Answer Question 1 from Section A and TWO questions out of the three from Section B.

Each question carries 20 marks.

This is a CLOSED book examination

The use of electronic calculators is NOT permitted
Section A

1. Compulsory

Answer each of the following questions very concisely. Each carries two marks.

a) Define the notion of a protocol and describe the main features of HTTP. In particular explain its statelessness and unidirectionality.

b) Give the main features of the HTTP command GET. What is the function called by the server in response to this command? What are the two parameters of this function and their respective roles?

c) Define the notion of a relative URL. Explain how a relative URL is used by a Web browser and how this feature affects servlet programming.

d) Describe the main features of a valid HTML page, covering specifically the notions of element, tag, content and how elements textually relate to one another. Do not describe attributes.

e) Describe the forms and roles of attributes in HTML.

f) What is the role of the init function? By which application is it called and when exactly? What is the role of the destroy function? By which application is it called and when exactly?

g) Explain the problem of session tracking and indicate which feature of HTTP causes this problem. Describe the principle common to the various methods of session tracking. (Do not describe any specific method.)

h) What is an assertion and how should assertions be used in program development? What is a program invariant? Illustrate your answer by a brief example.

i) What are preconditions? How should they be derived from program invariants? Illustrate your answer by a brief example.

j) Briefly describe the three main stages involved in using JDBC.
Section B

Answer TWO questions in this section

2. a) Describe the design principles underpinning the variant Java implementation Dictionary1 of the Evolving Dictionary Model (EDM), as a general framework for Web applications. In particular:

i) Describe the purposes of the four main categories A, B, C and D of classes involved.

ii) Describe how the Web pages of the application are related to category B1 classes. Recall that each page indexed \( p \) has two associated classes. Name these two classes and explain their respective roles.

iii) Explain how this design supports the scalability of the application and any other important criterion of good design for Web applications. (6 marks)

b) Illustrate your answer to part (a) by explaining the role of the following (simplified) program components. In particular explain the difference between a command function and the corresponding basic Dictionary operation.

// From class A0Dictionary1:
C0Dictionary1 D = new C0Dictionary1(Max);
// ...
public void doGet(HttpServletRequest req, HttpServletResponse res)
    throws ServletException, IOException
{ String Page;                             // Page number
    Page = req.getParameter("Page");
    if (Page.equals("0"))
        B1Page0Proc.ProcReq(req, res);
    else if (Page.equals("1"))
        B1Page1Proc.ProcReq(req, res, D);
    // ...
}

// From class B1Page1Proc:
public static void ProcReq(HttpServletRequest req,
        HttpServletResponse res, C0Dictionary1 D)
{ String Com;
    Com = req.getParameter("Com");
    if (Com.equals("Emp"))
        ComEmp(D, Com, req, res);
    else if (Com.equals("Ins"))
        ComIns(D, Com, req, res);
    // ...}

(Question 2 continues on the following page)
(Question 2 continues from the previous page)

```java
// From class C0Dictionary1:
public void Ins(String w, String d)
// Insert (w, d) into D
// Initial conditions
// w is a non-empty string
// d is a non-empty string
// for all i with 0 <= i < n (!word[i].equals(w))
(4 marks)
```

c) Complete the following implementation of ComIns() consistently with part (b), using the function calls B1Page2Gen.DisplayResult(res, Com, Errs), D.Ins(...), D.IsEntry(), Errs.IsMb(), Errs.NumErrs(), etc. (Do not implement the basic function Ins().)

```java
//...
Errs = new B0ErrorSet(B0ErrorSet.InsSet);
if (w == null || w.equals("")
   Errs.Ins(B0ErrorSet.Ins_EmptyWord);
(4 marks)
```

d) i) Describe the paradigm Model View Controller (MVC). Briefly show how this model relates to the three-stage design principle derived from the HTTP request-response cycle.

ii) Show that the generic Web application design illustrated by Dictionary1 may be described as a simple realisation of MVC. In particular clearly relate the relevant aspects of Dictionary1 to those of MVC. (6 marks)
3. a) The text of a JSF page, index.jsp, is given below. Describe the effects of every aspect of each of the numbered lines in detail.

```html
<html>
1  <%@ taglib uri="http://java.sun.com/jsf/core" prefix="f" %>
    <%@ taglib uri="http://java.sun.com/jsf/html" prefix="h" %>
    <f:view>
        <head>
            <title>Simple JSF Application 00</title>
        </head>
        <body>
2  <h:form>
            <h3>Welcome to your zeroth JSF application</h3>
            <h2>DING-DONG</h2>
            <table>
                <tr> <td>The bell did: </td>
                    <td>
3  <h:outputText value="#{bell.oldSound}"/>
                    </td>
                </tr>
                <tr> <td>What will it do next? </td>
                    <td>
4  <h:inputText value="#{bell.sound}"/>
                    </td>
                </tr>
            </table>
3  <h:commandButton value="Proceed" action="anotherSound"/>
        </h:form>
    </body>
</f:view>
</html>
```

(5 marks)

b) Explain the notions of a JSF component and the component tree associated with a JSF page. (5 marks)

c) Describe the JSF life cycle by a diagram and briefly explain each step with reference to your answer to (b). (5 marks)

d) Outline the main differences between a JSP page and a JSF page, with reference in particular to the aim of separating presentation logic and server-side internal processing. (5 marks)

[PTO]
4. a) Explain the notions of a *Java bean* and a *bean property*; the role of beans in developing a JSF application; and the basic rules which a bean must satisfy. (6 marks)

b) i) Explain the notion of a *configuration file* in a Web application, and the role of the file faces-config.xml in particular.

ii) Describe in outline the purpose and content of ‘navigation rules’ in the file faces-config.xml.

iii) Describe in outline the purpose and content of ‘managed-bean rules’ in faces-config.xml. (6 marks)

c) The following text consists of two classes from the QuizV1 Web application, simplified and jumbled up. Note that multiple occurrences of a line are only given once. Reconstruct these two classes.

```java
public class Problem {
    public class Problems {
        for (D.InitScan(), i = 0;
            return prblSet;
    } // class Problem
} // class Problems
        D.GetNext(), i++) {
            int i = 0;
        public Problems() {D = new D0DictionaryDB(4, errs);}
            this.question = question;
        public Problem[] prblSet() {
            public Problem(String question) {
                private D0DictionaryDB D = null;
            Problem[] prblSet = new Problem[D.Num()];
            public String getQuestion() { return question; }
                private B0ErrorSet errs = null;
            prblSet[i] = new Problem(D.CurWord());
        } // public Problem[] prblSet()
    D.NextEntry();
        }
```

(8 marks)