CITY UNIVERSITY OF HONG KONG

Course code & title :   CS3342 Software Design

Session   :   Semester A 2008/09

Time allowed   :   Two hours

This paper has TEN pages (including this cover page).

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1.   This paper consists of 4 questions.

2.   Answer <u>ALL</u> questions.

Student Number: _____

Seat Number: _____

Programme: _____

Attempt <u>ALL</u> questions.

1.   Object-Oriented Analysis

<div align="right">[44 marks]</div>

Case Introduction

Hong Kong is becoming the educational hub in the Asia Pacific Region. To catch this opportunity, City-Youth aims to develop a series of educational applications. City-Youth employs you to analyze and design a web-based educational application teaching Putonghua to children for the age group of 5–8 years old. The goal of the application is to teach both local and non-local children to recognize simple Chinese characters and speak in Putonghua. The current idea of teaching method is by means of storytelling.

Case Description

Around 100 stories are prepared in the form of flash animation files, and each story is ranked in one of the three difficulty levels, namely basic, intermediate, and advanced. Before the start of a semester, Tom, the system administrator of the target application, must prepare the story schedule. For each of the three difficulty levels, Tom will assign a story for each week. Tom calls the story schedule as "weekly program". To register a child to the appropriate difficulty level, it is the responsibility of the parents of the child, who usually makes the assignment according to the Putonghua proficiency of their children.

During the semester, children can log into the web site and watch a flash story of the week. Then, the system will conduct the pre-assigned 2 to 4 exercises of the story to each child who has watched the story. These exercises can be in any forms. For example, they can be true-or-false, multiple choices, fill-in-the-blanks, or any types of game-based questions. The system would allow each child to complete the exercises within the week and record the scores of the completed exercises. The system can notify the parents of every registered child about the scores of their child by SMS (Short Message Service).

Optionally, children may join some registered web-classes, which are held every week. The parents may make the web-class registration for their children through a web page during the week. The web-classes are Tutor-led online trainings related to the stories of the week (which is part of the weekly program), in which tutors may verbally answer children questions, and guide them to improve their oral skills in Putonghua. Tutor may record the learning progress of the children associated with the web-class registration records. Only one tutor is assign to each web-class and a tutor may involve in many web-classes. Tom is responsible for the maintenance of the web-classes schedule as well. After each web-class, if requested by any parent, the system will send a SMS message to the parent about the learning progress of their child.
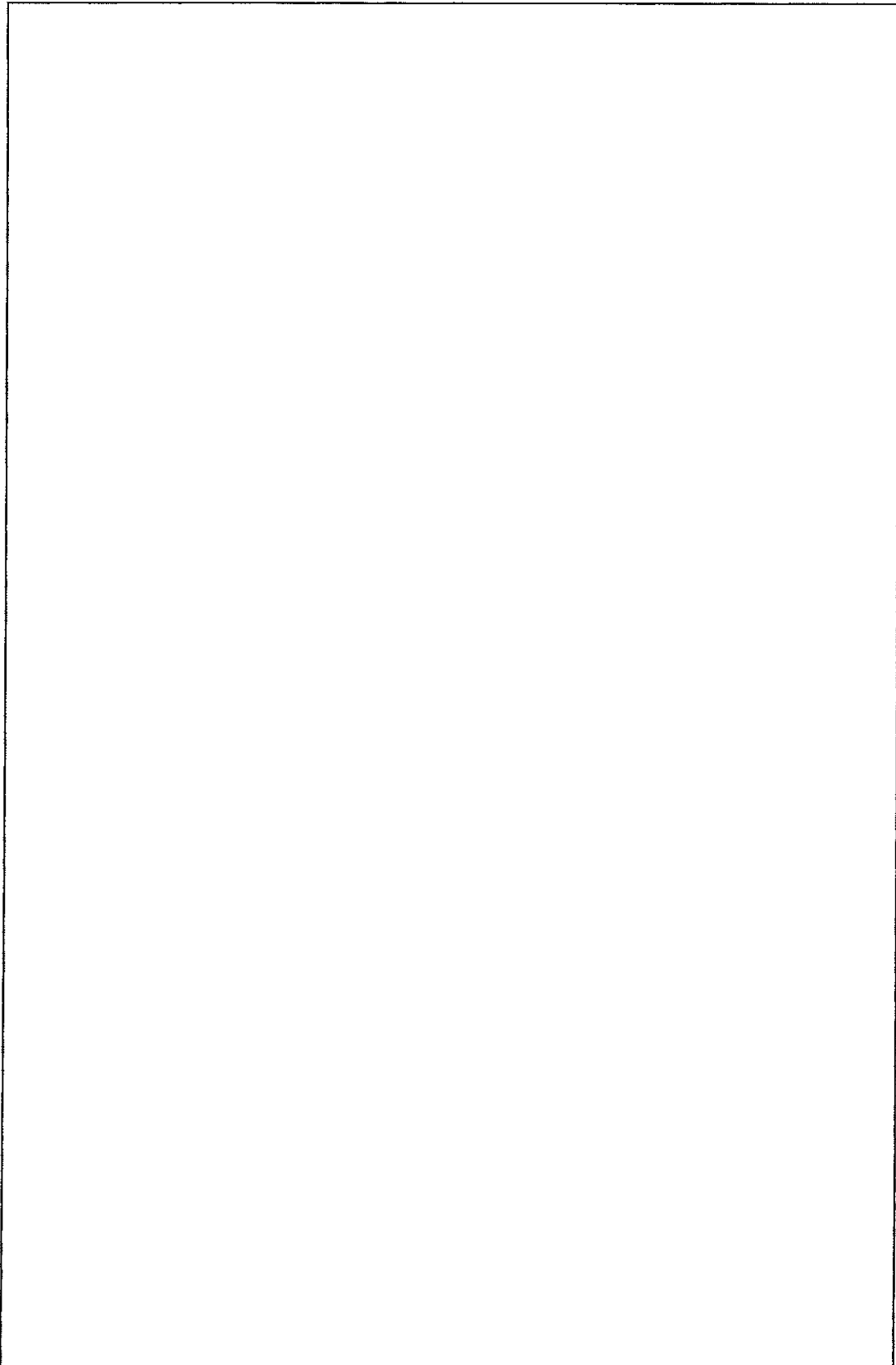
(a) Show all requirements of the application as use cases in the following table. Name your use cases properly, presents a brief description of each use cases.

[10 marks]

Use Case Description	Actors

(b) Draw a use case diagram of the application.

(c) Identify and select potential objects and propose classes for the application. [Note that, the number of blank rows does not indicate the number of potential objects.]

[10 marks]

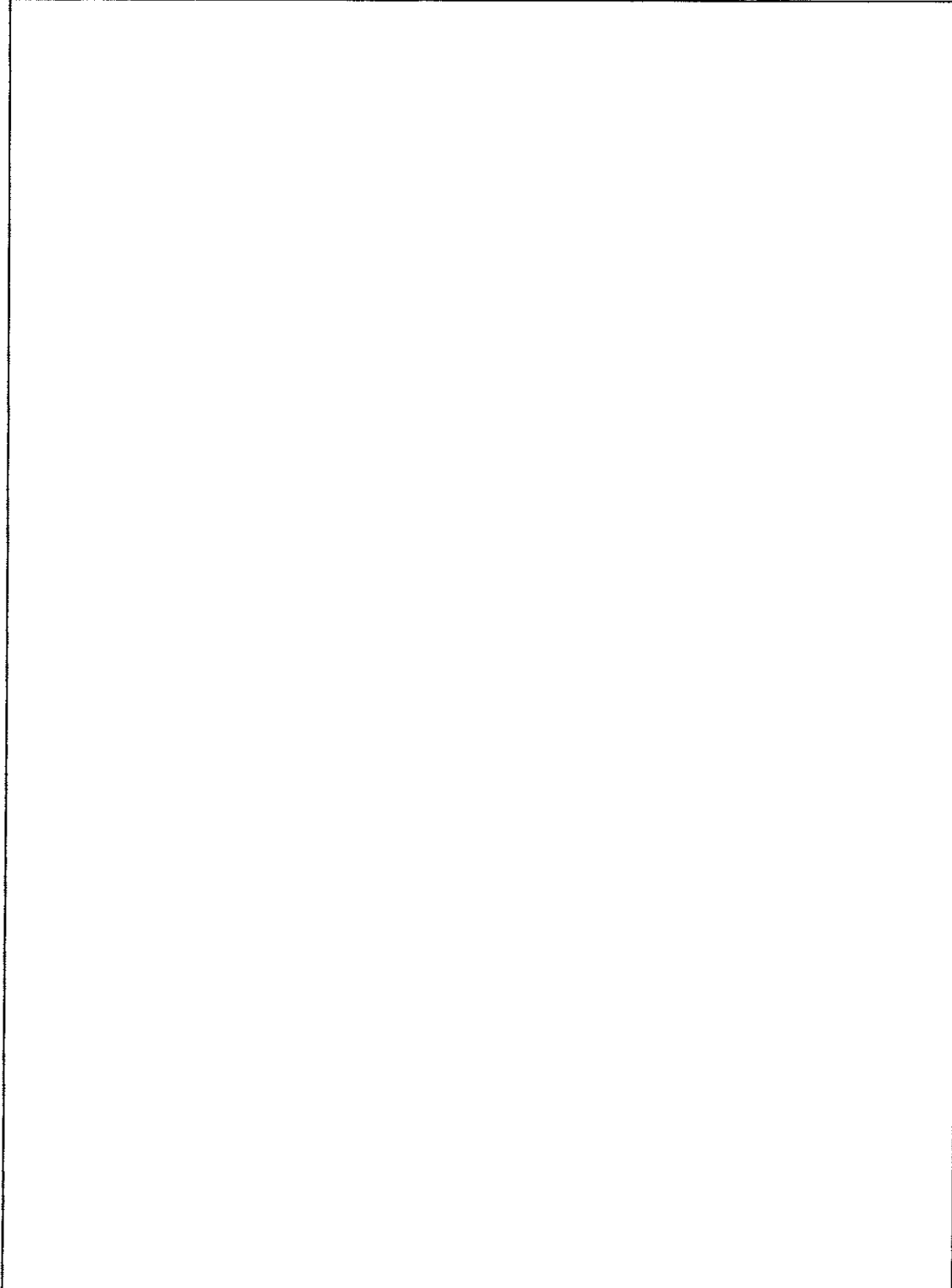| Potential Objects	Proposed?	Reason

(d) Reflect your results in Question 1(c) and draw a CLASS DIAGRAM. Show the associations, inheritance, aggregation and composition (if any) so that classes are properly related.

[12 marks]

2. Object-Oriented Design [24 marks]

Related to Question 1, here is the procedure of how the system displays the home page to the children. A child enters his/her ID and password into the log-in dialog. After the child has been authenticated, the system retrieves the following information from the internal storage: the flash story of the week, the exercises of the week, and the exercise scores of the child. Then, the system displays the home page on which it shows the links (URL) to the flash story and the exercises of the week to the child. The exercises, which have already been finished by the child, should been dimmed out.

(a) You are required to automate the information flow captured in the above procedure. Show the boundary class, control class, and entity classes required for the above procedure, and briefly describe their functions. [Note: You may refer to your class diagram in Question 1(d) to find classes that you have identified in the analysis phase.]

[10 marks]

Boundary Class	Control Class	Entity Class

(b) Sketch a communication diagram or a sequence diagram of the procedure using the identified boundary, control and entity classes. Show messages.
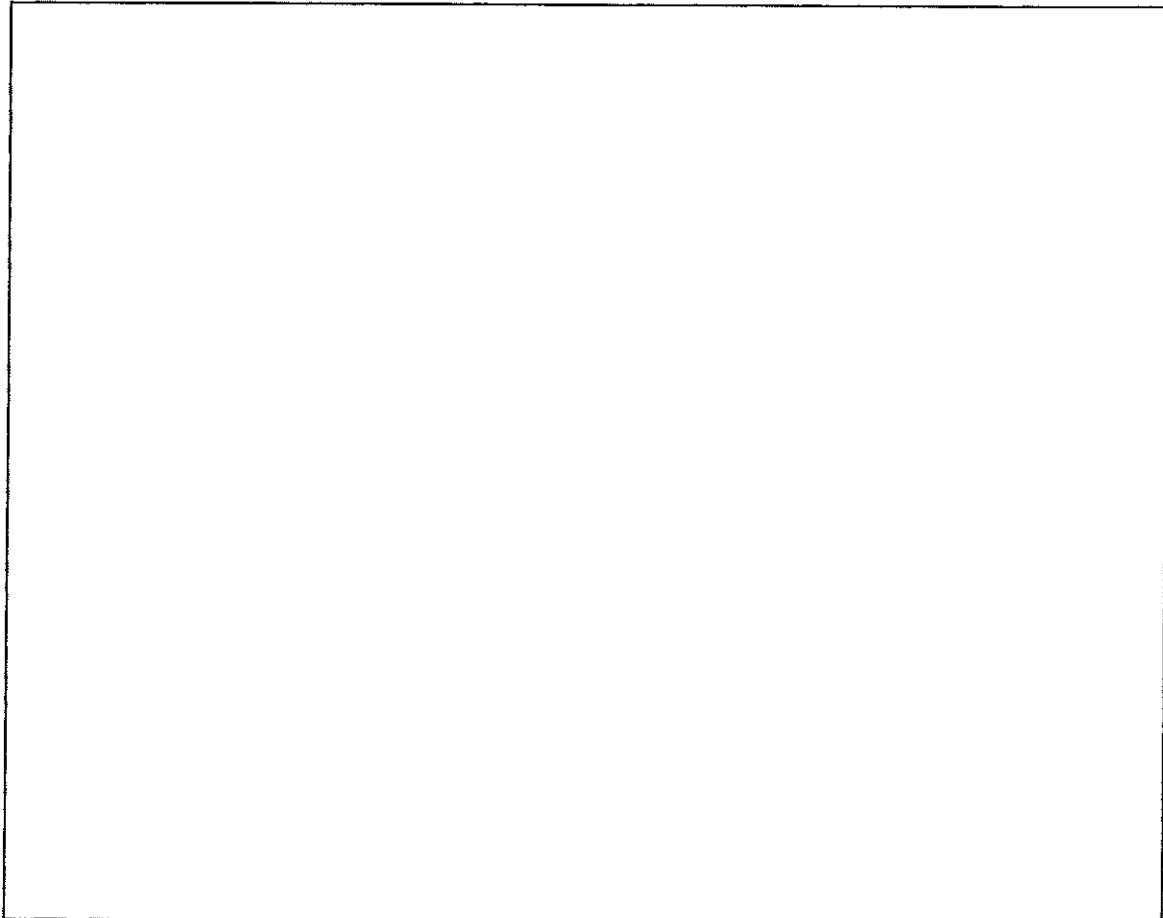
[14 marks]
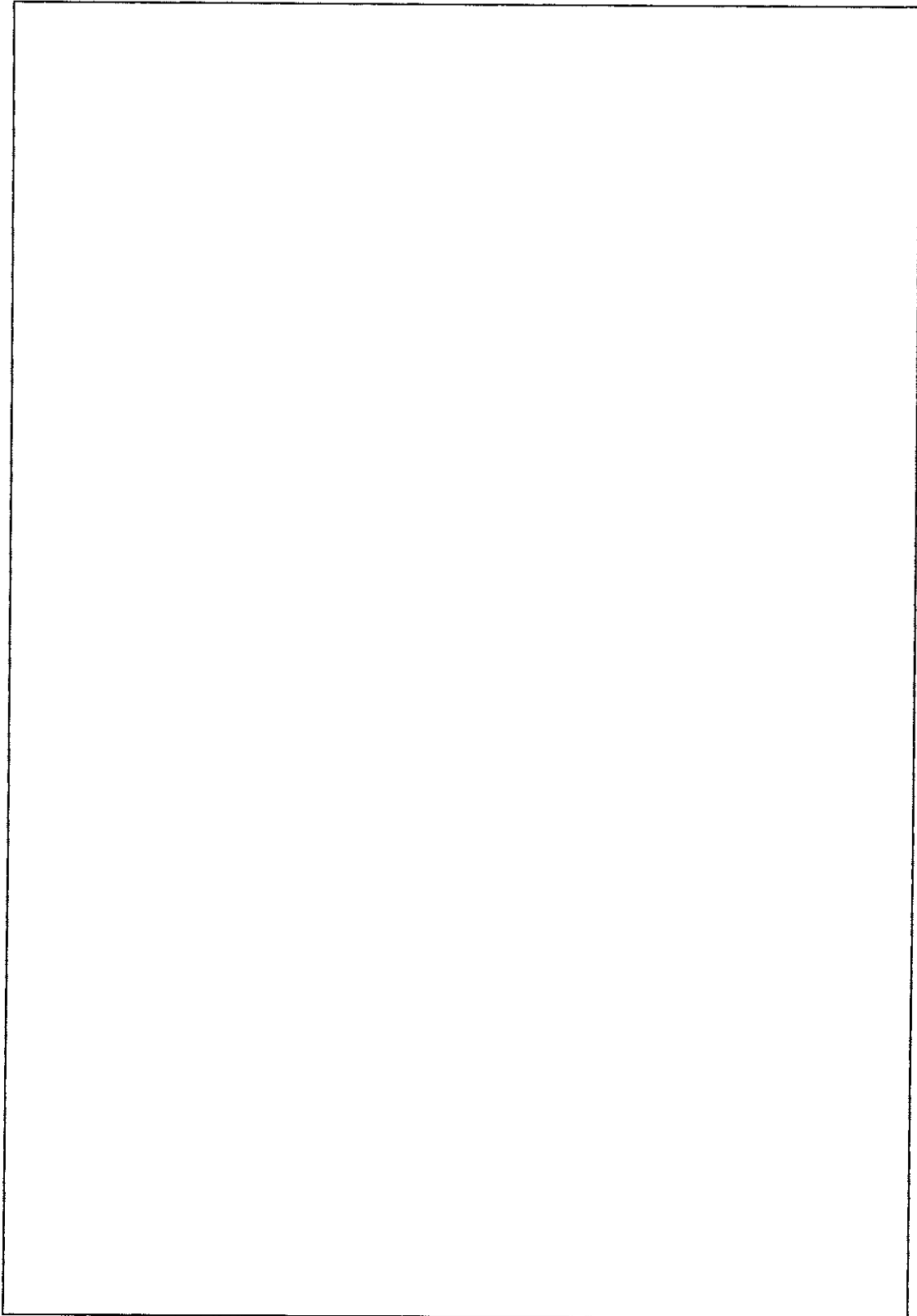
3. Draw a state machine diagram for a simple MP3 player. Here are the features:

[14 marks]

- There is a Power Button to turn on and off the MP3 player.
- There is a Power LCD to indicate that the MP3 player is running.
- When the MP3 is booting up, a Logo is displayed on the screen.
- After booting up, the MP3 would be reset to the first song position, and it is in the Stop state.
- Only FOUR buttons are available on the control panel. They are the buttons for Play, Stop, Forward and Backward.
- Whenever the Play Button is pressed, songs are played in sequence starting from the last stopped song. The song name of the song being g played is shown on the screen. Once the last song in the sequence has been played, the MP3 is automatically stopped.
- During a song is being played, a user is allowed to press the Forward Button to go to the next song in the sequence or the Backward Button to go to the previous song in the sequence.
- Whenever the Stop Button is pressed, the MP3 will go back to the Stop state. When the MP3 player is at the Stop state, a user may press the Forward Button to inform MP3 player to go to the last song in the sequence. Similarly, if the Backward Button is pressed, it will go to the first song.

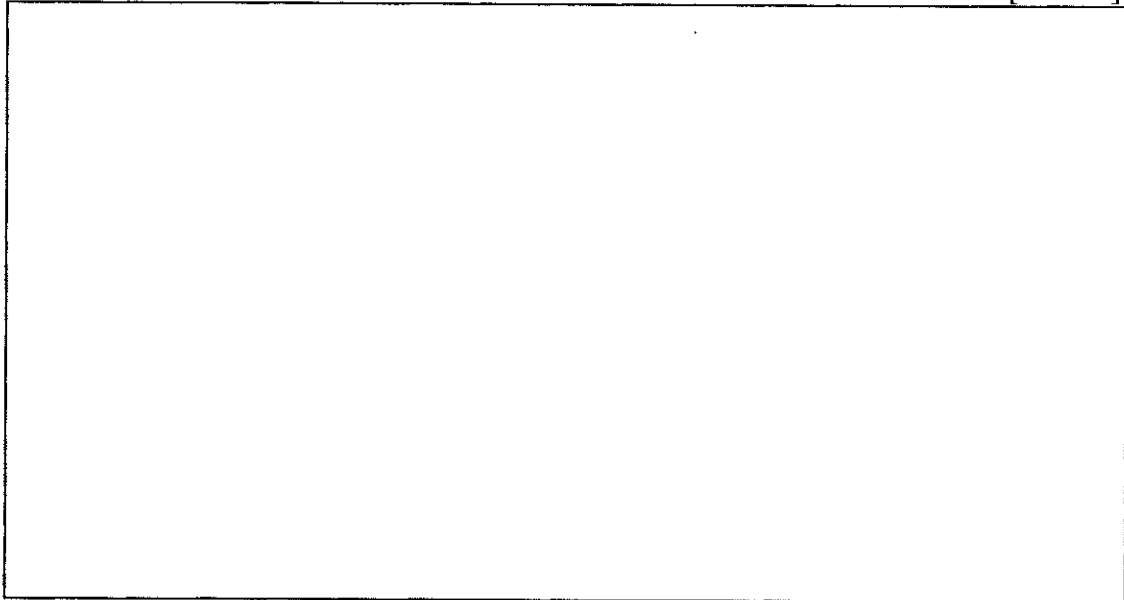(You may STATE any assumptions with the state machine diagram.)

4. Software Design Principles

[18 marks]

(a) Sketch one or multiple class diagrams to illustrate so that your answer uses at least THREE of the following five class design principles: Open-Closed Principle, Liskov Substitution Principle, Dependence Inversion Principle, Interface Segregation Principle, and Law of Demeter. Instead of sketching diagrams, you may choose to show code fragments C, C++, C# or Java to answer this question.

[9 marks]

(b) Explain how the selected three principles have been applied in your answer of 4(a).

[9 marks]

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