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B.Sc. Engg. / HD CSE 5th Semester — 28 May 2018

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION — **WINTER SEMESTER, 2017-2018**

DURATION: 3 Hours — **FULL MARKS: 150**

CSE 4513: Software Engineering and Object Oriented Design

Programmable calculators are not allowed. Do not write anything on the question paper.

There are **8 (eight)** questions. Answer any **6 (six)** of them.

Figures in the right margin indicate marks.

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1. a) Briefly describe prototyping software process model. 7

   b) Elaborate the role of Software Requirement Specification (SRS) in Software Testing. 8

   c) ISO 9001 provides guidelines for different aspects of software development process. One of the guidelines for Management is as follows: 10

```
Management Responsibility:
  - Management must have an effective quality policy.
  - The responsibility and authority of all those whose work
    affects quality:
      - must be defined and documented.
  - Responsibility of the quality system:
      - independent of the development process,
      - can work in an unbiased manner.
  - The effectiveness of the quality system:
      - must be periodically by audited.
```

   What SQA steps can an organization assume to fulfill the management requirements of ISO 9001?

2. a) Observer is a pattern used in software design when there are multiple views of a single data/ subjects. Briefly describe the observer pattern. 8

   b) What are the other patterns in distributed environment that have similar characteristics as observer pattern? Mention two such patterns and discuss their implementation issues? 7

   c) Design pattern is a proven solution to a well-researched problem. However, the pattern is applied to a particular context. In your software development project, you might have used some of the design patterns. Briefly explain how (in which context) you used **any one** of these patterns in your software project: **Adapter/factory/façade**. 10

3. a) Agile processes are normally customized in the software organizations to tune for the best productivity considering their situations. In the software development project, what agile process did you adapt for the development? List the number of customizations you made and explain the reasons for that. 8

   b) Briefly explain SCRUM agile process. 7

   c) Prepare a Risk Information Sheet (RIS) for the following risk: 'A personality feature will be added to the software for better user experience' which has a risk probability of 80% and will cost $20,000 dollars. 10

4. a) Briefly explain the use case based project size/ cost estimation technique. 7

b) Soft skill is very important for achieving individual and group success. What are the soft skills did you practice during the project work on software development? 6

c) Explain driver and stub code for software testing. Write a driver code for testing the following code snippet. Do you feel if any stub code will be necessary to write? If yes, the write the stub code also. 6

```
class GPS{
    public point3D adjustGPS(){
        Point3D gpsVal= System.getGPS();
        gpsVal.adjustXYZ(5,10,0);
        return gpsVal;
    }
}
```

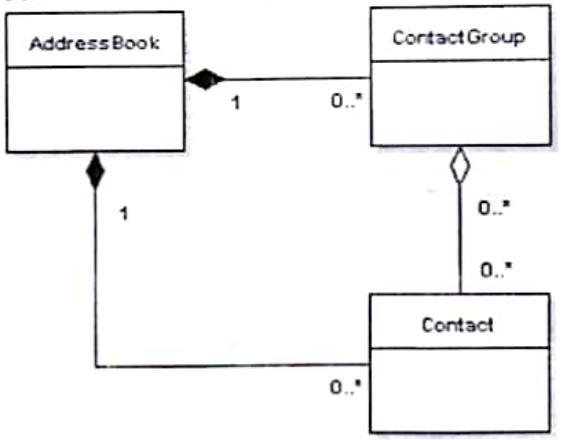
d) White box testing introduces a metric called code coverage which measures how much code is covered by a set of test cases. Consider the following decisions statements (e.g. if, switch, while, for etc.) and write appropriate test cases so that each side of the decisions are covered at least once. 6

```
int x, y;
x = c.readInt ();
y = c.readInt ();
if (y == 0)
    c.println ("y is zero");
else
    if (x == 0)
        c.println ("x is zero");
    else
    {
        for (int i = 1; i <=x ; i++)
        {
            if (i % y == 0)
                c.println (i);
        }
    }
```

5. a) Briefly describe Service Oriented Architecture (SOA). 7

b) Testing is a never ending activity and hence a testing strategy is needed to restrict the testing effort within the budget. One of the strategies can be: 'to find the vital few and test them'. Discuss the role of 'Cyclomatic Complexity', 'Call Graph', 'No of functions in a class' Metrics in finding the 'vital few'. How do you even define the 'vital few'? 6

c) Describe the following aggregration and composition relationship : 6



d) Change is difficult and costly to accommodate in typical software process model. Explain why? How does the agile process model accommodate change then? Show the cost savings of agile process using a chart/graph. 6

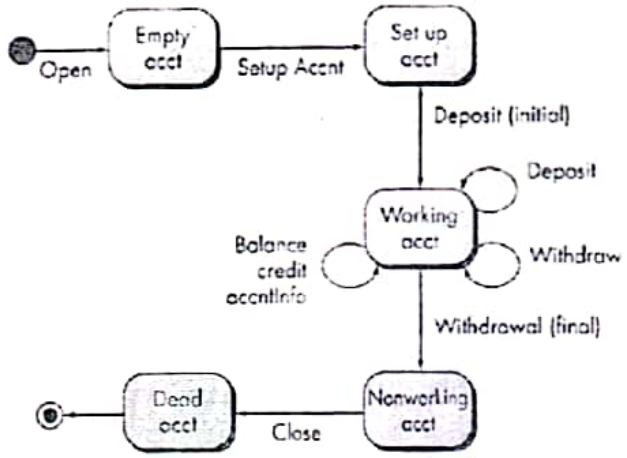
6. a) What is a 'critical path' in PERT/CPM ? How is it calculated? 7

b) Explain the following Babich's equation for company A with respect to its rivals B and C. 6

$$A_{t+1} = A_t(1 - x) + B_t y\left[\frac{A_t}{A_t + C_t}\right] + C_t z\left[\frac{A_t}{A_t + B_t}\right] + G\left[\frac{A_t}{A_t + B_t + C_t}\right]$$

c) Define Error Index (EI). Why is it defined as a quality metric? 6

d) What is a test case? Given the following state diagram, enumerate a number of test cases to verify all the possible states of the system. 6



7. a) Briefly describe waterfall model. When can waterfall process model be more productive even over agile process models? 10

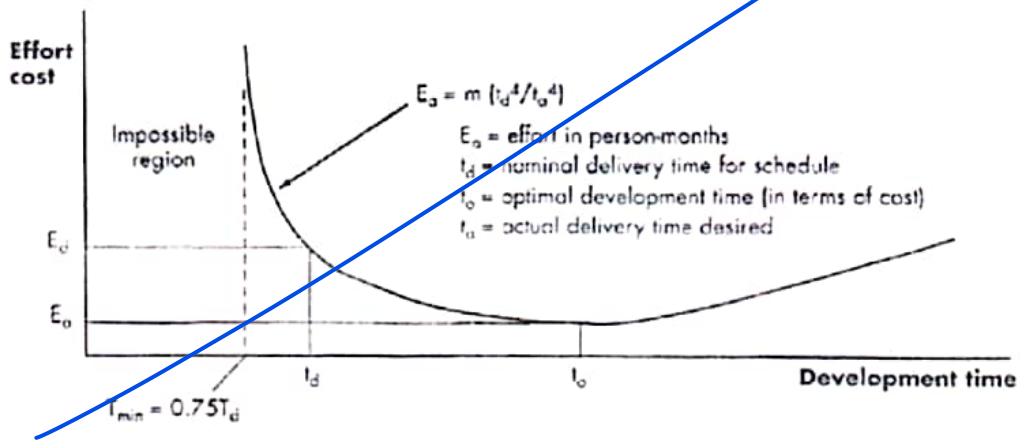
b) What are cohesion and coupling? What are their impacts on the modularity and extendibility of software? 7

c) Write a short note on class diagram and object diagram. 8

8. a) Briefly explain the architecture of a web application and explain how the input from a HTML form are propagated and processed in the server. 10

b) 'Islands of Automation' is a proven anti-pattern that arises from finding isolated solutions to different problems of a big system. Briefly explain the Islands of Automation with its architecture. How can the anti-pattern be corrected with its architecture and technologies? 8

c) Explain the following graph that shows the relationship between effort and delivery time in project scheduling. 7



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1. a) What is the relationship among error, fault and failure? How can software defects be prevented in the early stage of the software development? 2+3

   b) "Consider a hospital management website used by hospital staffs, doctors and patients for making appointments. The system also provides suggestions regarding nearby hospitals, consultancy centers, diagnostic centers etc. The system stores data in both cloud and file storage system." Given the scenario, draw the Architectural Context Diagram of the system. 5

   c) Assume, IUT course management system enables the course manager, teachers and students manage courses during a semester. At the beginning of each semester, the course manager creates the list of offered courses. It is the task of the course manager to create, delete or update course information. Teachers are also assigned courses by the manager. Each course is coordinated by a teacher. Students can enroll in multiple courses during a semester through the system. 2+4+4

   Given the scenario, answer the followings:

   i. Identify the data entities of the system.
   ii. Draw the Entity Relationship Diagram of the scenario
   iii. Draw the Schema Diagram of the scenario.

   d) Identify and explain the Generalization, Aggregation and Composition relationships in the following Figure 1. 5

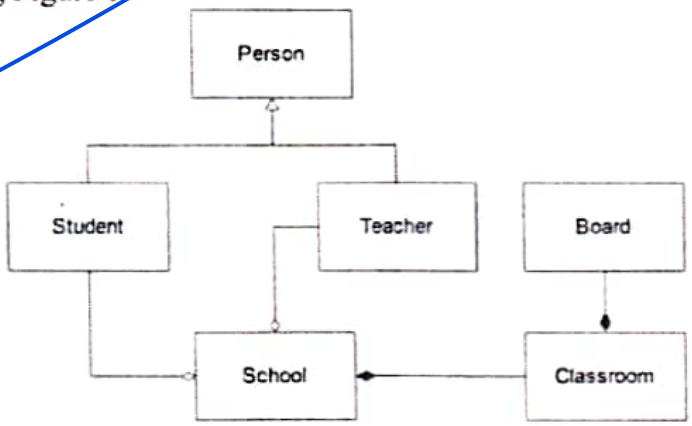

Figure 1: ERD for Question 1(d)

2. a) Describe Cross Site Scripting (XSS) with example. How can this attack can be prevented in web based systems? 3+3

   b) Capability Maturity Model (CMM) is a framework to analyze the approach and techniques followed by any organization to develop a software product. Briefly describe the organizational characteristics based on which CMM model analyzes the standard of an organization. 6

   c) What is Six Sigma? How is it used to assure industry level software quality? 5

   d) Define and draw Waterfall and Agile Software Process model. Discuss the advantages and disadvantages of each model. 4+4

3. a) Define Test Coverage. "100% coverage does not mean 100% tested." – Explain the assertion. 2+3

b) What is Cyclomatic Complexity? Given the code listing in Figure 2, compute the cyclomatic complexity, and identify the basic path set that can cover all the branches of the program. 1+7+6

```
int perform (int[ ] numbers, int N) {
      int i, count, sum, mean;
      i=count=sum=0;

      while (i<N && numbers[i]!=-1) {
            if (numbers[i]>=0 && numbers[i]<=1000){
                  count+= 1;
                  sum+= numbers[i];
            }
            i+= 1;
      }
      if (count>0 && sum>0)
            mean = sum/count;
      else
            mean = -1;
      return mean;
}
```

Figure 2: Code listing for Question 3(b)

c) Quality Engineering process has three activities – Pre-QA, In-QA and Post-QA activities. Briefly describe and draw the overall Quality Engineering Process. 3+3

4. a) State the differences between Black Box and White Box Testing. Following are fields that a user fills out while registering to a system: 2+12

Username: must be between 6 and 12 characters long, must start with a letter and include only letters and digits.
Age: must be a number greater or equal to 18 and less than 65.
City: must be one of Dhaka, Chittagong, Khulna or Sylhet
Postalcode: must be 6 characters long, start with a letter and alternates between letters and digits.

i. List valid and invalid equivalence classes for each input fields with examples.
ii. Besides for each field identify the boundary values.

b) Consider, in a website a user is prompted to upload a profile picture with certain conditions like – the image should be in '.jpg' format, the file size should be less than 32kb and the resolution should be exact 157×177. If any of the conditions fails the system will throw corresponding error message stating the issue and if all conditions are met photo will be updated successfully. 5
Draw the decision table for testing all possible situations a user can face while uploading the profile picture.

c) What are Quality Control (QC), Quality Assurance (QA) and Total Quality Management (TQM)? How can you advance your organization from QC to TQM? 3+3

5. a) Design patterns are known solution to existing problems. Abstract Factory pattern is applicable where multiple families of object components are involved while object creation.Demonstrate the Abstract Factory pattern with an example code. 10

b) Explain the quotation – "Don't unit-test GUIs. It's more trouble than it's worth." If so, how can we test GUI code? 2+1

c) XYZ company has completed the development of a website for Education Board Result Management System. Before releasing the product online, they have to perform rigorous testing. The company have decided to test following scenarios before product release: 8

i. At any particular time, generally 1000 users hit the website simultaneously. The system should behave normally, if concurrently 1000 users search for the results.

ii. During result publication hours, huge number of users may hit the system. If more than 1000 users query for result concurrently, the system may behave abnormally. After such a case, the system should resume properly with no data lose.

iii. Hackers may try to corrupt the system by sending 10,000 requests at a second.

iv. After result publication, most users tend to generate and download result reports.

For each of the above test scenarios identify and justify which testing type needs to be applied.

d) Is there any code smell in the following code snippet of Figure 3? If yes, describe methods to remove this smell. 4

```
public class Report{
      void printReport(Profile profile){
      string name = profile.GetFirstName() + " " +
      profile.GetLastName();
      System.out.println("Name is: "+name);
      string department = profile.GetDepartmentName();
      System.out.println("Department is: "+ department);
      double salary = profile.getBaseSalary() +
      profile.getBaseSalary() *.30;
      double tax = salary * .05;
      System.out.println("Salary is: "+salary+"and Tax is:"+ta:
      }
}
```

Figure 3: Code listing for Question 5(d)

6. a) How is SQL Injection carried out to attack web systems? What precaution needs to be taken to prevent it? 3+2

b) What is Refactoring? What are the two advices we need to follow before refactoring? 2

c) What is the difference between Stub and Driver? Describe with example. Write a code sample where Mock testing is used. 4+4

d) Observer Pattern defines a one-to-many dependency between objects so that when one object changes state, all its dependents are notified and updated automatically. Briefly describe observer pattern with an example. 10

7. a) State the difference between Singleton and Flyweight pattern. 3

b) What is Unit Testing? Do we write unit tests for all methods of code repository, Why? 2+2

c) Developers are always sensitive about their written code. A developer has written a calculator class that can calculate the average of array of integers. However, with time the requirement changes and now, the client wants to calculate the average of list of integers. Explain how the developer can adapt with the new requirement by applying the appropriate design pattern. 7

d) What is Long Method smell? Describe three mechanisms for reducing this code smell. 1+6

e) Briefly Explain Refused Bequest. Which design pattern can provide the solution for refused bequest and How? 4

8. a) Explain the terms – Test Driven Development (TDD), Sanity Testing, Scalability, Lazy Instance. 8

b) Define Oddball Solution with example. State the difference between literal and semantic code duplication. 2+2

c) Managers, Postman, Firefighters and Computer Engineers all are workers. All of them generally follow a similar daily routine like get up from sleep, get food, go for work, do work, return home, relax and get sleep. However, their way of working and relaxing will be different based on their job types. Having this scenario, apply and demonstrate Template Pattern such that code duplicity can be reduced. 7

d) Identify the code smells from the following code snippet in Figure 4: 6

```
Public void Course{

    string courseName;
    int id;

    public Course(String name, int id){
       this.courseName = name;
       this.id = id;
      }
    List<Student> students = new ArrayList<Student>();

    void EnrollStudent(string name, int id, string date, strir
department, string city, string country, string brithdate){
         students.add(new Student(name, id, city, "","000000",
department, date, country, birthdate));
   }
   void findStudentByDepartment(string dept){
      foreach(Student s: students){
         if(s.department.Equals(dept){
            System.out.println(s.id);
         }
      }
   }
   void findStudentByCity(string city){
      for(int i=0; i< students.size();i++){
         if(students.get(i).city == city){
            System.out.println(s.id);
         }
      }
   }
}
```

Figure 4: Code listing for Question 8(d)