components. A component can be a source code component, a binary component, or an executable component.

- Deployment Diagram

The deployment diagram shows the physical architecture of the hardware and software in the system.

UML model is chosen as an approach for modeling and documenting i-GEMS system as the UML diagrams can be applied throughout requirement, analysis, design, and implementation phases. Any of the nine diagrams from UML,

can be used as an incremental basis within the development phases when the need arises.

For the thesis, three main types of UML diagrams (use case diagram, sequence diagram and activity diagram) are deployed to demonstrate the existing application and communication circumstances, as well as the proposed i-GEMS system under the chapter 4 System Design. The other types of UML diagrams will be incorporated as part of the appendix.

On the whole, the goals of deploying UML are as follows:

- Provide users a ready-to-use, expressive visual modeling language so they can develop and exchange meaningful models based on object-oriented concepts.

- Be independent of particular programming languages and development processes.

- Provide a formal basis for understand the modeling language. It also helps in addressing the issues of scale inherent in complex, mission-critical systems.

- Encourage the growth of the OO tools market.

- Support higher-level development concepts.

3.3 System Development Methodology for i-GEMS

Based on the previous project methodology study, a customized system development methodology or operational framework is proposed for the i-GEMS system as demonstrated at Figure 3.4. The customized element is mainly fall on the design stage, which comprises of three sub stages (prototype design, design evaluation and design finalization).

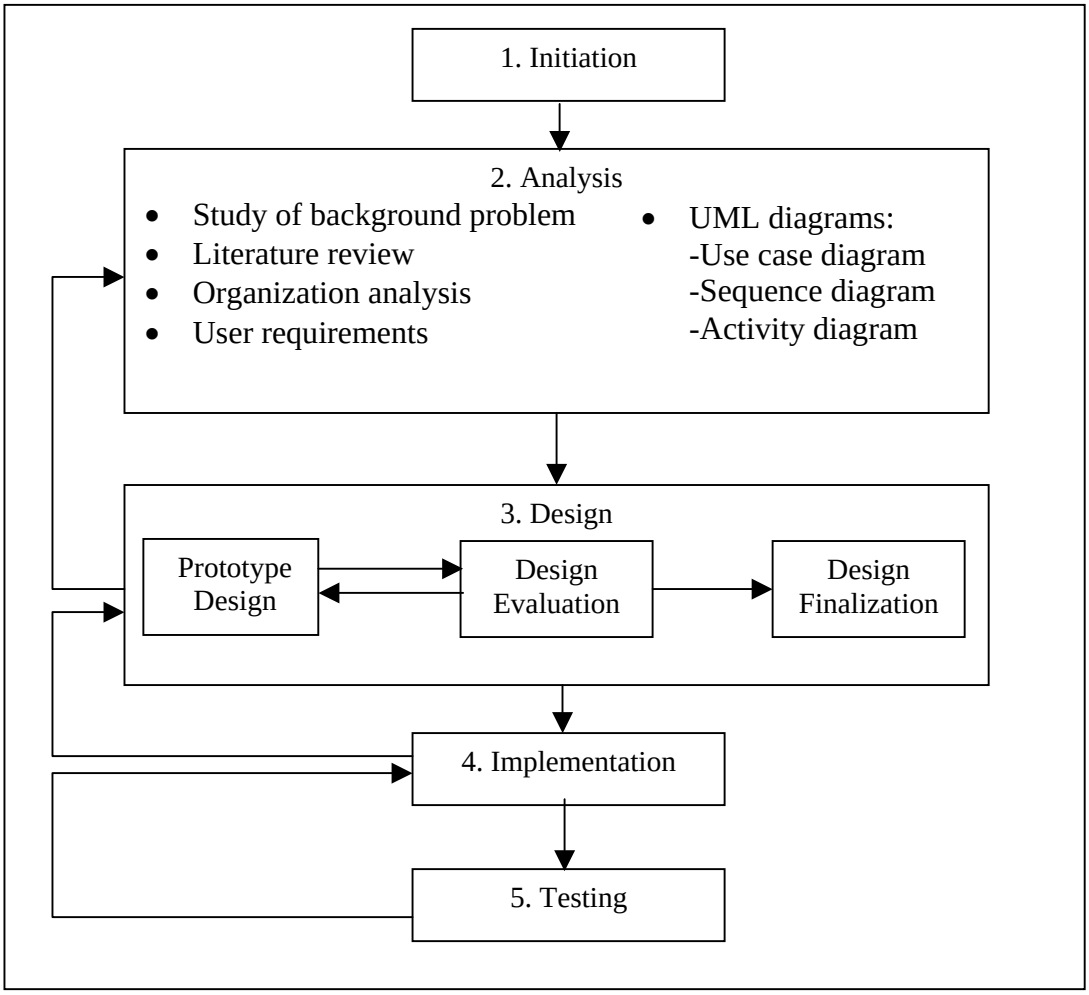


Figure 3.4: Proposed Operational Framework For I-GEMS System.

Initiation

This is the first phase of i-GEMS system, where the project title is proposed, initial problem is studied and the scope of works is defined. The delivery of initiation phase will be the i-GEMS proposal.

Analysis

During the analysis phase, existing background problem is studied (chapter 1). This is then followed by literature review that studies and analyses similar application and technology, which exist in the contemporary education sector. In addition, a detailed organization analysis and user requirements are analyzed and discussed at chapter 4.

Based on the gathered analysis information, UML diagrams will be deployed to model the existing application by using use case and sequence diagrams, while the proposed system will be modeled based on use case, sequence and activity diagrams.

Design

An i-GEMS system is designed based on the information gathered from the previous phases. As it progressed, an i-GEMS prototype design is evaluated persistently. Whenever there is a doubt during the design evaluation, the prototype design stage is revisited to modify or enhance the design. Bear in mind that the earlier the system evaluation and modification have performed, the cheaper the cost it incurs for a system. Compared to system modification that performed at later phase, such as after the implementation stage, usually the system will costs much higher.

The prototype design and design evaluation stages will be visited iteratively until it comes to a satisfied level, where it will then proceed to finalize the i-GEMS design. The primary approach in designing the system is based on UA methodology that embodies OOM, UML and iteration in development approach.

Implementation

In this phase, the i-GEMS system is implemented based on ASP.NET programming languages. In addition, Microsoft Access 2000 is used to serve as a database for the i-GEMS system. During the implementation, UML diagrams were referred constantly to ensure that corresponding and consistent user requirements are incorporated into the system.

As advocated in the OOM approach, basically the i-GEMS system is developed based on the concept of objects or components. The components are then combined together to serve as a complete system. Whenever there is a need, the design phase is revisited to clarify uncertainty and hence better implementation is delivered.

Testing

Once the system is developed completely, it is then proceed to the testing phase. UML and user requirements statement are served as main guide during the testing process. Whenever there is a system error, bug or unmatched requirement discovered, a report is lodged and if time were allowed, the system implementation phase would be revisited in order to modify and enhance the system. The implementation and testing phases are visited iteratively until the system is reaching to a satisfactory level. If some of the system deficiencies are not solved within the given time frame, then a report is lodged to serve as a reference for future maintenance.

As documentation is an essential for a system to serve as a reference, verification, maintenance, as well as a formal roll out of the system, therefore, within the proposed system development life cycle, each phase is involving documentation. With the proposed system development methodology, it serves as a useful guide in designing and developing the i-GEMS system.

3.4 Project Schedule

Based on the proposed system development methodology, a project schedule is planned as shown at Figure 3.5.

3.5 Chapter Summary

There are varieties of system development approaches available in the market, for instance, UA approach or OOM, waterfall model, prototyping model, spiral model, rapid application development (RAD) and so forth. Seeing that i-GEMS is a web-based application that developed using ASP.NET, hence the UA approach that advocates OOM in implementing system and UML for modeling diagram is selected as a guide in developing the proposed i-GEMS system.

According to researchers, UA methodology is based on the best practices that have proven successful in system development. The approach mainly revolves around OOM, UML, and iterative in development.

OOM develop a system based on objects that contains attributes and functions, which can be easily replaced, modified and reused. The approach encourages the view of a system as collection of cooperative and collaborating objects, which served as the basis for improvements in traceability, quality, maintainability and extensibility. UML is deployed to specifying, constructing, visualizing and documenting the i-GEMS system. As UML diagrams is best suit for object-oriented system development, and can be applied throughout requirement, analysis, design, and implementation phases, hence the UML is chosen to model the i-GEMS.

At section 3.3, a system development methodology or framework is proposed for the i-GEMS system. On the whole, the framework is comprises of initiation, analysis, design, implementation and testing phases.

Last but not least, at section 3.4, a Gantt chart that denotes the schedule of i-GEMS system based on the proposed system development methodology is created to serve as a guideline throughout the development of i-GEMS system.

CHAPTER 4

SYSTEM DESIGN

4.1 Organizational Analysis

TARC was established on 24 February 1969 with the mission to provide higher education opportunity for school leavers and young Malaysians who seek to further their education. TARC is 50% subsidized by the Government of Malaysia for all courses fees and capital expenditure. The other 50% is borne by the Trustees of TARC (MCA). As a result, the college can supply cheaper courses that affordable by lower income citizens.

As mentioned in Chapter 1 (section1.2), currently TARC has six campuses located throughout the nation. Among 105 courses that are offered at TARC, some common courses or subjects may be offered at the same time throughout the six campuses of TARC. For instance, the subject “Introduction to Information Technology” is a common subject that is offered to all first year diploma students during the first semester throughout these campuses. In other words, each campus may have several lecturers handling the same subject at the same time. However, these groups of lecturers do not know each other. They do not know who are the lecturers from different campuses teaching the same subject. In other words, there is lack of communication and information sharing among the lecturers from different campuses. As a result, lecturers from different campuses may develop their own set of teaching materials for the same subject, which has then led to resources wastage.

As lecturers from different campuses may produce different sets of teaching materials, it implies that the scope covered by the lecturers may be different. As a

consequence, during final examination, where all the six campuses students will seat for the same question paper for the common subject, some of the students at a certain campus are not able to answer the question as their campus lecturer did not cover that particular topic. Hence, the quality of the students cannot be measured accordingly and accurately. The consequence is worsen when the inconsistent scope covered by lecturers from different campuses have led to students failing the subject.

In other cases, some branches' lecturers may take the initiative by contacting unit leader (unit leader is one of the main campus lecturers who is selected as a leader for a unit or subject) from the main campus through their course tutor (course tutor is a person who is in-charge of a small group of lecturers). From the course tutor, they get the contact details and communicate with the unit leader through e-mail, telephone, fax or mailing to access or exchange the teaching materials. Among the methods, e-mail is the fastest way to exchange and share the teaching materials among the lecturers from different campuses. Nevertheless, e-mail system is not good enough to support the sharing as it is tedious, takes time to accomplish the task and functions provided are limited. Hence, i-GEMS is proposed to overcome the problem and served as a platform for information sharing and management.

In addition, the communication between the lecturers and students for most of the time is restricted to classroom hour only. Students sometimes may find difficulties in communicating with the respective lecturer. During lecture hour, student may not have enough time to consult the lecturer. Whereas for those students who are absent from the lecture may miss some important points or announcement. For those more proactive students, they may send their questions to the lecturer's email account and wait for a reply.

However, as not all lecturers using e-mail account constantly, as a result, some students may get the lecturer reply one week or even one month later. This situation may further discourage student from communicating with the lecturers. Therefore, it is said that lack of communication problem exists between the lecturers and students.

Hence i-GEMS is proposed to overcome the problem by allowing student to post their questions on the respective subject site and the questions can be answered by any lecturers; even lecturers from other campuses who are teaching the same subject. Furthermore, the question and answering section will be sharable by all the lecturers and students involved in the same subject. Thus, through I-GEMS system, it helps to improve the communication and information sharing among the lecturers and students, as well as among the teaching lecturers of a particular subject.

From Chapter 2 (section 2.2.1) of the report, TARC's existing e-leaning system was introduced. At the moment, the e-learning system is mainly deployed at main campus and it is not a default service that offered to all the academic staff. There are only 5% of the lecturers from the main campus have formally participated in using the system. In addition, as mentioned at section 2.2.1, the current stage of the e-learning system is mainly deployed to offer the Internet service in providing the teaching materials. The system does not support for collaboration and information sharing among the students and lecturers throughout the different campuses of TARC. In addition, as the existing system is subscribed with a third party (Blackboard Inc.), the system implementation is not accessible to the author. Hence, all above-mentioned factors have motivated the author to develop a newly i-GEMS solution that is customized to TARC's existing circumstances and requirements.

Project Structure and Function

The proposed system - i-GEMS is developed based on TARC's context and circumstances. Following are the lists of scope for the i-GEMS system based on lecturer, student and administrator perspectives.

From lecturer perspective, the functionalities of the proposed system are as follows:

- Lecturer verification. Not all of the people are allowed to access to the system. Only authorized lecturers can gain access to the system.

- The system is capable to analyze and process the different authorization level for different types of lecturer user.
- Lecturers from different campuses who are teaching the same subject are allowed to cooperate with each other to develop and manage the teaching materials.
- Lecturers who are teaching different subjects are allowed to refer to the other subject's academic materials in order to enhance their knowledge. However, this group of lecturers is not authorized to access the answer section. Only those lecturers who are teaching the subject are authorized to access and modify the answer session.
- The system allows lecturer to post their teaching materials, such as lecture notes, tutorial question, and assignment that is be accessible by the students.
- Lecturer can make an announcement on the system to inform and deliver a message to the students.
- A lecturer can upload objective test questions that are used to evaluate student's performance. Once all the test questions are posted, the system is capable to process and mark the students answer automatically. Then the system will analyze students' performance and produce a performance summary.
- The system allows lecturer to modify their password for security purpose.

From student perspective, the functionalities of the proposed system are as follows:

- Student verification. Not all people are allowed to access to the system. Only authorized students can gain access to the system.
- Students can download study materials, such as lecture notes, tutorial and assignment from the system.
- Whenever students have enquiries, they can raise the questions to the system. The answering session is not restricted by the student's lecturer only, instead, the answering session can also be handled by other campuses' lecturers who are teaching the same subject.
- The question and answering session can be accessed and discussed by all the students who are studying the same subject. Hence, the system allow the information sharing exist among the group.

- Students can access to the announcement made by their lecturer without constrained by location boundary. They can access the message at any time and anywhere.
- Student can participate a test session that is prepared by their lecturer at anytime and anywhere.
- The system will process and analyze a student's test performance and produce the result immediately.
- The system allows students to modify their password for security purpose.

From administrator perspective, the functionalities of the proposed system are as follows:

- To register authorized student courses to corresponding studying subjects.
- To register authorized lecturers to the respective subject modules.

4.2 Current Business Process and Data Model

4.2.1 UML Diagrams

Figure 4.1 and Figure 4.2 are the UML diagrams that demonstrate the existing communication approach in academic information sharing and management across branches or campuses of TARC.

Use Case Diagram

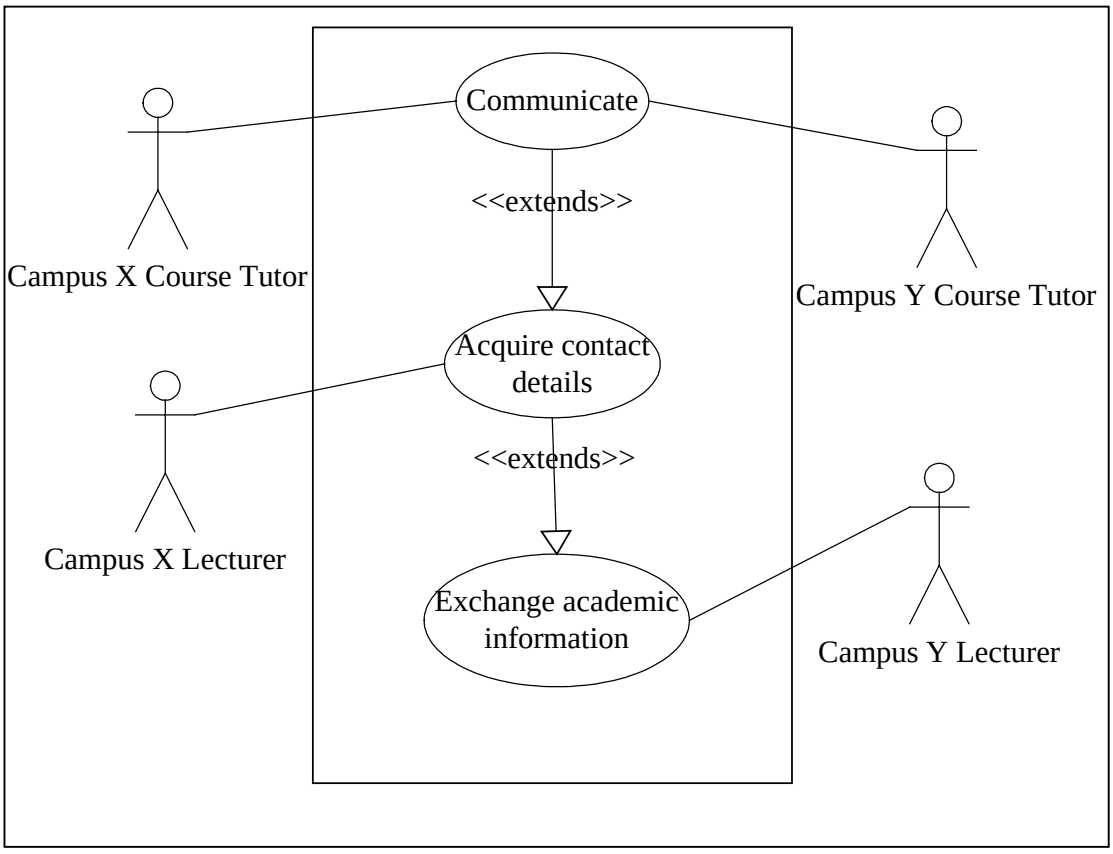


Figure 4.1: Use Case For Existing Communication Circumstance.

Description of Figure 4.1:

From section 2.2.1, the author has illustrated that for a common subject that is offered at several campuses of TARC, the communication and collaboration between the lecturers involved several steps. Assume that campus X lecturer and campus Y lecturer are both teaching a same subject AA. Campus X lecturer wants to collaborate the subject with other campus's lecturer, but he or she does not know

who is the other campus lecturer handling the same subject. Hence it requires campus X course tutor to communicate with campus Y course tutor to get the particular campus Y lecturer information who is teaching the same subject AA. From there, the campus X lecturer gets the campus Y lecturer's contact details and therefore start collaborating and sharing the academic information with campus Y lecturer.

Sequence Diagram

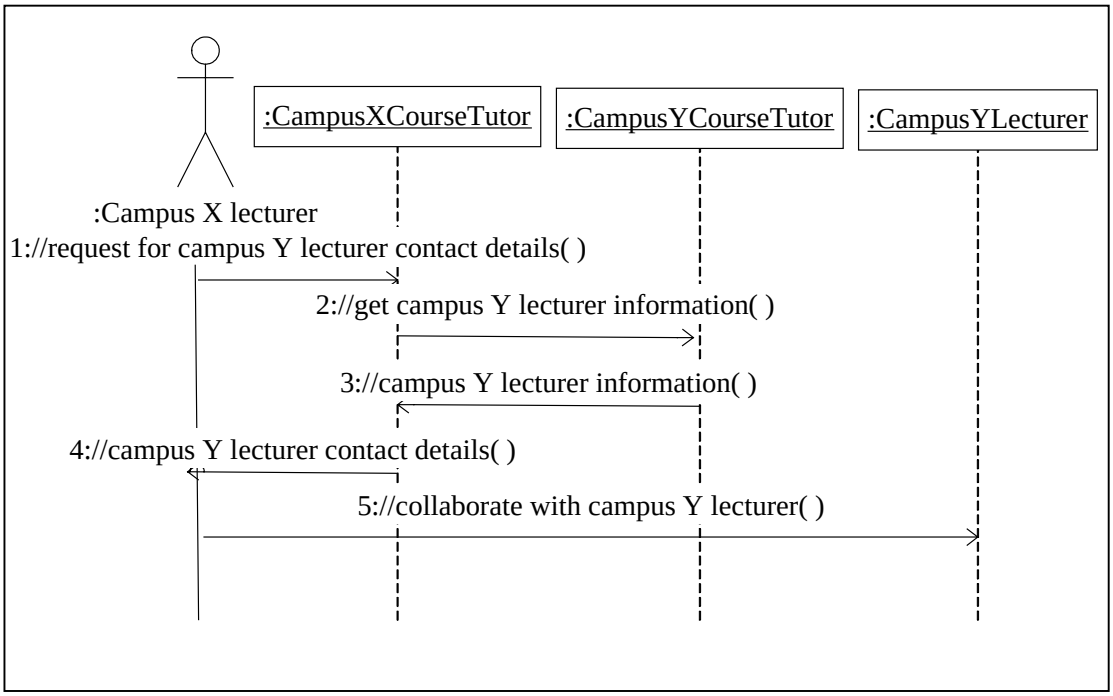


Figure 4.2: Sequence Diagram For Existing Communication Approach Across Campuses.

Description of Figure 4.2:

To initialize collaboration with campus Y lecturer, campus X lecturer first request campus Y lecturer's contact details through the campus X course tutor. Campus X course tutor will then contact campus Y course tutor to get the campus Y lecturer information, and then pass the information to campus X lecturer. Campus X lecturer can then start communicate and collaborate with campus Y lecturer for academic information.

Other than Figure 4.1 and Figure 4.2, reader can also refer to section 2.2.1 and section 4.2 for the analysis of current circumstances.

Figure 4.3, 4.4 and 4.5 are the UML diagrams that demonstrate TARC's existing e-learning application (or called as CeL system). For further descriptions on the existing application, reader can refer to section 2.2.1.

Use Case Diagram

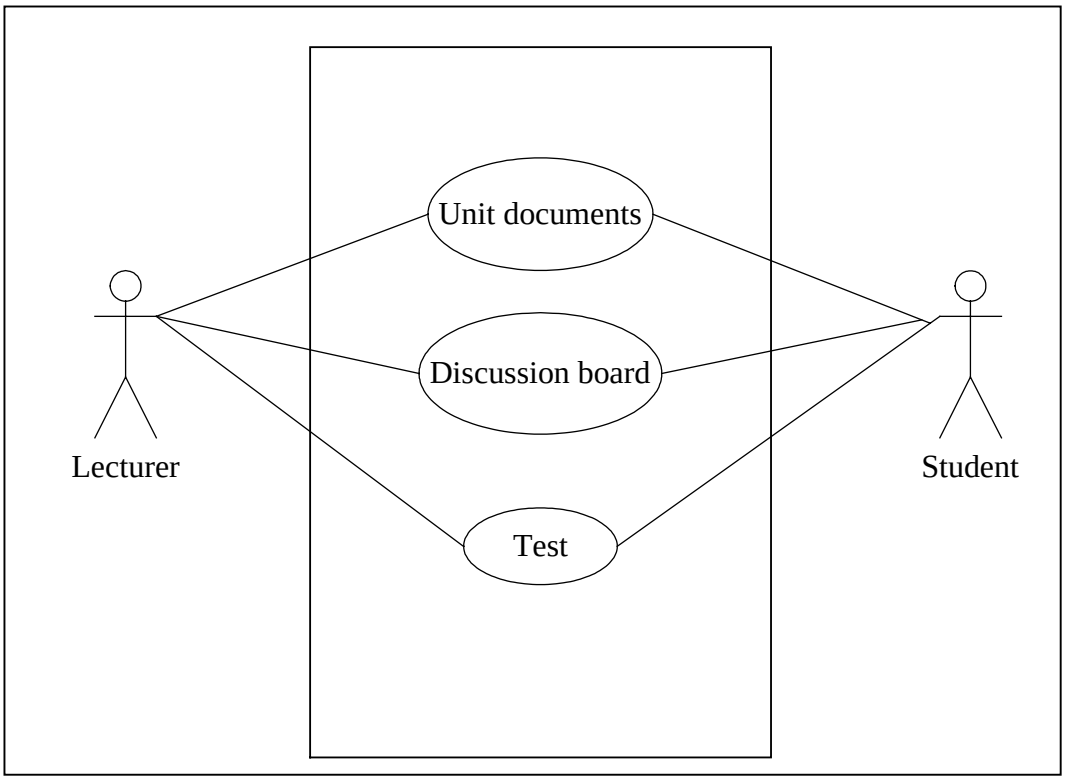


Figure 4.3: Use Case For Existing E-Learning Application.

Description of Figure 4.3:

As mentioned at section 2.2.1 and section 4.2, the existing e-learning system is currently offered at main campus only. At the moment, the system is mainly used for transferring academic materials to the Internet. It is not meant for supporting the collaboration and academic information sharing throughout the different campuses.

As shown in Figure 4.3, lecturer and student can access to the three main modules that offered by the e-learning system, which are unit documents, discussion

board and test modules. Unit documents are referring to a subject's related documents, such as lecture notes, tutorial question or assignment question.

Sequence Diagram

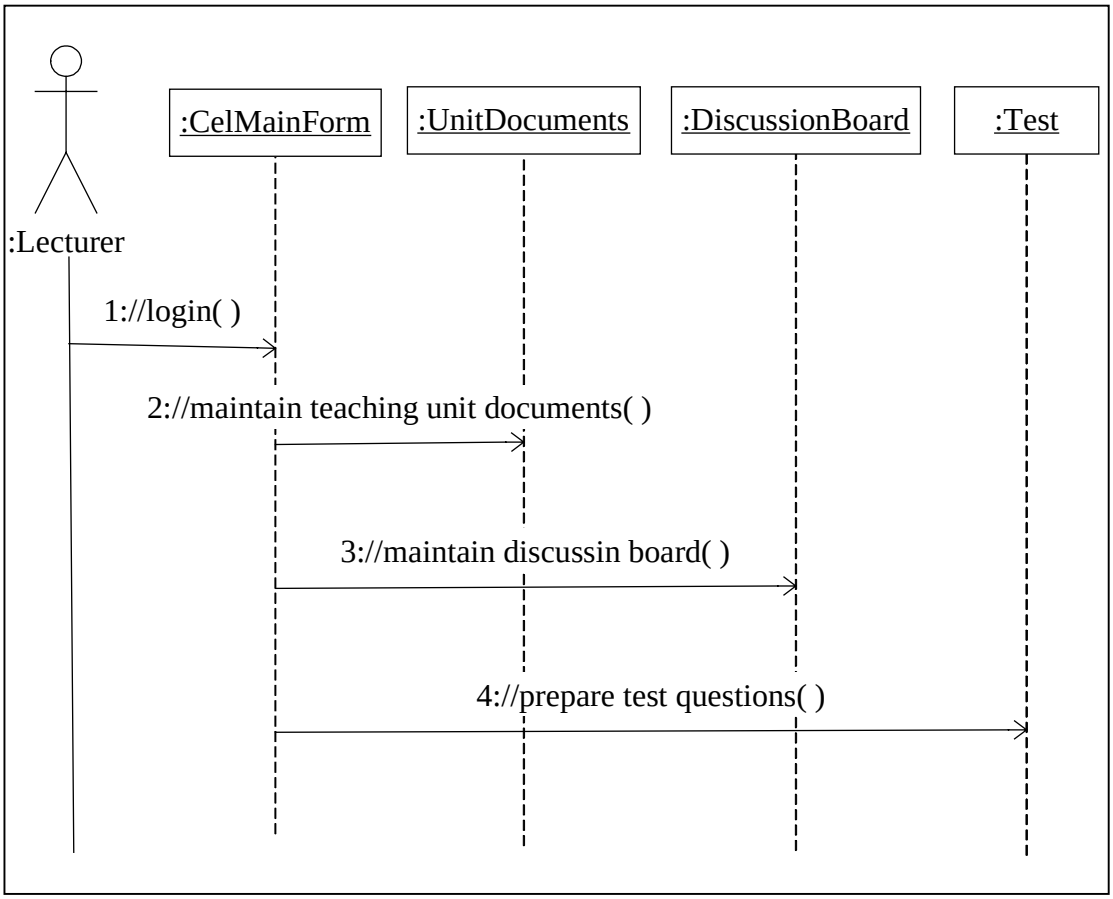


Figure 4.4: Sequence Diagram For Existing E-Learning Application – Lecturer View.

Description of Figure 4.4:

To access the e-learning or CeL system, a main campus lecturer user is required to login into the system. Only authorized lecturer can gain access to the CeL system. From the CeL main form, the lecturer user can opt for maintaining teaching unit documents, discussion board or preparing test questions.

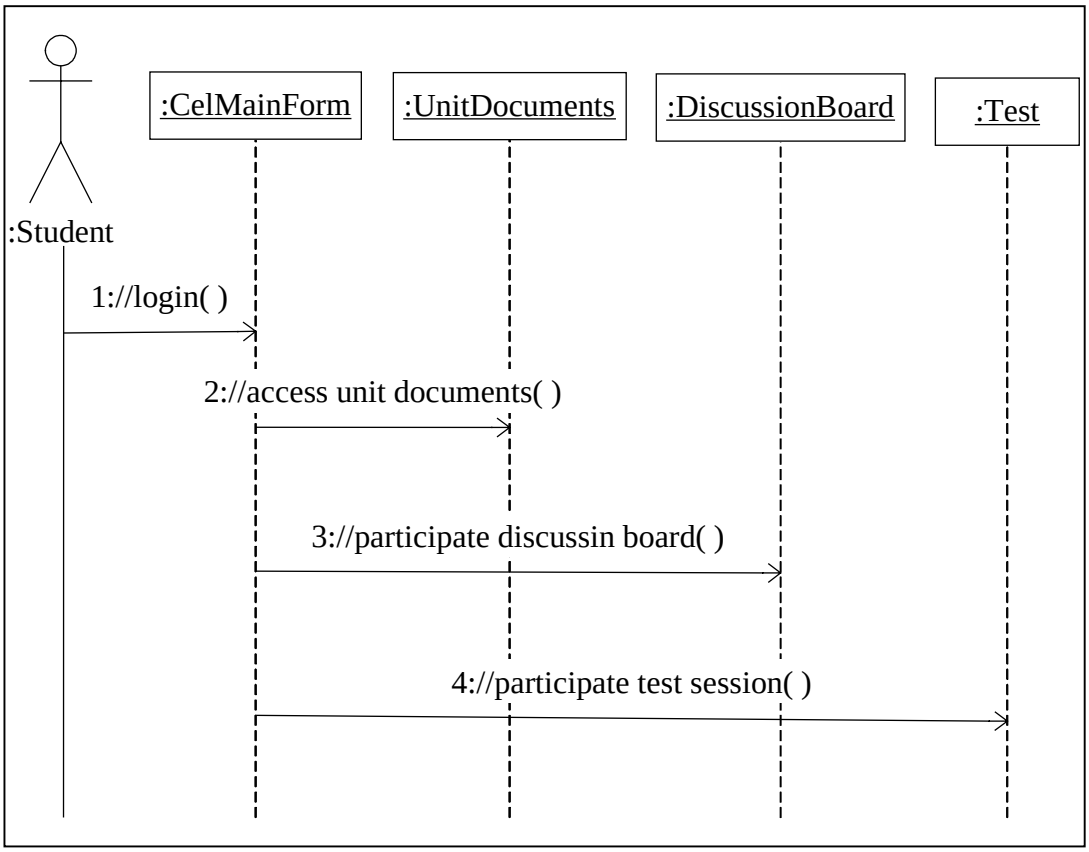


Figure 4.5: Sequence Diagram For Existing Application – Student View.

Description of Figure 4.5:

To access the e-learning system, a student user is required to login into the system. From the main page, the user can proceed to access unit documents, such as lecture notes, tutorial question or assignment. Whenever student has inquiry, the student can participate in discussion board to discuss the question. In addition, from the CeL system, the authorized student can participate in a test session, which is prepared by their main campus' lecturer.

4.2.2 System Architecture for Existing Application

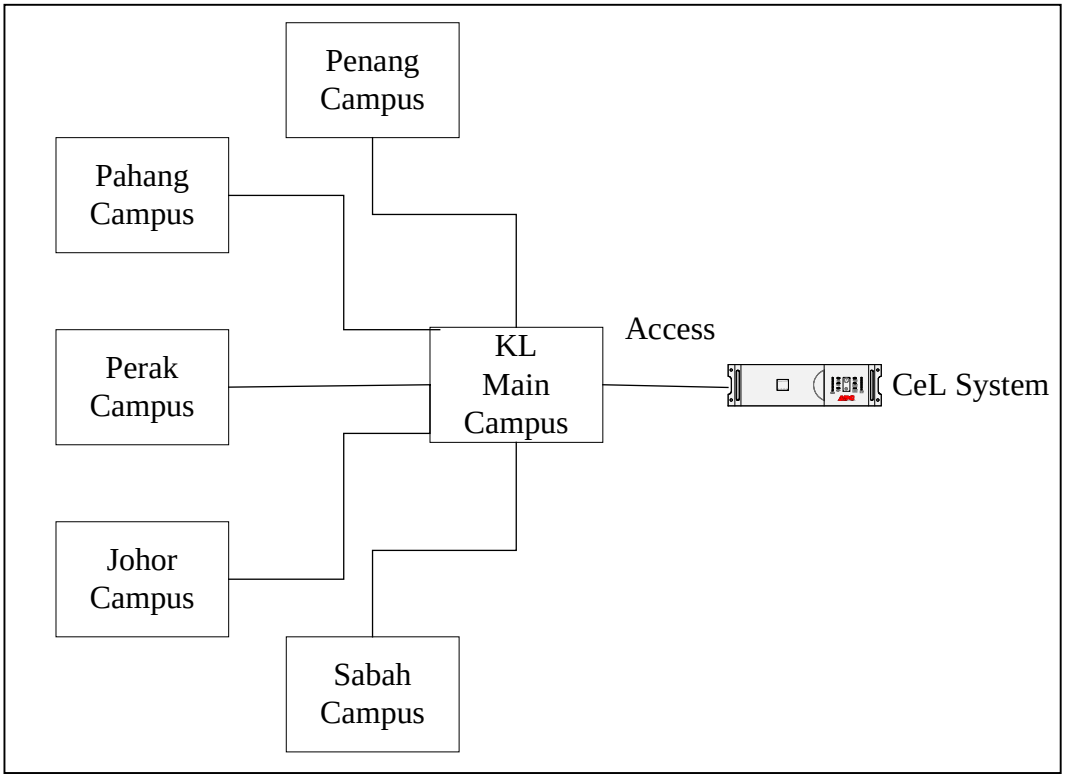


Figure 4.6: System Architecture For Existing E-Learning Or Cel System.

The existing e-learning application or CeL system (provided by Blackboard Inc.) is mainly offered at main campus only. Lecturers from other five campuses or branches who desire to collaborate and share academic information with a unit leader (a subject's leader) from the main campus, can communicate through email, telephone, fax or mailing approaches.

4.3 User Requirements

Currently the author is one of the academic staff working at TARC's main campus. She is a unit leader for a common subject – AACS1614 Introduction To Information Technology, which offered at main campus, Penang and Perak branches as well. The author possess the opportunity to have practical experience in communicating with other branch' lecturers as well as in using TARC's e-learning system. As mentioned in section 2.2.1, there still have some room for improvement in terms of existing application and collaboration framework. In addition, the author has observed and discussed with other academic staff and students on the related issues and has finalized their requirements as listed at below.

Registering

- To register an authorized lecturer to the corresponding academic module.
- To register an authorized student course to the corresponding subject module.

Security

- To verify user identity to ensure only authorized user is accessing the system.
- To analyze and process different access level to different types of user.
- To authorize a lecturer who is handling a subject module to manage and maintain the module.
- To authorize a lecturer to access other academic modules.
- To authorize a student to access study materials from the system.

Academic Module

Lecturer

- To manage and maintain lecture notes.
- To manage and maintain unit plan that indicates lecturers' contact information, overall syllabus, teaching schedule and percentage of marks allocation for a specific subject or unit. (Appendix D)
- To manage and maintain tutorial questions.
- To manage and maintain assignment.

- To manage and maintain objective test questions.
- To allow a lecturer to make announcement.
- To allow a lecturer to answer students' queries.
- To allow lecturers from different campuses who are sharing the same subject to communicate and discuss with each other in relate to the particular subject through the use of discussion module.

Student

- To allow a student to access lecture notes.
- To allow a student to access unit plan.
- To allow a student to access tutorial questions.
- To allow a student to access assignment.
- To allow a student to view announcement.
- To allow a student to post and share comments or queries with others.
- To allow a student to participate in objective test session.

Collaboration and sharing

- To group lecturers who are teaching same subject under the same subject module.
- To allow a group of lecturers to share same set of unit plan in delivering a common subject.
- To allow a group of lecturers to collaborate and share lectures notes for a common subject.
- To allow a group of lecturers to collaborate and share tutorial questions for a common subject.
- To allow a group of lecturers to collaborate and share assignment for a common subject.
- To allow a group of lecturers to share and discuss workload, problems faced in handling the teaching subject, knowledge or expertise through discussion board.
- To allow a lecturer to share his or her subject module with other lecturers who are not handling the subject.

4.4 Conceptual Design

4.4.1 Business Process and Data Model (UML Diagrams of To-Be System)

Figure 4.7 up to figure 4.18 are the UML diagrams that illustrate the proposed i-GEMS system.

Use Case Diagram

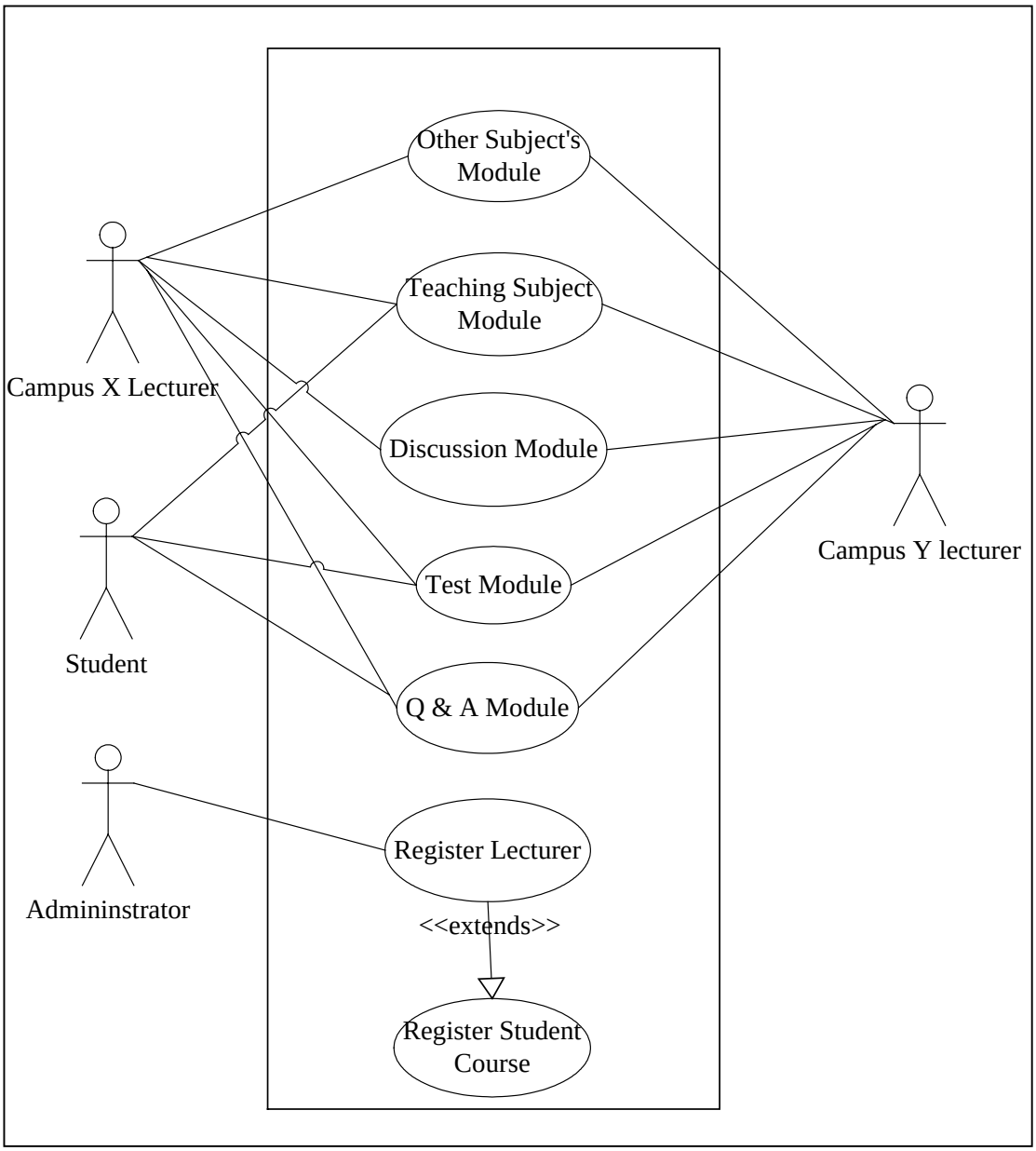


Figure 4.7: Use Case For I-GEMS System.

Description of Figure 4.7:

As i-GEMS system advocates collaboration and sharing of academic information across branches, the figure shows that both campus X and campus Y lecturers can access and maintain the five main modules:

- Teaching Subject Module (a subject that both campus X and campus Y lecturers are currently teaching)
- Test Module
- Discussion Module
- Q & A Module
- Other Subjects' Module

In the meantime, a student can access the three modules (Subject Module, Test Module and Q & A Module) to assist in their study. For an administrator, he or she is responsible to register a lecturer or student to the system in order to become a user of i-GEMS system.

Sequence Diagram

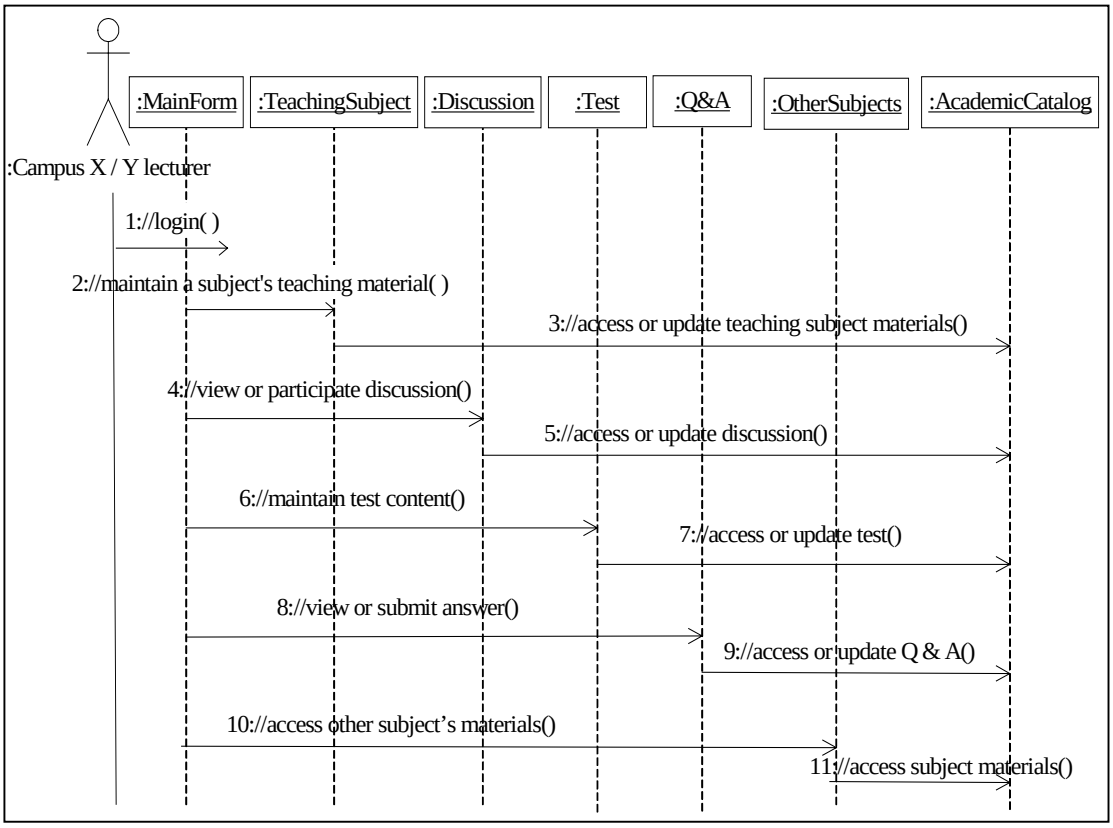


Figure 4.8: Sequence Diagram For Lecturer User.

Description of Figure 4.8:

Campus X or campus Y lecturers who are teaching a same subject are allowed to access and maintain the same academic module. First of all, a lecturer user is required to login into the system. From the main form or main page of i-GEMS system, the lecturer user can choose to proceed to maintain a subject's teaching material, to have discussion among lecturers teaching the same subject, maintain test content, view or submit answer for students' queries or access other subject's module. Each of the options involves accessing from or updating to the database –academic catalog.

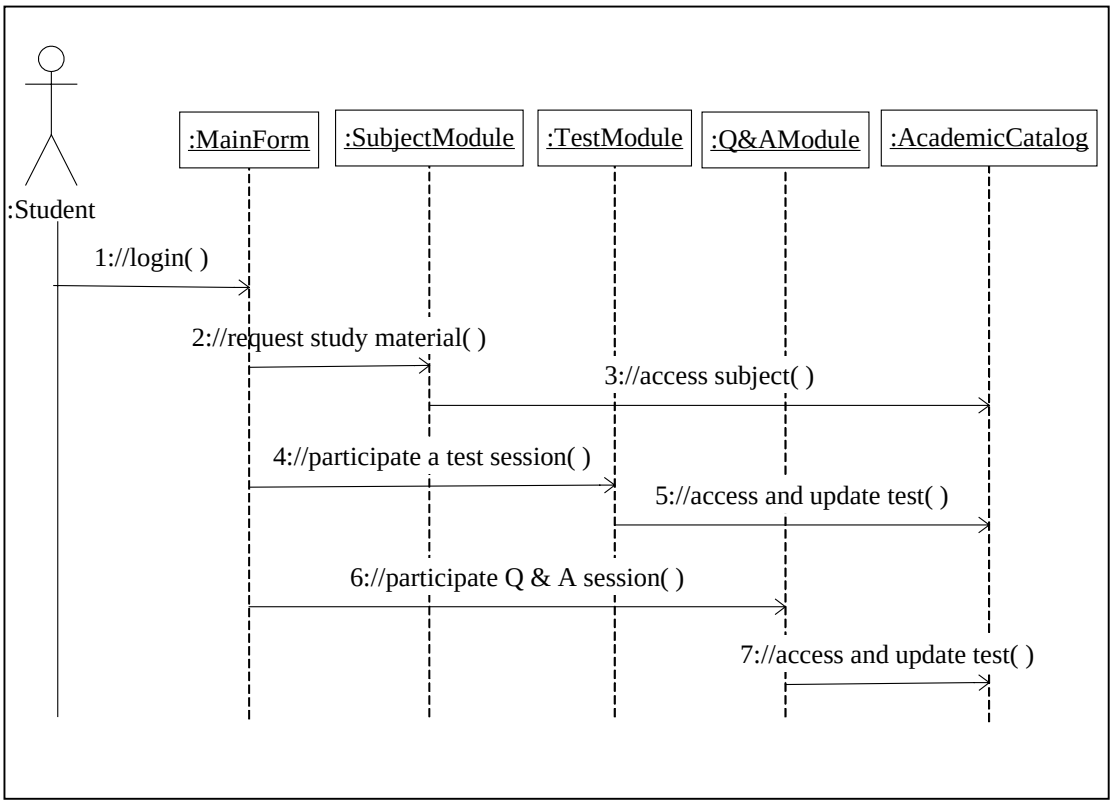


Figure 4.9: Sequence Diagram For Student User.

Description of Figure 4.9:

To access i-GEMS system, a student user is required login to the system. From the main form or main page, the user can choose to access subject materials, participate a test session or Q & A session. Each of the options involves accessing the information from database – academic catalog, while for a user who has

participated in a test or Q & A session, it may involve updating the answer of test or query to the database.

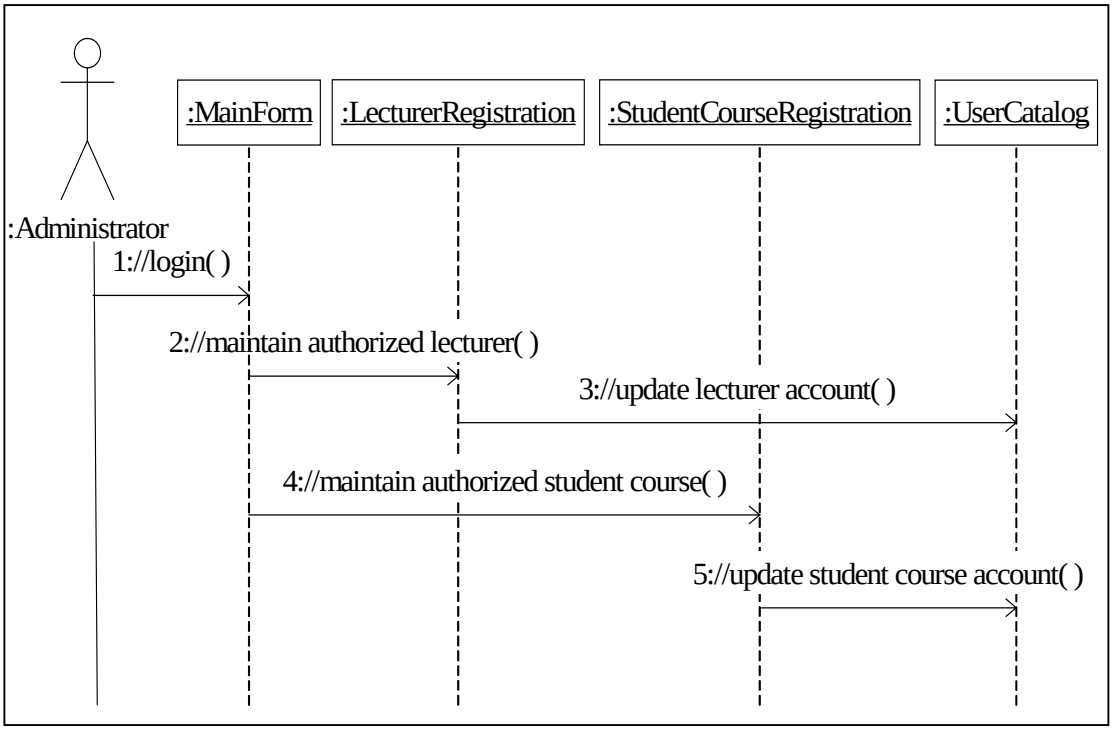


Figure 4.10: Sequence Diagram For Administrator User.

Description of Figure 4.10:

To access i-GEMS system, an administrator is required login to the system. From the main form or main page, the administrator can choose to register an authorized lecturer or student to the system. Meanwhile, the administrator can update or remove a user from the system who is no longer authorized to use the system, such as lecturer resignation or student withdrawal.

Activity Diagram

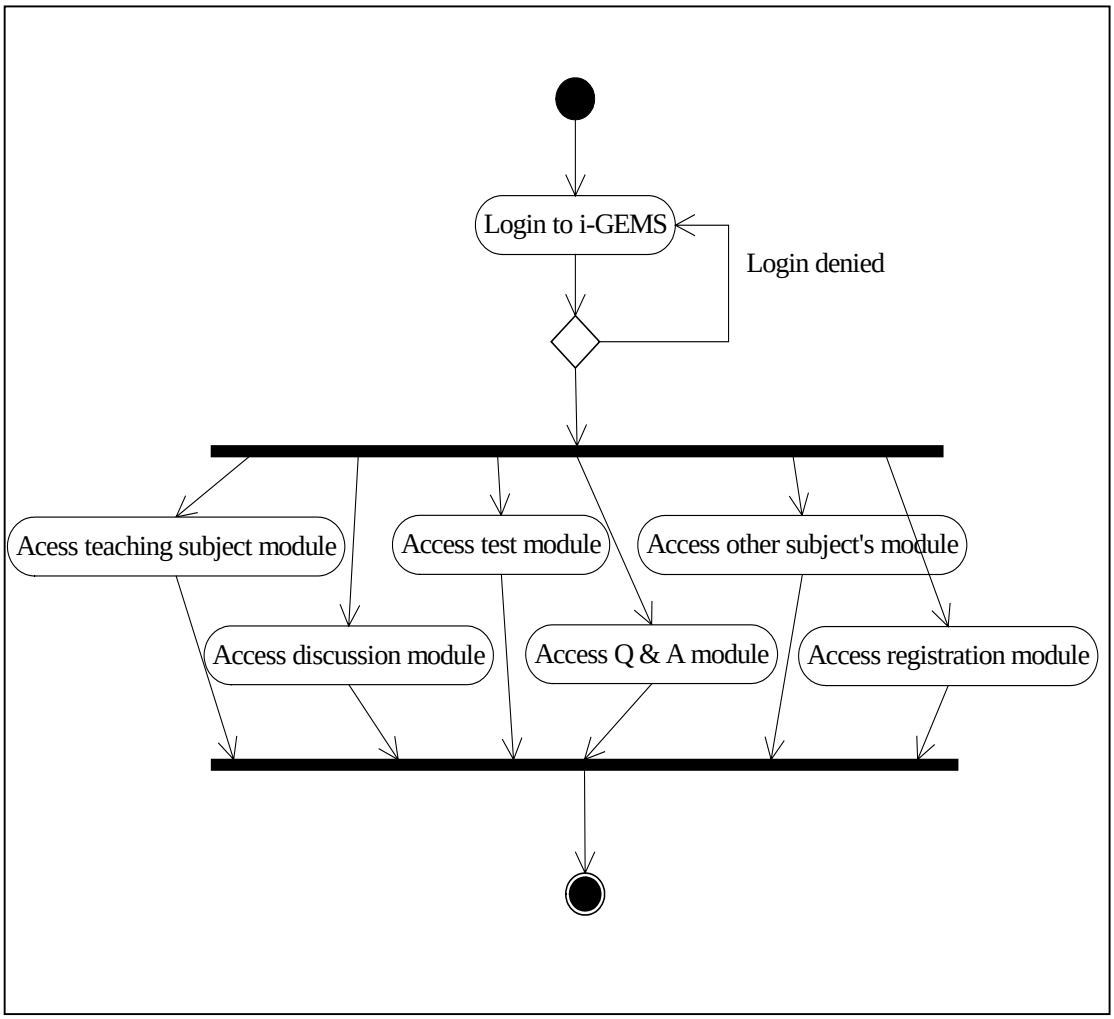


Figure 4.11: Activity Diagram For Overall System.

Description of Figure 4.11:

When a user logs in into the i-GEMS system, the user's identity will be verified. If the login information is not matched from database, then the login will be denied. Whereas if the login information is matched from system database, then a user can proceed to access the system and choose to deal with any of the six activities: access Teaching Subject Module, access Discussion Module, access Test Module, access Q & A Module, access Other Subject's Module or access Registration Module.

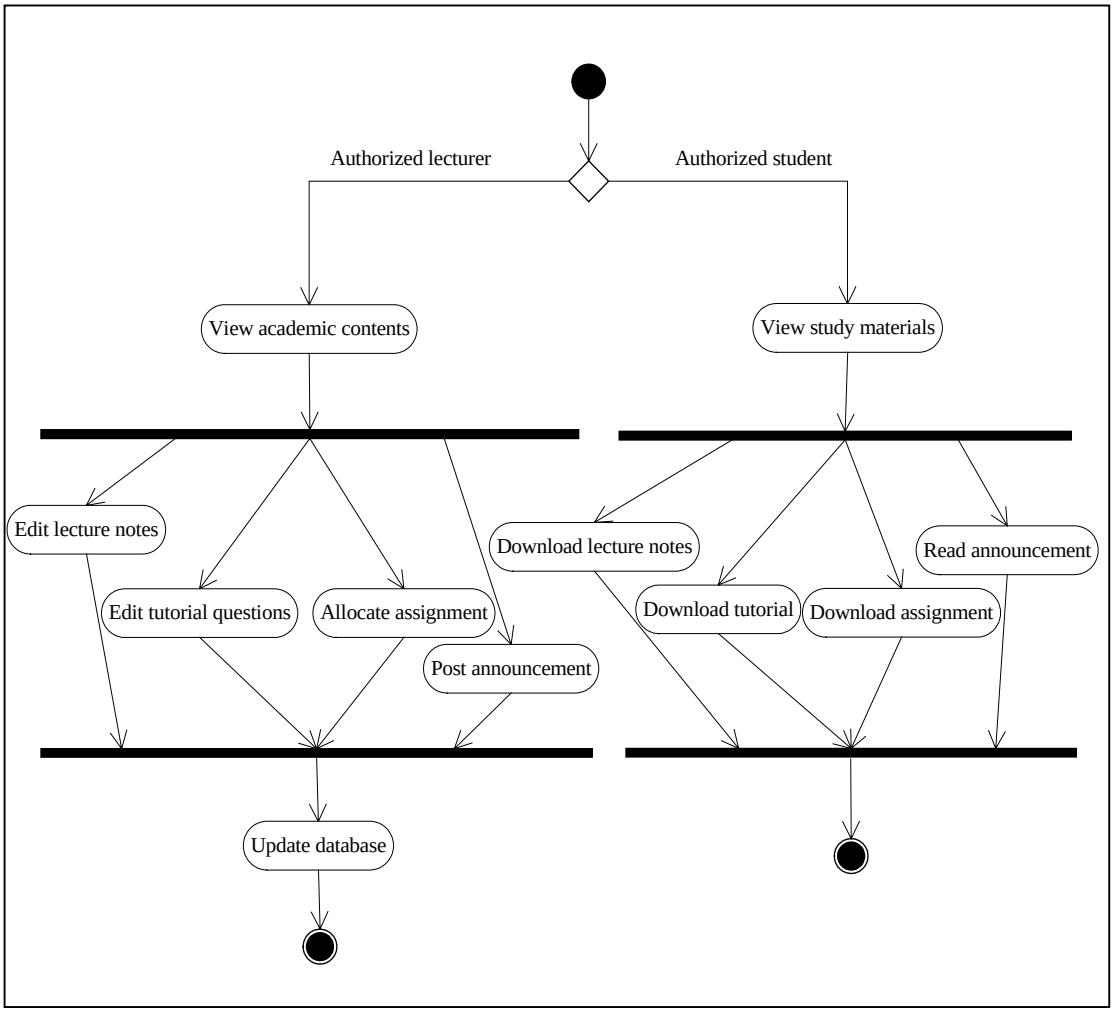


Figure 4.12: Activity Diagram – Access Academic Module.

Description of Figure 4.12:

From a Teaching Subject's Module, a user's identity is assessed. If the user is a lecturer teaching the subject, the lecturer can proceed to view academic contents. The user can then choose to edit lecture notes, edit tutorial questions, allocate assignment or post announcement. Whenever it is necessary, the activities may lead to updating the database of i-GEMS system. Whereas if the user is a student, then the student can proceed to view study materials, download lecture notes, tutorial, assignment or read announcement from the system.

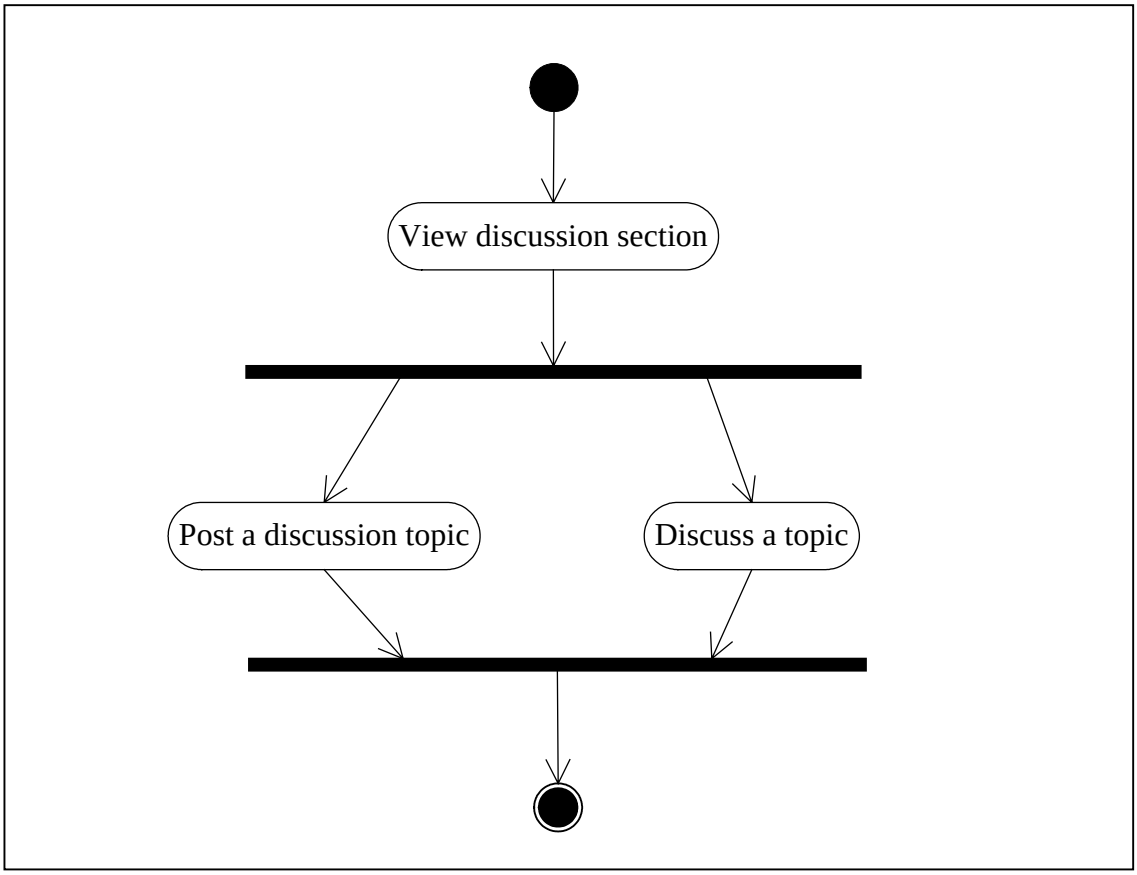


Figure 4.13: Activity Diagram – Access Discussion Module.

Description of Figure 4.13:

From a Discussion Module, lecturers who are teaching the same subject are allowed to have discussion on topics related to the teaching subject. From there, a lecturer user can choose to post a new discussion topic or to participate by replying to the existing discussed topics.

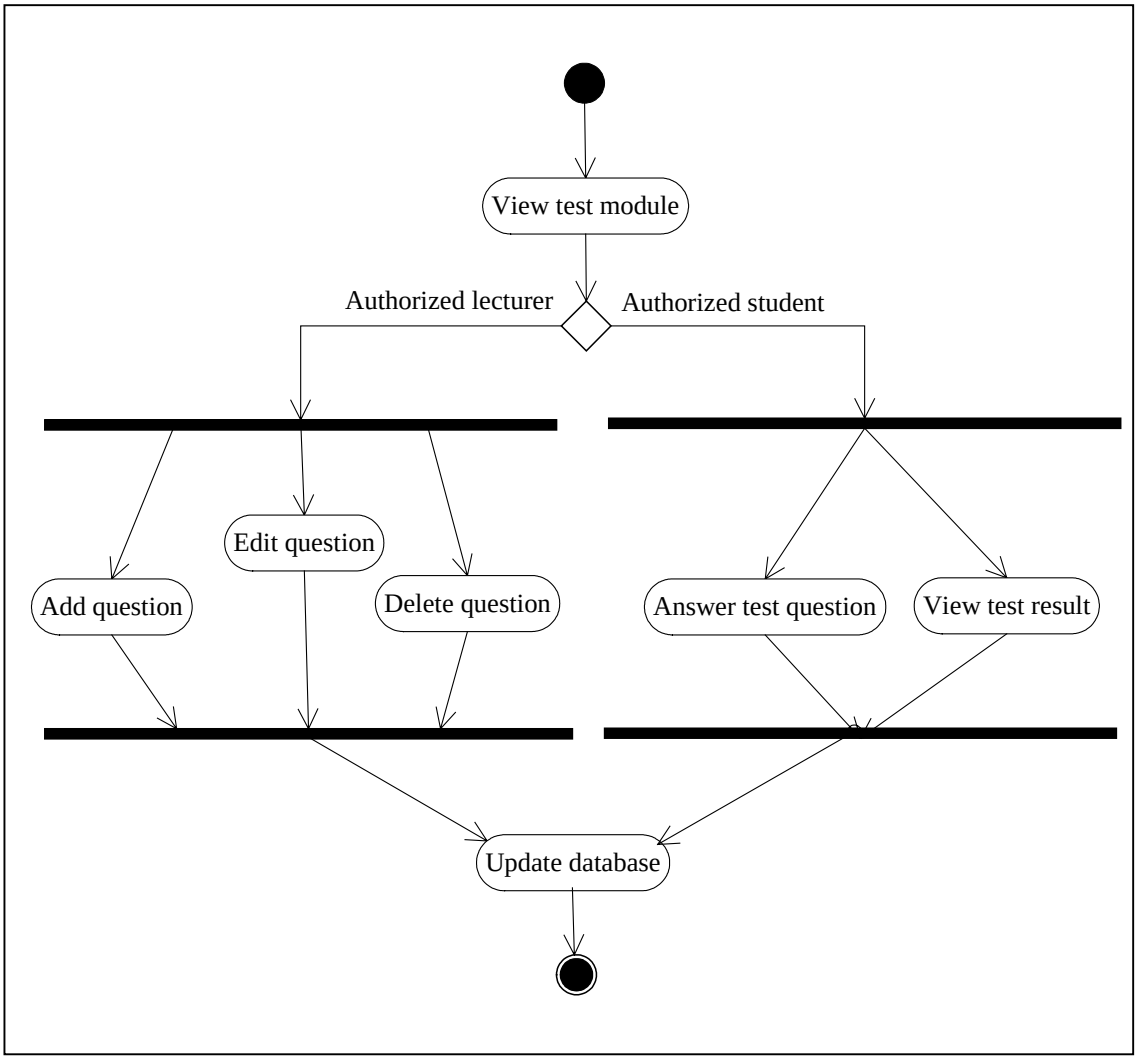


Figure 4.14: Activity Diagram – Access Test Module.

Description of Figure 4.14:

From the Test Module, a user's identity is assessed. If the user is a lecturer, the lecturer can proceed to add, edit or delete a question. Whereas if the user is a student, then the student can proceed to participate test session and view the result when finish answering the questions. Whenever it is necessary, the activities may lead to updating the database of i-GEMS system.

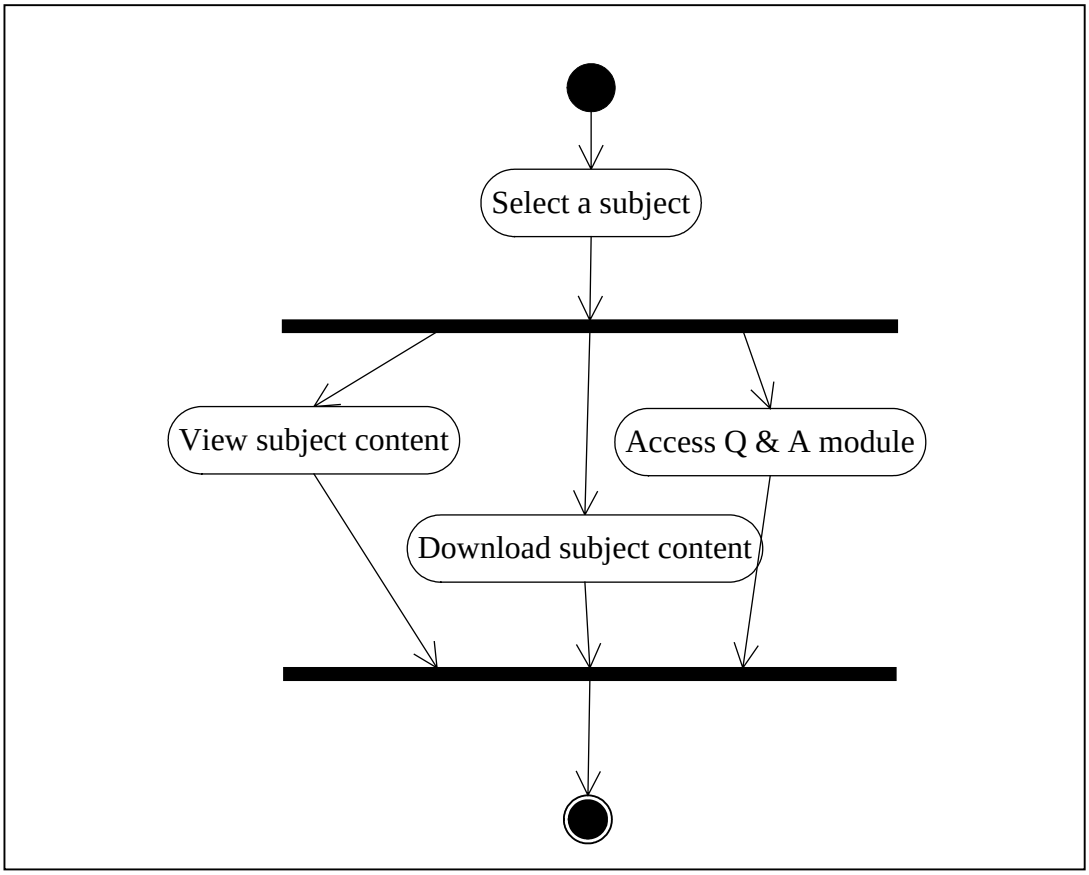


Figure 4.15: Activity Diagram – Access Other Subject's Module.

Description of Figure 4.15:

From Other Subject's Module, which is not handled by a lecturer, the user can enhance his or her knowledge by selecting a subject that the user is interested. The user can study the subject from the module, download the content whenever it is needed or user can also participate in Q & A section to raise their queries.

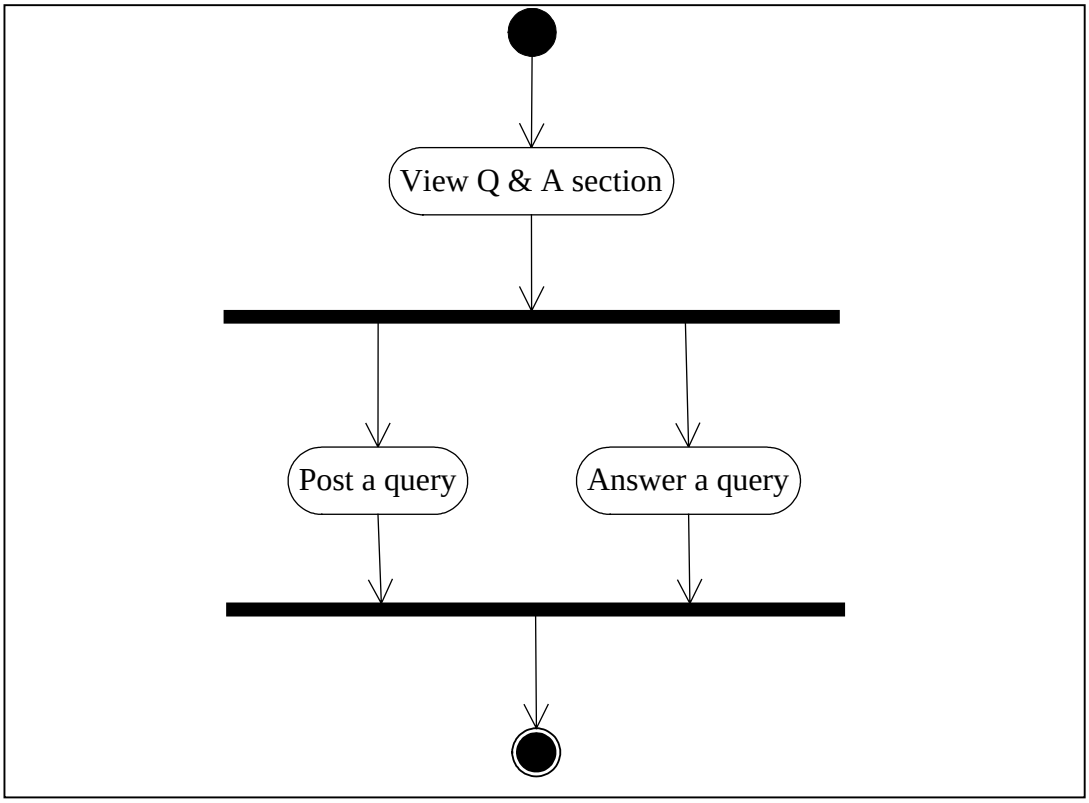


Figure 4.16: Activity Diagram – Access Q & A Module.

Description of Figure 4.16:

From Q & A Module, a user first access to the Q & A section. From there, a lecturer user can choose to post a question or student user can choose to answer the question.

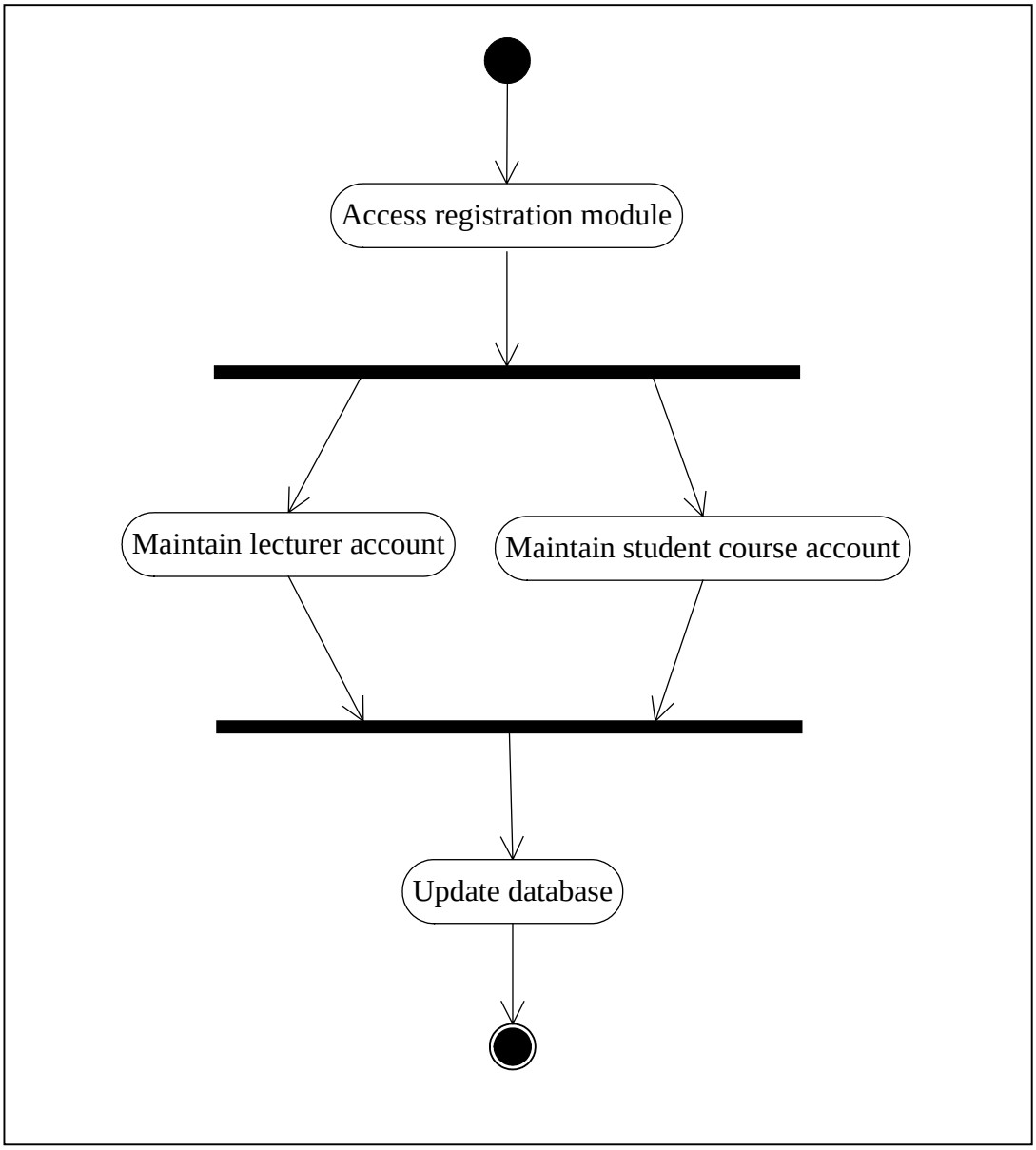


Figure 4.17: Activity Diagram – Access Registration Module.

Description of Figure 4.17:

From Registration Module, an administrator can choose either to maintain an authorized lecturer account or student course account. Whenever it is necessary, the activity may lead to updating the database of i-GEMS system.

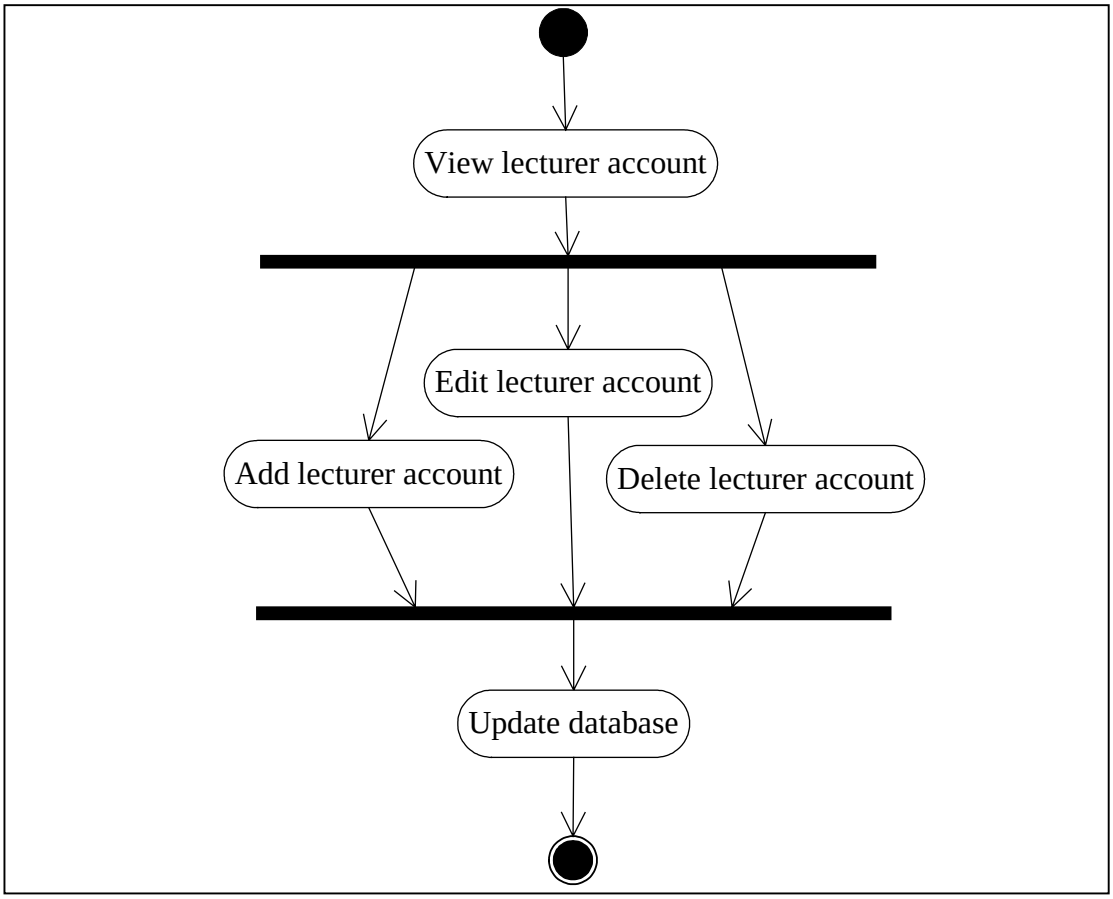


Figure 4.18: Activity Diagram – Maintain Lecturer Account.

Description of Figure 4.18:

From maintaining a lecturer account module, an administrator can choose to view, add, edit or delete a lecturer user account based on the circumstance. Whenever it is necessary, the activity may lead to updating the database of i-GEMS system.

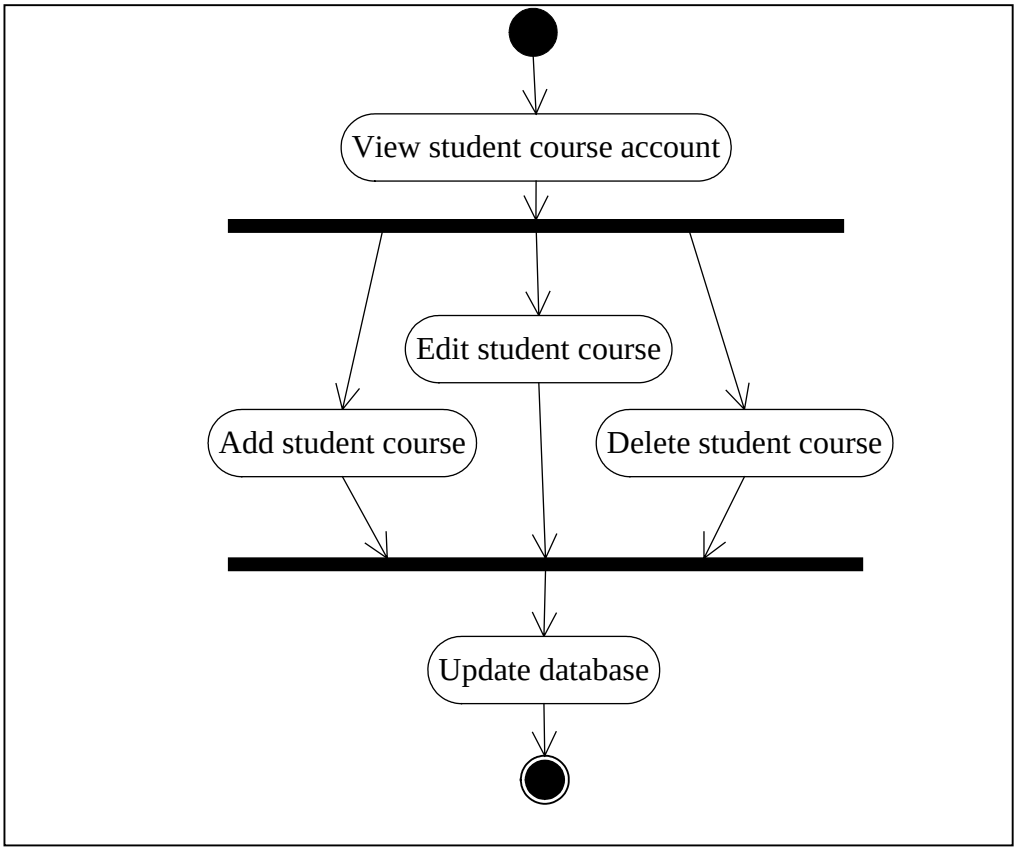


Figure 4.19: Activity Diagram –Maintain Student Account.

Description of Figure 4.19:

From maintaining a student account module, an administrator can choose to view, add, edit or delete a student user account where necessary. Whenever it is necessary, the activity may lead to updating the database of i-GEMS system.

4.4.2 Process Framework for Proposed System

The figure 4.20 below demonstrates the process flow or accessing approach for the proposed i-GEMS system.

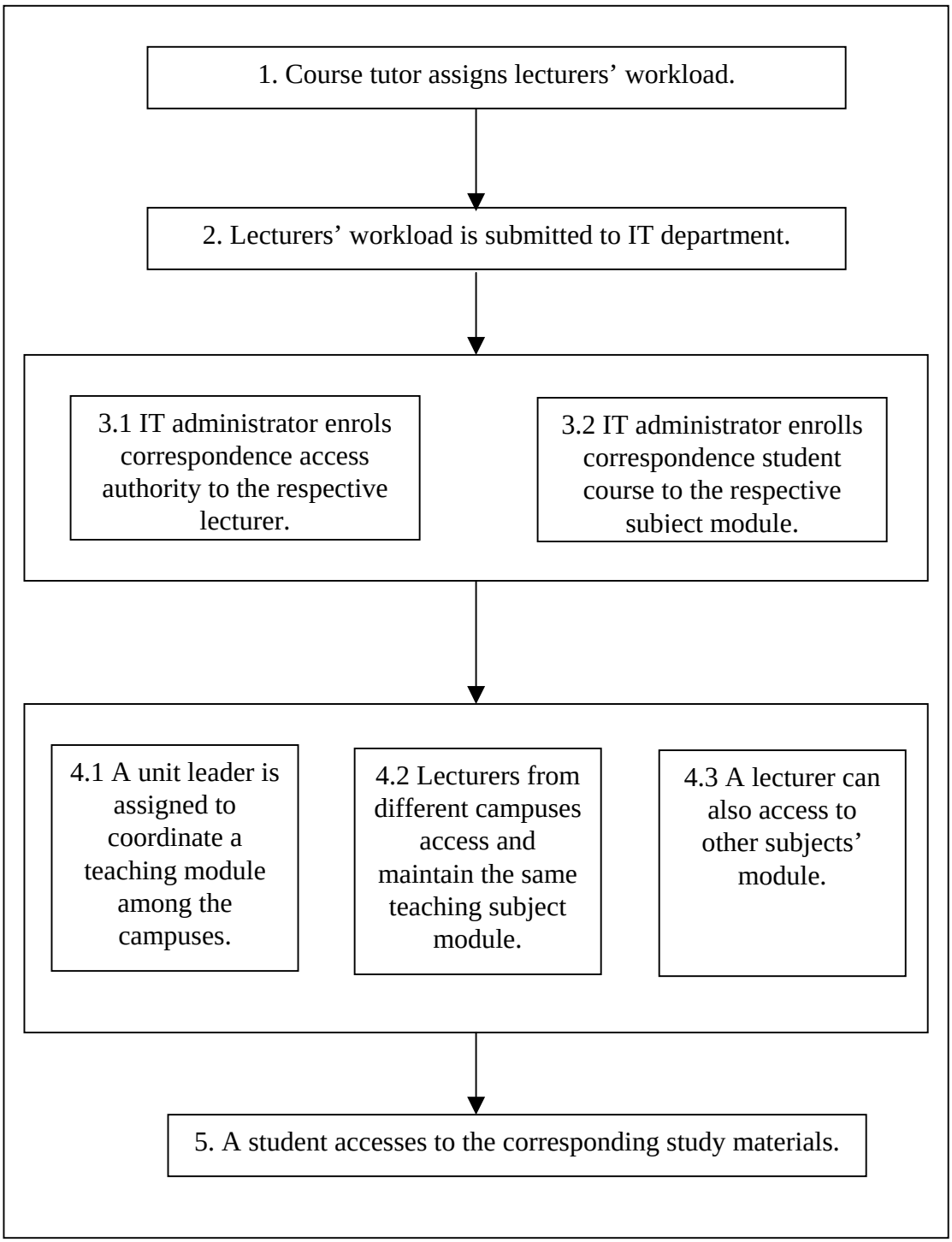


Figure 4.20: Process Framework For The Proposed I-GEMS System.

4.5 Physical Design

4.5.1 Database Design

An i-GEMS database has been designed using Microsoft Access to support the i-GEMS system. The database consists of 19 tables, as listed at below:

No.	Table Name	Table Description
1.	Subject	To show subject code, title, and subject's availability.
2.	Staff	To verify staff's identity.
3.	Subject Teaching	To identify the academic staff that are teaching a specific subject and their position hold.
4.	Student	To verify students' identity.
5.	Course	To identify subject that offered to a course.
6.	Student Result	To record students' test performance result.
7.	Time Frame	To indicate duration for each of the academic semester.
8.	Announcement	To record announcement based on subject.
9.	Unit Info	To maintain subjects' unit information.
10.	Lecture Notes	To maintain subjects' lecture notes teaching materials.
11.	Tutorial	To maintain subjects' Tutorial materials.
12.	Assignment	To maintain subjects' Assignment materials.
13.	Test Title	To maintain subject's test title, where each subject may have 1 or more than 1 test (e.g. Test 1, Test 2 and etc.) to evaluate students' understanding.
14.	Test Question	To maintain test questions according to a specific subject and test title.
15.	QA	To maintain students and academic staff's questions.
16.	QA Reply	To maintain students and academic staff's participation and reply in question and answering module.
17.	Discussion	To maintain discussion topics among the academic staff who are teaching same subject.
18.	Discussion Thread	To maintain academic staff's participation and thread in relate to the discussion to the same teaching subject.

19.	Academic Staff Info	To record academic staff's consultation hours, office location, and contact details.

Table 4.1: Database - Description Of 19 Tables For I-GEMS.

An i-GEMS database relationship diagram is shown on the next page.

4.5.2 Program (Structure) Chart

The following Figure 4.22 demonstrates the structure of i-GEMS that consists of 12 main modules. For further elaborations on the program, reader can refer to the section 4.5.4 *Detailed Modules / Features*.

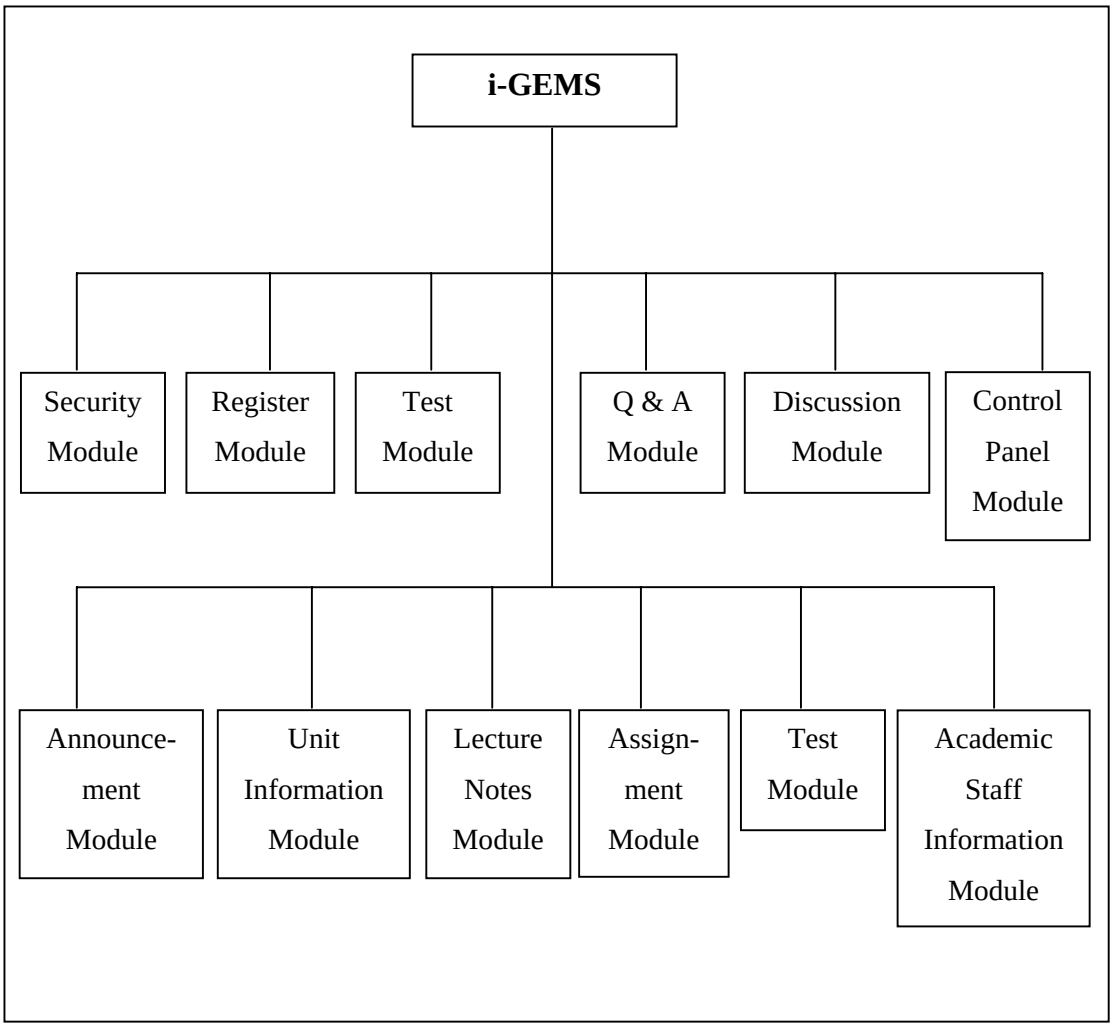


Figure 4.22: I-GEMS Structure Chart.

4.5.3 Interface Chart

I-GEMS has three main categories of users: administrator, academic staff, and student. The Table 4.2 illustrates the i-GEMS features which are accessible to the users. The "*" symbol signifies that a specific feature is available to the corresponding category of users.

Features	Administrator	Academic Staff	Student
Login page	*	*	*
i-GEMS **main page**:			
-Add Academic Staff	*		
-Edit Academic Staff	*		
-Delete Academic Staff	*		
-Add Student Course	*		
-Edit Student Course	*		
-Delete Student Course	*		
-Subject selection page	*	*	*
A subject's **main page**:			
• Announcement			
-Get latest announcement.		*	*
• Unit Information			
-Download the unit information.		*	*
-Access and view the unit information.		*	*
• Lecture Notes			
-Download the lecture notes.		*	*
-Access and view the lecture notes.		*	*
• Tutorial			
-Download the tutorial.		*	*
-Access and view the tutorial.		*	*
• Assignment			
-Download the assignment.		*	*
-Access and view the assignment.		*	*

• Test -Choose the test title. -Answer the test question. -System analyzes test performance and produce result. • Q & A -Choose to view a specific question. -To add a new question. -To reply a question. -To remove an unsuitable question. -To remove a reply. (Note: Only those lecturers who are teaching the subject are authorized to maintain the content of Q & A). • Discussion -Choose to view a specific discussion topic. -To add a new discussion topic. -To involve in a specific topic discussed by replying to the topic. -Unit leader is authorized to remove an unsuitable question. -Unit leader is authorized to remove an inappropriate thread. (Note: Only lecturers who are teaching the subject are authorized to participate in the discussion module) • Access Academic Staff Information • Change Password • Logout		* * * * * * * * * * * * * * *	* * * * * * * * * * *
Control Panel: (Note: Only academic staff or lecturers who are teaching the subject are authorized to access the control panel module) • Announcement: -Add, Edit and Delete Announcement • Unit Information: -Add and Remove Unit Information		 * *	

• Lecture Notes: -Add and Remove Lecture Notes		*	
• Tutorial: -Add and Remove Tutorial		*	
• Assignment: -Add and Remove Assignment		*	
• Test: -Add, Edit and Delete Test		*	
• Academic Staff Information -Add, Edit and Delete academic staff information		*	
• Test Result -To trace students' test result.		*	

Table 4.2: I-GEMS Interface Chart.

4.5.4 Detailed Modules / Features

On the whole, i-GEMS system comprises of 12 modules, each of the modules provides different functionalities and purpose to serve administrator, academic staff or lecturer, as well as the students of TARC. Following are the descriptions of the 12 modules.

i. **Security Module**

I-GEMS system is not accessible by the public, instead it is only accessible to valid academic staff and students of TARC. To use the system, a user must first login with valid user id and password. The security module will then verify user identity, analyze and grant user different access level according to user status. For instance, lecturer(s) who is/are teaching subject “Introduction To Information Technology” is authorized to maintain the content of the subject, while students are only allowed to access study materials, participate in Q&A or test session. In addition, for security consideration, user can change password by using one of the features “ Change Password” from the i-GEMS system.

ii. Register Module

The register module, which is used by administrator, provides functionalities to register an authorized lecturer to the corresponding teaching academic module, and to register an authorized student course to the corresponding studying subject module.

iii. Announcement Module

The main purpose of the module is to provide academic staff an easy to use and effective platform to broadcast and deliver their announcement to the students.

iv. Unit Information Module

The module serves as an ease to use platform for the academic staff or lecturers to maintain and share the Unit information (Unit is subject under TARC environment). As an example, a Unit plan can be posted by a Unit leader and updated by other lecturers who are also teaching the same Unit. Students studying the specific

subject can then refer and download the unit information to obtain details such as a subject's semester schedule, marks allocation, reference books and so forth.

v. Lecture Notes Module

The module serves as a centralized platform for the academic staff across the campuses to maintain and share same set of lecture notes. Through using the module, lecture notes will then be delivered consistently throughout the six campuses, hence it can help to avoid the lack of standardization problem that mentioned in "*1.3 Statement of The Problem*". In addition, students (across the six campuses) studying the subject can then view and download the lecture notes from the module.

vi. Tutorial Module

The module serves as a centralized platform for the academic staff across the campuses to maintain and share workload in producing a standardized and consistent tutorial. In addition, students (across the six campuses) studying the subject can then access and download the tutorial from the module.

vii. Assignment Module

The module serves as a centralized platform for the academic staff across the campuses to maintain and share workload in producing a standardized and consistent assignment. In addition, students (across the six campuses) studying the subject can then access and download the assignment from the module.

viii. Test Module

The test module serves as an easy to use mechanism for the academic staff to deliver their objective test questions through using the i-GEMS system. The module allows lecturer to post one or more test for a subject to evaluate students' understanding. For instance, a subject may have test 1, test 2 and so forth.

Students can then participate in a test section and submit their answers. The test module will then analyze and process students' answers, and produce test performance immediately.

The module provides 3 levels of general comments to the students according to their test performance. If student's marks are ranged from 0 to 49, the system will

display "*Your test performance is close to standard level. Try harder, you may lead to better performance by spending more effort on the subject*". If student's marks are within the range of 50 to 79, system will display "*Your test performance is average. You may lead to excellent performance by spending more effort on the subject*" On the other hand, if student's marks are 80 or above, then the system will compliment by showing message "*Your test performance is excellent! Well done! Please keep up with your performance*".

ix. Q & A Module

The module enables students (across six campuses) to raise and share their queries. Answering section is no more restricted to their own campus' lecturer, instead the questions can now be answered by all the campuses' lecturers who are teaching the same subject. Hence through using the module, it helps to enhance the efficiency and effectiveness of questioning and answering feature.

x. Discussion Module

Academic staff or lecturers across the campuses who are teaching a same subject can have their internal discussion through using the discussion module. Unit leader for the subject will serve as a discussion moderator and authorized to monitor and control the content of discussed topic. Through using the module, they may discuss on topics such as work allocation, problems faced in delivering the subject, proposed solutions to problems, knowledge sharing and so on.

xi. Academic Staff Information Module

The module enables the academic staff to post their contact details, such as their name, email, phone number, office location and available office hour for students' consultation. By accessing to this information, students can then consult to their corresponding lecturers personally.

xii. Control Panel Module

The control panel is the most essential feature in the i-GEMS system. The module serves as a panel to control academic materials by authorizing academic staff (across campuses) who are teaching same subject to maintain, share and standardize the subject's teaching materials, as well as to distribute workload among the

lecturers. Through using the module, teaching materials such as announcement, unit information, lecture notes, tutorials, assignment, test and academic staff information can then be added, edited or deleted to or from database.

4.5.5 System Architecture (Physical Design)

System Architecture for i-GEMS System is as Figure 4.23.

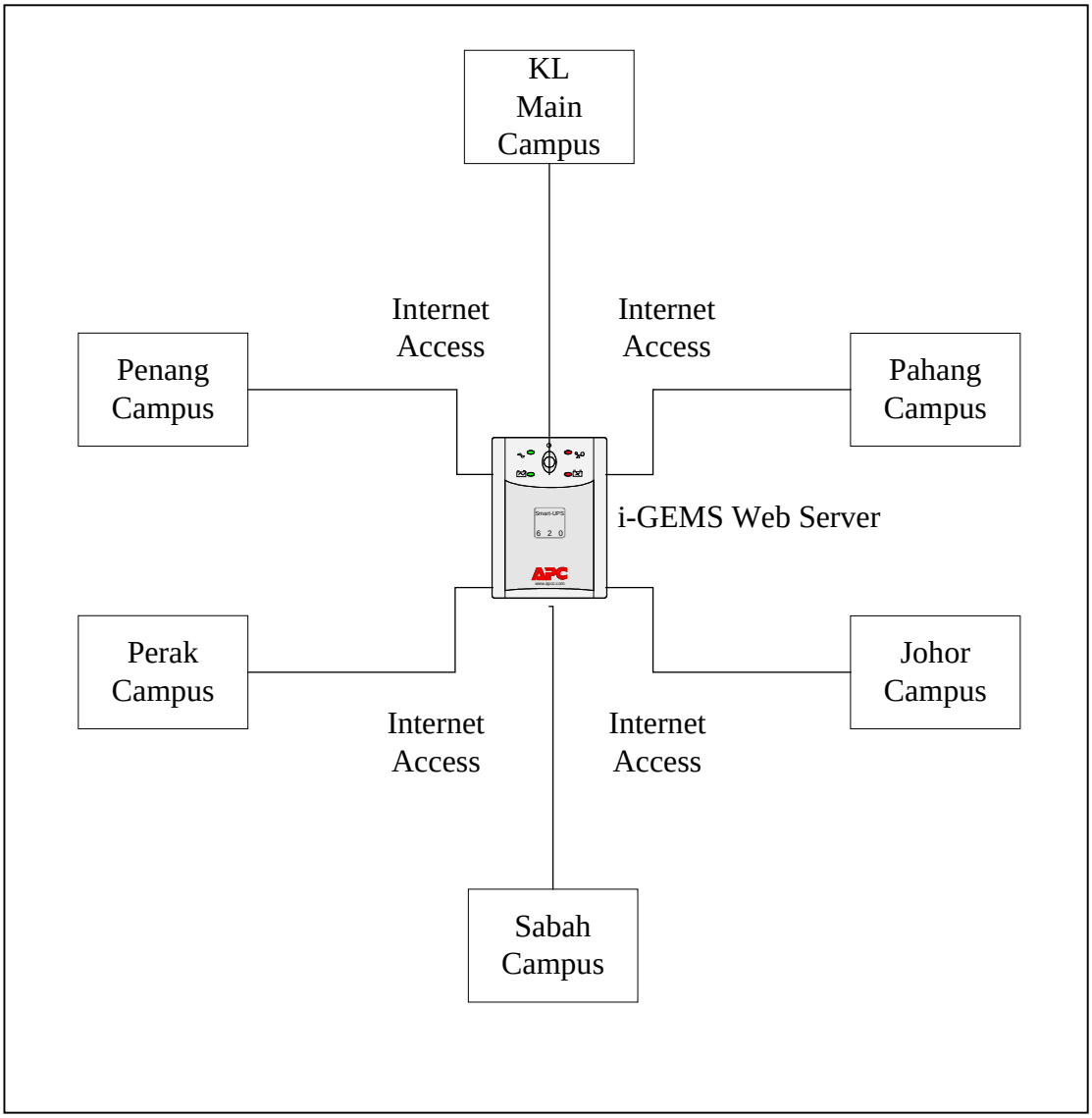


Figure 4.23: System Architecture For The Proposed I-GEMS System.

The i-GEMS system will be located at a web server, which is accessible and available to all the six campuses of TARC on a 24-by-7 basis.

4.6 Hardware Requirements

In terms of hardware requirements, table below illustrates the proposed web server that may be used to support the i-GEMS system.

Features	Computer Components	Estimated Market Price
Processor	INTEL PENTIUM 4 660 3.6GHz / LGA775 / 2MB 64Bit / 800FSB	RM1670
Motherboard	ASUS P5WD2 Premium i955X / DDR2 / 1066FSB / DUAL CORE / Gb LAN / SA	RM1080
Memory	KINGSTON 1GB DDR333 SO-DIMM	RM490
Network Card	LINKSYS 24-PORT 10/100/1000 SWITCH	RM1880
Hard Disk	320 GB WESTERN DIGITAL CAVIAR 8MB / ATA100	RM570
Display Card	PCX ABIT RX300SE	RM280
Sound Card	PCX ABIT RX300SE / 128 MB	RM280
Speaker	EDIFIER R251	RM179
Monitor	17” DIGITAL MONITOR	RM275
Drive	LITE-ON DVD+-R / +-RW 4X DUAL LAYER 16x8x16 CDRW 48x24x48	RM250
Printer	HP LASERJET 1015PPM / 1200DPI / 16MB RAM	RM865
Total:		RM7819

Table 4.3: Hardware Requirements For Supporting The I-GEMS System.

In short, the proposed web server emphasize more on providing high speed networking and processing capability in order to support the i-GEMS that cater for six campuses of TARC.

4.7 Test Plan

The main users of i-GEMS system are academic staff and students from computer science of TARC. The test plan for i-GEMS system comprises of module test (or unit component test) and integration test.

Based on the test plan, each module will first be tested and followed by the integration test. Within each of the module test, a detailed functional test is implemented to ensure all the sub features within the module is completed as expected. Following is the list of module test together with its corresponding functional test, which is based on a sampling subject "AACS1614 Introduction To Information Technology".

Announcement Unit Test:

- Allow an academic staff to add an announcement.
- Allow an academic staff to edit an announcement.
- Allow an academic staff to delete an announcement.
- Allow all users to access the posted announcement.
- The module is capable to arrange the latest announcement on the top, or according to descending order.

Unit Information Test:

- Allow an academic staff to upload a subject's Unit plan to the system. User is encouraged to name the Unit plan according to the proposed naming convention – example: "Unit plan AACS1614.doc", where AACS1614 is the subject code for "Introduction To Information Technology.
- Allow an academic staff to remove a subject's Unit plan from the system.
- Allow all users to view the Unit plan through the system.
- Allow all users to download the Unit plan from the system to a specified path or location correctly.

Lecture Notes Unit Test:

- Allow an academic staff to upload a lecture notes to the system. User is encouraged to name the lecture notes according to the proposed naming convention – example: “Lecture Notes AACS1614 Chapter 1.doc”.
- Allow an academic staff to remove a lecture notes from the system.
- Allow all users to view lecture notes through the system.
- Allow all users to download lecture notes from the system to a specified path or location correctly.

Tutorial Unit Test:

- Allow an academic staff to upload a tutorial to the system. User is encouraged to name the tutorial according to the proposed naming convention – example: “Tutorial 1 AACS1614.doc”.
- Allow an academic staff to remove a tutorial from the system.
- Allow all users to view tutorial through the system.
- Allow all users to download tutorial from the system to a specified path or location correctly.

Assignment Unit Test:

- Allow an academic staff to upload an assignment to the system. User is encouraged to name the assignment according to the proposed naming convention – example: “Assignment 1AACS1614.doc”.
- Allow an academic staff to remove an assignment from the system.
- Allow all users to view assignment through the system.
- Allow all users to download assignment from the system to a specified path or location correctly.

Academic Staff Information Unit Test:

- Allow an academic staff who is teaching subject AACS1614 to add his or her contact details to the system.
- Allow an academic staff who is teaching subject AACS1614 to edit his or her contact details from the system.

- Allow an academic staff who is teaching subject AACS1614 to delete his or her contact details from the system.
- Allow all users to access the academic staff information.

Test Unit:

- Allow an academic staff who is teaching subject AACS1614 to develop one or more objective test by adding a new test title, such as “Test 1”, “Test 2” and so forth for a whole semester.
- Allow an academic staff who is teaching subject AACS1614 to edit the objective test title from the system.
- Allow an academic staff who is teaching subject AACS1614 to delete the objective test title from the system.
- Allow an academic staff who is teaching subject AACS1614 to add objective questions with its corresponding answer into a specific test title.
- Allow an academic staff who is teaching subject AACS1614 to edit an objective question from a specific test title.
- Allow an academic staff who is teaching subject AACS1614 to delete an objective question into a specific test title.
- Allow students who are studying the subject to participate in each test for one time. Students are not allowed to retake the same test.
- Once a student has submitted his or her answer, immediately test unit is able to analyze and process the student’s answer and produce result immediately.
- The test unit is capable to give advise to the student according to his or her test performance.

Q & A Unit Test:

- All types of user are allowed to access and share the question and answering section.
- All types of user are allowed to raise a new question topic.
- All types of user are allowed to participate in a topic by answering a question or raise sub question that is related to the topic.
- Only academic staff who is teaching the subject is authorized to monitoring and controlling the Q & A section by removing any inappropriate content.

Discussion Unit Test:

- Only academic staff who is teaching the subject AACS1614 is allowed to participate in the discussion unit.
- Allow an academic staff who is teaching the subject to new a discussion topic.
- Allow an academic staff who is teaching the subject to involve in a topic discussion by replying to the discussed topic.
- Only unit leader for the subject is authorized to monitoring and controlling the discussion section by removing any inappropriate discussed content.

Control Panel Test:

- Only academic staff who is teaching the subject AACS1614 is authorized to access control panel to produce and maintain the materials of the subject.

Once each of the modules or unit components is tested completely, all the modules are then integrated to form a complete i-GEMS system. Integration test is carried to evaluate the overall i-GEMS performance and operations.

Integration Test

Security integration test:

- All users are required to login to the system with valid user id and password.
- A user is allowed to change existing password by accessing “Change Password” feature.
- When finish using the i-GEMS system, user can logout from the system.
- The i-GEMS system is capable to analyze user’s access authority and grant the authorization level according to the user’s identity.

User Categorizing Integration Test:

- The i-GEMS system is capable to distinguish a student user and direct the user to a student’s main page.
- The i-GEMS system is capable to distinguish an administrator user and direct the user to an administrator’s main page.

- The i-GEMS system is capable to distinguish an academic staff who is teaching the subject AACS1614 and direct the user to an academic staff's main page that allow the user to maintain and control the content of the subject.
- The i-GEMS system is capable to distinguish an academic staff who is not teaching the subject AACS1614 and direct the user to an academic staff's main page, where the controlling and maintenance features are not accessible by the user.

Time Frame Integration Test:

- Subject AACS1614 is accessible at first semester for every academic year.
- Subject AACS1614 is not accessible to student user at second semester.
- Subject AACS1614 that is not offered at second semester is accessible by all of the academic staff. However, apart from the unit leader for the subject, all the academic staff are not allowed to maintain and control the subject's content.
- Subject AACS1614 that is not offered at second semester is accessible by unit leader of the subject and the unit leader has authority to maintain and control the subject's content.

4.8 Chapter Summary

From the section 4.1 existing TARC's organizational analysis is elaborated in details. Predicaments that currently facing such as lack of communication and information sharing among the lecturers from different campuses, resources wastage as teaching materials has been redeveloped at different campuses for a same subject, inefficient of e-mail communication approach in supporting academic sharing among lecturers and so forth. Hence i-GEMS system is proposed to overcome the problems faced. The proposed system advocates managing academic information through collaboration across the campuses, which then lead to standardization of academic materials. In addition, the system also serves as a platform to provide information sharing and learning by allowing lecturers to access other non-teaching academic materials. Through the system, it helps to enhance communication between students and lecturers, as it is no more restricted by the location boundaries.

A database that consists of 19 tables has been designed using Microsoft Access to support the i-GEMS system. Fundamentally, the users of i-GEMS system are categorized into three main groups: Administrator, academic staff and students. Each category of users has different authorization and access level that granted by the system. For details on user access level, reader can refer to section 4.5.3 *Interface Chart*.

A test plan for i-GEMS system that comprises of module test and integration test is developed. Within each of the modules test, a detailed functional test is implemented to ensure all the sub features within the module is completed as expected, and then it is followed by the integration test. On the whole, i-GEMS system comprises of 12 modules: *Security Module, Register Module, Announcement Module, Unit Information Module, Lecture Notes Module, Tutorial Module, Assignment Module, Test Module, Q & A Module, Discussion Module, Academic Staff Information Module,* and *Control Panel Module*. Each of the modules provides different functionalities and purpose to serve the academic staff or lecturer, as well as the students of TARC.

CHAPTER 5

DESIGN IMPLEMENTATION & TESTING

5.1 Coding Approach

ASP.NET is the core programming language that used to implement the i-GEMS system, together with support of Web Matrix program, which is an ASP.NET compiler. Instead of using others prominent ASP.NET compiler such as Microsoft Visual Studio .NET, Web Matrix is chosen as it is a community-supported, easy-to-use development tool for building ASP.NET web applications. Moreover, Web Matrix is a freeware compiler, where the program can be downloaded free from http://www.asp.net/webmatrix/.

ASP.NET is Microsoft's latest version of popular dynamic Web programming technology, where it is a convergence of two major Microsoft technologies – .NET and Active Server Pages (ASP). ASP.NET is a programming framework built on the common language runtime (CLR) that can be used on a server to build powerful Web applications. Common language runtime (CLR) is an environment that can run and maintain any codes written in any computers.

One of the powerful features in ASP.NET is, when writing an application, developers can choose to write application using Visual Basic .NET, C# or J# programming languages, or even a combination of languages. In i-GEMS system, Visual Basic .NET has been used as the primary programming language in implementing the system.

ASP.NET is an object-oriented language. An object is a self-contained unit of functionality. It holds data and codes, accesses and manipulates that data in simple, well-defined approach. When developing an application, developers can use ASP.NET server controls or object to create common user interface elements and programs. Making use of the reusable built-in controls or custom objects allow the author to rapidly build the web-based application, as the controls has simplified pages of codes. Figure 5.1 shows the server objects provided by the ASP.NET.

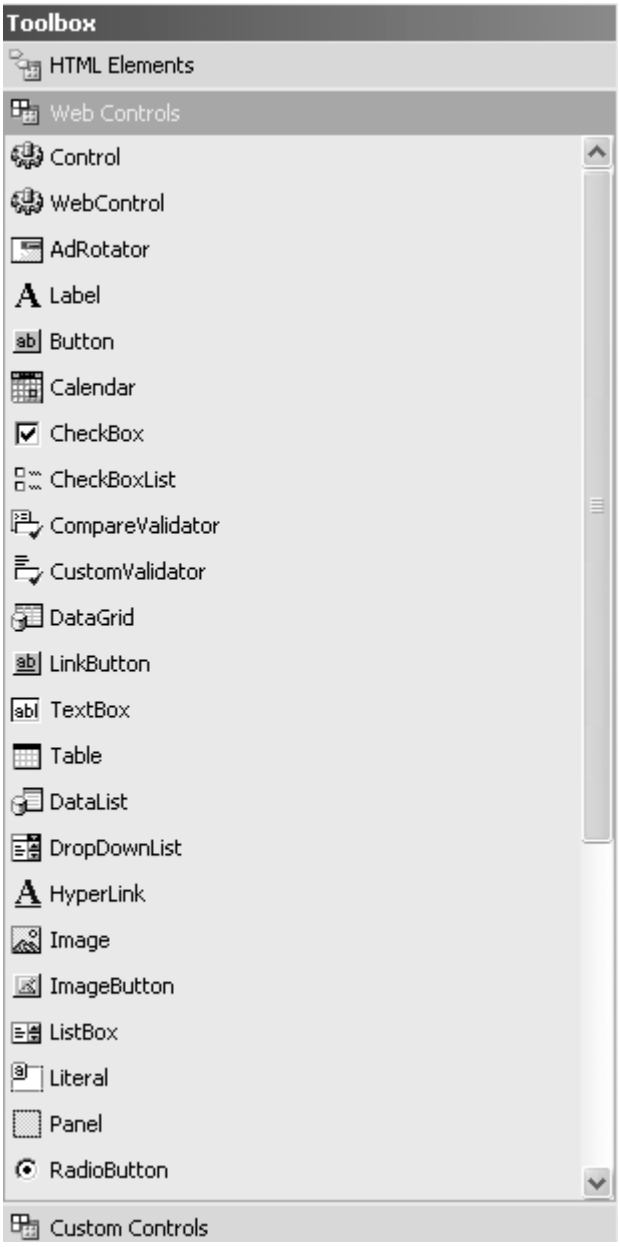


Figure 5.1: ASP.NET Web Controls.

The following is a list of several important advantages that offered by ASP.NET:

- **Enhanced Performance.** ASP.NET is compiled common language runtime code running on the server. ASP.NET provides advantage of early binding, just-in-time compilation, native optimization, and caching services right out of the box.

- **World-Class Tool Support**. The ASP.NET framework is complemented by a rich toolbox and designer in an integrated development environment. WYSIWYG (What You See Is What You Get) editing, drag-and-drop server controls, and automatic deployment are the features this powerful tool provides.

- **Power and Flexibility**. Because ASP.NET is based on the common language runtime, the power and flexibility of that entire platform is available to Web application developers. The .NET Framework class library, Messaging, and Data Access solutions are all seamlessly accessible from the Web. ASP.NET is also language-independent, so you can choose the language that best applies to your application or partition your application across many languages.

- **Simplicity**. ASP.NET makes it easy to perform common tasks, from simple form submission and client authentication to deployment and site configuration. For example, the ASP.NET page framework allows you to build user interfaces that cleanly separate application logic from presentation code and to handle events in a simple, Visual Basic - like forms processing model. Additionally, the common language runtime simplifies development, with managed code services such as automatic reference counting and garbage collection.

- **Manageability**. ASP.NET employs a text-based, hierarchical configuration system, which simplifies applying settings to your server environment and Web applications. Because configuration information is stored as plain text, new settings may be applied without the aid of local administration tools. This "zero local administration" philosophy extends to deploying ASP.NET Framework applications as well. An ASP.NET Framework application is deployed to a server

simply by copying the necessary files to the server. No server restart is required, even to deploy or replace running compiled code.

- **Scalability and Availability**. ASP.NET has been designed with scalability in mind, with features specifically tailored to improve performance in clustered and multiprocessor environments. Further, processes are closely monitored and managed by the ASP.NET runtime, so that if one misbehaves (leaks, deadlocks), a new process can be created in its place, which helps keep your application constantly available to handle requests.

- **Customizability and Extensibility**. ASP.NET delivers a well-factored architecture that allows developers to "plug-in" their code at the appropriate level. In fact, it is possible to extend or replace any subcomponent of the ASP.NET runtime with your own custom-written component. Implementing custom authentication or state services has never been easier.

5.1.1 Snapshot of Critical Programming Codes

As i-GEMS is implemented by using ASP.NET, all the pages must be defined with extension .aspx. This is important as all ASP.NET pages are identified by the .aspx suffix that is attached to the end of the filename. Only pages with .aspx will be sent to ASP.NET for processing. The following demonstrates some of the critical programming codes that are used in implementing the system.

Connecting and maintaining a database

To connect to a database, a developer can either use code wizards (Figure 5.2) or to define all the connections and queries manually (Figure 5.3 – Figure 5.6).

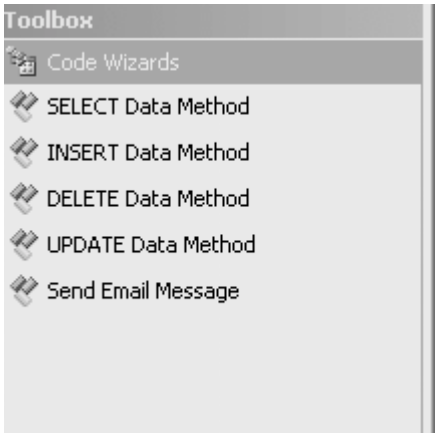


Figure 5.2 Connecting Access Database Using Code Wizards

```
(From C Announcement.aspx – GetAnnouncement procedure):

Function GetAnnouncement() As System.Data.DataSet

  Dim connectionString As String = "Provider=Microsoft.Jet.OLEDB.4.0; Ole DB_
Services=-4; Data Source=" & Request.PhysicalApplicationPath & "\iGEMS.mdb"

  Dim dbConnection As System.Data.IDbConnection = New
System.Data.OleDb.OleDbConnection(connectionString)

  Dim queryString As String = "SELECT [Announcement].* FROM _
[Announcement] WHERE ([Announcement].[SubjectCode] =" & SubjectCode &")
ORDER By TodayDate DESC, TodayTime DESC "

  Dim dbCommand As System.Data.IDbCommand = New
System.Data.OleDb.OleDbCommand

 dbCommand.CommandText = queryString

 dbCommand.Connection = dbConnection

  Dim dbParam_subjectCode As System.Data.IDataParameter = New
System.Data.OleDb.OleDbParameter
  dbParam_subjectCode.ParameterName = "@SubjectCode"
  dbParam_subjectCode.Value = subjectCode
  dbParam_subjectCode.DbType = System.Data.DbType.String
   dbCommand.Parameters.Add(dbParam_subjectCode)

  Dim dataAdapter As System.Data.IDbDataAdapter = New
System.Data.OleDb.OleDbDataAdapter
  dataAdapter.SelectCommand = dbCommand
  Dim dataSet As System.Data.DataSet = New System.Data.DataSet
  dataAdapter.Fill(dataSet)

  Return dataSet
End Function
```

Figure 5.3: To Retrieve An Announcement From Access Database By Using Code Wizard.

```
(From CP Add Announcement.aspx - btnSubmit_Click procedure):

Try
        Dim DBConn As System.Data.OleDb.OleDbConnection
        Dim dbCommand As New System.Data.OleDb.OleDbCommand()
        Dim strPath As String
        Dim SubjectCode As String
        Dim SenderID As String
        Dim TodayDate As Date
        Dim SQL AS String
        Dim AnnTopic As String

       TodayDate = Now()
        strPath =Request.PhysicalApplicationPath & "\iGEMS.mdb"
        DBConn = New
System.Data.OleDb.OleDbConnection("Provider=Microsoft.Jet.OLEDB.4.0;DATA
SOURCE=" & strPath)

        SubjectCode=Application("SubjectID")
        SenderID=Application("UserID")
         AnnTopic = txtTopic.Text

        SQL="Insert Into Announcement (SubjectCode, Topic,
Message,StaffID,TodayDate, TodayTime) Values('" & SubjectCode & "','" &
txtTopic.Text & "','" & txtMessage.Text & "','" & SenderID & "','" &
TodayDate.Date  & "','" & TimeOfDay &  "')"
        dbCommand.CommandText =SQL
        dbCommand.Connection = DBConn
        dbCommand.Connection.Open()
        dbCommand.ExecuteNonQuery()
        DBConn.Close()

Catch err As System.Exception

            dim msg as string
            msg = err.Message
            MsgBox(msg, ,"Error Message")
End Try
```

Figure 5.4: To Insert An Announcement Into Access Database.

```
(From CP Edit Announcement.aspx - btnUpdate procedure):

    Dim DBConn As System.Data.OleDb.OleDbConnection
    Dim dbCommand As New System.Data.OleDb.OleDbCommand()
    Dim strPath As String
    Dim Sql As String

    strPath =Request.PhysicalApplicationPath & "\iGEMS.mdb"

    DBConn = New
System.Data.OleDb.OleDbConnection("Provider=Microsoft.Jet.OLEDB.4.0;DATA
SOURCE=" & strPath)

Sql= "Update Announcement SET Topic = '" & txtTopic.Text & "',Message ='" &
txtMessage.Text & "', StaffID='" &  txtSenderID.Text  & "', TodayDate='" &
txtDate.Text  & "', TodayTime='" &  txtTime.Text & "' WHERE SubjectCode = '" &
SubjectCode & "' AND StaffID ='" & AnnSender & "'AND TodayDate='" &
AnnDate & "' AND TodayTime='" & AnnTime & """

    dbCommand.CommandText = Sql
    dbCommand.Connection = DBConn
    dbCommand.Connection.Open()
    dbCommand.ExecuteNonQuery()
    DBConn.Close()
```

Figure 5.5: To Update An Announcement Into Access Database.

```
(From CP Announcement.aspx – Ann_Delete procedure):

        Dim DBConn As System.Data.OleDb.OleDbConnection
        Dim dbCommand As New System.Data.OleDb.OleDbCommand()
        Dim strPath As String

        strPath =Request.PhysicalApplicationPath & "\iGEMS.mdb"

        DBConn = New
System.Data.OleDb.OleDbConnection("Provider=Microsoft.Jet.OLEDB.4.0;DATA
SOURCE=" & strPath)

       dbCommand.Connection = DBConn
       dbCommand.Connection.Open()
       dbCommand.CommandText = "DELETE FROM Announcement WHERE
SubjectCode = '" & SubjectCode & "' AND StaffID ='" & AnnSender & "'AND
TodayDate='" & AnnDate & "' AND TodayTime='" & AnnTime & "'"

       dbCommand.ExecuteNonQuery()
       DBConn.Close()
```

Figure 5.6: To Delete An Announcement From Access Database.

Creating folders and uploading a file

The Figure 5.7 demonstrates how to add folder (such as Lecture Notes folder, Tutorial folder, Unit Info folder and etc.) for a subject and the codes in uploading an academic file to the corresponding folder.

```
(From CP Add Lecture Notes.aspx – btnUpload procedure):
     Dim intFileNameLength as Integer
     Dim strFileNamePath as String
     Dim strFileNameOnly as String

     'To find the FileName (excluding the path)
     strFileNamePath = MyFile.PostedFile.FileName
     intFileNameLength = Instr(1, StrReverse(strFileNamePath), "\")
     strFileNameOnly = Mid(strFileNamePath, (Len(strFileNamePath)-
 intFileNameLength)+2)

    'To create the corresponding folder for the subject
    Dim objFileSysOb
    Dim GetSize
    Dim FileSize As Integer
    Dim Path1 As String
    Dim Path2 As String
```

```
    objFileSysOb=Server.CreateObject("Scripting.FileSystemObject")

    'Path for Create Subject folder
     Path1=Request.PhysicalApplicationPath &  SubjectCode

    'Path for Create Lecture Notes folder within the particular subject folder
     Path2=Path1 & "\" & "Lecture Notes"

     'Create the Subject folder only if it is not exist
     IF NOT ObjFileSysOb.FolderExists(Path1) THEN
            objFileSysOb.CreateFolder(Path1)
     END IF

     'Create the lecture notes folder only if it is not exist
      IF NOT ObjFileSysOb.FolderExists(Path2) THEN
             objFileSysOb.CreateFolder(Path2)
      END IF

      'Add the file only if it is not exist
IF NOT ObjFileSysOb.FileExists(Path2 & "\" & strFileNameOnly) THEN

     'Copy the file to the destination Path2
     MyFile.PostedFile.SaveAs(Path2 & "\" & strFileNameOnly)
     GetSize=objFileSysOb.GetFile(Path2 & "\" & strFileNameOnly)
     FileSize = GetSize.Size

call InsertFile(strFileNameOnly, Path2 & "\" & strFileNameOnly, FileSize)

    txtTitle.Text=""
    txtComment.Text=""
ELSE
     MsgBox("The file is already existed. Please select another file to add.", ,"File
Existed")
END IF

ELSE
      MsgBox("Please select a file to add", ,"File Missing")
END IF
```

Figure 5.7: Create Folder And Upload File.

DataGrid Control

Another critical programming technique in implementing i-GEMS system is the DataGrid control or object, which is the most essential object that used to display most of the academic materials. The Figure 5.8 shows that a DataGrid control is used to bind with announcement table from Access database.

Topic	Message	Date	Time
Databound	Databound	Databound	Databound
Databound	Databound	Databound	Databound
Databound	Databound	Databound	Databound
Databound	Databound	Databound	Databound
Databound	Databound	Databound	Databound

Figure 5.8: Datagrid Control.

To employ a DataGrid control, just drag the control from Web control toolbox, as shown in the Figure 5.9.

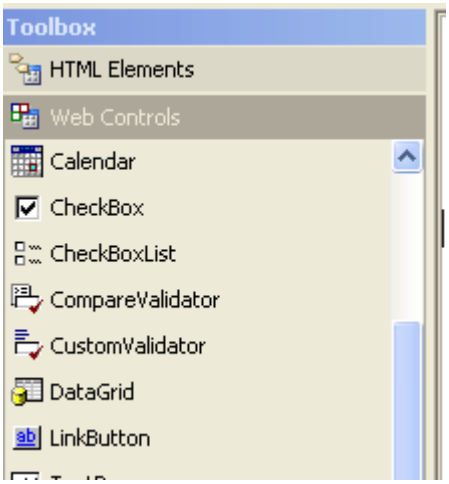


Figure 5.9: Drag Datagrid Control From Web Control Toolbox.

The Figure 5.10 demonstrates the coding approach in binding an Announcement table to the DataGrid control.

```
(From Announcement.aspx ):
Codes under HTML body section:
<asp:DataGrid id="CAnnouncementList" style="Z-INDEX: 100; LEFT: 20px;
POSITION: absolute; TOP: 60px" runat="server" AutoGenerateColumns="false"
width="100%">
```

```
<HeaderStyle font-bold="True" forecolor="White"
backcolor="#6666CC"></HeaderStyle>

<AlternatingItemStyle backcolor="Gainsboro"></AlternatingItemStyle>
<ItemStyle backcolor="White"></ItemStyle>
<Columns>
        <asp:TemplateColumn HeaderText="Topic">
                <ItemTemplate>
                   <%# Container.DataItem("Topic")%>
                </ItemTemplate>
        </asp:TemplateColumn>

        <asp:TemplateColumn HeaderText="Message">
                <ItemTemplate>
                   <%# Container.DataItem("Message")%>
                </ItemTemplate>
        </asp:TemplateColumn>

        <asp:TemplateColumn HeaderText="Date">
                <ItemTemplate>
                   <%# Container.DataItem("TodayDate")%>
                </ItemTemplate>
        </asp:TemplateColumn>

        <asp:TemplateColumn HeaderText="Time">
                <ItemTemplate>
                   <%# Container.DataItem("TodayTime")%>
                </ItemTemplate>
       </asp:TemplateColumn>
</Columns>
</asp:DataGrid>

Codes under ASP.NET script section:
Sub Page_Init()
      CAnnouncementList.DataSource=GetAnnouncement()
      CAnnouncementList.DataBind()
End Sub


Note: Reader can refer to Figure 5.3 for the GetAnnouncement procedure.
```

Figure 5.10: Binding A Datagrid Control To Announcement Table.

5.2 Test Result / System Evaluation

Based on the Test Plan identified on page 89 to 93; the following section further illustrates the test result of i-GEMS based on the three main categories of users (administrator, academic staff and student).

5.2.1 Administrator User

The following table 5.1 demonstrates i-GEMS evaluation based on administrator user perspective. A tick under "Yes" column indicates that the tested functionality is completed and working properly, while "No" column signifies the vice versa status. (Note: Academic staff in the i-GEMS context is equivalent to lecturer, unit leader, or tutor.)

Test Case	Functionalities	Yes	No	Remarks / Actual Output
Login	Able to gain access to the i-GEMS system for an authorized user.	✓		Redirect to administration's main page.
Add Academic Staff	Able to register an authorized lecturer to the respective teaching subject module.	✓		A lecturer is added to a teaching subject module.
Edit Academic Staff	Able to modify information of a lecturer in relate to the teaching subject module.	✓		The modified information in relate to lecturer teaching subject is updated to database.
Delete Academic Staff	Able to remove a lecturer from a teaching subject module	✓		A lecturer is removed from a specific teaching subject module.
Add Student Course	Able to register a student course to a specific studying subject module.	✓		A student course is added to a specific studying subject module.

Edit Student Course	Able to modify information of student course in relate to the studying subject module.	✓		The modified information in relate to student course studying subject is updated to database.
Delete Student Course	Able to remove a student course from a studied subject module.	✓		A student course is removed from a specific subject module.
Change Password	Able to change an administrator's password.	✓		The modified password is updated to database.
Logout	Able to logout from the i-GEMS system.	✓		Redirect to Login page.

Table 5.1: System Evaluation – Administrator User.

5.2.2 Academic Staff User

The table 5.2 below demonstrates i-GEMS evaluation based on academic staff user perspective.

Test Case	Functionalities	Yes	No	Remarks / Actual Output
Login	Able to gain access to the i-GEMS system for an authorized user.	✓		Redirect to Subject Selection page.
Subject Selection	Able to display a list of subject options and allow user to make a selection.	✓		Redirect to the corresponding subject's main page.
Subject's Main Page	Allow an authorized user to access specific subject's teaching material.	✓		The content is displayed according to the user's selection. By default, announcement is displayed under content section.

Announce-ment	Able to display a subject's latest announcement properly.	✓		Announcement is displayed. The latest announcement is always displayed on the top.
Unit Information	Allow an academic staff user to view the content of a unit information file. Able to download a unit information file to a specified path correctly.	✓		The selected file is displayed under content section. The selected file is saved or downloaded to the user's computer.
Lecture Notes	Allow an academic staff user to view a lecture notes' content. Able to download a lecture notes file to a specified path correctly.	✓		The selected lecture notes is displayed under content section. The selected lecture notes is saved or downloaded to the user's computer.
Tutorial	Allow an academic staff user to view a tutorial's content Able to download a tutorial file to a specified path correctly.	✓		The selected tutorial is displayed under content section. The selected tutorial file is saved or downloaded to the user's computer.
Assignment	Allow an academic staff user to view an assignment's content. Able to download an assignment file to a specified path correctly.	✓		The selected assignment is displayed under content section. The selected assignment file is saved or downloaded to the user's computer.
Test	Allow user to participate in an objective test questions.	✓		Test questions are presented to the user. Once user submitted test answer, system analyzes user's

				performance and produces test result immediately.
Q & A	Allow academic staff to answer a question. Allow academic staff to add a question. Allow an academic staff who is teaching the subject to moderate question topics. Allow an academic staff who is teaching the subject to moderate content of reply.	✓		The user's answer or reply is added immediately under a specific question section. The user's question is added to database and display immediately under content section. An improper question is removed from the Q & A module. An improper reply is removed from the Q & A module.
Discussion	Allow an academic staff who is teaching the subject to add a discussion topic. Allow an academic staff who is teaching the subject to participate in a topic discussion. Allow a Unit leader for the subject to moderate discussion topics. Allow a Unit leader for the subject to moderate the content of discussion thread or reply.	✓		The user's discussion topic is added to database and display immediately under content section. The user's thread is added immediately under a specific discussion topic. An improper discussion topic is removed from the discussion module. An improper thread is removed from the discussion module.
Academic Staff Information	Able to display a subject's academic staff information properly.	✓		Academic staff information, such as name, email, phone number, office

				location and office hours are displayed under content section.
Change Password	Able to change an academic staff's password.	✓		The modified password is updated to database.
Control Panel	Allow an academic staff who is teaching the subject proceed to Control Panel to maintain a subject's teaching materials.	✓		Redirect to Control Panel Page.
Logout	To logout from the i-GEMS system.	✓		Redirect to Login page.

Table 5.2: System Evaluation - Academic Staff User.

Control Panel:

In i-GEMS, only academic staff who are teaching a subject are authorized to access the corresponding subject's control panel in order to maintain, share, and standardize the teaching materials. Hence, the control panel functionalities are only tested by academic staff who are teaching the subject, as demonstrated at the table 5.3.

Test Case	**Functionalities**	**Yes**	**No**	**Remarks / Actual Output**
Announce-ment	Able to add an announcement. Able to edit an announcement.	✓		-Redirect to Announcement page to add an announcement. -An announcement is saved into database and recorded into a log file. -Redirect to Edit Announcement page. -Modified

				announcement is updated to database and recorded in a log file.
	Able to delete an announcement.			The selected announcement is removed from database and recorded in a log file.
Unit Information	Able to add a unit information file.	✓		-Redirect to Unit Information page. -“Choose file” dialog box is displayed when click on “Browse” button. -Selected file name and path is displayed in “File” field. -The selected file is uploaded to the i-GEMS system.
	Able to remove a unit information file.			The selected file is removed from the i-GEMS system.
Lecture Notes	Able to add a lecture notes file.	✓		-Redirect to Lecture Notes page. -“Choose file” dialog box is displayed when click on “Browse” button. -The selected file name and path is displayed in “File” field. -The selected file is uploaded to the i-GEMS system.
	Able to remove a lecture notes file.			The selected file is removed from i-GEMS system.

Tutorial	Able to add a tutorial file. Able to remove a tutorial file.	✓		-Redirect to Tutorial page. -“Choose file” dialog box is displayed when click on “Browse” button. -The selected file name and path is displayed in “File” field. -The selected file is uploaded to the i-GEMS system. The selected file is removed from the i-GEMS system.
Assignment	Able to add an assignment file. Able to remove an assignment file.	✓		-Redirect to Assignment page. -“Choose file” dialog box is displayed when click on “Browse” button. -The selected file name and path is displayed in “File” field. -The selected file is uploaded to the i-GEMS system. The selected file is removed from the i-GEMS system.
Test	Able to add a test title Able to edit test title. Able to delete a test title.	✓		-Redirect to Test page. - A test title is added into database. -Redirect to Edit Test Title page. -Modified test title is updated to database. The selected test

				title is removed from database.
Academic Staff Information	Able to add an academic staff's contact details. Able to edit an academic staff's contact details. Able to delete an academic staff's contact record.	✓		-Redirect to Academic Staff Information page. -An academic staff's contact record is saved into database. -Redirect to Edit Academic Staff Information page. -Modified academic staff record is updated to database. The selected academic staff's contact record is removed from database.
Test Result	Able to access students' test performance for a selected test title.	✓		-Redirect to Test Result page. -Students' test result for a particular test title is presented.

Table 5.3: System Evaluation – Control Panel.

5.2.3 Student User

The following table 5.4 demonstrates i-GEMS evaluation based on student user perspective.

Test Case	Functionalities	Yes	No	Remarks / Actual Output
Login	Able to gain access to the i-GEMS system for an authorized user.	✓		Redirect to Subject Selection page.
Subject Selection	Able to display a list of subject options and allow user to make a selection.	✓		Redirect to the corresponding subject's main page.

Subject's Main Page	Allow a student user to access a studying subject's materials.	✓		The content is displayed according to the user's selection. By default, announcement is displayed under content section.
Announce-ment	Able to display a subject's latest announcement properly.	✓		Announcement is displayed. The latest announcement is always displayed on the top.
Unit Information	Allow a student user to view the content of a unit information file. Able to download a unit information file to a specified path correctly.	✓		The selected file is displayed under content section. The selected file is saved or downloaded to the user's computer.
Lecture Notes	Allow a student user to view a lecture notes' content. Able to download a lecture notes file to a specified path correctly.	✓		The selected lecture notes is displayed under content section. The selected lecture notes is saved or downloaded to the user's computer.
Tutorial	Allow a student user to view a tutorial's content Able to download a tutorial file to a specified path correctly.	✓		The selected tutorial is displayed under content section. The selected tutorial file is saved or downloaded to the user's computer..
Assignment	Allow a student user to view an assignment's content. Able to download an assignment file to a specified path correctly.	✓		The selected assignment is displayed under content section. The selected assignment file is saved or downloaded to the

				user's computer.
Test	Allow a student user to participate in an objective test questions.	✓		Test questions are presented to the user. Once user submitted test answer, system analyzes user's performance and produces test result immediately.
Q & A	Allow a student user to add a new question. Allow a student user to reply a posted question.	✓		The user's question is added to database and display immediately under content section. The user's reply is added immediately under the specific question topic.
Academic Staff Information	Able to display a subject's academic staff information properly.	✓		Academic staff information, such as name, email, phone number, office location and office hours are displayed under content section.
Change Password	Able to change a student's password.	✓		The modified password is updated to database.
Logout	Able to logout from the i-GEMS system.	✓		Redirect to Login page.

Table 5.4: System Evaluation – Student User.

5.2.4 User Acceptance Test

User acceptance test is part of Implementation phase for i-GEMS system. The purpose of the test is for the end user to verify that the i-GEMS system meets all specified objectives (refer to section *1.4 Project Objectives* and *1.5 Project Scope*), as well as to ensure that all user requirements are included in the new i-GEMS system (refer to section *4.3 User requirements*).

Three types of user acceptance test has been created (for three main types of users: administrator, academic staff and student) and distributed to the end user. Reader can refer to the forms of user acceptance test from Appendix E to Appendix G.

Among the users, there was one administrator, five academic staff and five students from TARC have taken a test on the i-GEMS system. On the whole, most of the users are satisfied with the system functionalities as it has met with the user requirements and project scope. While for the usability test, out of eleven users, eight users agreed that the i-GEMS usability is acceptable. On the other hand, there were two users commented that the system design still can be further enhanced to become more attractive.

In general, through conducting the user acceptance test, it demonstrates that the i-GEMS system has achieved the project scope and user requirements that specified earlier. Nonetheless, there is still some room space for future enhancement in terms of system usability.

5.3 User Manual for Administrator

Installation Procedure:

i. Installing Microsoft .NET Framework 1.1

Microsoft .NET Framework 1.1 is required in running the web-based i-GEMS system. The copy of Microsoft .NET Framework 1.1 package can be downloaded for free usage at http://www.microsoft.com/downloads.

Once the package is downloaded, choose to install the package and you will be prompted for installing Microsoft .NET Framework 1.1 (Figure 5.11).

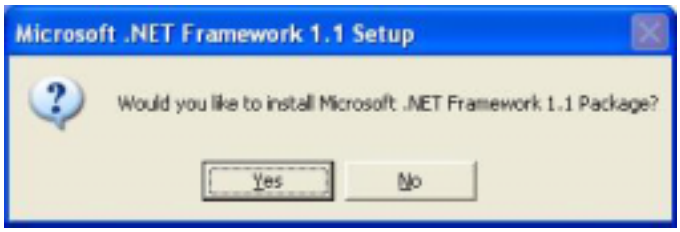


Figure 5.11 Microsoft .NET Framework 1.1 Installation Setup.

Select “Yes” to continue installation. A successful installation will lead to following prompt (Figure 5.12).

Figure 5.12: Prompt That Showing Completed Installation Of Microsoft .NET Framework 1.1.

ii. Installing Microsoft ASP.NET Web Matrix

Download the free copy of Microsoft ASP.NET Web Matrix from http://www.asp.net/webmatrix/.

When the install package is launched for the first time, “Microsoft ASP.NET Web Matrix – InstallShield Wizard” will be prompted (Figure 5.13).

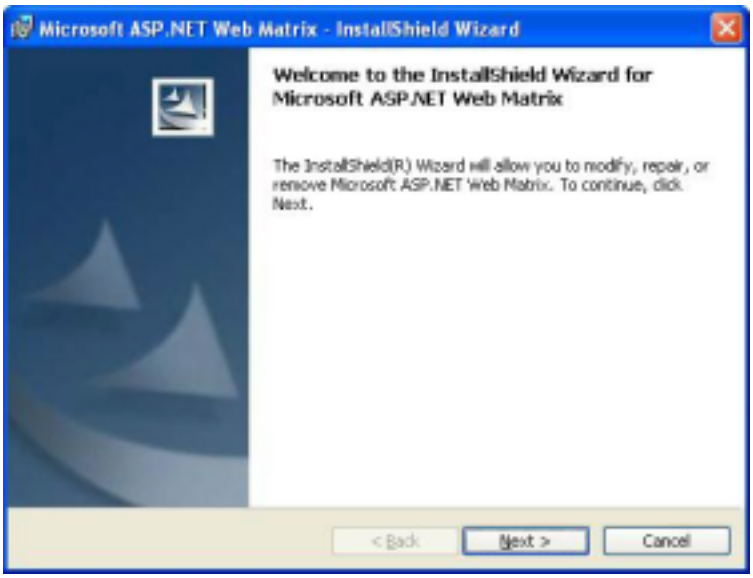


Figure 5.13: Microsoft ASP.NET Web Matrix - InstallShield Wizard.

Follow the ongoing screen installation instructions till the end of installation. (Figure 5.14).

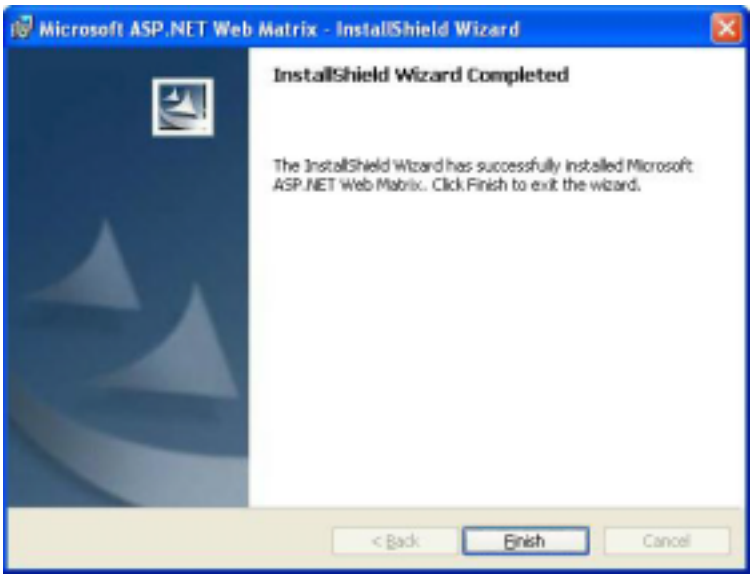


Figure 5.14: Prompt Showing Completed Installation Of Microsoft ASP.NET Web Matrix.

iii. Installing Internet Information Services (IIS)

Internet Information Services (IIS) is required to serve as a powerful web server that is used to provide a highly reliable, manageable, and scalable application infrastructure for the web-based i-GEMS system.

IIS installation can be accessed from clicking “Start” button from desktop and choose “Control Panel” (Figure 5.15).

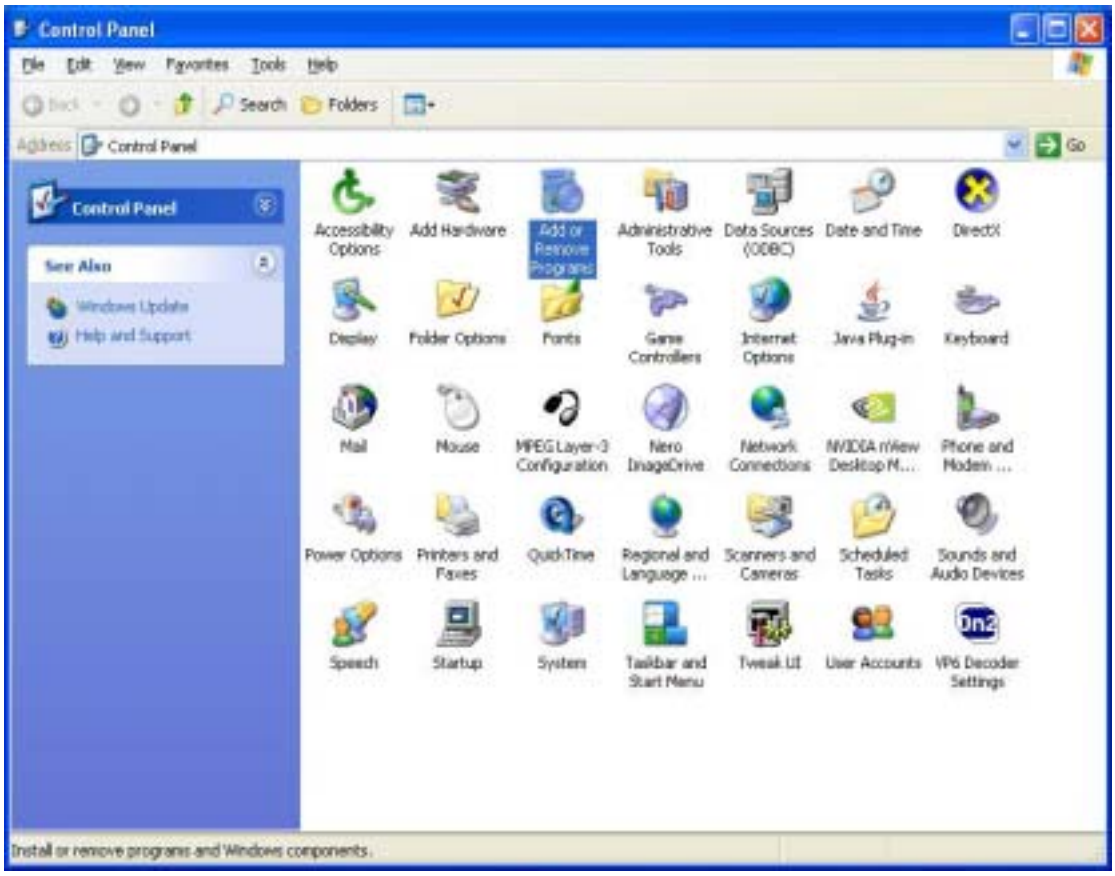


Figure 5.15: Window’s Control Panel.

From the “Control Panel”, select Add or Remove Programs. Then click on “Windows Setup” and user will be prompt by the following screen (Figure 5.16).

Figure 5.16: Windows XP Setup.

From the “Windows Components Wizard” select “Internet Information Services (IIS)” and click “Next” button (Figure 5.17).

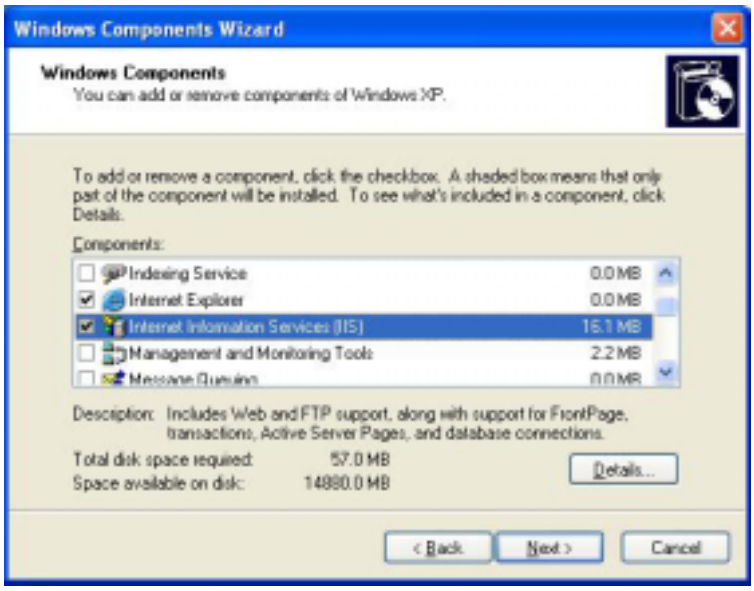


Figure 5.17: Selecting IIS From Windows Components Wizard.

Follow the ongoing screen instructions till the IIS installation is completed (Figure 5.18 and Figure 5.19).

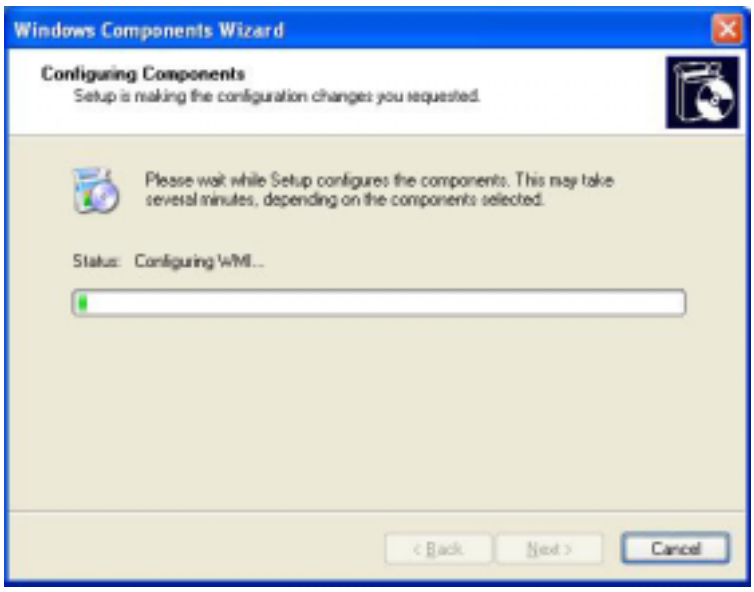


Figure 5.18: Windows Components Wizard – Configuring Components.

Figure 5.19: Completing The Windows Components Wizard.

System Integration Manual - i-GEMS System:

After installing Microsoft .NET Framework 1.1, Microsoft ASP.NET, Web Matrix and Internet Information Services (IIS), the installation can then proceed to the last stage – to install the i-GEMS system.

From the Project 2's CD copy a whole folder named "i-GEMS" to the path "C:\Inetpub\wwwroot". Administrator can now launch the i-GEMS system by using Web Matrix program, which is a powerful ASP.NET compiler, to run the source code "Login.aspx" (Figure 5.20). Right-click the "Login.aspx" file, choose "Open With" and select Web Matrix. If Web Matrix is not found under "Open With" menu, select the program from "Start" button, click "All Programs" and open the Web Matrix.

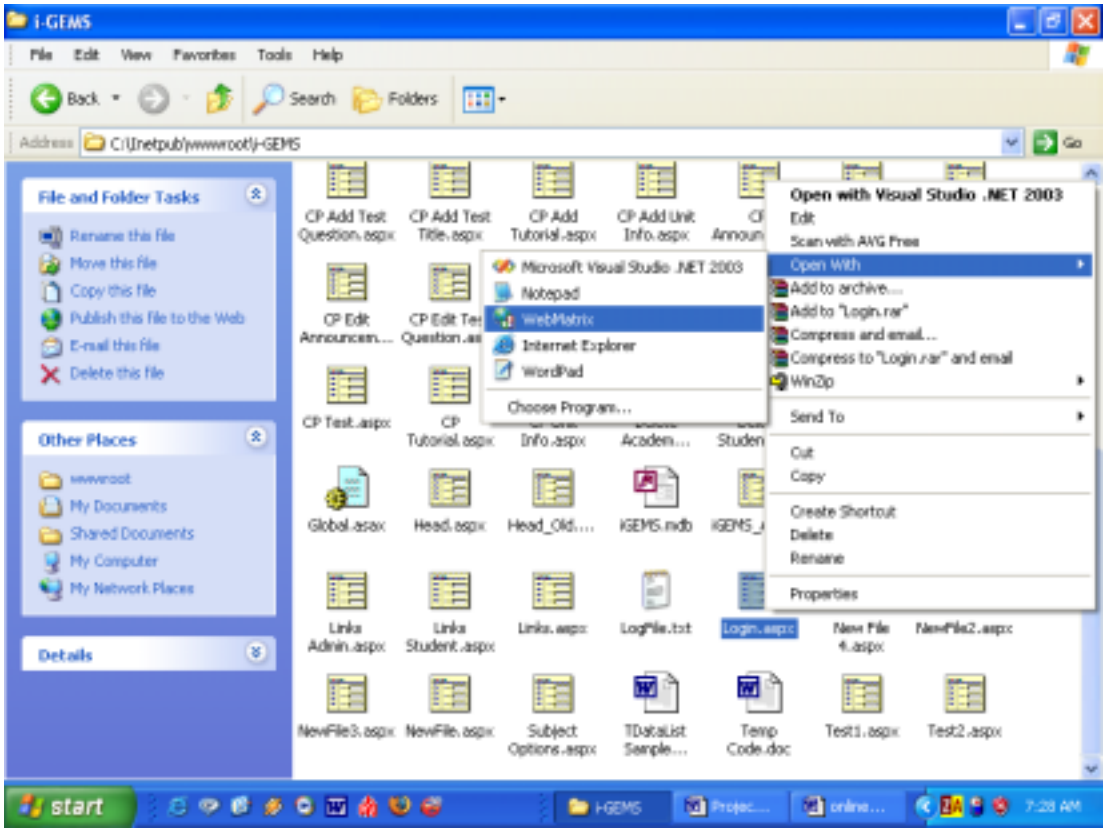


Figure 5.20: Running I-GEMS System Using Web Matrix ASP.NET Compiler.

Microsoft ASP.NET Web Matrix will then be launched, together with the "Login.aspx" file, as shown below (Figure 5.21).

Figure 5.21: Microsoft Asp.Net Web Matrix.

To run the i-GEMS system, press F5 key from the keyboard, you will then be prompted by the following screen (Figure 5.22).

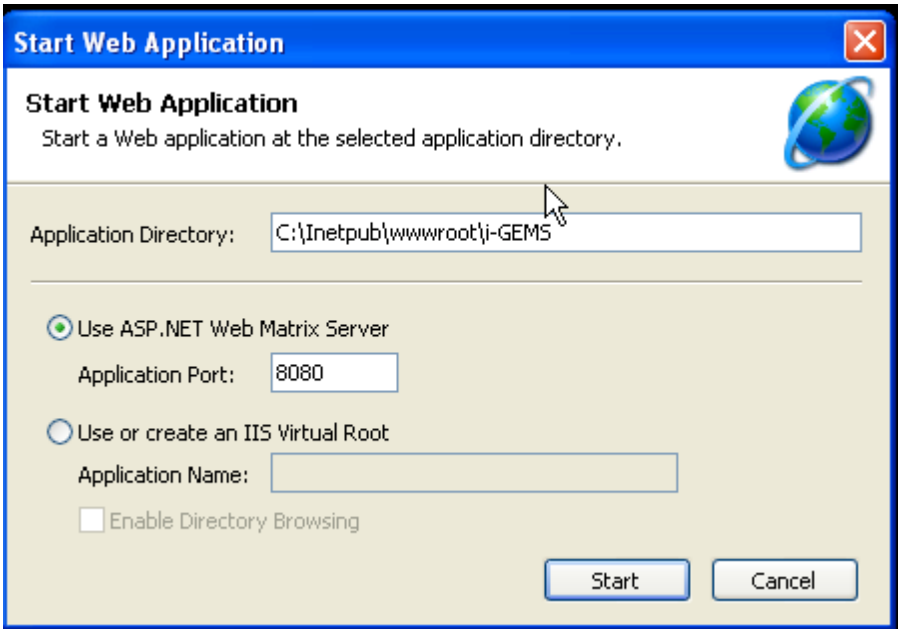


Figure 5.22: Start Web Application.

Remain all default setting and click “Start” button. The system’s default Internet browser will automatically launch the i-GEMS System. In this case, Internet Explorer has been set as default Internet browser (Figure 5.23).

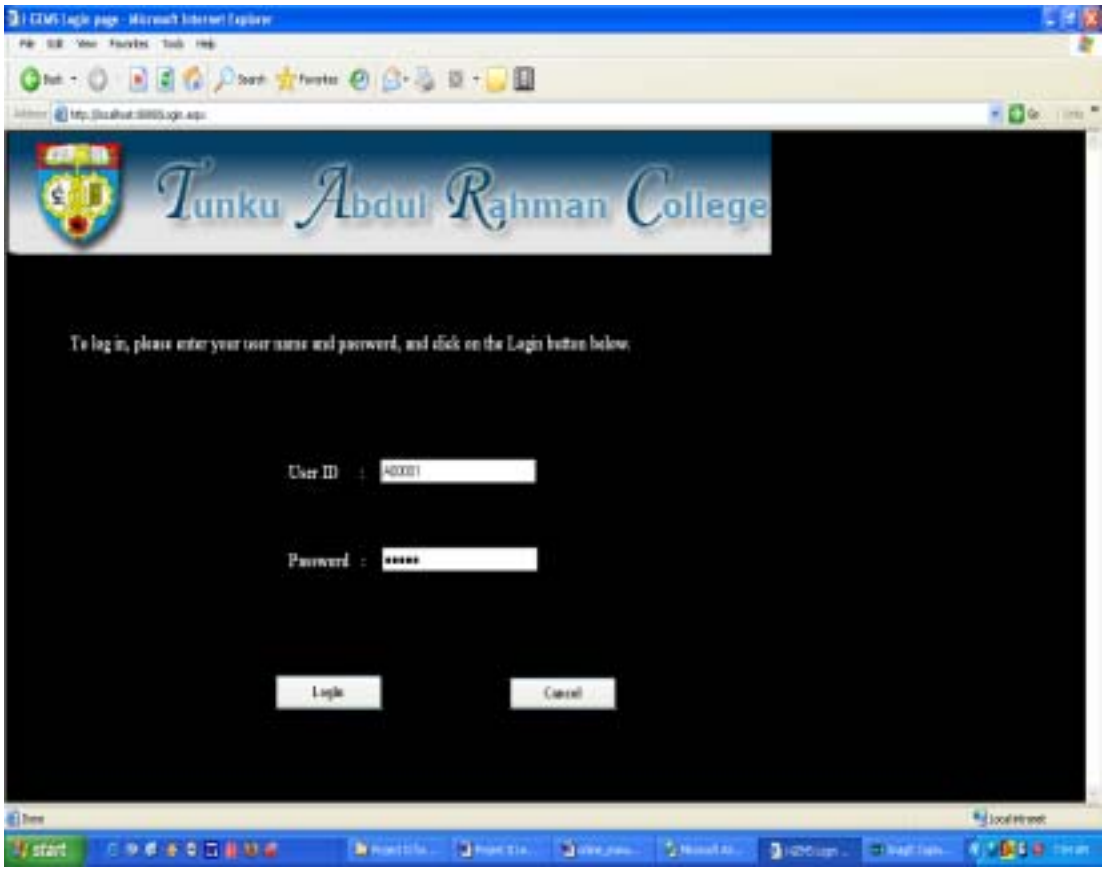


Figure 5.23: I-GEMS Login Page.

To log in, administrator keys in A00001 as user id, 00001 as password and click “Login” button. A successful login will direct user to following main page (Figure 5.24).

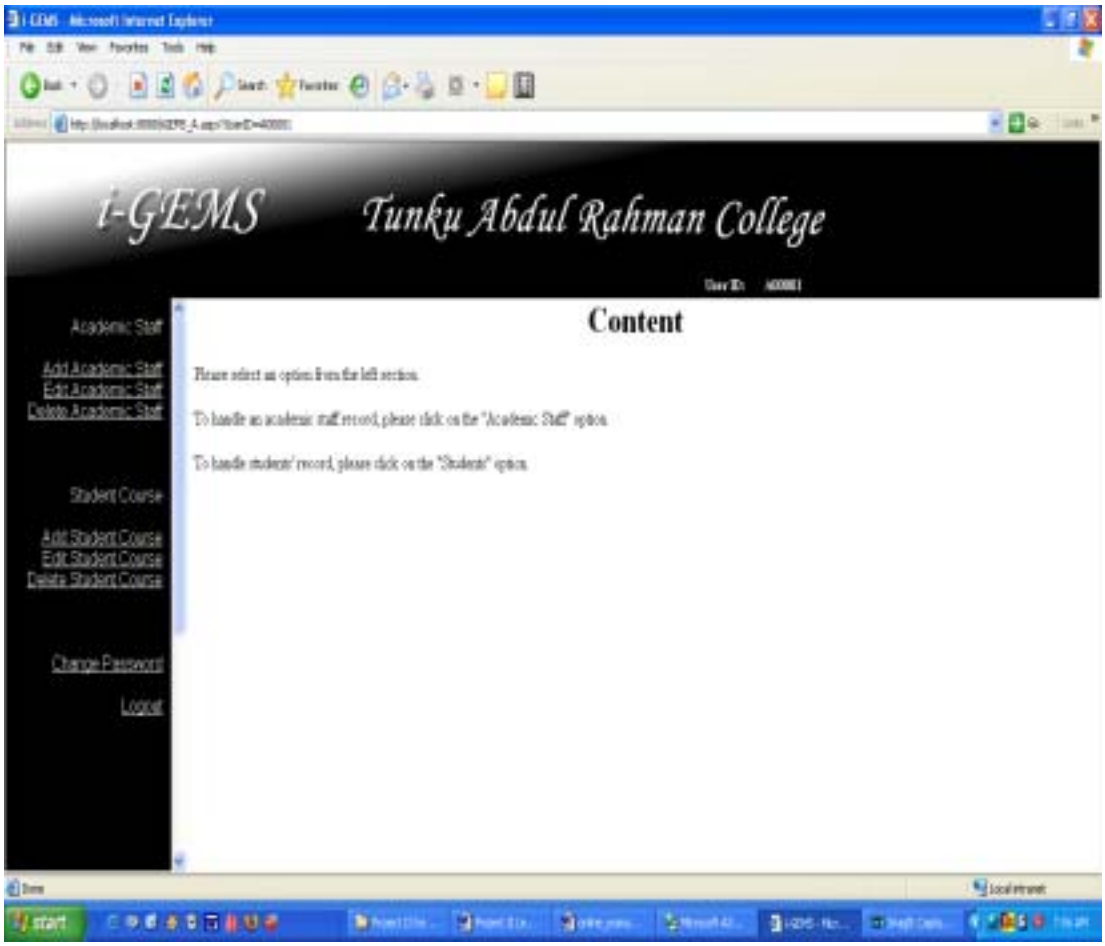


Figure 5.24: I-GEMS Administrator's Main Page.

Administrator can now proceed to register an academic staff to his or her corresponding teaching subject by clicking "Add Academic Staff" from left panel, following screen is shown (Figure 5.25). Fill in all the fields and click "Add" button.

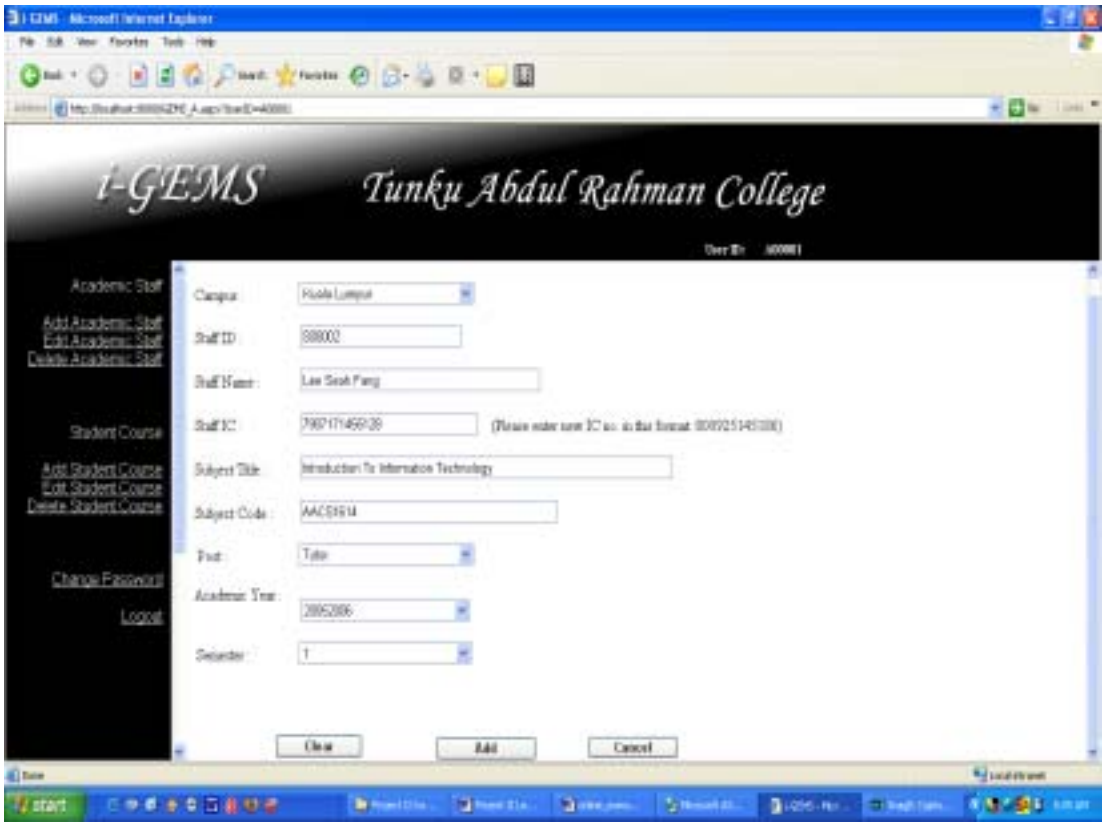


Figure 5.25: Registration Of Academic Staff To The Corresponding Teaching Subject.

To edit the added record, click “Edit Academic Staff” from left panel and following screen will be prompted (Figure 5.26).

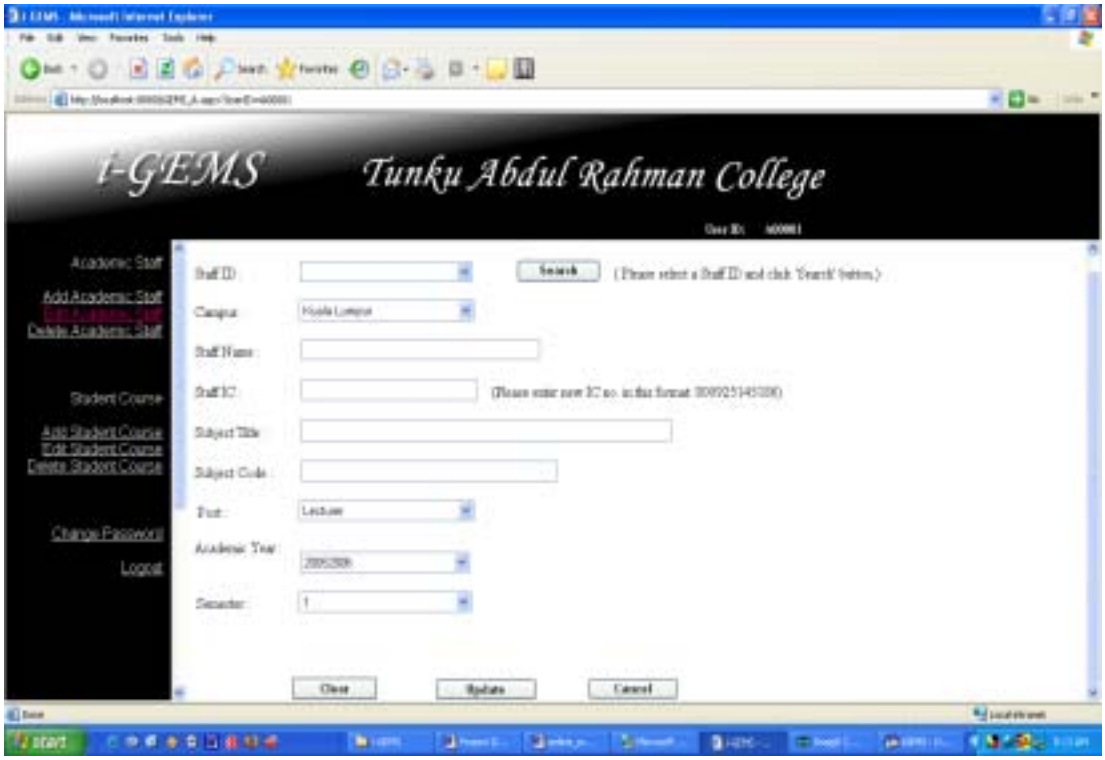


Figure 5.26: Edit An Academic Staff Teaching Record.

From the “Staff ID” field, click the arrow down button and select a staff ID, then click “Search” button. The corresponding academic staff record will be displayed (Figure 5.27). Make any necessary modification and click “Update” button.

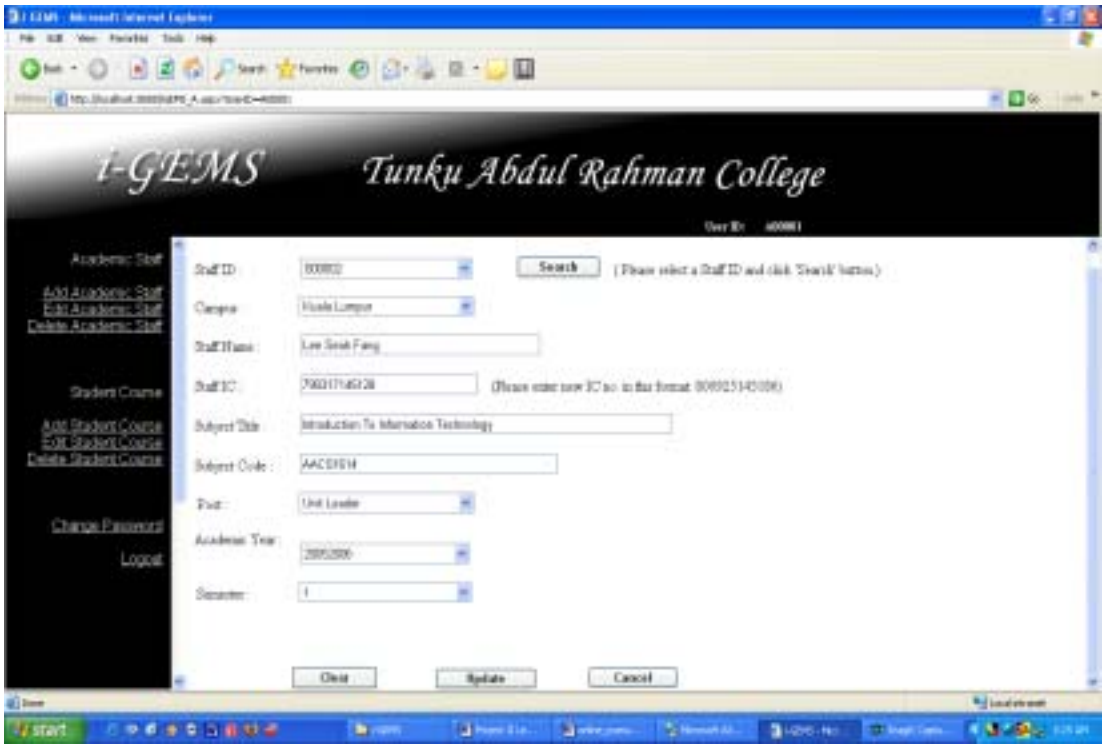


Figure 5.27: Updating An Academic Staff Teaching Record.

If an academic staff is no more teaching a subject, administrator can remove the staff from that subject by selecting “Delete Academic Staff” from left panel. From the “Staff ID” field, click the arrow down button and select a staff ID, then click “Search” button. The corresponding academic staff record will be displayed. Choose “Delete” button, a “Deletion Confirmation” will prompted to confirm the deletion. Choose “Yes” to delete the record from database, or choose “No” to cancel the operation (Figure 5.28).

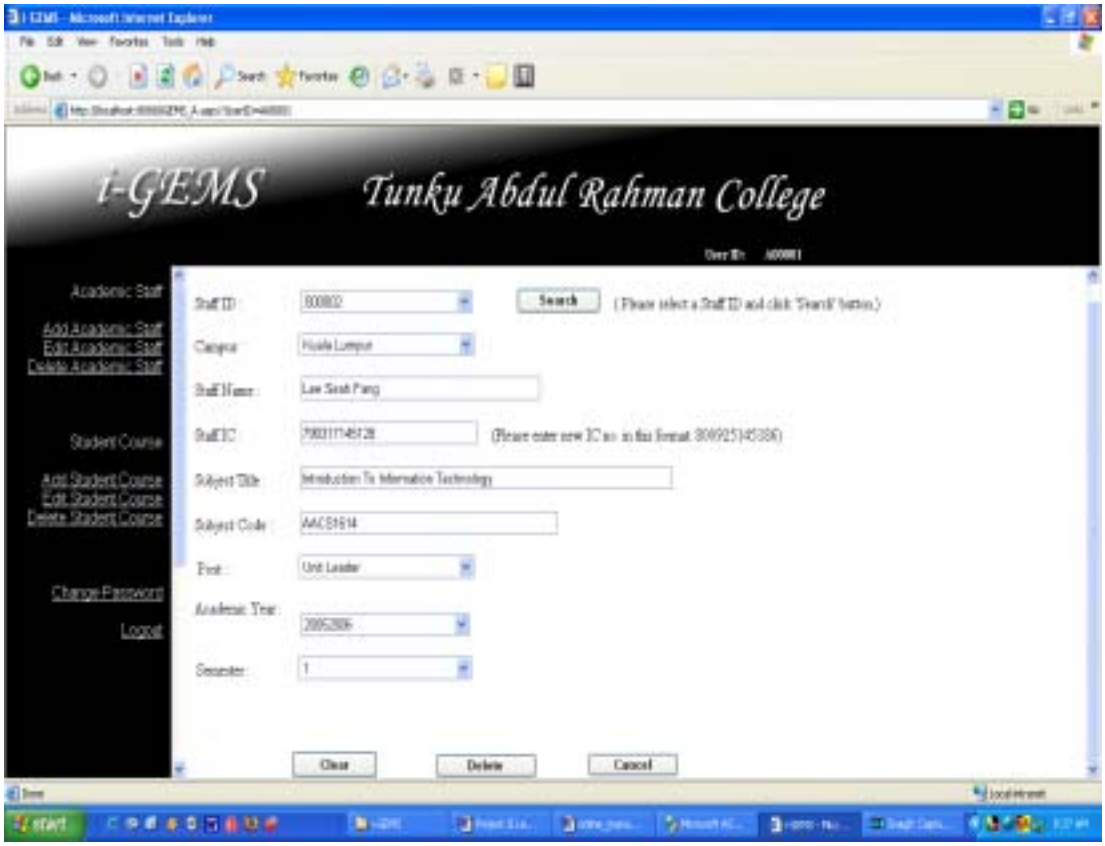


Figure 5.28: Removing An Academic Staff From A Subject.

To register a student course to a corresponding studying subject, choose “Add Student Course” from left panel, following screen will be displayed (Figure 5.29). Fill in all the fields and click “Add” button to save the record.

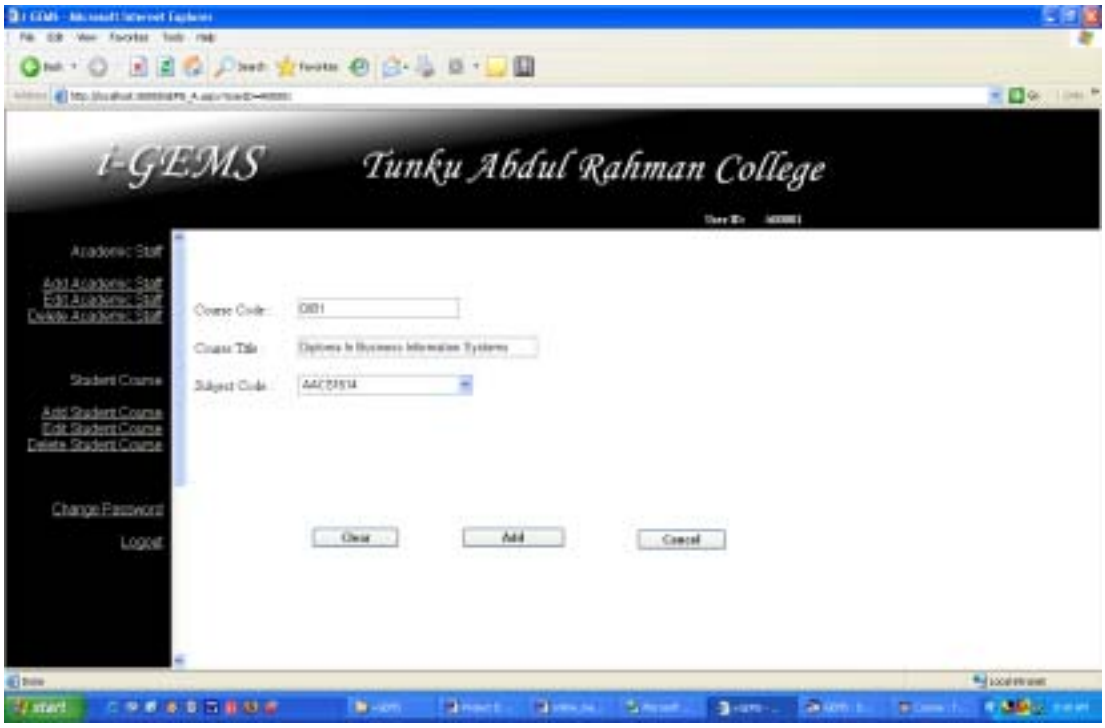


Figure 5.29: Adding A Student Course To A Corresponding Studying Subject.

To edit the added record, click “Edit Student Course” from left panel and following screen will be prompted (Figure 5.30). From the “Course Code” field, click the arrow down button and select a course code, then click “Search” button. The corresponding course record will be displayed. Make any necessary modification and click “Update” button.

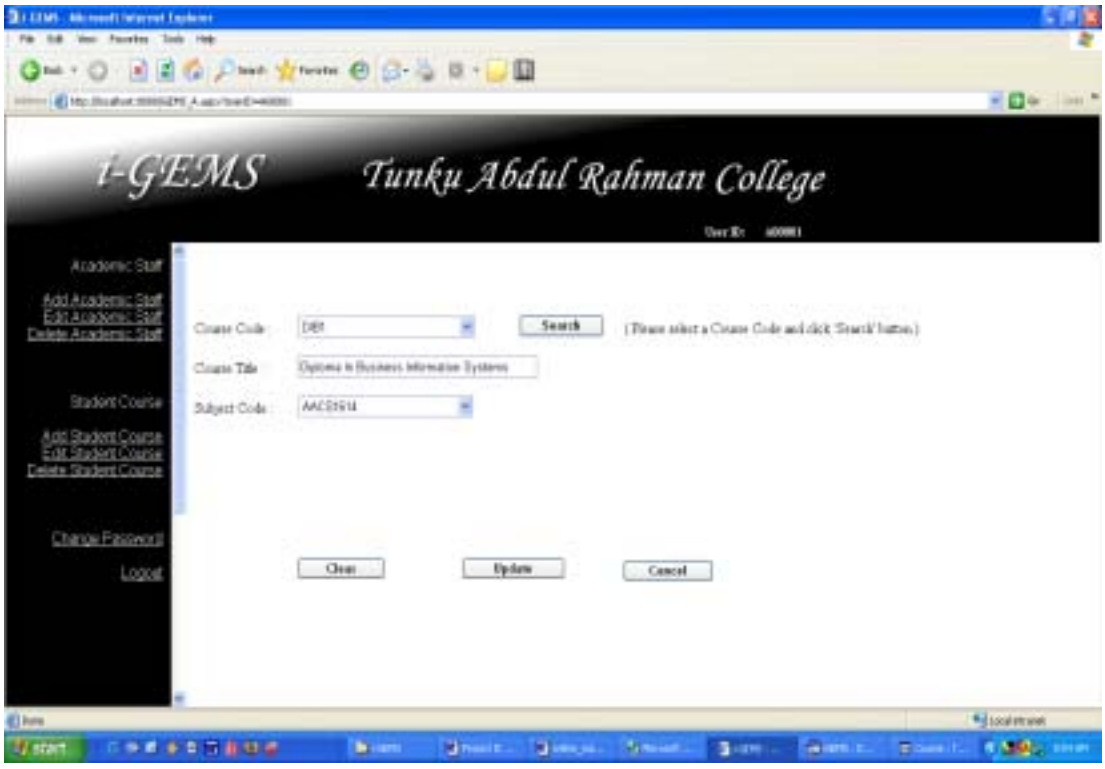


Figure 5.30: Updating A Student Course To A Corresponding Studying Subject.

Administrator can remove a course from a subject by selecting “Delete Student Course” from left panel. From the “Course Code” field, click the arrow down button and select a course code, then click “Search” button. The corresponding course record will be displayed. Choose “Delete” button, a “Deletion Confirmation” will prompted to confirm the deletion. Choose “Yes” to delete the record from database, or choose “No” to cancel the operation (Figure 5.31).

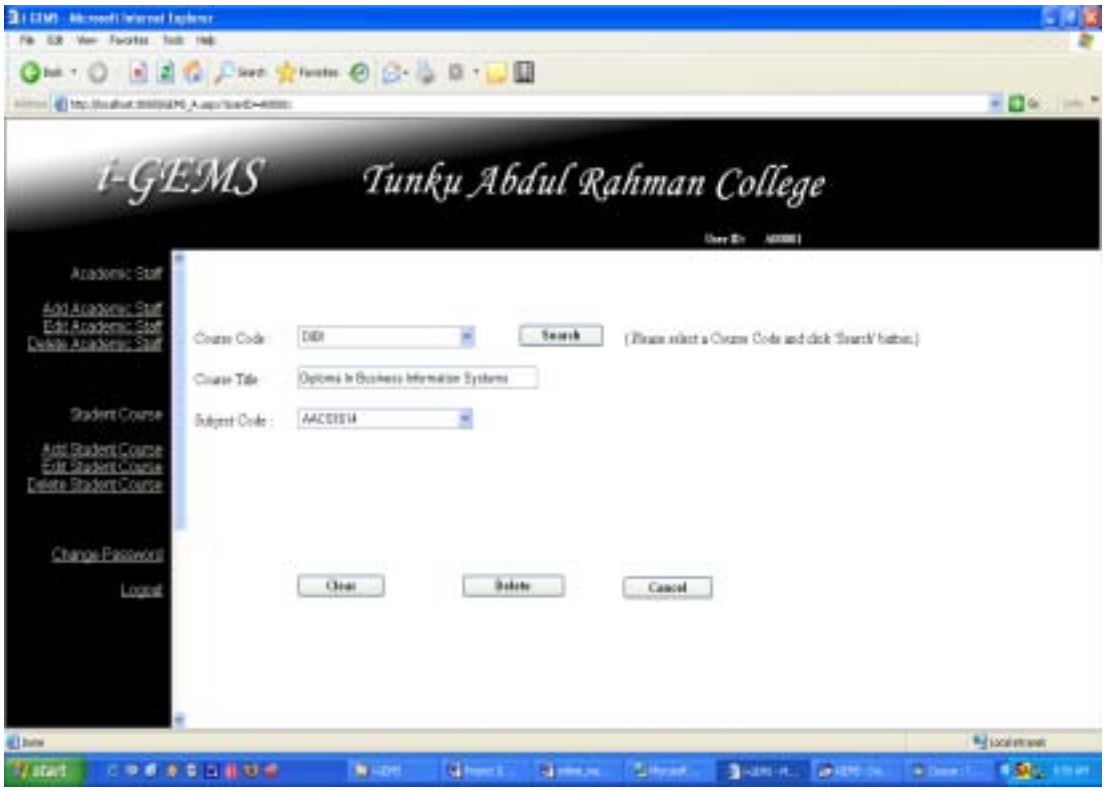


Figure 5.31: Removing A Course From A Subject.

5.4 Chapter Summary

ASP.NET is the main programming language that is used to implement the i-GEMS system. ASP.NET is an object-oriented language. In developing the proposed system, the author has used ASP.NET server controls or object to create common user interface elements and programs Making use of the reusable built-in controls or custom objects allow the author to rapidly build the web-based application, as the controls has simplified pages of codes.

At section 5.1.1, some snapshot of critical programming codes are demonstrated. Among the demonstration, it includes a section that illustrates how to connect and maintain a database by using code wizard or manual approach. While the subsequent demonstration shows how to create a folder in specified path and upload a file into the folder. The last part illustrates the DataGrid control, which is the most essential object that used to in implementing the i-GEMS system.

At section 5.2, four main test result or system evaluation tables have been created to test the functionalities of i-GEMS system, as well as to evaluate the completion status. The four tables include: system evaluation by administrator, system evaluation by academic staff user, system evaluation by student user, and system evaluation for control panel functionalities. On the whole, based on user acceptance test, it shows that the i-GEMS system has fulfilled the project scope and user requirements that endorsed earlier.

CHAPTER 6

ORGANISATIONAL STRATEGY

6.1 Roll-out Strategy

To align TARC's environment with the i-GEMS system, some organization strategies are proposed. The vision of TARC is to offer higher education opportunity for school leavers and young Malaysians who have been seeking for furthering their education. Through the proposed system, it helps to achieve the vision better by ensuring standardized and good quality education is delivered to the students throughout the six campuses of TARC. In addition, the system can facilitate students' study by allowing them to access all the necessary study materials from the electronic system at any time and anywhere.

To ensure the success implementation of i-GEMS system, a rollout strategy is proposed to introduce the proposed system to end users. The rollout strategy is divided into several stages. The first and foremost step is to have i-GEMS system installed at a Web server. Once the system is installed, it can then proceed to have a pilot deployment aimed at main campus (Kuala Lumpur) and Penang campus, where the target users should involve academic staff teaching diploma computer science subjects only and the corresponding computer science students. These two campuses are chosen as pioneer campus for the reason that most of the common computer subjects are offered at these two campuses. The pilot experiment will be implement for 1 semester duration.

Satisfactory result of the pilot deployment implemented at Kuala Lumpur and Penang campuses will then be expanded to other campuses. It is estimated that to deploy i-GEMS system for all computer science diploma subjects across the six campuses require two years time span.

In other words, two years later, the i-GEMS system should be fully adopted for computer science diploma subjects. At this stage, as the i-GEMS system has been existed for two years at computer science division, it will be then appropriate to expand the proposed system to other divisions such as Mathematics, Biology and Chemistry, Business, Social Science, and so forth. At that stage, it will have lesser resistance from the end users in using the proposed system as i-GEMS has been deployed at computer science division. Instead, cooperation and adoption are expected from the rest of end users. The time needed to fully implement i-GEMS system at all campuses and for all streams that offered at TARC is estimated to be another three years.

Seeing that currently e-learning system or system like i-GEMS is not fully adopted by academic staff at TARC. Many still resist using the electronic system in delivering education. Most of them still prefer to depend on traditional classroom teaching to impart their knowledge. Hence, it requires total of five (two + three) years time to fully roll out the i-GEMS system at TARC College. To ensure the proposed system can be rolled out successfully, it requires commitment from top management in executing the rollout strategy as well as change management strategy that is discussed at next section.

6.2 Change Management

In order to align with TARC's vision and to ensure the success rollout of i-GEMS system, the following change management strategies are suggested:

Information System/Information Technology (IS/IT) Management Strategies:

- Standardization policy. A policy on setting the standards for academic materials to be delivered to students throughout the six campuses of TARC must be developed at the onset. For those courses that are offered at several campuses, the lecturers from different campuses are not encouraged to set different types of teaching materials. Instead, standardized and consistent teaching materials should be delivered throughout the whole nation campuses. This policy can be implemented by careful coordination from a unit leader (a subject's leader) to supervise the process.

- Communication and collaboration policy. For a common subject that is delivered at more than one campus, lecturers who are involved in teaching the common subject should communicate and collaborate with each other. Communication and collaboration among the lecturers should not only happen within the same campus only, it should also reach through the inter-campuses communication and collaboration among the lecturers.

- Knowledge sharing policy. A good study environment should encourage the existence of knowledge sharing among each other. Academic staff are encouraged to share their expertise and experiences by allowing others to access their academic modules from the system. The sharing should not be restricted to the same campus lecturers only, instead, the knowledge sharing should be implemented throughout the six campuses.

- Students and lecturers interaction. Students are encouraged to communicate with their lecturers through using the i-GEMS system. Through the electronic system, students and lecturers interaction is no more restricted to traditional classroom

teaching or face-to-face communication basis. Whenever students have queries, they are encouraged to pose their questions at anytime (even after classroom session) and receive feedback from any campuses' lecturers who are teaching the subject through the electronic system.

Business IS Strategies:

- Lecturer training. Through attending system training, lecturers will be introduced to the concept and features of the new system. By knowing the system better, it can reduce the lecturers' resistance towards the changes and slowly it may become a norm for the lecturers to use the system as part of their teaching tools.

- Student training. College should encourage students to use the system by providing training to them. From the training, students will obtain the system usage knowledge, such as the skills of downloading study materials, how to participate in Q & A section or to participate a test from the i-GEMS system and so forth.

- System registration. The system registration and usage should start from computer science department. As a lead in information technology, all the academic staff and students from the computer science department should take an initiative to register themselves and participate in using the electronic system.

- Just-in-time access to timely information. I-GEMS allows academic staff to update lessons and teaching materials instantly through the use of electronic system. This keeps the content fresh, consistent and enables students to access to the most current data immediately. Information can be retrieved just before it is required, rather than merely relying on printing and photocopying.

To implement the proposed change management strategies successfully, it is always essential to obtain the top management commitment in executing the strategies. Through the proposed strategies mentioned above, it will help to ensure that the i-GEMS solution can be implemented more effectively and efficiently.

6.3 Data Migration Plan

The main data for i-GEMS system is academic teaching materials such as lecture notes, tutorial, assignments, Unit information and so forth. These academic materials are appropriate to be transferred by corresponding end users (academic staff) only when they are using the i-GEMS system.

On the other hand, data that are needed to register an academic staff to an assigned teaching subject and a student course to the corresponding studying subject will be migrated when the division (such as computer science) of a campus is involved using the i-GEMS system. In other words, to ensure that migrated data is always the most-up-to-date and be transformed at the right time, these data will only be transferred when a corresponding division and end users are participating in using the i-GEMS system.

6.4 Business Continuity Plan (BCP)

A Business Continuity Plan (BCP) for i-GEMS system is required to plan for how TARC will resume partially or completely interrupted critical function(s) or data after a disaster or disruption. It is recommended that IT department should prepare a disaster recovery manual that contains the names and contact details of crisis management staff, post-failure procedures in resuming the system, location of backup data, copies of insurance contracts, and other critical materials that necessary for i-GEMS continuity operation.

In addition, it is recommended that system backup should be performed twice per semester. For each semester, it is appropriate to perform the first system data backup at mid of semester, where half of the academic materials are loaded. While second data backup is scheduled at the end of semester, as most of the academic materials are available and finalized. With the creation of a disaster recovery manual and system backup twice a semester, these will help to ensure the continuity operation of i-GEMS system.

6.5 Expected Organizational Benefits

Through developing the i-GEMS system, some competitive advantages and benefits are expected to be delivered, as discussed at the following.

- **Towards innovative education delivering**

The embarking on e-learning system or i-GEMS serves as a stepping-stone to lead TARC towards next generation of education delivering. At the moment, i-GEMS advocate managing academic information through collaboration across campuses, and knowledge sharing across subjects. With these fundamental principles, i-GEMS may then expand to cater other education functionalities as well, such as e-exam, e-library, e-publishing, e-administration and the rest. To the author's vision, future education may revolve to an extent whereby a complete education system will be delivered through the use of ICT and Internet so that education opportunity is accessible by anyone from any places.

- **Serve as faster, cheaper and more efficient communication platform**

As the proposed system is intended for advocating and facilitating academic collaboration among the campuses lecturers, hence it serves as an easier, faster, cheaper and more efficient platform for communication across the campuses. For a common subject that offered at more than one campus, the lecturers from different campuses who are teaching the same subject can get to know each other through the i-GEMS system. This has eliminated existing tedious workflow whereby to communicate with other campus lecturer, one has to go through the course tutor to get the other campus lecturer's contact details and then just can initiate the communicate through email, telephone, fax or posting. An estimated communication saving cost based on the proposed system is calculated and demonstrated at Appendix C.

- **Increase work satisfaction of lecturers through collaborating and sharing academic materials**

From the i-GEMS system, different campuses lecturers can collaborate and exchange academic information with each other on a few clicks. They can now cooperate in preparing the lecture notes, tutorial questions, assignment, test and so forth. Instead of preparing all these academic materials by a campus lecturer, the workload now can be sharable across the campuses. The sharing will reduce the effort of a lecturer in preparing teaching materials as well as it helps to avoid redundancy in preparing the same set teaching materials at other campuses. As a result, these contributions will further enhance the college efficiency and effectiveness in delivering the education as well as increase the reputation of TARC.

- **Increase students motivation and interest**

In addition, the collaboration and sharing that exist among the campuses has ensured that a standardized and consistent education is delivered throughout the nation. As mentioned at section 1.7, those students who are studying a common subject across the campuses can now be evaluated fairly and accurately. Compared to existing circumstances (section 1.2), lack of collaboration among the campuses has led to inconsistent academic scope covering, which in turn has caused some students failing a subject due to the uncovered topics at their campus. Time, cost and efforts are required for a failed student to resit for the subject.

The Figure 6.1 demonstrates an estimated cost incurred for a student who fails a subject due to the inconsistent scope covering.

Diploma fees	:RM8000
Tuition fees per credit	:RM52
4 credits per subject (RM52 x 4)	:RM208
Resit registration fees	:RM50
Cost incurred for resit processing	
-Administration cost	:RM5
-Examination miscellaneous cost (Question setting, paper, arrangement and etc.)	:RM80

Overall cost incurred for a student who failed a subject:

Tuition fees	:RM208
Resit registration fees	:RM50
Resit administration cost	:RM5
Examination miscellaneous cost	:RM80
Total	:RM343

Figure 6.1: Estimated Cost Incurred For A Student Who Fails A Subject.

- **Broaden knowledge without paying more**

Furthermore, as i-GEMS system allow a lecturer to access other subjects' module, hence it provides an opportunity for the academic staff to explore and broaden their knowledge other than their own fields of teaching. Through the feature, it provides a free of charge channel for one to learn new knowledge through the proposed system. For instance, a lecturer who is interested in learning ASP.NET, rather than taking a seminar that cost around RM2000 from outsiders, the lecturer can now learn the ASP.NET which is also offered at TARC through accessing the subject module from i-GEMS system.

- **Provide flexibility in answering approach**

The other advantage offered by i-GEMS system compared to existing system is, students' questions can also be answered by lecturers from other campuses who are teaching the same subject. Compared to existing application, students' questions are attended by their own campus lecturer only. If the specific lecturer is not free or not frequently using the e-learning system, the student may get the reply at one week, or one month later, or the worst case is never get reply from the specific lecturer. Thus from the i-GEMS system, it helps to reduce or avoid such problem by allowing other campuses' lecturers (teaching the same subject) who are free and convenient, to answer the students' questions. The flexibility in answering section will increase the prompt reply rate and this in turn can motivate students in using the system.

- **Accessible at any time and any place**

With the assistance of web-based i-GEMS system, it enables learning to be available to students 24 hours a day, seven days a week around the nation. Students can access to the study materials or having communication with lecturers whenever it is convenient for them. Through the proposed system, they can view and access study materials from any places with a computer that connected to the Internet. This is especially for those students who have personal commitments and could not attend classes at TARC, they can always check through the electronic system for any important message or announcement, as well as studying materials that prepared by their lecturers.

In short, i-GEMS offers greater competitive advantages to TARC as it advocates academic collaboration across the campuses, information sharing and learning across different subjects' modules, as well as promoting higher interaction and education learning between the students and lecturers.

6.6 Chapter Summary

Organizational strategy is essential to ensure the success implementation of i-GEMS. A rollout strategy that requires total of five years time is suggested in order to fully deploy the proposed system at TARC College. At first stage, a pilot deployment of the system will aim at main campus and Penang campus for computer science diploma subjects. When the result of pilot deployment is satisfied, within two years duration, the system will then expand to other campuses' computer science division. It is then followed by i-GEMS deployment for other division streams such as Mathematics, Electronic Engineering, Microelectronic, Business Studies and so on with another three years time.

Currently most of the academic staff are more inclined to traditional classroom teaching in delivering education, thus resistances is expected from the end users when deploying the proposed system. Hence, it is essential to obtain commitments from top management in executing the rollout strategy as well as change management strategy, such as standardization policy, knowledge sharing, end users training and so forth.

In data migration plan, in order to ensure that transformed data is always the up to date and be timely, these data should only be migrated at the time when a division and corresponding end users are participating in using the i-GEMS system. While in BCP, a disaster recovery manual should be developed by IT division and system backup be performed twice per semester to ensure the continuity operation of i-GEMS system.

At last section of the chapter, expected organizational benefits or competitive advantages gained from i-GEMS system are discussed. For instance, as the proposed system advocating academic collaboration among the campuses lecturers, hence it serves as an easier, faster, and more efficient platform for cooperation across the campuses. Through using the system, academic workloads can then be sharable across campuses. Other advantages include standardization in education delivering, accuracy in evaluating students across campuses and the rest.

CHAPTER 7

DISCUSSION & CONCLUSION

7.1 Achievements

MCU1124 Project 2 is a Master's project for IT - Management course. As a student of the master program, the author has worked hard and tried her best effort in producing the report within the given timeframe. Finally, the report has been successfully produced on time and conforming to the latest report format and requirements that requested from the Universiti Teknologi Malysia (UTM). The report consists of seven main chapters – Project Overview, Literature Review, Methodology, System Design, Design Implementation and Testing, Organizational Strategy, and the last chapter – Discussion & Conclusion.

Throughout the process of preparing the project, knowledge acquired from the master course, such as the knowledge of system development application, OOM, UML diagrams, project Gantt chart, strategic planning for information systems, effective approach in formulating IS/IT strategic, and IT for organization transformation was constantly applied.

Chapter 2 – Literature Review, reviewed various topics that are related to or similar to the proposed project. From the chapter, the author has captured overall understanding on the concept of E-learning or e-university, the existence of emerging learning system providers, as well as the future trend and development of learning system in higher education sector.

Based on the study and analysis of existing problems (from chapter 1 and section 4.2), as well as the literature review, the author has proposed an i-GEMS system solution that is customized to TARC's circumstances. A system development methodology that designed according to the i-GEMS requirements is delivered at section 3.3. Based on the proposed system development methodology, a Gantt chart is scheduled accordingly at section 3.4. In addition, an overall conceptual view of the proposed system has been designed using UML modeling diagrams (section 4.4**).**

From Chapter 4 (System Design) and Chapter 5 (Design Implementation and Testing), the proposed i-GEMS system that consists of 12 main modules and 19 tables was designed and implemented. The 12 modules are *Security Module*, *Register Module*, *Announcement Module*, *Unit Information Module*, *Lecture Notes Module*, *Tutorial Module*, *Assignment Module*, *Test Module*, *Q & A Module*, *Discussion Module*, *Academic Staff Information Module,* and *Control Panel Module*. Each of the modules presents different functionalities and purpose to serve the academic staff and students of TARC.

To ensure a success deployment of i-GEMS system, a chapter that discusses organization strategy is produced. The discussed strategies are including rollout strategy, change management, data migration, Business Continuity Plan, and expected organizational benefits.

In the author's view, the greatest achievement in delivering the project is being able to accomplish the Master thesis and proposed i-GEMS system, which have fulfilled all the endorsed requirements, project scope, as well as format that required by the UTM.

7.2 Constraints & Challenges

Constraints

On the whole, the i-GEMS system is not applicable to all of the higher education institutions. Instead the system is proposed and designed based on TARC circumstances, where academic staff and students of TARC are the main users of the system.

For illustration purpose, rather than covering all the courses that offered at TARC, the i-GEMS system is developed using the pilot of computer science first year diploma courses.

As TARC's existing e-learning system is subscribed with Blackboard Inc., it is impossible for the author to access the system implementation. Hence, the i-GEMS system is not serve as a modification from the existing system, instead it is another newly developed system that is customized to TARC's circumstances and requirements.

Seeing that the goal of i-GEMS system is not developed to serve all the education functionalities, other than the scope specified in the report, other functionalities are not included. For instance, course scheduling, student administration, examination management, library system and so forth are not included in the i-GEMS system.

Challenges

Time duration is one of the challenges faced in producing project 2. As the author's Project 1 is just completed on May 2005, it left a few months available for the author to proceed and complete project 2.

Other than time duration, mastering programming language was another great challenge to the author. The author has learned and explored herself the programming language ASP.NET from nil knowledge level until being able to produce a completed i-GEMS system within three months duration, where the first

two months were used to develop the system and third month was mainly for system testing and enhancements. It was a very challenging task especially for the first month in learning and developing the i-GEMS system, the learning process was slow and stressful as lots of difficulties and hurdles were encountered yet most of the system functionalities were not delivered.

As the system developing process was totally the author's self-learning session, the author has referred to lots of programming books and Web sites in mastering the ASP.NET. Many programming problems were faced during the system implementation, from initial system design, connecting and maintaining database, and to deliver all the required functionalities. Sometimes, in order to develop some of the simple functions that the author has taken as granted features, it may require hours or even days to produce that so-called simple functionalities. For instance, functions that enable user to upload a file, to display a document properly within i-GEMS system, to allow user to download a file into a specified path correctly, to display up-to-date academic materials on a DataGrid control, to fix database connection errors, and many other features have actually taken plenty of hours and efforts in producing all those functions.

However, due to the author's persistence and determination, finally the i-GEMS system has been completed on time and fulfilling all the project scope and user requirements as endorsed earlier. It is a great accomplishment to the author, as the proposed system has been developed from nil knowledge on the ASP.NET programming language to finally successfully producing the completed i-GEMS system.

7.3 Aspiration

On the whole, although i-GEMS system has delivered all functionalities that stated in user requirements, nevertheless there are still some room spaces for future enhancement in terms of system usability and functionalities.

The design of user interface can be further enhanced in order to increase the system attractiveness. This can be done be referring to many other professional Web sites and from there refining current system interface.

On the other hand, instead of to serve as e-learning system only, for future development, i-GEMS system can be further expanded to include other TARC's functionalities and operations. The functionalities including online course enrollment, examination management, e-payment, student administration and so on. However, to produce such a complicated system, it may then require another several years to complete. In spite of this, the author may consider to include some of the functions for future system development.

7.4 Chapter Summary

In the author's opinion, the greatest achievement in producing the project is the accomplishment of Master thesis and i-GEMS system, which have met with all the endorsed project scope, user requirements, as well as format that required by the UTM.

For the project constraint, as i-GEMS is designed and customized to TARC's environment, hence the system is not applicable to all of the higher education institutions. On the other hand, the greatest challenge to the author in producing project 2 was to mastering and learning ASP.NET by her own within three months period, where the first two months were mainly used to develop i-GEMS system and third month was used for system testing and enhancements.

Even though the task to produce Master project is stressful and tough to the author, where it required lots of hard works, efforts and time spent for completion. However, it is worthwhile to spend all the efforts as the author has learnt and gained lots of knowledge, experiences, and fulfillment in producing the Master project.

REFERENCES

Ali Bahrami (1999), *Object Oriented Systems Development*, McGraw-Hill Companies, Inc.

Aune Valk, Indrek Reimand, Ene Tammeoru, Jüri Lõssenko and Karin Ruul (2004), *Consortium-type e-university Estonian e-University model*, Estonian e-University model

Cheick Kante and Vishal Savani (2003), *E-Learning – The New Frontier in The Developing World*, World Links Washington, DC

Estonia (2003), *Strategy Of Estonian E-University 2004-2007*, Europe

Hans-Erik Eriksson and Magnus Penker(1997), *UML Toolkit*, John Wiley & Sons, Inc

H.M.Deitel, P.J.Deitel and T.R.Nieto (2001), *e-Business & e-Commerce: How to Program*, Upper Saddle River, New Jersey: Prentice-Hall, Inc.

James C Taylor (2002), *Automating e-Learning: The Higher Education Revolution*, University of Southern Queensland, Australia

Maris Treimanis (2003), E-University concept & the University of Latvia, *BALTIC IT&T 2003 FORUM*, April 3

Ron Oliver (2002), *The role of ICT in higher education for the 21st century: ICT as a change agent for education*, Edith Cowan University, Perth, Western Australia

WebCT (2003), *Access, Quality and Cost: e-Learning's Contribution*, Lynnfield, Massachusetts

Zane Berge (2002), *New Roles For Learners And Teachers In Online Higher Education*, University of Maryland System, UMBC.

Website:

ASP.NET (http://samples.gotdotnet.com/quickstart/)

Blackboard Inc. (htt//www.blackboard.com)

Deitel & Associate, Inc (http://www.deitel.com)

Nanyang Technological University
(http://www.ntu.edu.sg/CorpComms/News+Releases/2003/ukeu.htm)

Patrick Henry (2000), *Software Development Life Cycle Models*,
(http://www.csd.uwo.ca/courses/CS377b/CS377-Development.html)

Paul Henrik Jorgensen (1998), *Introduction to Object Oriented Approach*,
(http://www.kb.nl/coop/elag/elag98/presentations/jorgensen/)

Productivity4you (http://www.p4you.com)

ScribeStudio™ (http://www.scribestudio.com)

Select Business Solutions, Inc (http://www.selectbs.com/solutions/rad.htm)

Startvbdotnet.com (http://www.startvbdotnet.com/sdlc/default.aspx)

The e-University Compendium (http://www.heacademy.ac.uk/1641.htm)

Tony Drewry, *Data Flow Diagrams*
(http://www.cems.uwe.ac.uk/~tdrewry/dfds.htm)

Tunku Abdul Rahman College (http://www.tarc.edu.my)

WebCT (http://www.webct.com)

APPENDIX A

E-LEARNING APPLICATION FORM:

KOLEJ TUNKU ABDUL RAHMAN

COMMUNICATION & INFORMATION TECHNOLOGY CENTRE

REQUEST TO CREATE TEACHING UNITS IN COLLEGE E-LEARNING SYSTEM (CeL)

(To be submitted through respective School/Department)

Request

Campuses: ☐ KL Branch: ☐ PG ☐ PK ☐ PH ☐ JH ☐ SB

School / Dept:

Date to be made available for staff access (at the latest):

Date to be made available for student access (at the latest):

Date to be made unavailable:

RECOMMENDATIONS FROM HEAD OF SCHOOL/DEPARTMENT

Comments: _____

_____

_____

Date: Signature: ……..

(Head of School / Dept)

FOR OFFICIAL CITC USE

Date receive:

Unit Creation	**Unit Made Available**
Date completed:	Date completed:
Signature:	Signature:

APPENDIX B

STAFF INFORMATION SHEET:

No	Unit Code	Unit Title	Courses Taking Unit	Name of Staff	Staff ID	College E-Mail	Role (I/A)*

* Please indicate whether the staff will be an Instructor (I) or an Assistant (A). There can only be one instructor for each unit. Attach details in separate sheets if there are insufficient rows of entry.

APPENDIX C

Projected Cost Benefits

Current process for communication across campuses lecturers (per subject)	RM
Labor cost:	1500.00
Stationary cost:	300.00
Communication expenses:	350.00
Other incurred cost:	150.00
Total:	2300.00

i-GEMS process for communication across campuses lecturers (per subject)	RM
Labor cost:	600.00
Stationary cost:	80.00
Communication expenses:	80.00
Other incurred cost:	50.00
Total:	810.00

Projected saving in communication across branches lecturers (per subject)	RM
Labor cost:	900.00
Stationary cost:	220.00
Communication expenses:	270.00
Other incurred cost:	100.00
Total:	1490.00

APPENDIX D

Unit Plan for subject "Introduction To Information Technology"

Course Tutor:	**E-mail Adress:**
Mr Yong Chan Huang (Main campus) Mr Nikalus Swee (Penang campus) Ms Ling Soon Hua (Perak campus)	yongch@mail.tarc.edu.my sweesl@mail.tarc.edu.my lingsh@mail.tarc.edu.my
Lecturer:	
Ms Lee Seah Fang (Main campus – unit leader) Ms Woo Woon Yim (Penang campus) Ms Wong Sim Mei (Perak campus)	leeseahfang@mail.tarc.edu.my woowy@mail.tarc.edu.my wongsm@mail.tarc.edu.my

Unit Overview:

Section A: Hardware
Chapter 1: Introduction to Computers Chapter 2: Input Chapter 3: The Components of the System unit Chapter 4: Output Chapter 5: Storage
Section B: Software
Chapter 6: Application software Chapter 7: Operating system and Utility Programs

Semester Schedule:

Week	Lecture	Tutorial
1	Chapter 1	
2	Chapter 2	Tutorial 1
3	Chapter 2	Tutorial 1 and 2
4	Chapter 3	Tutorial 2
5	Chapter 3	Tutorial 3
6	Chapter 4	Tutorial 3 and 4
7	Chapter 4	Assignment Presentation
8	Chapter 5	Assignment Presentation
9	Chapter 5	Tutorial 4
10	Chapter 6	Tutorial 5
11	Chapter 6 & Test	Tutorial 5
12	Chapter 7	Tutorial 6
13	Chapter 7	Tutorial 6 and 7
14	Revision	Tutorial 7 and Q&A

Marks Allocation:

Coursework:

Assignment	50% (Presentation: 20%, Report: 30%)
Test	40%
Participation	10%
Total	100%

Final Examination:

Section A: 25 objective questions	25%
Section B: 3 theory questions	75%
(Choose 3 out of 4 questions)	100%

Total final marks is constituted of: Coursework 40% + Final Examination 60%

APPENDIX E

User Acceptance Test for i-GEMS System – Administrator User

Functionalities test:

Acceptance Testing Action	**Yes**	**No**	**Remarks**
Able to gain access to the i-GEMS system for an authorized user.			
Able to register an authorized lecturer to the respective teaching subject module.			
Able to modify information of a lecturer in relate to the teaching subject module.			
Able to remove a lecturer from a teaching subject module			
Able to register a student course to a specific studying subject module.			
Able to modify information of student course in relate to the studying subject module.			
Able to remove a student course from a studied subject module.			

Usability test:

Please rank each of the following features based on the given criteria:
1 – Strongly disagree
2 – Disagree
3 – No comment
4 – Agree
5 – Strongly Agree

Acceptance Features	**1**	**2**	**3**	**4**	**5**
Do you agree that the i-GEMS system is easy to use?					
Do you agree that the i-GEMS system is easy to learn?					
Do you agree that the functionalities are complete?					

Do you agree that the system design is appropriate?					
Do you agree that the system design is attractive?					
Do you agree that the system design is consistent?					
Do you agree that the system's font size is appropriate?					
Do you agree that the system's font color is appropriate?					
Do you agree that the information presented is enough?					
Can you understand the instructions given by the system?					

Comments:_____
_____
_____
_____

Revision: 1.0v Date: _____

Signature: _____

Name : ( )

APPENDIX F

User Acceptance Test for i-GEMS System – Academic Staff User

Functionalities test:

Modules	Acceptance Testing Action	Yes	No	Remarks
Login	Able to gain access to the i-GEMS system for an authorized user.			
Subject Selection	Able to display a list of subject options and allow user to make a selection.			
Subject's Main Page	Allow an authorized user to access specific subject's teaching material.			
Announcement	Able to display a subject's latest announcement properly.			
Unit Information	Allow an academic staff user to view the content of a unit information file. Able to download a unit information file to a specified path correctly.			
Lecture Notes	Allow an academic staff user to view a lecture notes' content. Able to download a lecture notes file to a specified path correctly.			
Tutorial	Allow an academic staff user to view a tutorial's content Able to download a tutorial file to a specified path correctly.			
Assignment	Allow an academic staff user to view an assignment's content. Able to download an assignment file to a specified path correctly.			
Test	Allow user to participate in an objective test questions.			

Q & A	Allow academic staff to answer a question. Allow academic staff to add a question. Allow an academic staff who is teaching the subject to moderate question topics. Allow an academic staff who is teaching the subject to moderate content of reply.			
Discussion	Allow an academic staff who is teaching the subject to add a discussion topic. Allow an academic staff who is teaching the subject to participate in a topic discussion. Allow a Unit leader for the subject to moderate discussion topics. Allow a Unit leader for the subject to moderate the content of discussion thread or reply.			
Academic Staff Information	Able to display a subject's academic staff information properly.			
Change Password	Able to change an academic staff's password.			
Control Panel	Allow an academic staff who is teaching the subject proceed to Control Panel to maintain a subject's teaching materials.			
Logout	To logout from the i-GEMS system.			

Usability test:

Please rank each of the following features based on the given criteria:
1 – Strongly disagree
2 – Disagree
3 – No comment
4 – Agree
5 – Strongly Agree

Acceptance Features	**1**	**2**	**3**	**4**	**5**
Do you agree that the i-GEMS system is easy to use?					
Do you agree that the i-GEMS system is easy to learn?					
Do you agree that the functionalities are complete?					
Do you agree that the system design is appropriate?					
Do you agree that the system design is attractive?					
Do you agree that the system design is consistent?					
Do you agree that the system's font size is appropriate?					
Do you agree that the system's font color is appropriate?					
Do you agree that the information presented is enough?					
Can you understand the instructions given by the system?					

Comments:_____
_____
_____
_____

Revision: 1.0v Date: _____

Signature: _____

Name : ( )

APPENDIX G

User Acceptance Test for i-GEMS System – Student User

Functionalities test:

Modules	Acceptance Testing Action	Yes	No	Remarks
Login	Able to gain access to the i-GEMS system for an authorized user.			
Subject Selection	Able to display a list of subject options and allow user to make a selection.			
Subject's Main Page	Allow a student user to access a studying subject's materials.			
Announcement	Able to display a subject's latest announcement properly.			
Unit Information	Allow a student user to view the content of a unit information file. Able to download a unit information file to a specified path correctly.			
Lecture Notes	Allow a student user to view a lecture notes' content. Able to download a lecture notes file to a specified path correctly.			
Tutorial	Allow a student user to view a tutorial's content Able to download a tutorial file to a specified path correctly.			
Assignment	Allow a student user to view an assignment's content. Able to download an assignment file to a specified path correctly.			
Test	Allow a student user to participate in an objective test questions.			
Q & A	Allow a student user to add a new question. Allow a student user to reply a posted question.			
Academic Staff Information	Able to display a subject's academic staff information properly.			
Change Password	Able to change a student's password.			

Logout	Able to logout from the i-GEMS system.			

Usability test:

Please rank each of the following features based on the given criteria:
1 – Strongly disagree
2 – Disagree
3 – No comment
4 – Agree
5 – Strongly Agree

Acceptance Features	**1**	**2**	**3**	**4**	**5**
Do you agree that the i-GEMS system is easy to use?					
Do you agree that the i-GEMS system is easy to learn?					
Do you agree that the functionalities are complete?					
Do you agree that the system design is appropriate?					
Do you agree that the system design is attractive?					
Do you agree that the system design is consistent?					
Do you agree that the system's font size is appropriate?					
Do you agree that the system's font color is appropriate?					
Do you agree that the information presented is enough?					
Can you understand the instructions given by the system?					

Comments:_____
_____
_____
_____

Revision: 1.0v Date: _____

Signature: _____

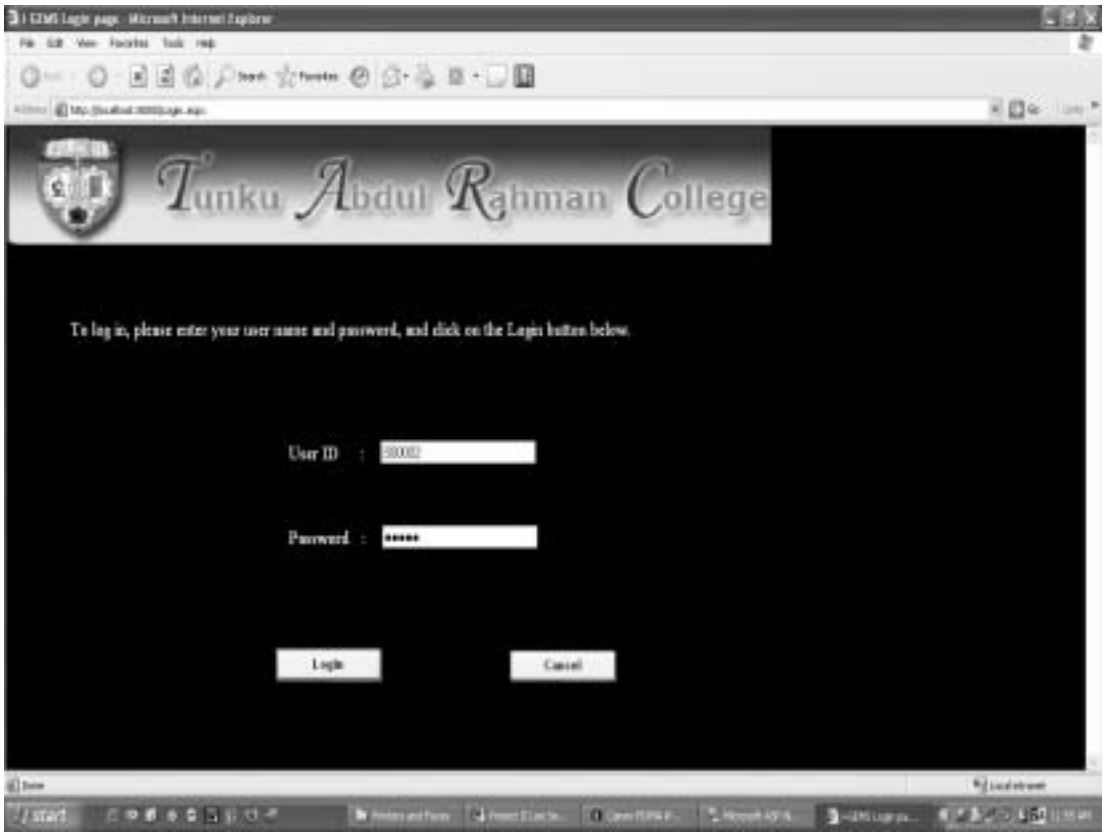
Name : ( )

APPENDIX H

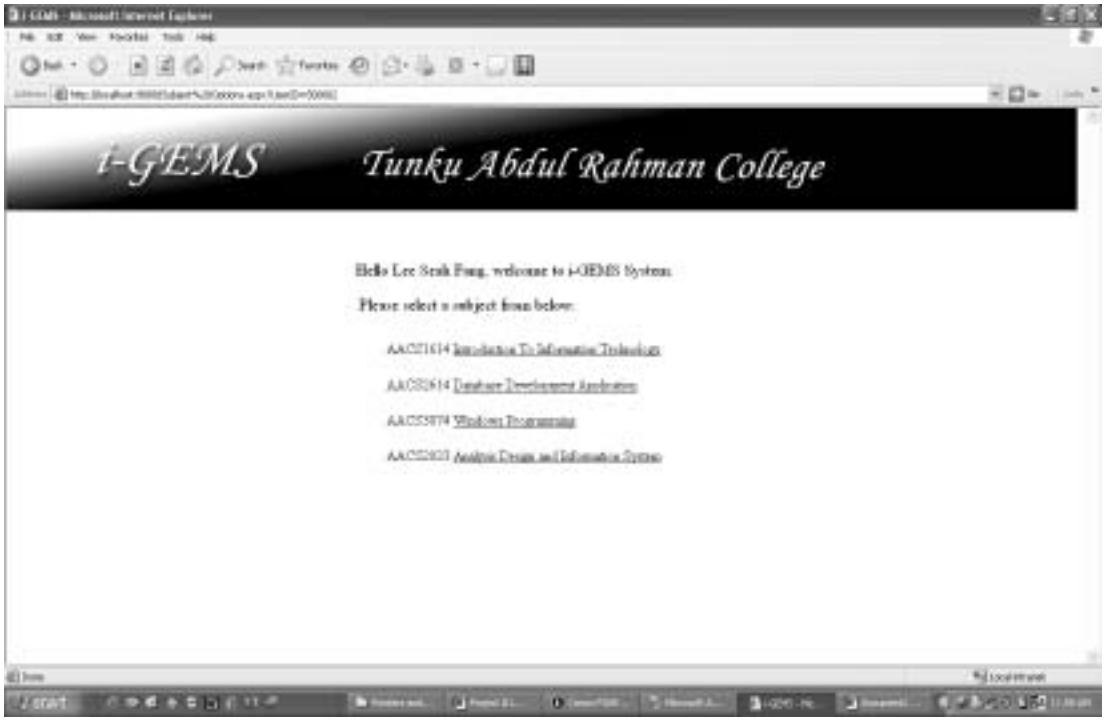
i-GEMS SCREEN DESIGN

The following i-GEMS screens demonstrate the functionalities that can be accessed by an academic staff who is teaching a subject "AACS1614 *Introduction To Information Technology*".

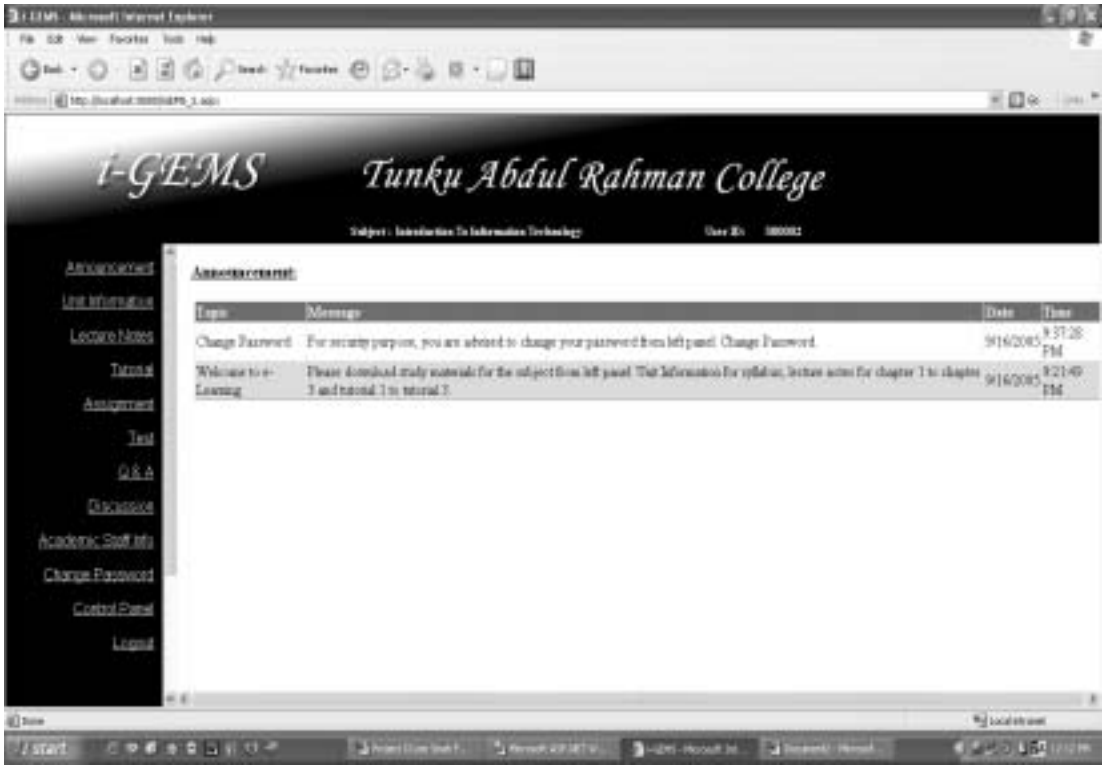
Login page:



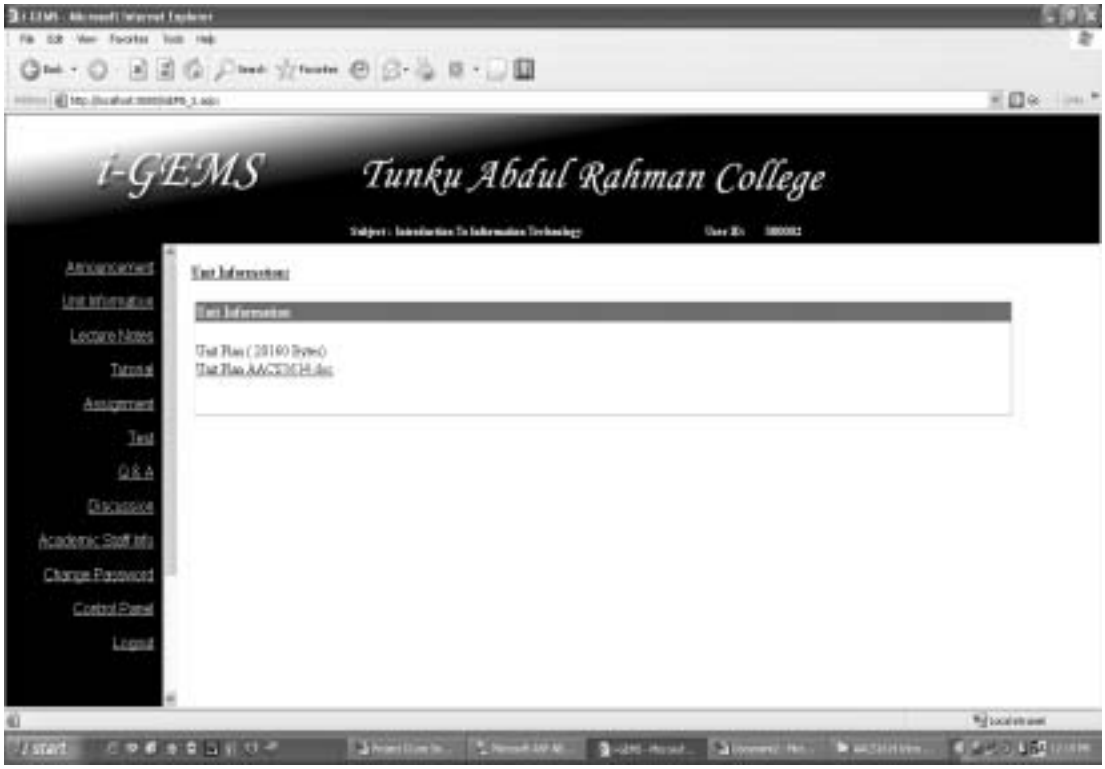
Subject selection page:



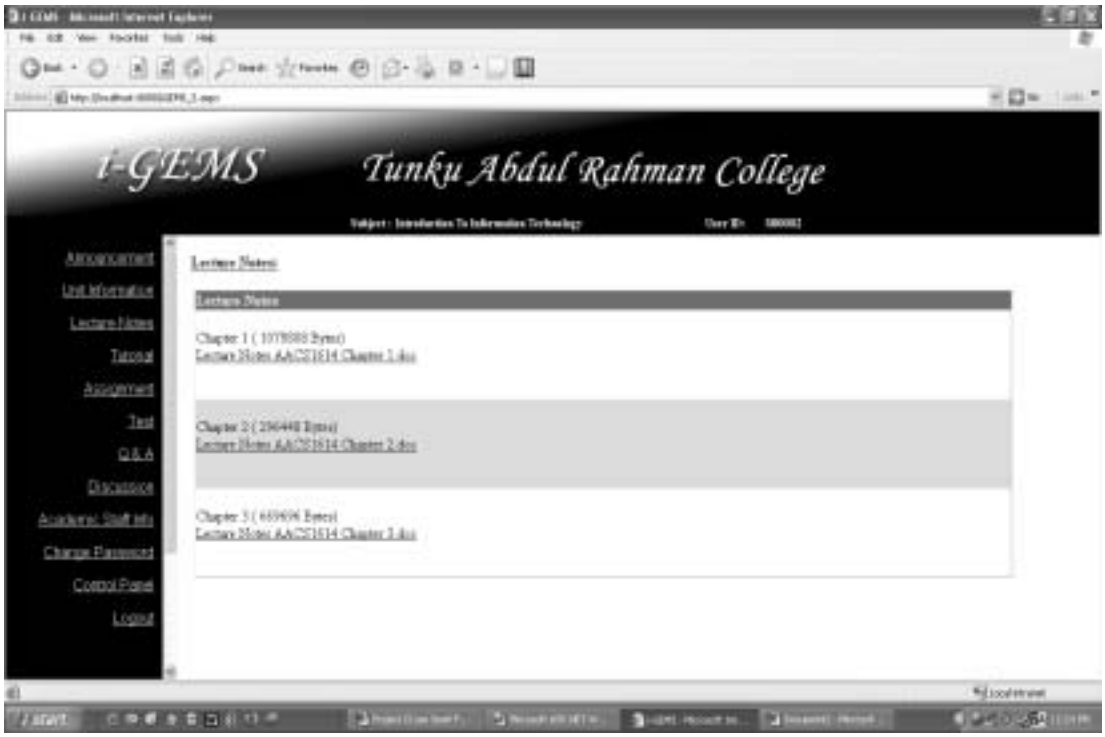
Subject "*AACS 1614 Introduction To Information Technology*" main page:



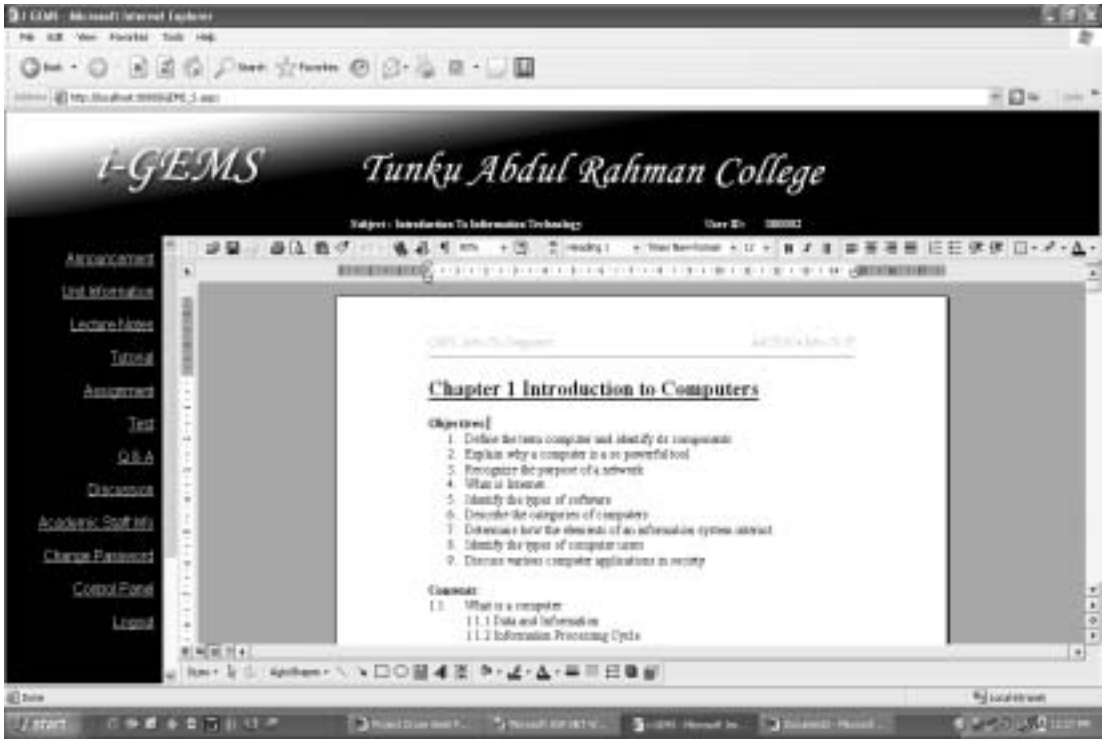
Unit Information page:



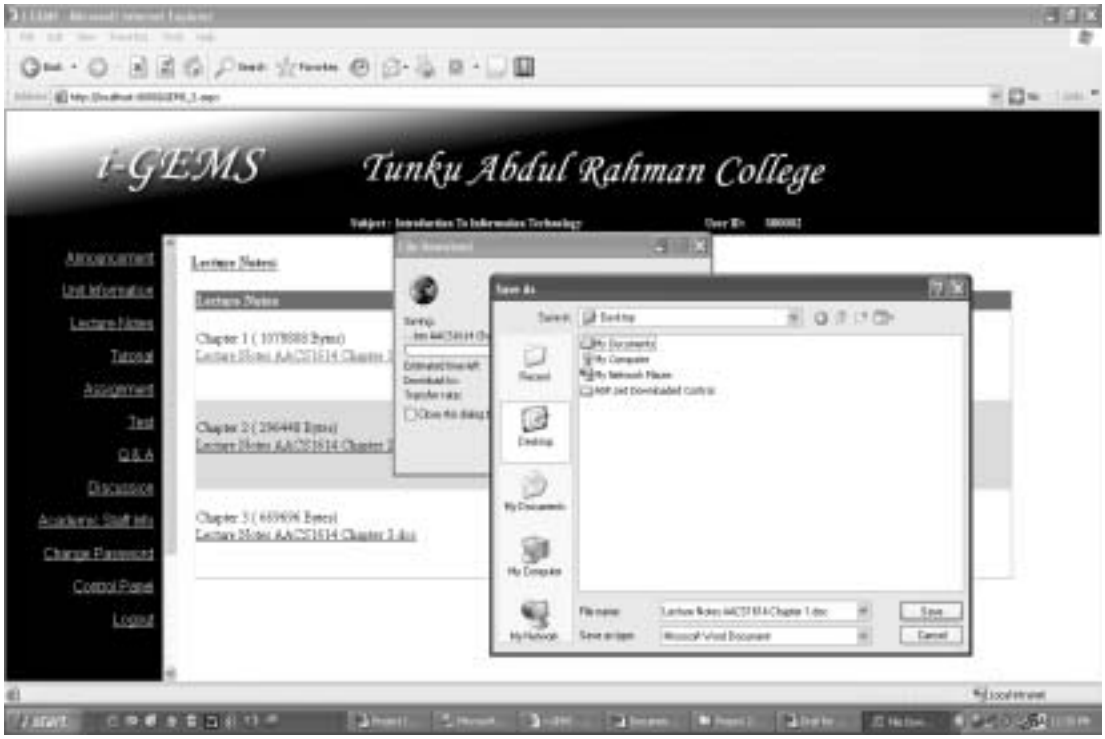
Lecture Notes page:



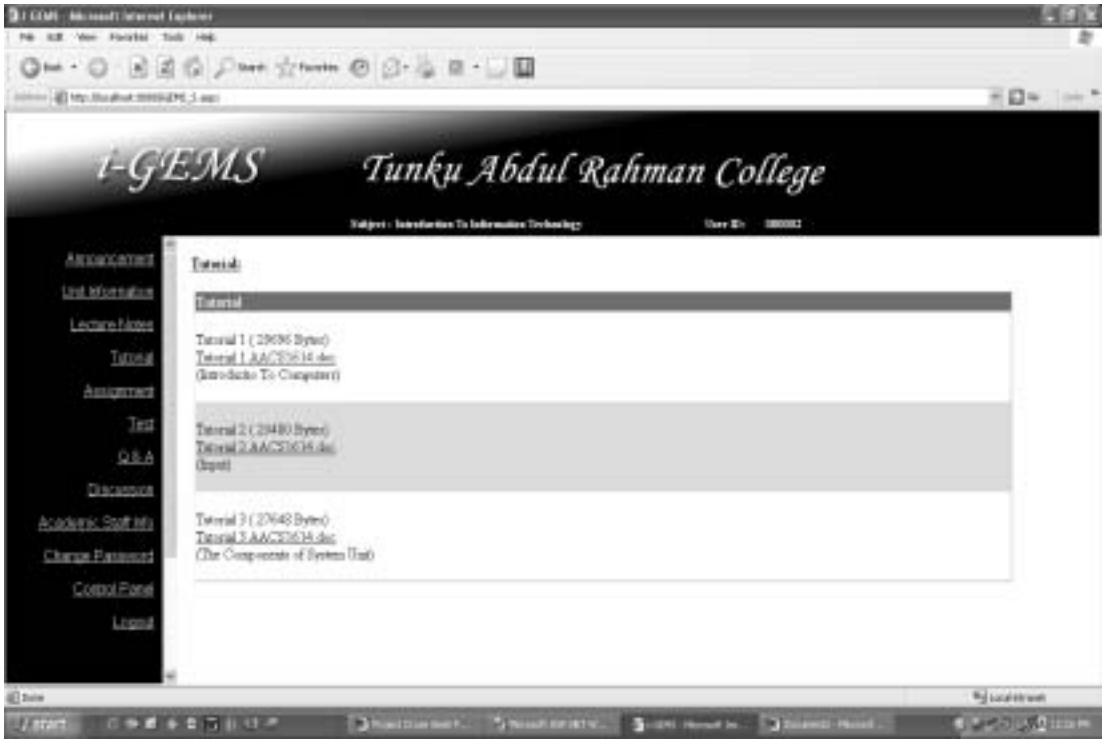
Viewing Lecture Notes Chapter 1:



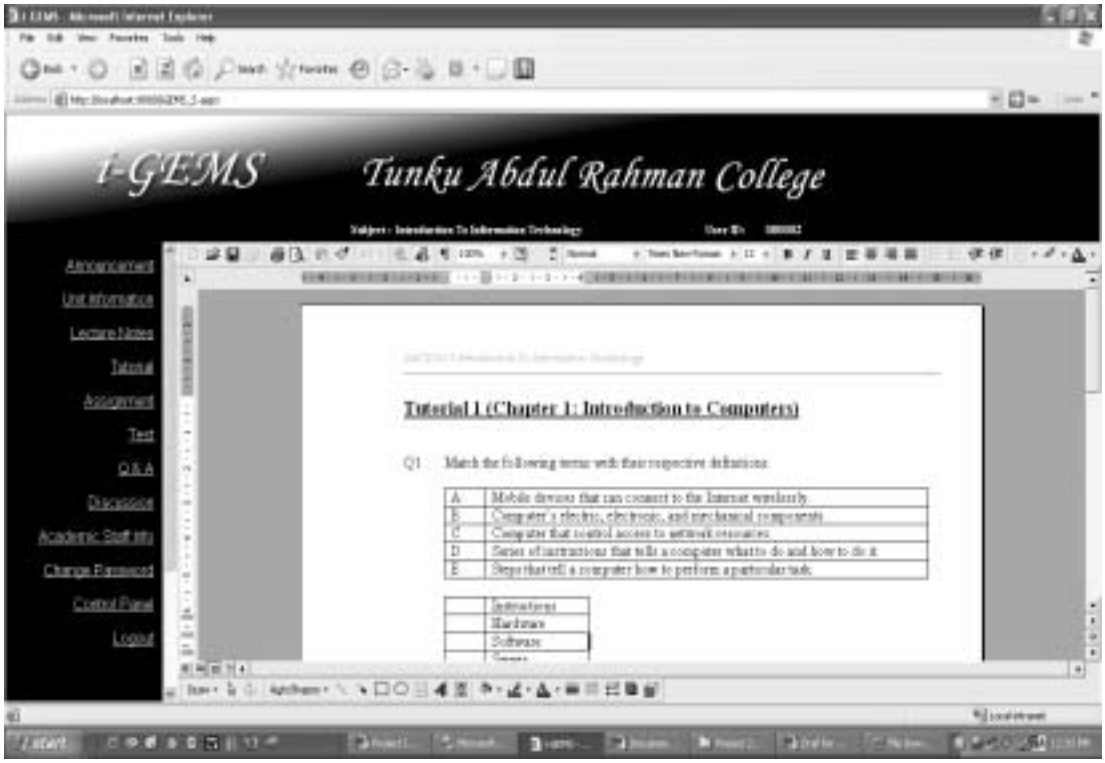
Downloading Lecture Notes Chapter 1:



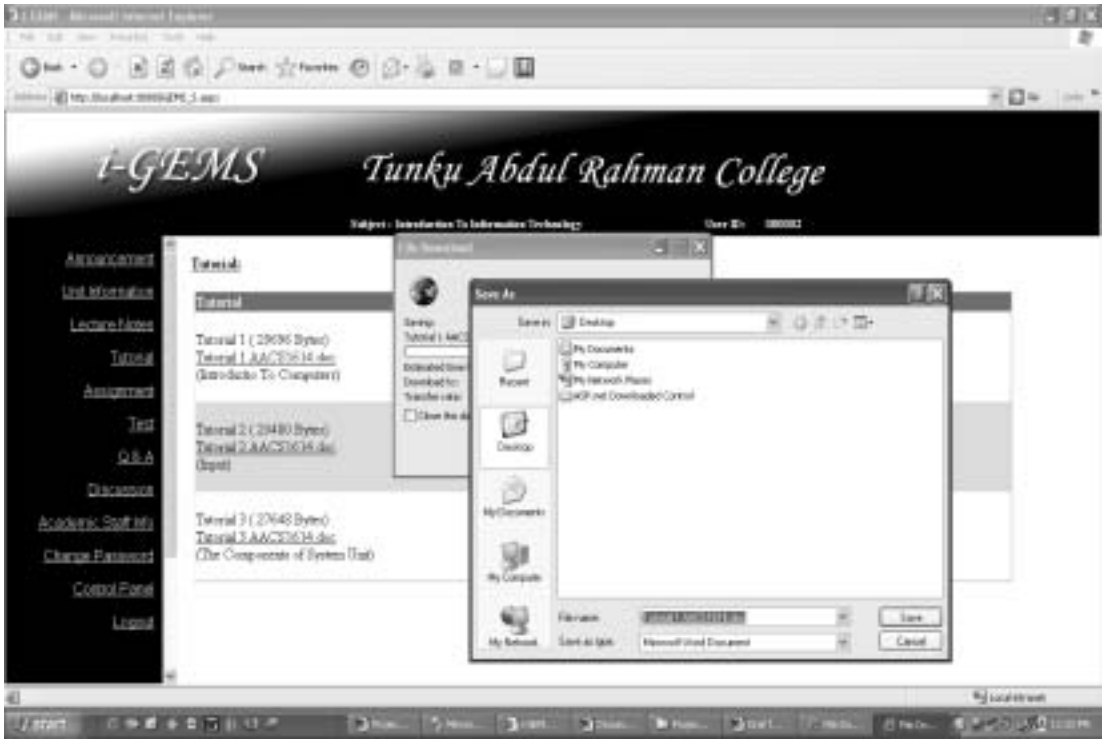
Tutorial page:



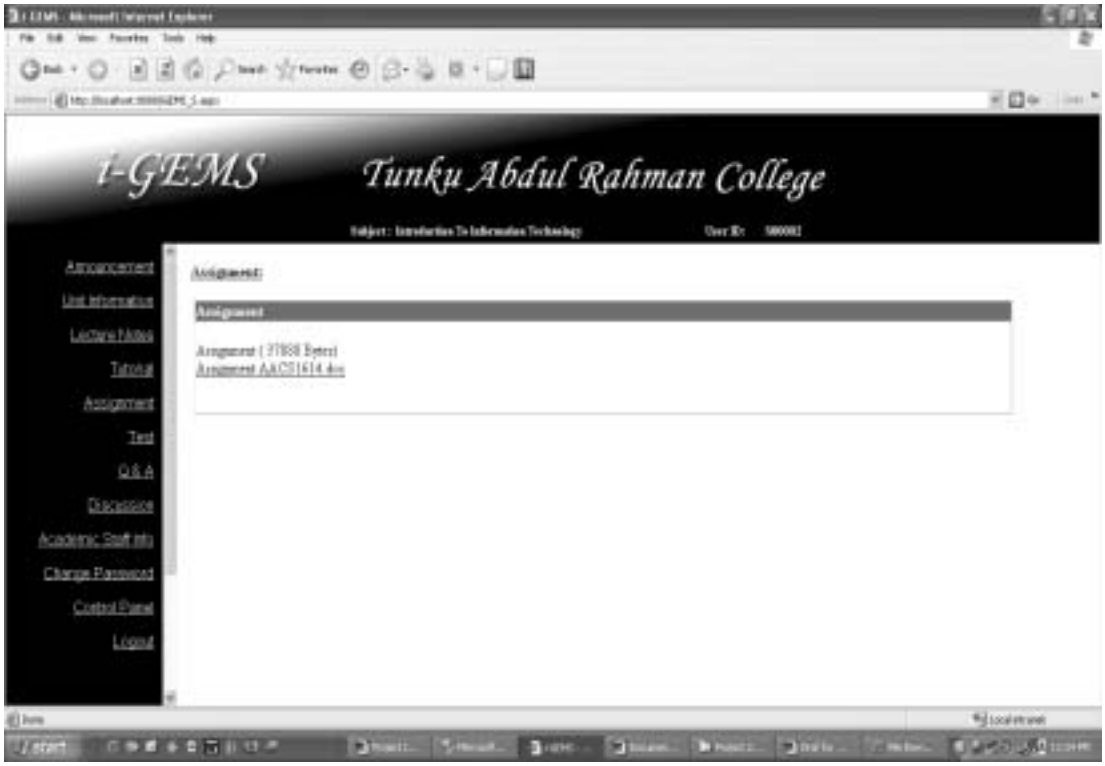
Viewing Tutorial 1:



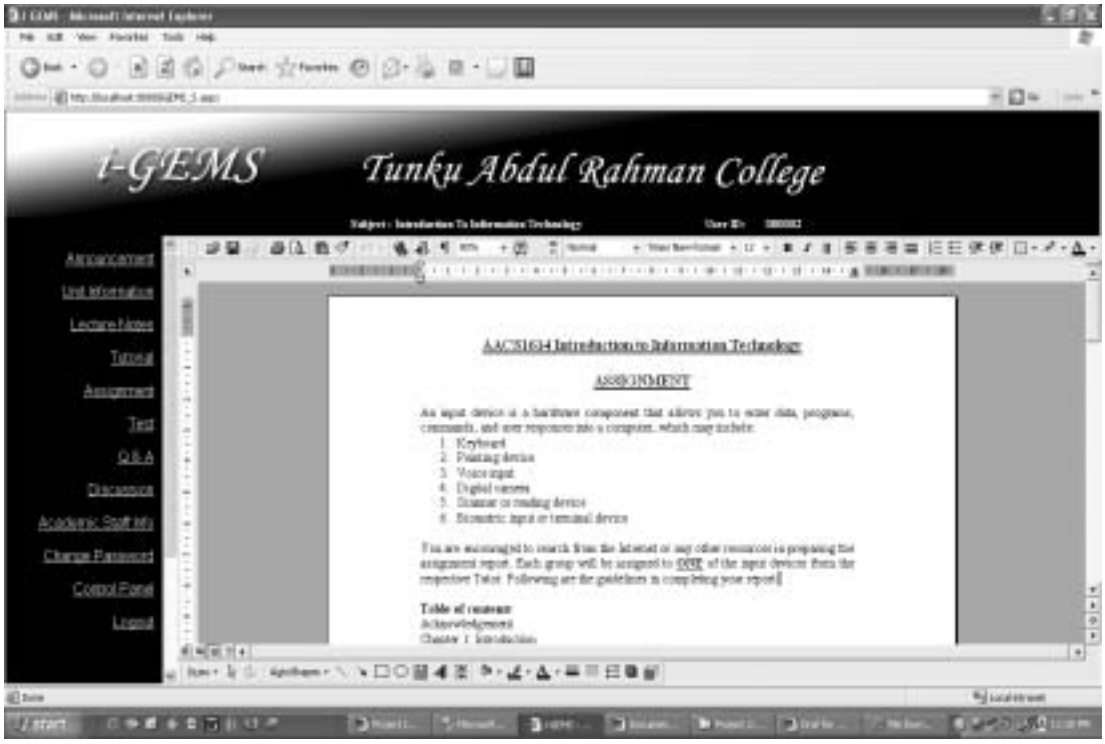
Downloading Tutorial 1:



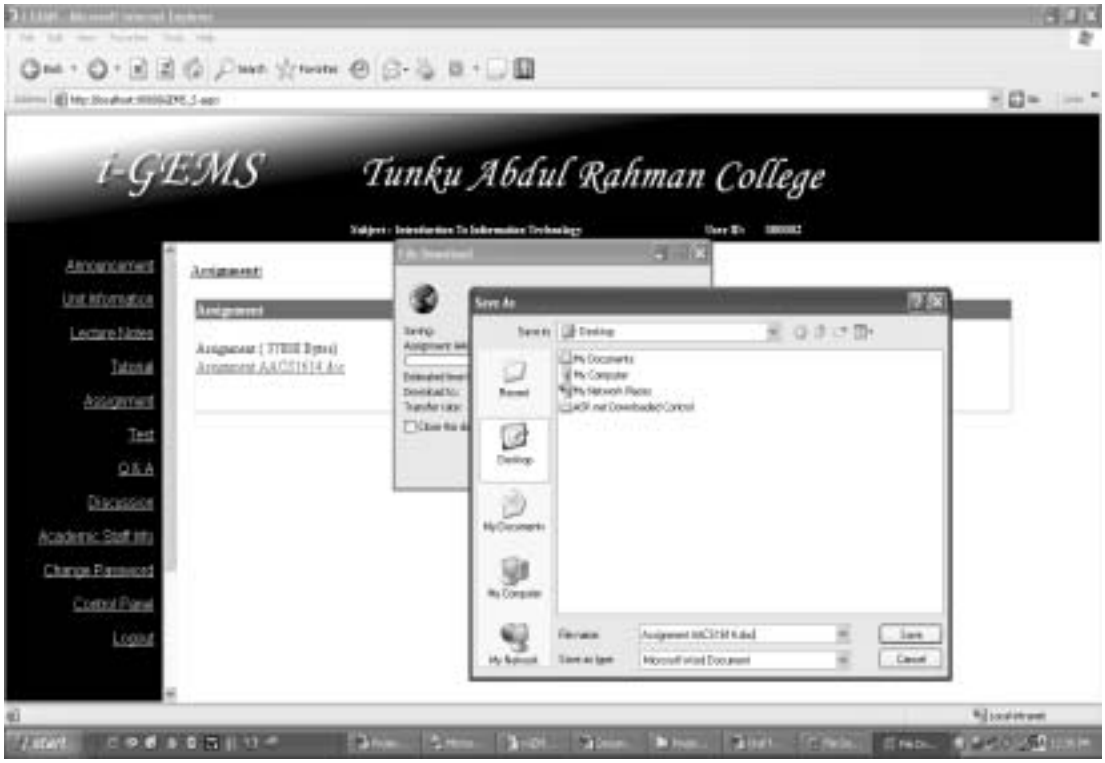
Assignment page:



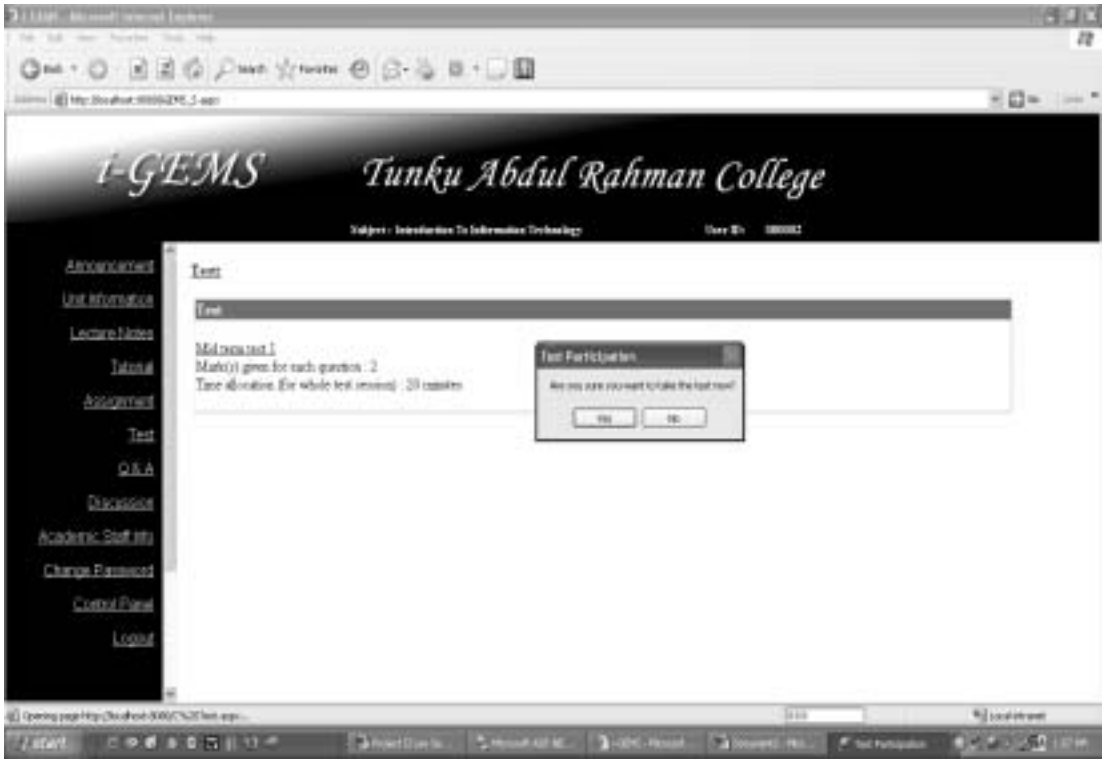
Viewing Assignment:



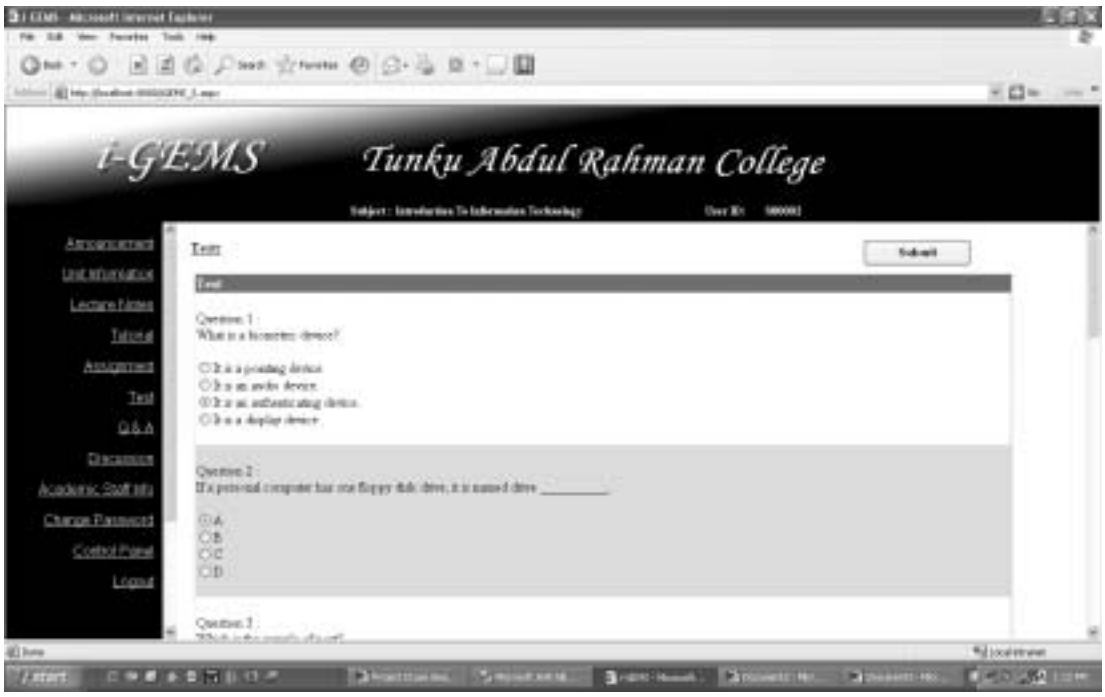
Downloading Assignment:



Participating a Test:

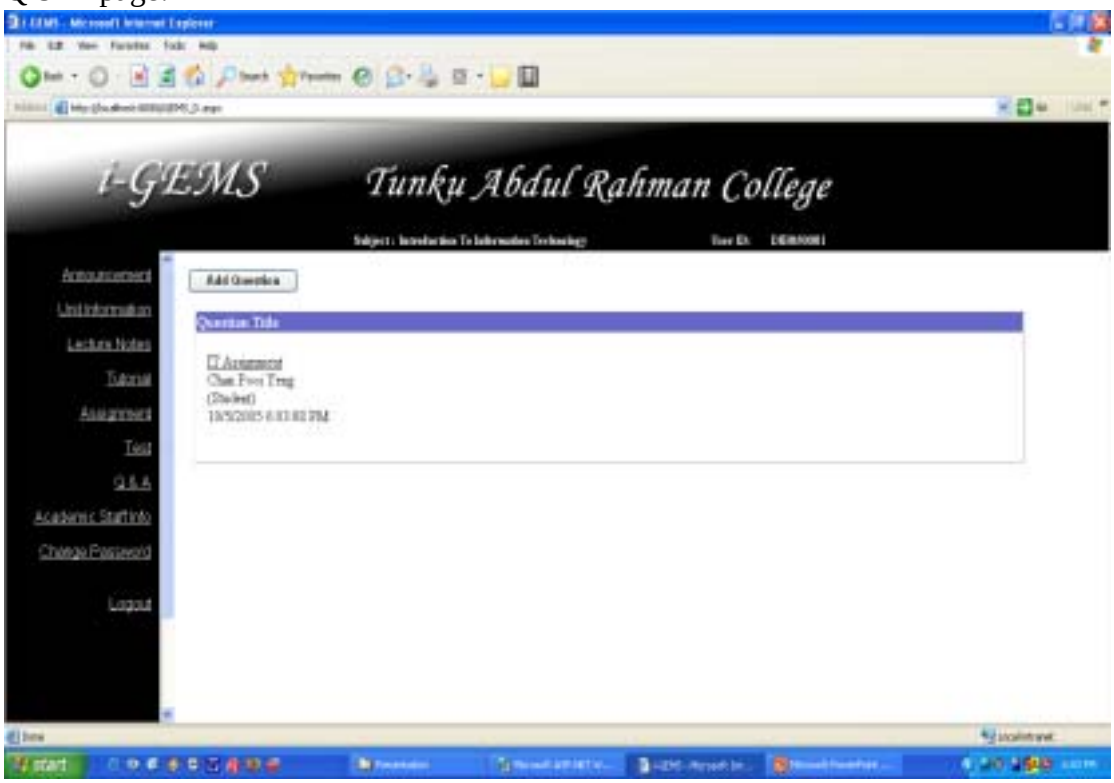


Answering a Test:

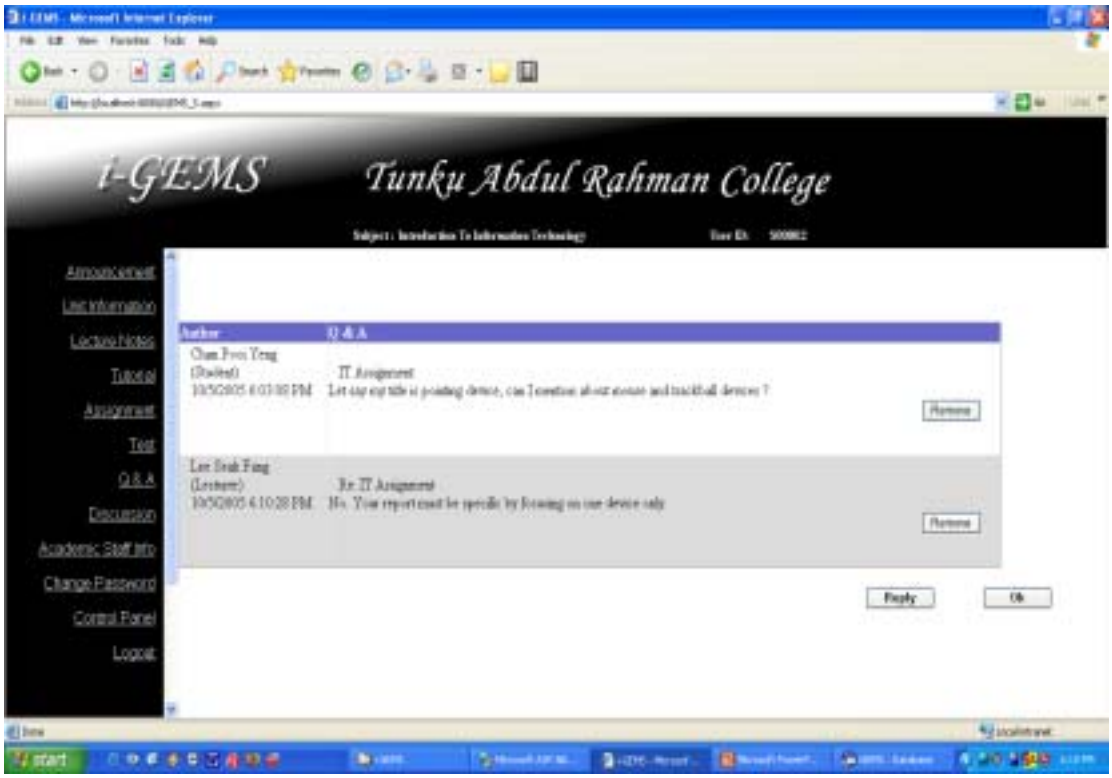


Test result:

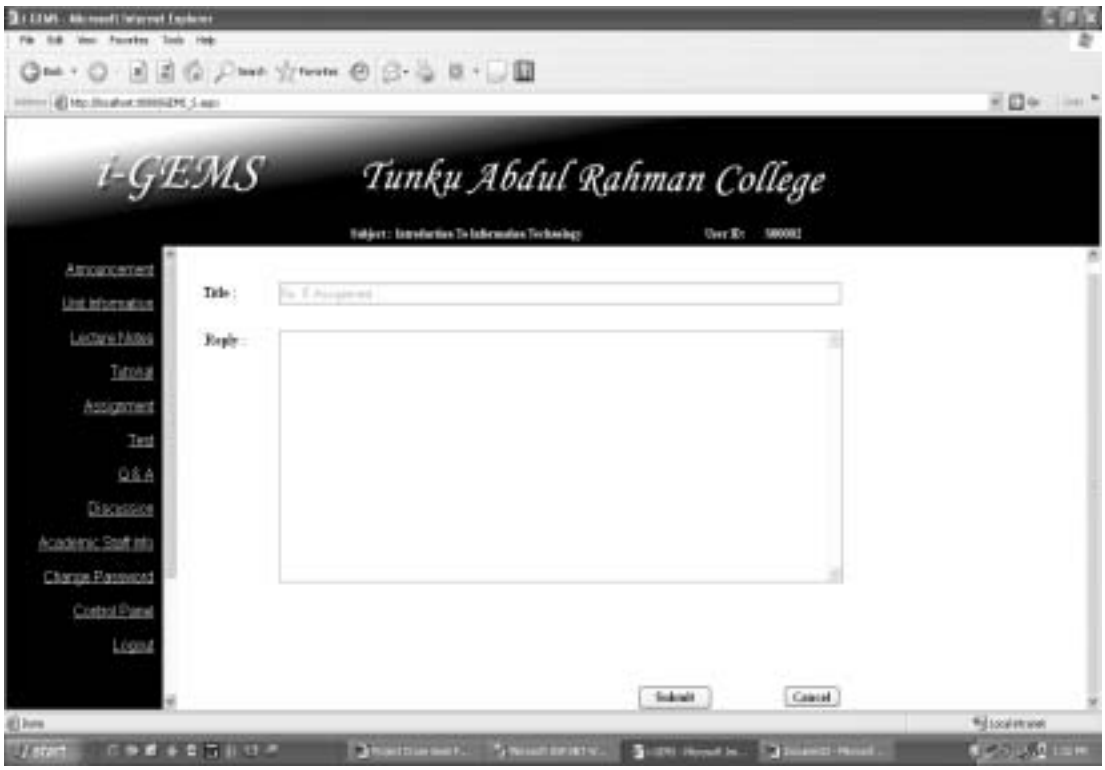
Q & A page:



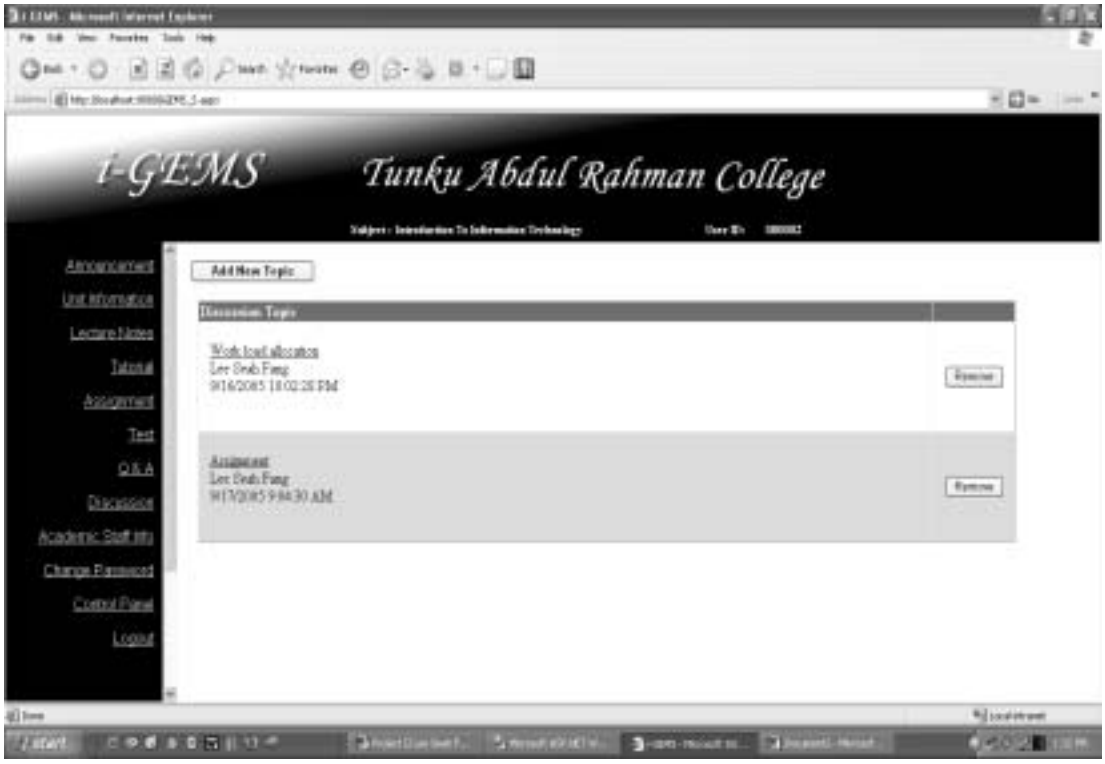
Accessing Q & A:



Replying a question:



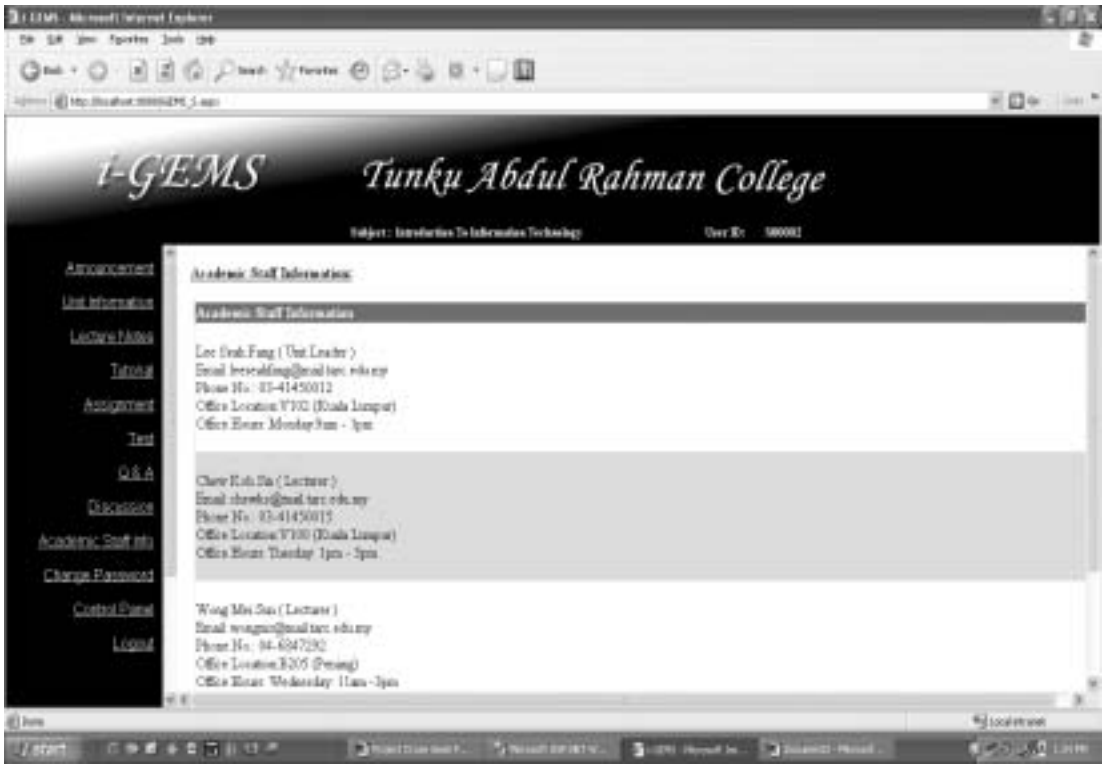
Discussion page:



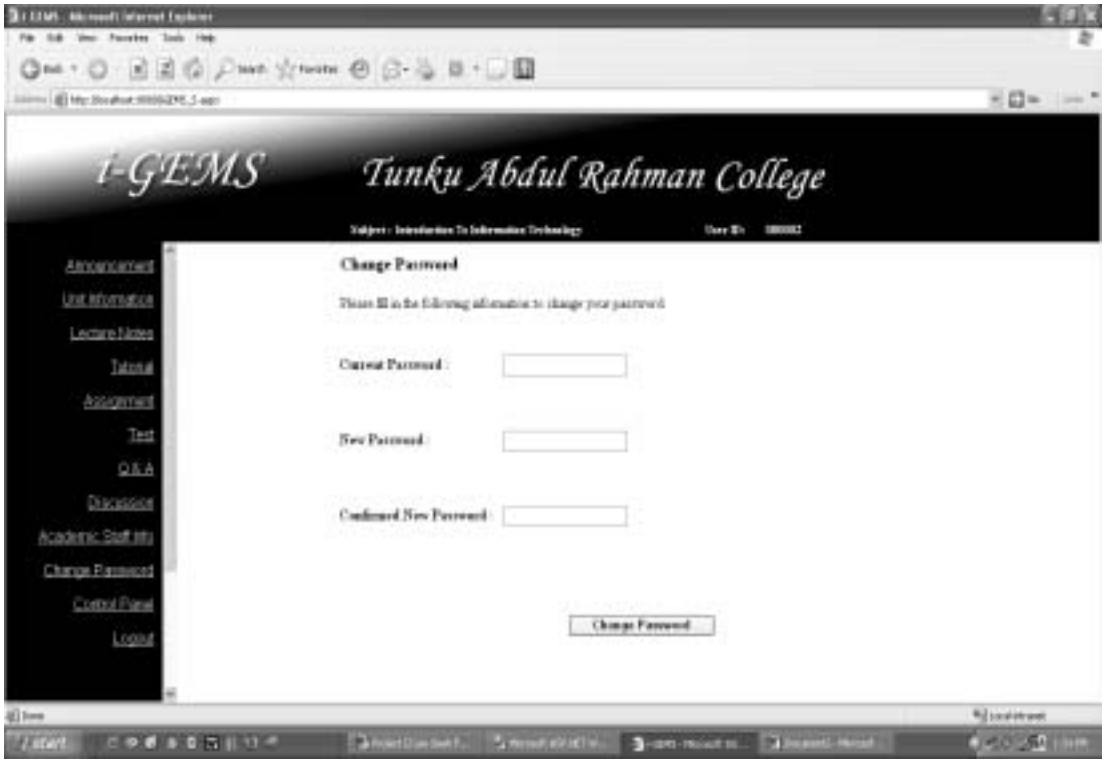
Accessing Discussion:

Participating a discussion:

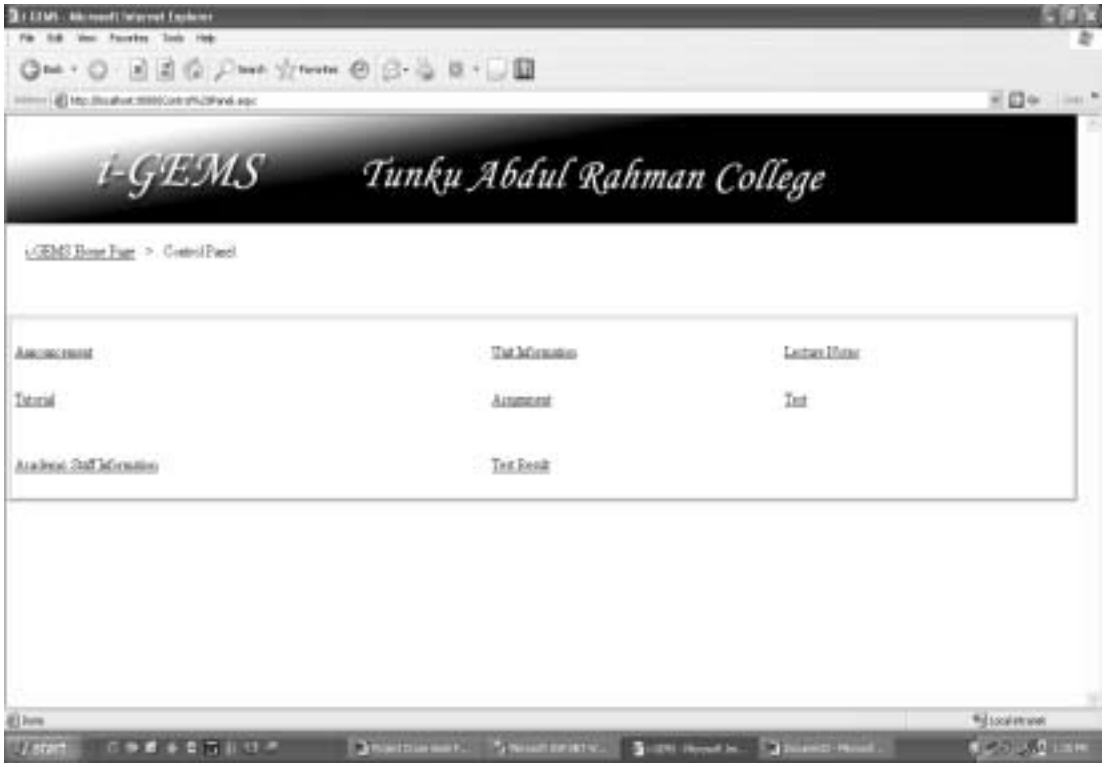
Academic Staff Information page:



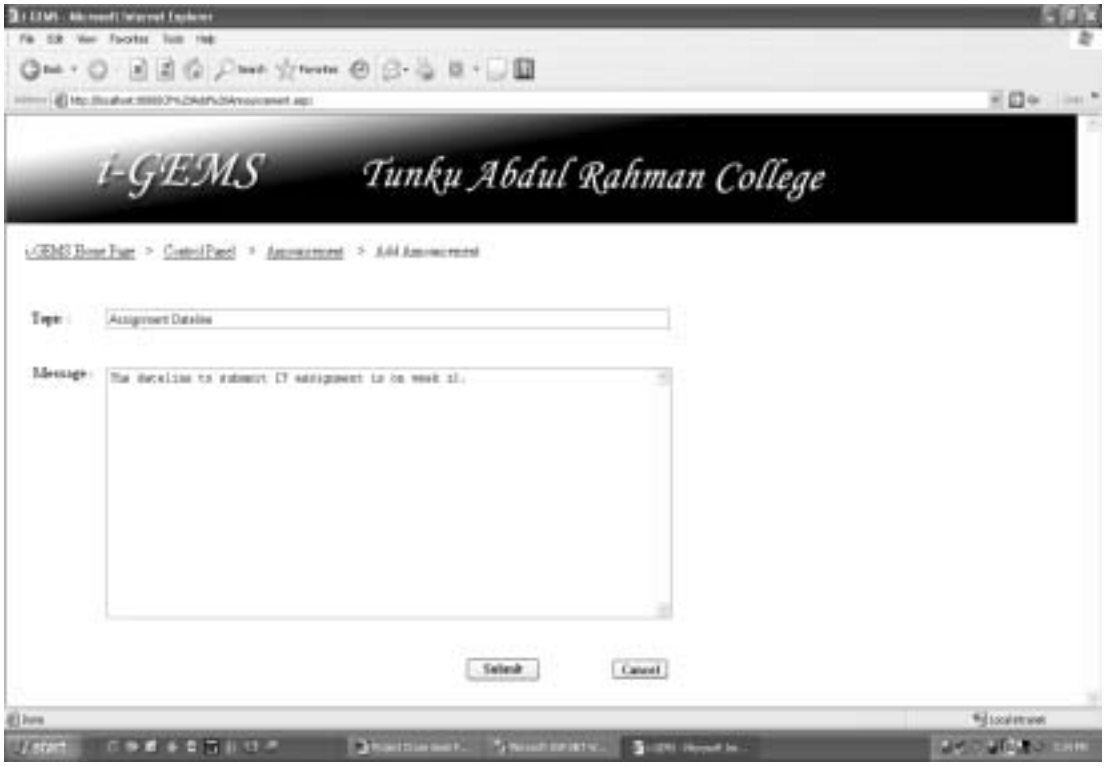
Change password page:



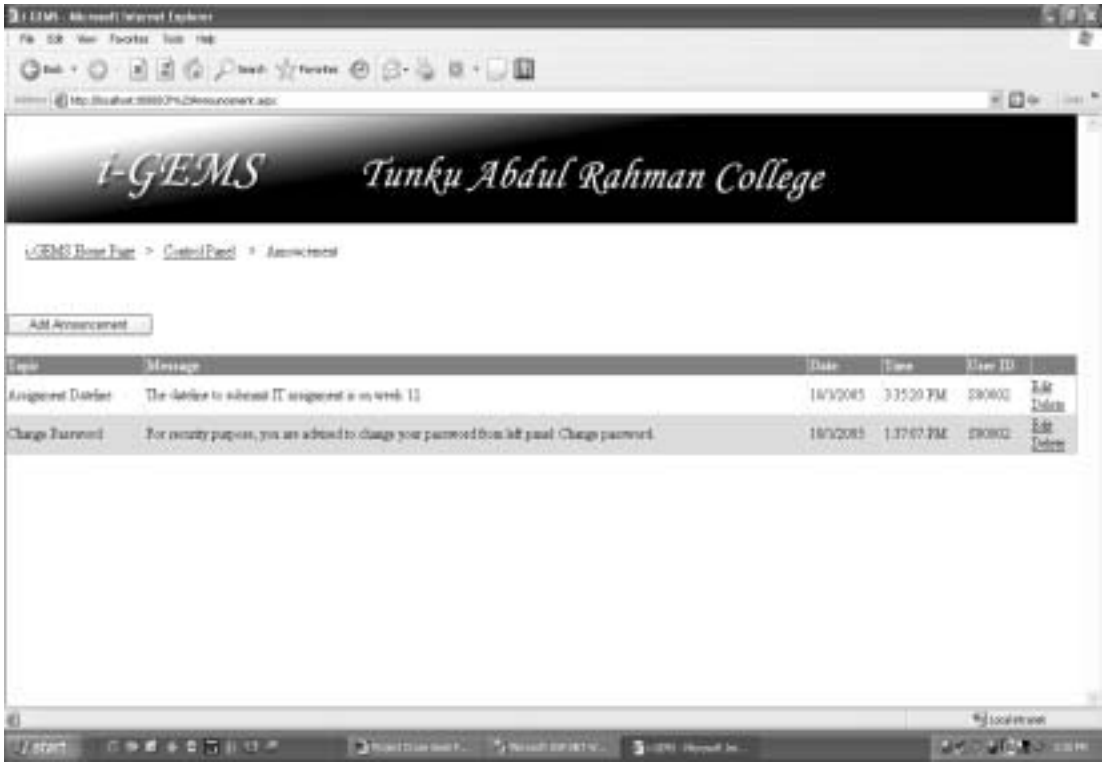
Control Panel:



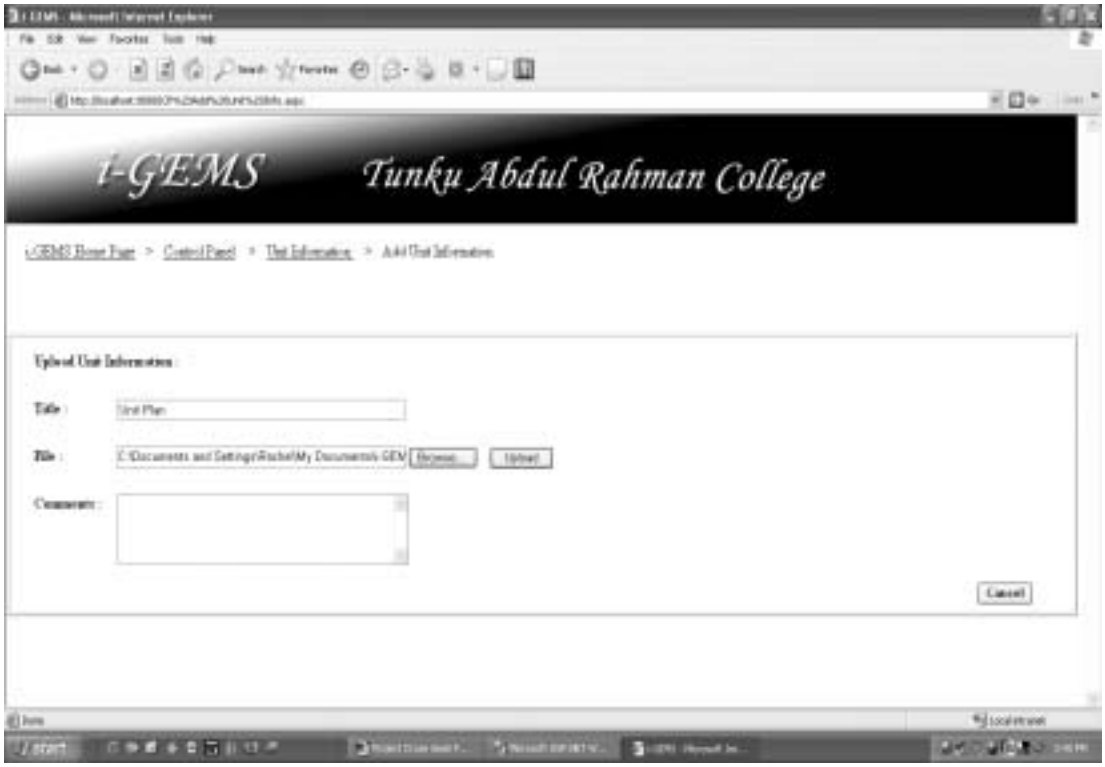
Control Panel > Adding an announcement:



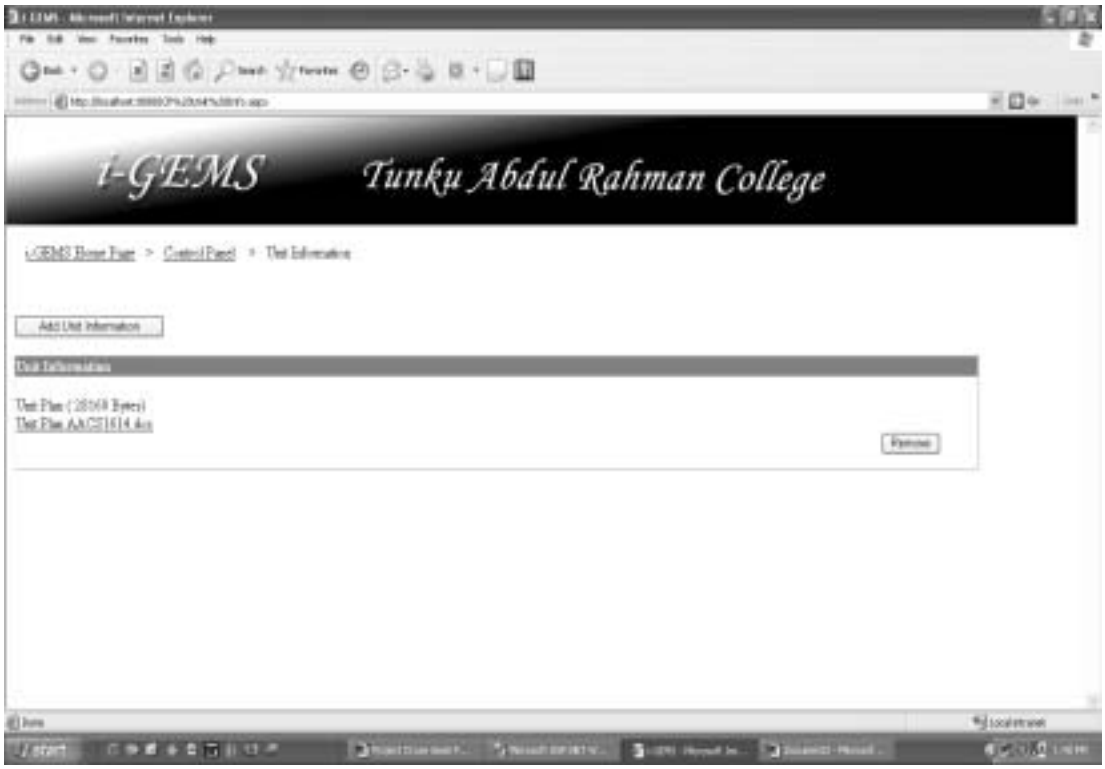
Control Panel > Maintaining announcements:



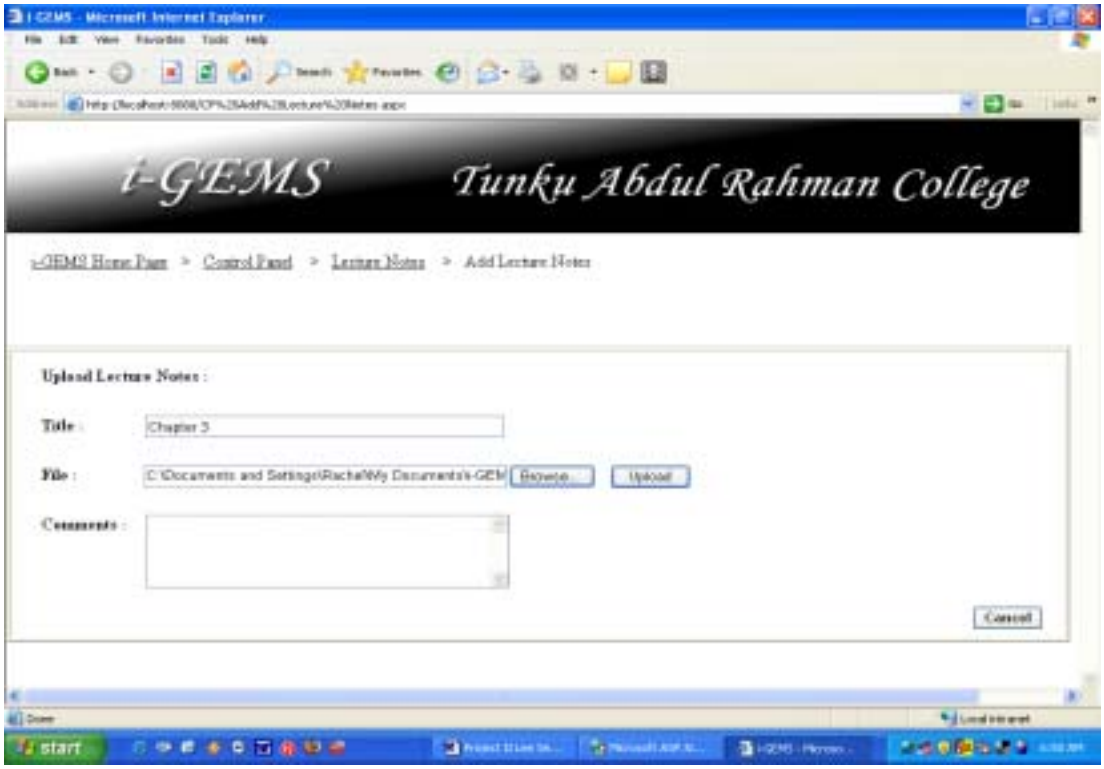
Control Panel > Uploading an Unit information file:



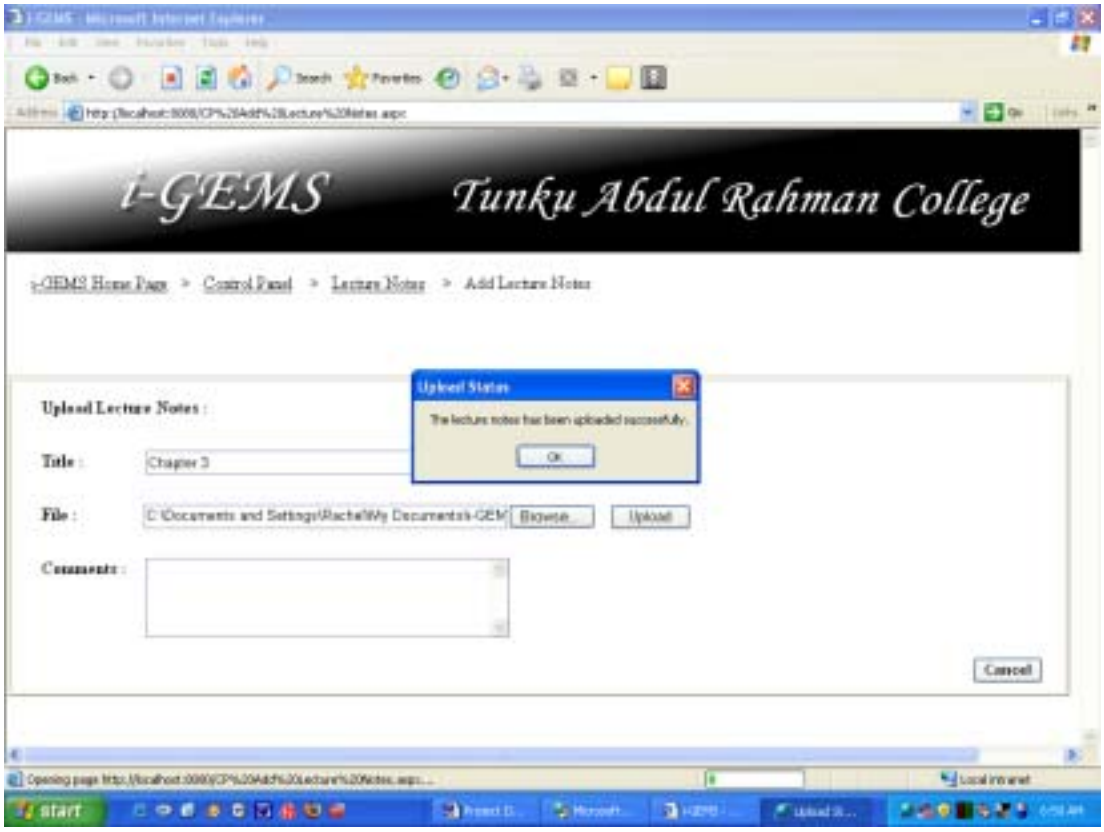
Control Panel > Maintaining Unit information:



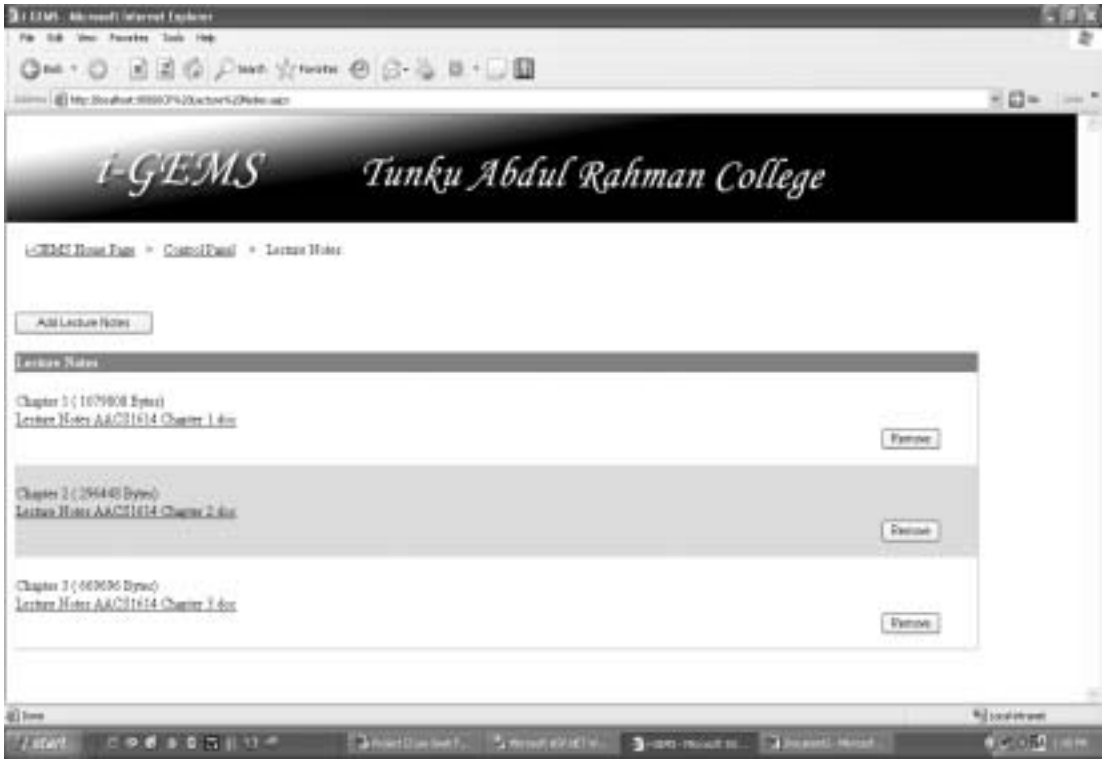
Control Panel > Uploading a lecture notes:



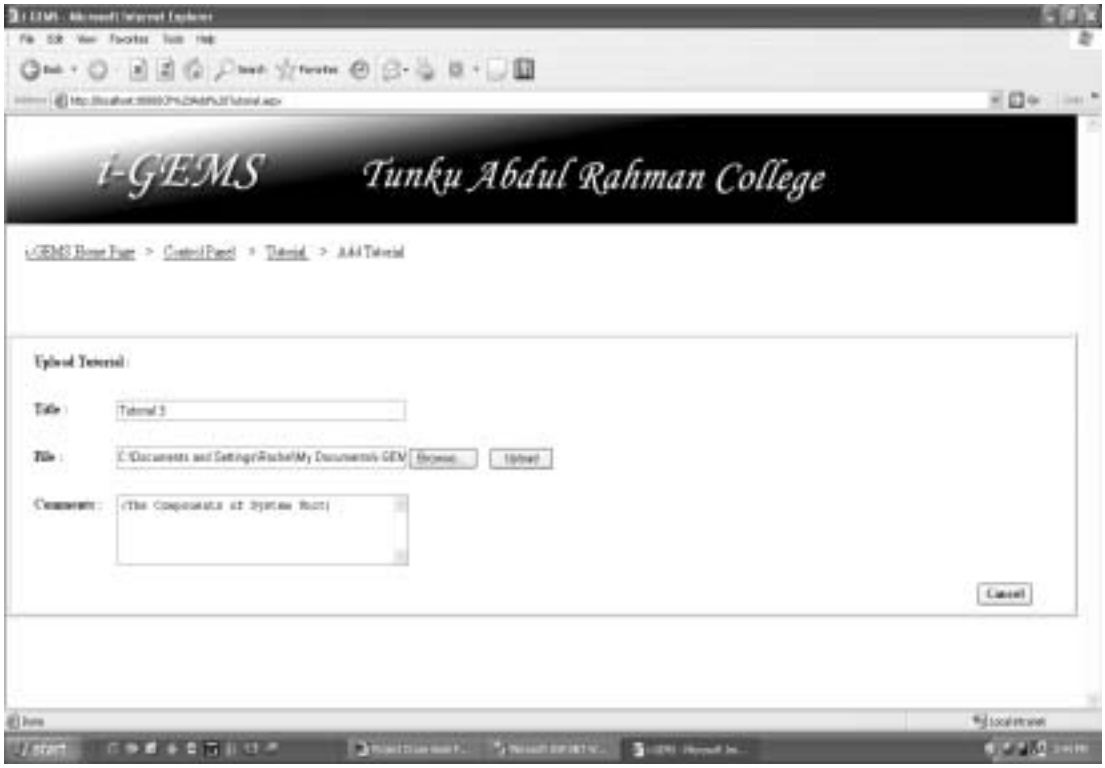
Control Panel > Upload status:



Control Panel > Maintaining lecture notes:

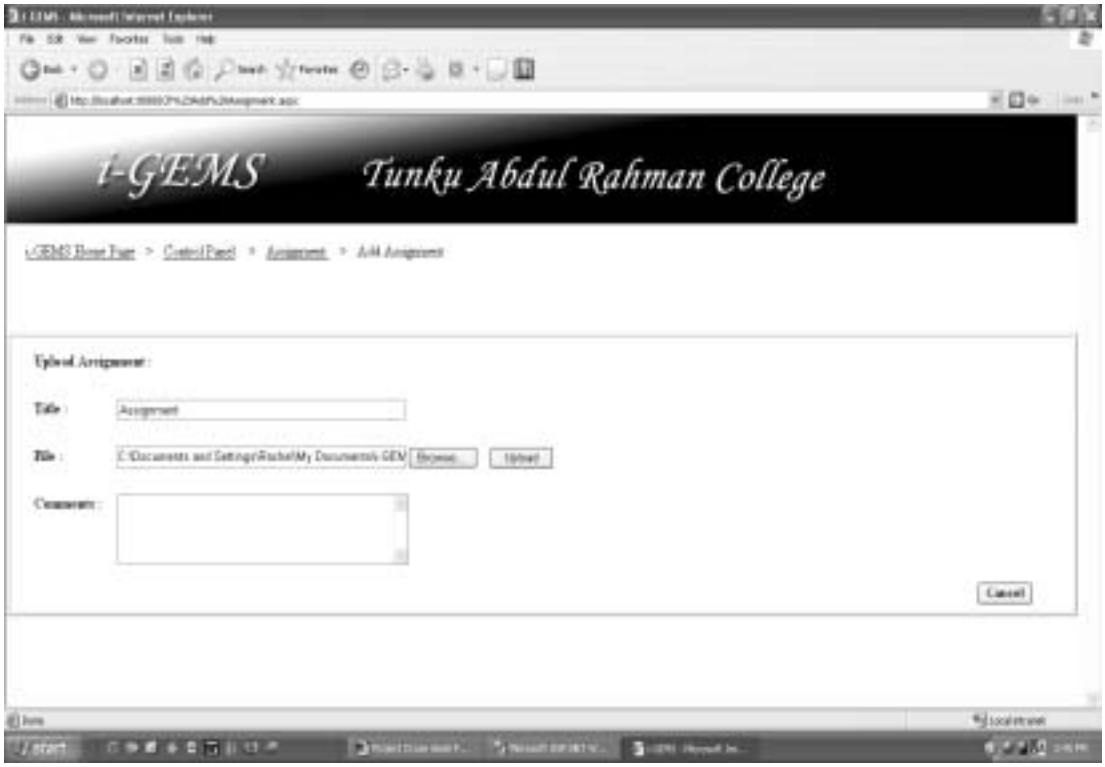


Control Panel > Uploading a tutorial:

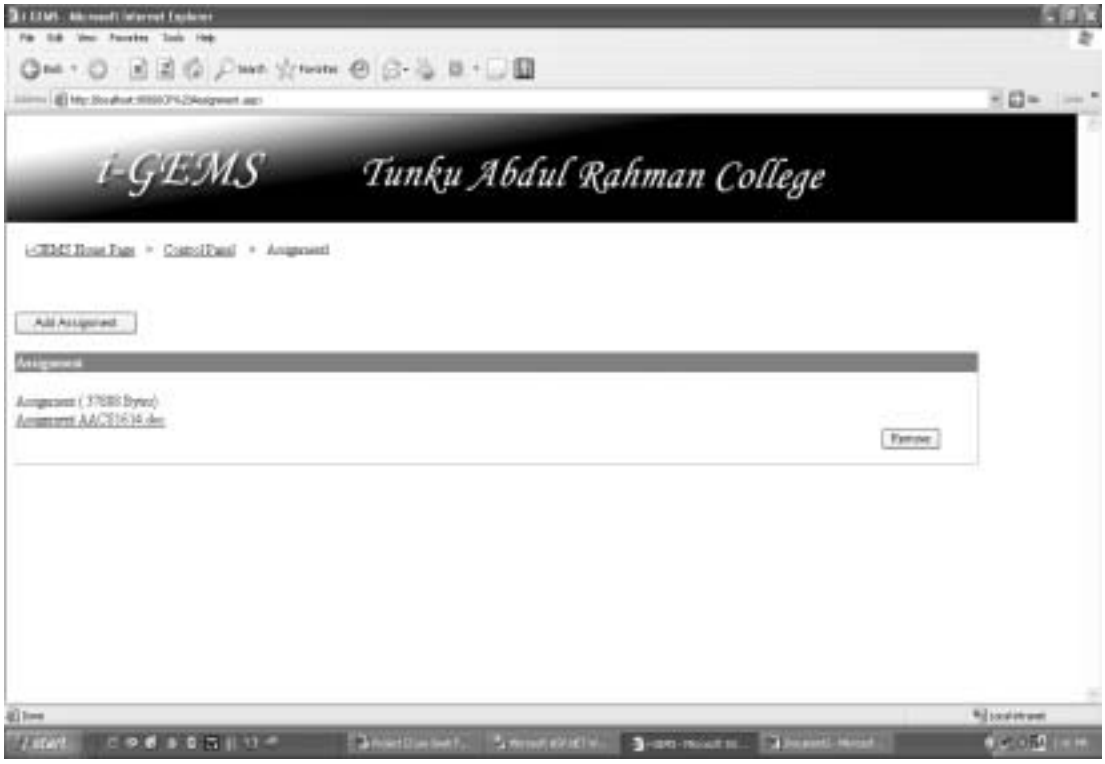


Control Panel > Maintaining tutorials:

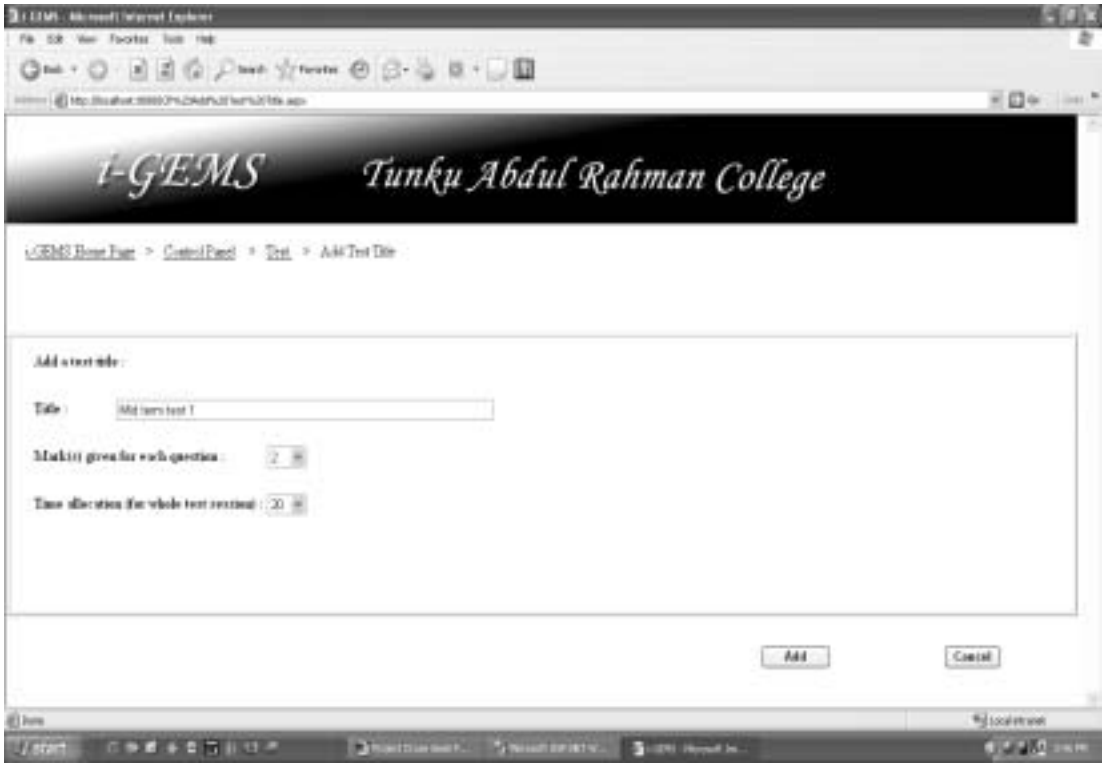
Control Panel > Uploading an assignment:



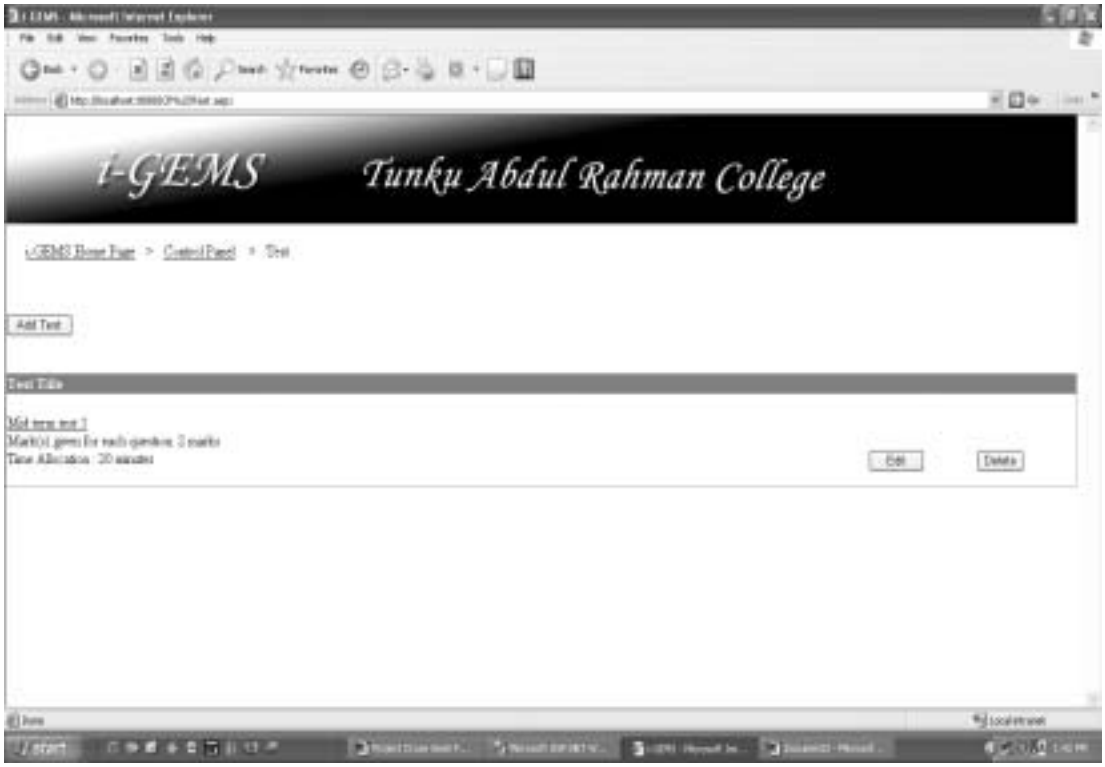
Control Panel > Maintaining an assignment:



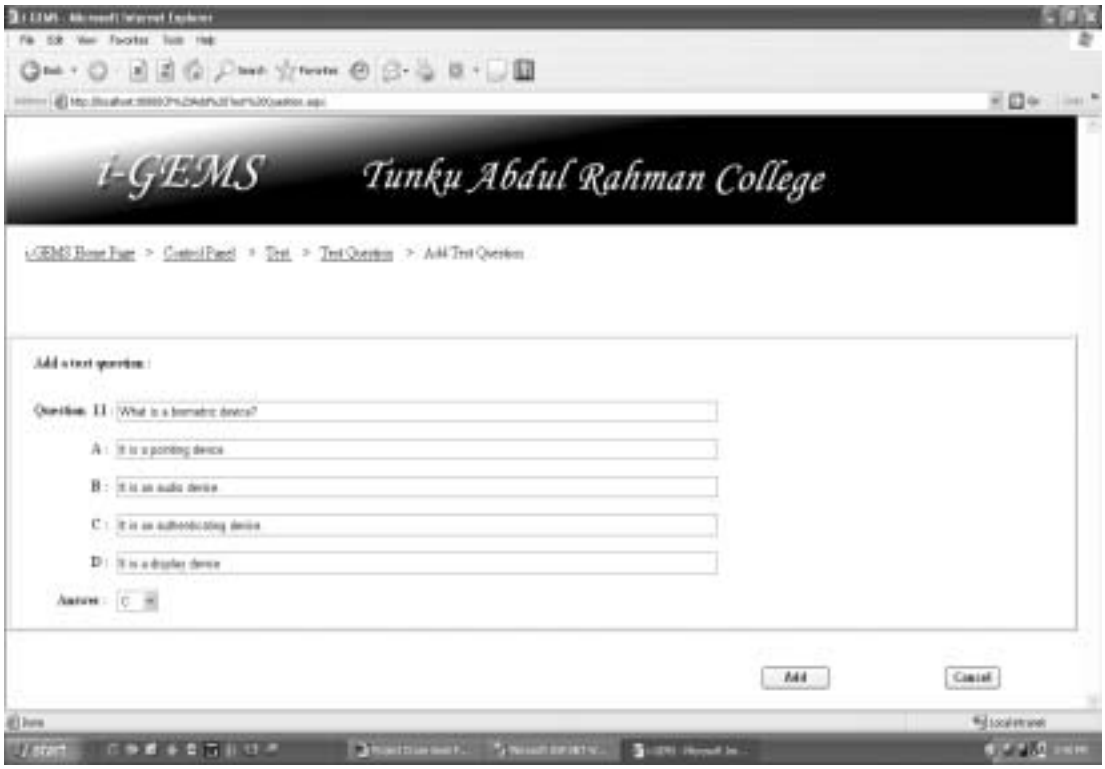
Control Panel > Adding a test title:



Control Panel > Maintaining a test:

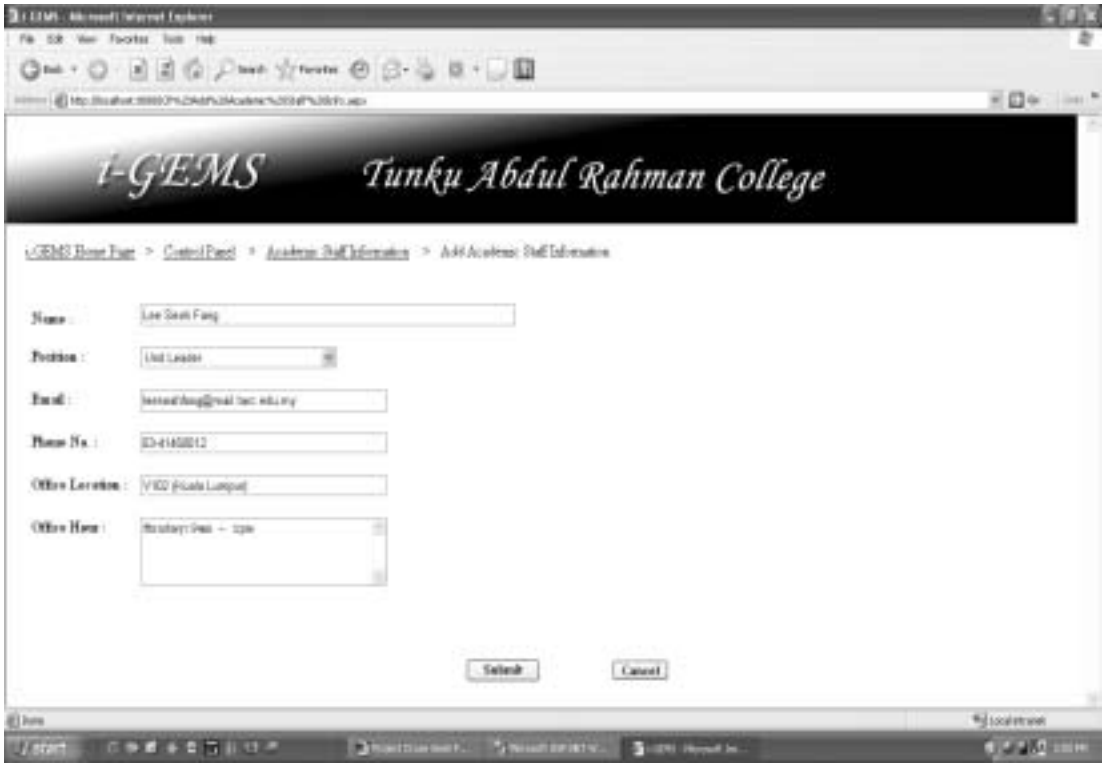


Control Panel > Adding a test question:



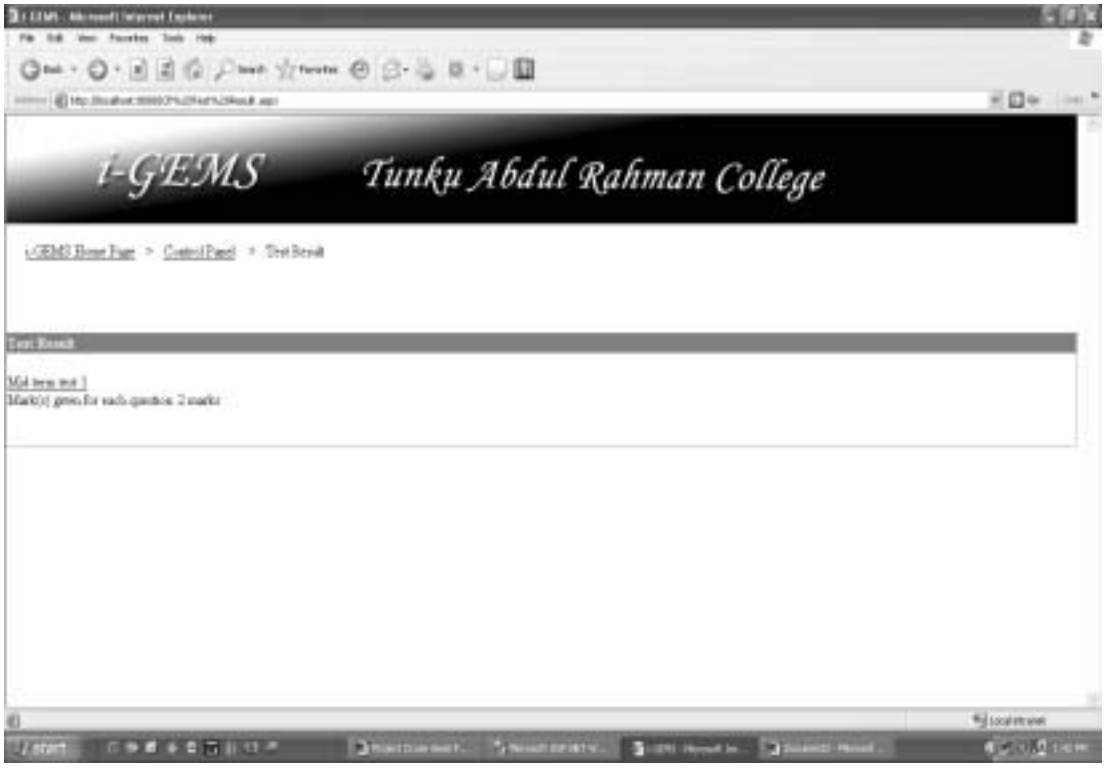
Control Panel > Maintaining test questions:

Control Panel > Adding an academic staff information:



Control Panel > Maintaining academic staff information:

Control Panel > Accessing test result:



Control Panel > Viewing test result: