GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester -VI

Course Title: Software Testing
(Course Code: 4360706)

Diploma Programme in which this course is offered	Semester in which offered
Computer Science & Engineering	6th semester

1. RATIONALE

Software testing is an indispensable process in the software development life cycle, serving asa critical quality assurance measure. Its primary objective is to identify and rectify defects, ensuring that the software meets specified requirements and functions as intended. Througha systematic and rigorous examination of the software, testing helps detect errors, inconsistencies, and potential vulnerabilities, thereby enhancing the reliability and robustnessof the final product. By validating each component and feature, software testing contributes to the overall improvement of software quality, fosters user satisfaction, and reduces the likelihood of post-deployment issues. Additionally, it provides stakeholders with confidence in the software's performance, functionality, and security, ultimately supporting the delivery of a high-quality and dependable product.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching-learning experiences:

- **Proficient in identifying and resolving software defects through comprehensive testing methodologies and tools to ensure the delivery of high-quality and reliable software products.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge, and the relevant soft skills associated with this competency are to be developed in the student to display the following COs:

The student will develop underpinning knowledge, adequate software testing skills of competency for testing various applications using different testing techniques to attain the following course outcomes.

a) Describe importance of Software Testing to enhance the quality of software products.
b) Apply black-box and white-box testing techniques effectively.
c) Develop effective test cases based on specifications, utilizing appropriate templates and methodologies.
d) Apply bug identification skills to create a comprehensive defect report for the software application.
e) Utilize popular testing tools (e.g., Selenium, JUnit, TestNG) for creating and executingautomated test scripts.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme(In Hours)			Total Credits (L+T/2+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	-	2	4	30	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

Legends: L*-Lecture;* ***T*** *– Tutorial/Teacher Guided Theory Practice;* ***P*** *-Practical;* ***C*** *– Credit,* ***CA*** *- Continuous Assessment;* ***ESE*** *-End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the subcomponents of the COs. These PrOs need to be attained to achieve the COs.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	A). Create a glossary of at least five software testing terminologies with explanations. B). Describe why both SDLC and STLC are essential in the softwaredevelopment process.	I	02
2	Enlist and present at least three popular testing methodology (e.g., Agile, Waterfall) with its advantages and disadvantages.	I	02
3	Write program and design test cases for the following Control and decision-making statement. 1) For... Loop 2) Switch...case 3) Do... While 4) If...else	II	02
4	Design test cases for different tasks (OTP Verification, Image upload, Age verification in Registration) in any software modules using Equivalence partitioning, boundary value analysis, and decision table testing techniques of Black Box Testing.	II	02
5	A) Identify system specification & design test cases for Sales Invoice Management. B) Design Test Cases for Flight Ticket Booking system.	II	04
6	Develop test scenarios and test cases for the login functionality of a social media application.	III	02

7	Develop an RTM and measure testing metrics for any two dynamic web pages of an e-commerce website.	III	02
8	Execute test cases for a travel booking app and prepare a test summary report.	III	02
9	Prepare defect report after executing test cases for registrationpage.	IV	02
10	Prepare defect report after executing test cases for Withdrawn of amount from ATM Machine.	IV	02
11	A) Install and set up the Selenium WebDriver and necessary drivers (e.g., ChromeDriver, GeckoDriver) on your system. B) Install JUnit, TestNG using an IDE (Integrated Development Environment) like Eclipse or IntelliJ.	V	02
12	Design and run test script for a registration page using Selenium tool and JUnit.	V	02
13	Design and run test script for a Login page and home page using Selenium tool and TestNG.	V	02
	Total		**28**

Note

*i. More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

*ii. The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.*

S. No.	**Sample Performance Indicators for the PrOs**	**Weightage in %**
1	Test Planning	20
2	Design Test Case	25
3	Execute Test Cases	20
4	Preparation of Defect report	20
5	Answer to questions and documentation	15
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practical in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Computer system with operating system: Windows 7 or higher Ver., macOS, and Linux, with 4GB or higher RAM	Al l
2	Microsoft office or any Open-source spreadsheet package.	Al l
3	CODE Editor (Notepad++, VS Code, Sublime), JAVA IDE (Eclipse,NetBeans, IntelliJ)	Al l
4	Testing frameworks (e.g. Selenium, JUnit, TestNG)	XI, XII, XIII

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfill the development of this competency.

a) Work as a test engineer.
b) Follow ethical practices.

The ADOs are best developed through the laboratory/field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

9. UNDERPINNING THEORY

Only the major Underpinning Theory is formulated as higher-level UOs of *Revised Bloom's taxonomy* in order development of the COs and competency is not missed out by the students and teachers. If required, more such higher-level UOs could be included by the course teacher to focus on the attainment of COs and competency.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Unit – I Introductio nto Software Testing	1a Describe the fundamental concepts of software testing. 1b Discuss how the V Model facilitates the integration of verification and validation activities. 1c Differentiate between SDLC and STLC. 1d Discuss how testing approaches may vary across different SDLC models (e.g., Waterfall, Agile).	1.1 Software testing and its importance. 1.2 Software Testing terminologies. 1.3 Verification and Validation (V Model), Quality Assurance, Quality Control. 1.4 Software development life cycle (SDLC) and testing phases 1.5 STLC – Software Testing Life Cycle in details, SDLC vs STLC 1.6 Types of testing (manual vs. automated) 1.7 Testing principles, processes,

		and methodologies.
Unit – II **Software Testing Technique sand Levels**	2a Describe Functional testing various Techniques. 2b Describe Non-Functional testing various Techniques. 2c Differentiate black-box and white-box testing approaches. 2d Comparative analysis of Static Testing, Dynamic Testing, Smoke Testing, Sanity Testing, regression testing.	2.1 Introduction of Black-box testing and white-box testing 2.2 Black Box Testing: Equivalence partitioning, boundary value analysis, and decision table testing 2.3 White box testing: Statement Coverage, Branch Coverage, Test of Conditions, Path Coverage 2.4 Unit testing, integration testing, system testing, acceptance testing 2.5 Static Testing, Dynamic Testing, Smoke Testing, Sanity Testing, regression testing, Static vs. dynamic testing, Smoke VsSanity Testing 2.6 Various type of Non-Function Testing
Unit-III **Software Testing Management**	3a create a comprehensive test plan in the software development. 3b Develop test cases based on specified requirements and design documents. 3c design test scenarios that cover multiple test cases and user interactions. 3d utilize various matrices to improve the testing process.	3.1 Test Planning: Preparing a Test Plan, Deciding Test Approach, Setting Up Criteria for Testing, Identifying Responsibilities, Staffing, Resource Requirements, Test Deliverables, Testing Tasks. 3.2 Test cases: Designing Test cases, Developing Test Cases, Writing Test cases, Test Case Templates, Types of Test Cases, Test Case Specification. 3.3 Test Reporting: Executing Test Cases, Preparing Test Summary Report, Test Data 3.4 Test Scenarios, Difference between Test Scenarios and Test Cases. 3.5 Requirements Traceability Matrix (RTM), Metrics and measurements in software testing.
Unit– IV **Defect Management**	4a Describe defect management process and its critical role. 4b Elaborate Defect Life Cycle.	4.1 Defect Classification, Defect Prioritization and Severity 4.2 Defect Management Process

	4c Create customize defect templates based on specific project requirements. 4d Apply defect prevention techniques effectively to minimize the occurrence of defects.	4.3 Defect Life Cycle Workflow and Stages, Defect Template 4.4 Roles and responsibilities of participants of Defect Triage Process, Step in Defect Triage Process, Activities performed during Defect Triage Process, Defect Resolution Process 4.5 Defect Prevention Process, Estimate Expected Impact of Defect, Techniques for Finding Defects, Reporting a Defect.
Unit– V Testing AutomationTools	5a Illustrate importance of testing automation. 5b Acquire a working knowledge of popular test automation tools. 5c Develop skills in maintaining and updating automated test scripts for application.	5.1 Introduction to test automation. 5.2 Benefits and challenges of test automation 5.3 Overview of popular testing tools (e.g., Selenium, JUnit, TestNG) 5.4 Creating and executing automated test scripts.

Note*: The UOs need to be formulated at the 'Application Level' and above of Revised Bloom's Taxonomy' to accelerate the attainment of the COs and the competency.*

10. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	**Unit Title**	**Teaching Hours**	**Distribution of Theory Marks**			
			R Level	**U Level**	**A Level**	**Total Marks**
I	**Introduction to Software Testing**	06	02	04	04	10
II	**Software Testing Techniques andLevels**	12	04	10	04	18
III	**Software Testing Management**	08	02	04	08	14
IV	**Defect Management**	08	04	04	06	14
V	**Testing Automation Tools**	08	02	04	08	14
Total		**42**	**14**	**26**	**30**	70

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*
Note*: This specification table provides general guidelines to assist students for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary slightly from the above table.*

11. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a) Develop a test plan for a given software project.
b) Identify test objectives, scope, resources, and schedule.
c) Learn to log and manage defects using a bug tracking system.
d) Perform exploratory testing on a given application without predefined test cases.
e) Practice boundary value analysis and equivalence partitioning.
f) Develop automated test scripts for a specific functionality using a chosen test automation tool.

12. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/subtopics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4***means different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) About ***20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-learning***, but to be assessed using different assessment methods.
e) With respect to ***section No.11***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
f) Guide students for various open-source software testing tools editors.

13. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project is group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups haveto be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain a dated work diary consisting of individual contributions in the project work and givea seminar presentation of it before submission. The total duration of the micro-project shouldnot be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit a micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

a) User Authentication Testing for a Web Application
b) Data Validation Testing for a Database Management System (DBMS)

c) Integration Testing for a Payment Gateway
d) Functional Testing of a Travel Booking Website
e) Automated Testing for a Task Management Tool
f) Accessibility Testing for a Healthcare Application
g) GUI Testing for an Inventory Management System
h) Usability Testing for a News Aggregation Website
i) Performance Testing for a Document Management System
j) Integration Testing for a Chat Application
k) Automated Testing for a Voting System

14. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Autho r	Publication with place, year and ISBN
1	Software Testing: Principles, Techniquesand Tools	S Limaye M. G.	McGraw Hill Education; 1st edition ISBN-10 :9780070139909
2	Software Testing Principles and Practice	Srinivasan Desikan	Pearson Education ISBN-10 : 9788177581218
3	Software Testing Concepts and Tools	Nageshwara Rao Pusuluri	DreamTech, ISBN10: 8177227122
4	Software Testing Tools	Dr. K.V.K.K. Prasad	Wiley- Dreamtech Press, ISBN 10: 8177225324

15. SOFTWARE/LEARNING WEBSITES

1. https://onlinecourses.nptel.ac.in/noc18_cs42/
2. https://www.guru99.com/software-testing.html
3. http://www.softwaretestinghelp.com
4. Tools QA
5. Software Testing in Continuous Delivery | Atlassian
6. The Complete 2023 Software Testing Bootcamp | Udemy
7. Software Testing - Testing Tutorials, Testing Tools, Testing Softwares, Testing Jobs, TestingTechniques (onestoptesting.com)

16. PO-COMPETENCY-CO MAPPING

Semester VI	Software Testing (Course Code: 4360706)						
	POs and PSOs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solutions	PO 4 Engineering Tools, Experimentation &Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning
Competency • Proficient in identifying and resolving software defects through comprehensive testingmethodologies and tools to ensure the delivery of high-quality and reliable software products.							
Course Outcomes CO a). Describe importance of Software Testing to enhance the quality of software products.	2	1	-	1	-	-	1
CO b). Apply black-box and white-box testing techniques effectively.	2	3	2	2	1	1	1
CO c). Develop effective test cases based on specifications, utilizing appropriate templates and methodologies.	2	2	2	2	-	1	1
CO d). Apply bug identification skills to create a comprehensive defect report for the software application.	3	2	3	2	1	1	1
CO e). Utilize popular testing tools (e.g., Selenium, JUnit, TestNG) for creating and executing automated test scripts.	2	2	2	3	2	2	2

Legend: '**3**' for high, '**2**' for medium, '**1**' for low or '**-**' for the relevant correlation of each competency, CO, with PO/ PSO

17. COURSE CURRICULUM DEVELOPMENT

COMMITTEEGTU Resource Persons

Sr. No.	Name and Designation	Institute	Email
1	Mr. Alpeshkumar R. Thaker	Government Polytechnic Ahmedabad	alpeshrthaker@gmail.com
2	Mr. Umang D. Shah	Government Polytechnic Ahmedabad	umang.shah111gp@gmail.com