

A10.2-R4: SOFTWARE TESTING AND QUALITY MANAGEMENT

Objective of the Course

This objective of the course is to make students aware about the importance of the software testing during software development. The course covered to be in line with the development tools and languages taught in this level. The course will prepare the student for software testing and debugging. It will further laid the foundation for advanced courses in Software quality assurances.

Outline of Course

S. No.	Topic	Minimum number of hours
1.	Introduction	02
2.	Importance of Software Testing	04
3.	Testing Techniques and Strategy	10
4.	Verification and Validation	06
5.	Building Test Cases and Plans	20
6.	Quality Assurance and Standards	10
7.	Debugging Technique and Tools	04
8.	External Source of Errors	04
	Lectures	= 60
	Practical/tutorials	= 60
	Total	= 120

Detailed Syllabus

- 1. Introduction** **02 Hrs.**
Software program and its objective, Software development techniques, top-down verses bottom-up approach, modular and structures programming. A brief introduction about object oriented approach.
- 2. Importance of Software Testing** **04 Hrs.**
Software testing and its importance, software development life cycle verses software testing life cycle, Deliverables, version and error control
- 3. Testing Techniques and Strategy** **10 Hrs.**
Unit testing, Integration testing, System testing, Acceptance testing
White-Box testing: Flow Graph notation, Cyclomatic Complexity, Graph matrices, control structure and loop testing.
Black-Box testing: Equivalence partitioning, Boundary Value Analysis, Orthogonal Array testing.
- 4. Verification and Validation** **06 Hrs.**
Requirement verification, Coding standards, Walk through, Formal Inspection, Design validation and verification, Function test, Design metrics, correctness proof and its requirement.

5. Building Test Cases and Plans**20 Hrs.**

Format of test cases, Du, dc and other data paths, Test data selection, branch coverage, statement coverage, pre-condition and post-condition, Test schedule and check pointing, suitable exercises for creating test cases for each type of techniques mentioned in para 3.

6. Quality Assurance and Standards**10 Hrs.**

Basic software quality parameters and its metrics, Software Configuration Change and types of errors, Quality management models: ISO, SPICE, IEEE, CMM

7. Debugging Technique and Tools**04 Hrs.**

Integrated development environment, debugging, tracing, data inspection, exception errors, code and data redundancy, unreachable code.

8. External Source of Errors**04 Hrs.**

Main memory, conflicting dll and unknown interface as source of error and their rectification.

Note: Any open-source Software Tools may be utilized, such as “winrunner”.

RECOMMENDED BOOKS

MAIN READING

1. Desikan S, Ramesh G, "Software Testing", Pearson Education, 2008.
2. Tamres L, "Introducing Software Testing", Pearson Education, 2007.
3. Dustin E, "Effective Software Testing", Pearson Education, 2007.
4. Mathur A.P, "Fundamentals of Software Testing", Pearson Education, 2008.

SUPPLEMENTARY READING

1. Brian Marick, "The Craft of Software Testing", Pearson Education, 2008.
2. Rajani & Oak, "Software Testing : Methodology, Tools and Processes" Tata McGraw-Hill, 2007.
3. R. Pressman, "Software Engineering", 6th Edition, Tata McGraw-Hill.

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Model Question Paper

NOTE:

1. There are **TWO PARTS** in this Module/Paper. **PART ONE** contains **FOUR** questions and **PART TWO** contains **FIVE** questions.
2. **PART ONE** is to be answered in the **TEAR-OFF ANSWER SHEET** only, attached to the question paper, as per the instructions contained therein. **PART ONE** is **NOT** to be answered in the answer book.
3. Maximum time allotted for **PART ONE** is **ONE HOUR**. Answer book for **PART TWO** will be supplied at the table when the answer sheet for **PART ONE** is returned. However, candidates, who complete **PART ONE** earlier than one hour, can collect the answer book for **PART TWO** immediately after handing over the answer sheet for **PART ONE**.

TOTAL TIME: 3 Hours

TOTAL MARKS: 100
(PART ONE -40; PART TWO-60)

PART ONE

(Answer ALL Questions; each question carries ONE mark)

1. **Each question below gives a multiple choices of answers. Chose the most appropriate one.**
 - 1.1 Verification is:
 - a) Checking that we are building the right system
 - b) Checking that we are building the system right
 - c) Performed by an independent test team
 - d) Making sure that it is what the user really wants
 - 1.2 A regression test:
 - a) Will always be automated
 - b) Will help ensure unchanged areas of the software have not been affected
 - c) Will help ensure changed areas of the software have not been affected
 - d) Can only be run during user acceptance testing
 - 1.3 Which of the following could be a reason for a failure
 - 1) Testing fault
 - 2) Software fault
 - 3) Design fault
 - 4) Environment Fault
 - 5) Documentation Fault
 - a) 2 is a valid reason; 1,3,4 & 5 are not
 - b) 1,2,3,4 are valid reasons; 5 is not
 - c) 1,2,3 are valid reasons; 4 & 5 are not
 - d) All of them are valid reasons for failure
 - 1.4 Test is prioritized so that:
 - a) you shorten the time required for testing

- b) You do the best testing in the time available
 - c) You do more effective testing
 - d) You find more faults
- 1.5 Which of the following is not a static testing technique
- a) Error guessing
 - b) Walkthrough
 - c) Data flow analysis
 - d) Inspections
- 1.6 During which test activity could faults be found most cost effectively?
- a) Execution
 - b) Design
 - c) Planning
 - d) Check Exit criteria completion
- 1.7 The purpose of requirement phase is
- a) To freeze requirements
 - b) To understand user needs
 - c) To define the scope of testing
 - d) All of the above
- 1.8 The process starting with the terminal modules is called -
- a) Top-down integration
 - b) Bottom-up integration
 - c) None of the above
 - d) Module integration
- 1.9 The inputs for developing a test plan are taken from
- a) Project plan
 - b) Business plan
 - c) Support plan
 - d) None of the above
- 1.10 Inspections can find all the following except
- a) Variables not defined in the code
 - b) Spelling and grammar faults in the documents
 - c) Requirements that have been omitted from the design documents
 - d) How much of the code has been covered
- 2. Each statement below is either TRUE or False. Identify and mark them accordingly in the answer book.**
- 2.1 In information technology, we often build products requirements/specifications which although documented not true quality needs of our customers.
- 2.2 Our products must be corrected so that they will eventually meet our customers' true quality needs.
- 2.3 Can produce products at our convenience and at any cost
- 2.4 Quality is not an attribute of product
- 2.5 Quality is not a binary state
- 2.6 Quality need not be defined in quantitative terms in order to be measurable.

- 2.7 Quality can be controlled only if it is measured.
- 2.8 Non conformance must be detected as early as possible measured.
- 2.9 High defect prone products and processes are identified testing the product after all processes are over.
- 2.10 0% of all defects are attributable to incorrect ineffective processes.

3. Match words and phrases in column X with the nearest in meaning in column Y

X	Y
3.1 A process of selecting test cases/data by identifying the boundaries that separate valid and invalid conditions	a) Quality Assurance
3.2 It is based upon graphical representation of the program process	b) Software Configuration
3.3 The input domain of the system is partitioned into classes of representative values, so that the no of test cases can be limited to one-per-class, which represents the minimum no. of test cases that must be executed.	c) CMM-Managed
3.4 A planned and systematic set of activities necessary to provide adequate confidence that requirements are properly established and products or services conform to specified requirements	d) Data flow modeling
3.5 Foundation for continuing improvement and optimization of process	e) Boundary value Analysis
3.6 The nodes represent the data objects. The links represent the transformations that occur to translate one data object to another.	f) Equivalence testing
3.7 Computer programs (source code and executables), documentation (technical and user), data (internal and external to programs)	g) Unit Testing
3.8 Brainstorming meeting, whose goal is to identify the problem, propose elements of a solution, negotiate different approaches, and specify a preliminary set of solution requirements	h) Black Box
3.9 It is the process of testing each software component individually using stubs and/or drivers.	i) Control Flow Analysis
3.10 A technique in which the input domain is divided into classes of equivalent data items	j) Facilitated application specification technique (FAST).

4. Fill in the blanks in 4.1 to 4.10 below, by choosing appropriate words and phrases given in the list below:

(a) Quality control	(b) Design,	(c) Management cycle	(d) 14
(e) Customer	(f) Acceptable quality level	(g) Test tools	(h) implementation and test
(i) White box	(j) optimising process		

4.1 For quality to happen, there must be well-defined standards and procedures which are

followed

- 4.2 Quality means fit for use. This is _____ view.
- 4.3 The no of principles in Dr. W. Edwards Deming's quality principles is _____.
- 4.4 The other name PDCA referred to is _____.
- 4.5 With the _____, the data is available to justify the application of technology to various critical tasks, and numerical evidence is available on the effectiveness with which the process has been applied to any given product
- 4.6 If changes are not controlled, then orderly _____ is impossible and no quality plan can be effective.
- 4.7 AQL stands for _____.
- 4.8 Is a vehicle for performing a test process _____.
- 4.9 The process by which product quality is compared with applicable standards; and the action taken when nonconformance is detected is called _____.
- 4.10 cyclomatic Complexity method is one of the method of _____ Testing.

PART TWO
(Answer ANY FOUR questions)

5.
 - a. How does software differ from the artifacts produced by other engineering disciplines?
 - b. How do software process metrics differ from software project metrics?
 - c. What is meant by the term software reliability?

(5+5+5)

6.
 - a. What are the names of the five levels of the SEI Capability Maturity Model? In your own words, briefly describe each.
 - b. Describe the change control process for a modern software development project.

(10+5)

7.
 - a. System Testing
 - b. What is equivalence partitioning as it applies to software testing?
 - c. Boundary Value Analysis
 - d. Black box vs. white box testing
 - e. Acceptance Testing

(3+3+3+3+3)

8.
 - a. What are the key differences between validation testing goals and acceptance testing goals?
 - b. A computer system is required that will support the following small garage business.

Customers bring their cars to the garage for servicing and repair. The attendant must check the car in, record details about the owner and the car, along with any specific customer requests. The workshop manager inspects each car and creates a job specification for it. He then schedules the job and assigns a mechanic to complete the specified tasks. During this process, if any new problems are discovered a new job specification is created by the workshop

manager before carrying out the work. When the job is finished the mechanic completes a report detailing the time spent, work done and materials used. This information is used by the attendant to create an invoice for the customer when they come to collect their car.

Represent the system described above as a use-case diagram

(5+10)

9.

- a. What is the difference between testing Techniques and tools? Give examples.
Quality control activities are focused on identifying defects in the actual products produced; however your boss wants you to identify and define processes that would prevent defects. How would you explain to him to distinguish between QA and QC responsibilities?
- b. Describe the process used in the UML (unified modeling language) approach to object-oriented design.

(10+5)

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Assignment 1.

A program reads three integer values, representing the lengths of the sides of the triangle. The program prints whether the triangle is scalene, isosceles or equilateral. Develop a set of test cases that would test the program adequately.

Assignment 2.

Derive a flow graph for the above program and apply basis path testing to develop test cases that will guarantee the execution of all the statements. Execute the cases and show the results.

Assignment 3.

Given the following procedure

```
PROCEDURE AVERAGE
Interface Returns avg, input, valid
Interface accepts value, min, max
```

```
int value [100];
int avg; input, valid, min, max, sum, i

i = 1;
input = valid = 0;
sum = 0
Do WHILE value [i] <> - 999 and input <100
Input = input + 1
If value [i]>= min and value [i] <=max
THEN valid = valid + 1
      Sum = sum + value [i]
ELSE
      SKIP
END IF
i = i + 1;
END DO
IF Valid > 0
THEN avg = sum/valid
ELSE
      Avg = -999
END IF
END AVERAGE
```

- a) Draw a flow graph for the above given algorithm.
- b) Determine the cyclomatic complexity by applying
 - i) Number of regions
 - ii) Edges and nodes
 - iii) Predicate nodes
- c) Determine a basis set of linearly independent paths.

Assignment 4.

Prepare the test cases corresponding to each independent path identified in Q3.

Assignment 5.

Draw a Graph Matrix corresponding to algorithm given in Q3 & compute the cyclomatic complexity. Prepare the test cases of the given algorithm to test the conditions using CONDITION TESTING.

Assignment 6.

Write a program in any programming language to accept a number and generate a table. Draw a flow graph and design various test cases for testing all possible paths.

Assignment 7.

Write a program in a programming language, specified by the examiner, to accept a 10 numbers & sort them in the order accepted at run time. Make a flow graph and design test cases for the condition testing. Also mention the expected results.

Assignment 8.

You are to prepare a Test Plan. What are the various test factors to be analyzed that correspond to Project Risks?

Assignment 9.

A university's web site allows students to enroll online bio-data. The form contains following fields:

- i. Name of the student
- ii. Father's name
- iii. Address
- iv. City
- v. State
- vi. Pin code
- vii. Sex
- viii. Date of Birth
- ix. Academic Qualifications
 - a. Exam Passed
 - b. University/Board
 - c. Marks obtained
 - d. Division
 - e. Max Marks

Design the validation checks for the given fields.

Assignment 10.

Assume there is functionality to log-in through the screen given below:

Log in name: _____ Password _____ <div style="border: 1px solid black; padding: 5px; display: inline-block;">SUBMIT</div>
--

Write a set of black box test cases to test the functionality of the given screen.

Assignment 11.

Prepare a checklist to review the Requirements and Design

Assignment 12.

Write a program to find the sum of the matrices. Write all the test cases so as to verify the correctness of the logic.

Assignment 13.

Write the code for binary and linear search. Find the cyclomatic complexity of the two by drawing the flow graph.

Assignment 14.

Prepare a list of checks to test date, numeric and alpha fields in any data entry screen.

Assignment 15.

Create du and dc graph for the following program:

```

scanf(x,y);
  if (y < 0)
    pow = pow - y;
  else
    pow = y;

  z = 1.0;
  while(pow != 0)
  {
    z = z * x;
    pow = pow - 1;
  }
  if (y < 0)
    z = 1.0/z;
  printf(z);

```

Assignment 16.

Create the flow graph of the above Q15 and compute the cyclomatic complexity.

Assignment 17.

Prepare the list of test cases for q16

Assignment 18.

Write a program to compute the factorial of a number and create du and dc graph for the same.

Assignment 19.

Create the graph matrix of the Q18 and compute the cyclomatic complexity.

Assignment 20.

Prepare the list of test cases for q19

Assignment 21.

Write a program to create fibonacci series and and create du and dc graph for the same.

Assignment 22.

Create the flow graph of Q21 and compute the cyclomatic complexity.

Assignment 23.

Prepare the list of test cases for q22

Assignment 24.

Prepare a checklist to test the Graphical User Interface of Windows based application.

Assignment 25.

Prepare a comprehensive checklist to test a WEB Site