BCS THE CHARTERED INSTITUTE FOR IT

BCS HIGHER EDUCATION QUALIFICATIONS
BCS Level 6 Professional Graduate Diploma in IT

WEB ENGINEERING

Wednesday 27th April 2022 – Afternoon

Answer **any** THREE questions out of FIVE. All questions carry equal marks.

Time: THREE hours.

Answer any Section A questions you attempt in Answer Book A
Answer any Section B questions you attempt in Answer Book B

The marks given in brackets are **indicative** of the weight given to each part of the question.

Calculators are **NOT** allowed in this examination.

Section A

Answer Section A questions in Answer Book A

A1.

a) What is meant by the Internet of Things (IoT)? Assess the principal technologies that have been brought together to make IoT viable.

(5 marks)

b) Describe **FIVE** applications made possible by the Internet of Things, with examples which show how this technology has been used effectively.

(10 marks)

c) Assess the key issues that need to be addressed before IoT can be fully accepted.

(5 marks)

d) What is meant by ‘virtualisation’? Illustrate your answer with suitable examples.

(5 marks)

A2.

a) What are Web Services? Explain how they work and why a developer might want to use them, with suitable examples.

Why might it be necessary to require authentication to use such a service?

(5 marks)

b) One way of controlling access is the use of a username and password.

Analysis of typical users indicates that many passwords can be easily guessed. These include simple character strings such as “111111” or common words such as “password”, or family names, etc. To prevent this, organisations often have password policies to ensure that users do not choose passwords that are easily broken by a dictionary attack.

Three typical schemes are:

- Scheme A: Password must have exactly 8 letters and not include a dictionary word.
- Scheme B: Password must have more than 16 letters and contain at least one number and non-alphanumeric character.
- Scheme C: Passwords must be changed at 30-day intervals.

For **each** scheme, explain **ONE** weakness from either a security or usability perspective.

(6 marks)

```
                                <First_name>Henry</First_name>
                            </name>
                        </composer>
                    </track>
                    <track>
                        <track-title>Pour Mon Ami</track-title>
                    </track>
                        <composer>
                                <name>
                                <Last_name>Donizetti</Last_name>
                                <First_name>Gaetano</First_name>
                            </name>
                        </composer>
                <performer>
                                <name>
                                <Last_name>Pavarotti</Last_name>
                                <First_name>Luciano</First_name>
                    <role>Soloist</role>
                                </name>
                        </performer>
                </cd>

        </genre>
</cdcatalogue>
```


c) Another possibility is to use two-stage authentication.

Three typical schemes are:

- Scheme D: Send an email to a previously registered account giving a code that must be typed in to gain access.
- Scheme E: Ensure that a device with a pre-loaded security code is attached to the computer.
- Scheme F: Make use of a physical characteristic of the authorised user, such as iris or fingerprint recognition.

For **each** scheme, explain **ONE** weakness from either a security or usability perspective.

(6 marks)

d) There have been calls in many countries for online social media content to be monitored and either marked or removed. This is for many reasons which include interference with elections, protection of children, perpetuation of fraud, etc. Considering the technological and ethical factors, discuss the following statement:

“All social media content should be monitored and, if it is considered inappropriate, removed.”

You should ensure that you present a balanced argument (considering situations when monitoring and removal of social media content might have positive and negative consequences) and come to a clear conclusion.

(8 marks)

[Turn Over]

Section B
Answer Section B questions in Answer Book B

B3.

a) A solution stack is a complete set of software components required to run a web application.

LAMP is a well-known solution stack for dynamic web sites. What are the **FOUR** components that make up the acronym and what role does **each** have in the architecture of the website?

(5 marks)

b) It is possible to perform 'server-side scripting' using a variety of programming languages. Give the names of **FOUR** different server-side scripting languages.

Give **THREE** distinct factors which may lead a web developer to choose (or avoid) a particular server-side scripting language when embarking on a new project. For **each** factor, clearly explain the potential impact on the project.

(6 marks)

c) When developing complex web applications, it is often advised to reuse existing code (and supporting tools). These additional software components are typically distributed as libraries or structured as frameworks.

i) Explain the difference between a software library and a framework. When is it appropriate to use each?

(4 marks)

ii) Give the name of a well-known web application framework and specify the language in which it is written.

(2 marks)

iii) Assess when it is appropriate to:

- Use a framework
- Use a software library
- Develop the code oneself.

Your answer should include examples showing the reasons you would choose each one.

(8 marks)

B4.

The South Pennine National Park Authority (SPNPA) has had a large increase in visitors due to restrictions imposed because of the current health crisis. This has led to overcrowding in some of its car parks when others are often nearly empty. To direct potential visitors to car parks where there are spaces the SPNPA has decided to implement an online booking system where potential visitors are required to book places for the day of their visit.

You have been tasked with developing a simple web-based application to manage these bookings. A simple database structure is proposed as shown in figure B4.1.


```
                    <track-title>5th Symphony – 3rd Movement</track-title>
                </track>
                <track>
                    <track-title>5th Symphony – 4th Movement</track-title>
                </track>
            <note>My favourite recording of this piece</note>
        </cd>
    </genre>
    <genre>
            <genre_title>Choral</genre_title>
<cd>
        <cd_title>Operatic Arias</cd_title>
                <image src="aria.jpg" height="100" width="100" />
        <cd-code> DG123</cd-code>
                <track>
                <track-title>Nessun Dorma</track-title>
            <composer>
                        <name>
                        <Last_name>Puccini</Last_name>
                        <First_name>Giacomo</First_name>
                    </name>
                </composer>
<performer>
                        <name>
                        <Last_name>Domingo</Last_name>
                        <First_name>Placido</First_name>
                <role>Soloist</role>
                    </name>
            </performer><performer>
                        <name>
                        <Last_name>Carreras</Last_name>
                        <First_name>Jose</First_name>
                <role>Soloist</role>
                    </name>
                </performer>
<performer>
                        <name>
                        <Last_name>Pavarotti</Last_name>
                        <First_name>Luciano</First_name>
                <role>Soloist</role>
                    </name>
                </performer>
        </track>
                <track>
                    <track-title>Dido's Lament</track-title>
                <composer>
                        <name>
                        <Last_name>Purcell</Last_name>
```

Figure B4.4 Sample Data for Booking Table

carpark.id	date	vehicle.id
1	2022-10-04	1
1	2022-10-04	2
1	2022-10-04	3
1	2022-10-04	4
1	2022-10-04	5
2	2022-10-04	6
2	2022-10-04	7
3	2022-10-05	8
3	2022-10-05	3
4	2022-10-05	4

Figure B5.1 Sample CD DTD File

```
<?xml version="1.0" encoding="ISO-8859-1" standalone="no"?>
<!DOCTYPE cdcatalogue SYSTEM "cdcatalogue.dtd">
<?xml-stylesheet type="text/xsl" href="cg.xsl"?>
<cdcatalogue>
        <genre>
       <genre_title> Orchestral </genre_title>
                  <cd>
              <cd_title>Beethoven's 5th Symphony</cd_title>
    <cd>
 <cd_title>Beethoven's 5th Symphony</cd_title>
        <image src="Beethoven5.jpg" height="100" wi+dth="100" />
 <cd-code> DEC057</cd-code>
         <track>
        <track-title>5th Symphony – 1st Movement</track-title>
  <composer>
                    <name>
                   <Last_name>Beethoven</Last_name>
                      <First_name>Ludwig</First_name>
                  </name>
              </composer>
              <performer>
                    <name>
                     <Last_name>Rattle</Last_name>
                       <First_name>Simon</First_name>
                   <role>Conductor</role>
                  </name>
              </performer>

</track>
          <track>
               <track-title>5th Symphony – 2nd Movement</track-title>
          </track>
          <track>
```


N.B. This question involves server-side scripting. The preferred language is PHP, but answers written in ASP or JSP are also accepted.

Clearly state which server-side scripting language you will be using for the whole question, and make sure all relevant files are named accordingly.

a) Explain why the SPNPA uses https: protocol rather than http:. You should evaluate especially the security aspects, and how they may affect the SPNPA.
(4 marks)

b) Start by developing a simple webpage https://spennineNP.gov.uk/parking.html that welcomes potential visitors to the national park and lists the car parks and the capacity of each. What code is required to:

i) Connect to the database called PARKING located on the NPA server https://spennineNP.gov.uk/ with the username PARKCONTROL and the password parkit.
(4 marks)

ii) Display the names of each of the car parks, and the capacity of each. Sample data for the table car park is provided in Figure B4.2
(3 marks)

iii) Provide a script for a form that allows a visitor to enter their car registration number and the date and car park they wish to use for their visit. Sample data for the table vehicle is provided in Figure B4.3 and for the table booking in Figure B4.4
(5 marks)

iv) How would you modify this script to allow a visitor to book more than one visit at the same time?
(4 marks)

v) As currently specified, it would be possible to book more places than are available on a particular day. Describe a set of modifications to both the script and the database that rejects a booking should the chosen car park be full on that day. How would you provide that alternative car parks that do have spaces are offered instead?
(5 marks)

You only need to provide the code to access the database and display the results.
Sample data for the tables used is provided in Figure B4.1, Figure B4.2 and Figure B4.3.
The id field of both vehicle and carpark are automatically incremented by MySQL.
The following SQL syntax may be useful to accomplish some of this question's tasks:

INSERT INTO tbl_name (col1, ...) values (val1, ...);

SELECT * FROM tbl_name WHERE col1 = val1;

SELECT * FROM tbl1_name (INNER | LEFT | RIGHT | FULL) JOIN tbl2_name ON tbl1_name.col1 = tbl2.col1;

where tbl_name, col1, val1 etc. are replaced with appropriate values.
[Turn Over]

B5.

a) A DTD element may be accompanied by one of the five symbols * , | + ? . Describe the meaning of **each** of these symbols with suitable examples.

(4 marks)

b) Round brackets are used to group elements in different ways. Give **THREE** different examples and describe the meaning of each.

(3 marks)

c) An XML author must decide when to use attributes to contain data and when to use nested elements. Give an example to demonstrate this and state **FOUR** reasons why attributes are of limited use.

(4 marks)

d) Briefly explain the benefits and usage of the empty element in an XML DTD document citing a suitable example.

(3 marks)

e) Write an external DTD for the XML file in figure B5.1:

- Sequence of elements is as shown in the XML document (i.e. cdcatalogue is a container of genre elements).
  - genre element must be present zero or more times.
  - Each genre element contains a genre_title and zero or more cds.
- Each cd record consists of:
  - cover image for each cd that captures attributes of height, width and location of image
  - For each cd, exactly one cd_title and one cd_code element must be present
  - one or more tracks.
    - A track has a title and optionally a composer and one or more performers.
    - Composer and performer consist of both a First_name and a Last_name.
    - The performer may also have a role, which may be conductor, orchestra, or soloist,
    - For each cd, there may be one or more notes.

(11 marks)

End of Examination

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FIGURES TO ACCOMPANY 2022 EXAMINATION PAPER IN WEB ENGINEERING

Figure B4.1 Entity Relationship Diagram for Car Park Database

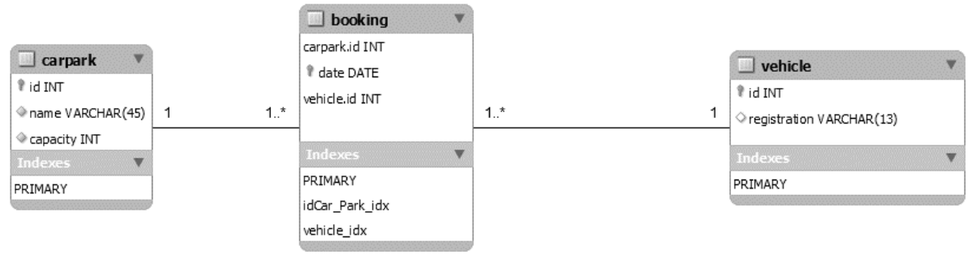

Figure B4.2 Sample Data for Car Park Table

id	name	capacity
1	North	5
2	South	5
3	East	5
4	West	5

Figure B4.3 Sample Data for Vehicle Table

id	registration
1	AA12XYZ
2	AB54GHJ
3	VB23HJK
4	DD76YUU
5	HG98VRT
6	ER14LPQ
7	KH78NMH
8	RF52FBG
9	KS94VER
10	XX74DSA

[Turn Over]