

UCA Course Registration System - Test Plan

Project: UCA Course Registration CLI Application

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1. Test Strategy Overview

This test plan implements a testing approach that ensures each layer functions correctly both independently and when integrated by using unit, component, and system testing.

1.1 Testing Levels

Level 1: Unit Testing

For the unit tests the scope would be individual classes and methods in isolation with the target layers being Student, Course, and Enrollment. The purpose of these tests was to verify that each class correctly implements its business rules and validation logic. Our approach test both valid inputs and invalid inputs. The tools used for testing were Junit 5.

Level 2: Component/Integration Testing

When testing interactions between the service layer and the repository layer we wanted to target the combination of components: RegistrationService + StudentRepository, RegistrationService + CourseRepository, and RegistrationService + EnrollmentRepository. This would verify that these components worked together and that the data flowed as it should between layers and at the service level. We used mock data that was isolated from file I/O.

Level 3: System Testing

For system testing we wanted to test complete end-to-end workflows through the entire application. The workflows we tested was the enrollment cycles, waitlist management, and data persistence. This validated that the entire system worked as a cohesive unit and met all functional requirements.

1.2 Test Coverage Goals

Our model layer met 100% of validation logic and business rules, the service layer saw success with all public methods with both success and failure scenarios. The repository layer successfully achieved CRUD operations and data persistence. At a system level all user-facing features were able to be accessed from the CLI menu.

2. Representative Test Cases

Below are 5 representative test cases covering all three testing levels:

Test Case 1: Student Model Tests

Test ID	Test Case	Input	Expected Output	Result
UT-STU-001	Create student with valid data	("B001", "Alice", alice@uca.edu)	Student object created	Pass
UT-STU-002	Student with null ID	(null, "Alice", "alice@uca.edu")	IllegalArgumentException	Pass
UT-STU-003	Student with empty ID	("", "Alice", "alice@uca.edu")	IllegalArgumentException	Pass
UT-STU-006	Student with invalid email	("B001", "Alice", "not email")	IllegalArgumentException	Pass
UT-STU-008	Students with same ID are equal	Two students, same ID	equals() returns true	Pass

Test Case 2: Course Model Tests

Test ID	Test Case	Input	Expected Output	Result
UT-CRS-01	Create course with valid data	("CSCI4490", "SE", 30)	Course object created	Pass
UT-CRS-06	Course with capacity 0	("CSCI4490", "SE", 0)	IllegalArgumentException	Pass
UT-CRS-07	Course with negative capacity	("CSCI4490", "SE", -1)	IllegalArgumentException	Pass
UT-CRS-08	Course with capacity > 500	("CSCI4490", "SE", 501)	IllegalArgumentException	Pass
UT-CRS-12	Courses with same code are equal	Two courses, same code	equals() returns true	Pass

Test Case 3: Service Tests

Test ID	Test Case	Input	Expected Output	Result
UT SVC-01	Add student with valid data	("B001", "Alice", alice@uca.edu)	Student saved, logger called	Pass
UT SVC-02	Add duplicate student	Existing student ID	EnrollmentException thrown	Pass
UT SVC-03	Add student with invalid email	Invalid email format	EnrollmentException thrown	Pass
UT SVC-04	Add course with valid data	("CSCI4490", "SE", 30)	Course saved, logger called	Pass
UT SVC-05	Add duplicate course	Existing course code	EnrollmentException thrown	Pass

Test Case 4: Integration Tests

Test ID	Test Case	Input	Expected Output	Result
CT-SVC 01	Enroll student in available course	Student B001 → CSCI4490	Enrollment created, not waitlisted	Pass
CT-SVC 02	Enroll student in full course	Student B003 → Full course	Added to waitlist	Pass
CT-SVC 03	Enroll non-existent student	Invalid student ID	EnrollmentException thrown	Pass
CT-SVC 04	Enroll in non-existent course	Invalid course code	EnrollmentException thrown	Pass
CT-SVC 05	Enroll already enrolled student	Duplicate enrollment	EnrollmentException thrown	Pass
CT-SVC 06	Drop student without waitlist	Drop enrolled student	Student dropped, no promotion	Pass
CT-SVC 07	Drop student promotes from waitlist	Drop with waitlist present	First waitlisted promoted	Pass
CT-SVC 08	Drop non-enrolled student	Not enrolled student	EnrollmentException thrown	Pass

CT-SVC 09	Drop waitlisted student	Waitlisted student	Removed from waitlist	Pass
CT-SVC 10	Get course enrollment info	Valid course code	Correct enrolled/waitlist counts	Pass

Test Case 5: System Tests

Test ID	Test Case	Workflow	Expected Output	Result
ST-01	Complete Registration workflow	Add students → Add courses → Enroll → List	All operations succeed, data consistent	Pass
ST-02	Waitlist promotion workflow	Fill course → Create waitlist → Drop → Verify FIFO promotion	Correct promotion order maintained	Pass
ST-03	Multiple course enrollments	One student enrolls in 3 courses → Drop one	Other enrollments unaffected	Pass
ST-04	Error handling throughout workflow	Various invalid operations	All errors caught	Pass
ST-05	Large scale enrollment	150 students → 100-capacity course	100 enrolled, 50 waitlisted	Pass
ST-06	Boundary conditions	Min/max capacity courses	Correct handling of edge cases	Pass

Test Case 6: Performance Tests (Non-functional)

Test ID	Test Case	Load	Performance	Result
PT-01	Add many students	1,000 students	Complete in < 5 seconds	Pass
PT-02	Enroll many students	500 students in one course	Complete in < 10 seconds	Pass
PT-03	Waitlist promotion	50 drops with promotions	Complete in < 5 seconds	Pass
PT-04	Query performance	50 enrollment info queries	Complete in < 1 second	Pass

PT-05	Memory efficiency	1,000 students + 100 courses	Memory usage < 50MB	Pass
PT-06	Concurrent operations	200 rapid enrollments	Complete in < 5 seconds	Pass
PT-07	Maximum capacity stress test	600 students → 500 cap course	Complete in < 15 seconds	

Test Execution

```
bash
```

```
# Run all tests
```

```
mvn test
```

```
# Run with coverage report
```

```
mvn clean test jacoco:report
```

```
# Run specific test class
```

```
mvn test -Dtest=StudentTest
```

```
# Run specific test method
```

```
mvn test -Dtest=StudentTest#testCreateStudentWithValidData
```

Dependencies

- JUnit Jupiter: 5.10.0 (testing framework)
- Mockito: 5.5.0 (mocking framework)
- AssertJ: 3.24.2 (fluent assertions)
- JaCoCo: 0.8.10 (code coverage)

Screenshots

```
m1330@DESKTOP-U1BQKC0 MINGW64 ~/Downloads/LAB2 REVIRE/Lab3-3/uca-course-registration (main)
$ mvn test -Dtest=RegistrationServiceTest
[INFO] skip non existing resourceDirectory C:\Users\m1330\Downloads\LAB2 REVIRE\Lab3-3\uca-course-registration\src\main\resources
[INFO]
[INFO] --- compiler:3.11.0:compile (default-compile) @ course-registration ---
[INFO] Nothing to compile - all classes are up to date
[INFO]
[INFO] --- resources:3.3.1:testResources (default-testResources) @ course-registration ---
[INFO] skip non existing resourceDirectory C:\Users\m1330\Downloads\LAB2 REVIRE\Lab3-3\uca-course-registration\src\test\resources
[INFO]
[INFO] --- compiler:3.11.0:testCompile (default-testCompile) @ course-registration ---
[INFO] Nothing to compile - all classes are up to date
[INFO]
[INFO] --- surefire:3.1.2:test (default-test) @ course-registration ---
[INFO] Using auto detected provider org.apache.maven.surefire.junitplatform.JUnitPlatformProvider
[INFO]
[INFO] -----
[INFO] T E S T S
[INFO] -----
[INFO] Running edu.uca.registration.service.RegistrationServiceTest
OpenJDK 64-Bit Server VM warning: Sharing is only supported for boot loader classes because bootstrap classpath has been appended
[INFO] Tests run: 17, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 1.752 s -- in edu.uca.registration.service.RegistrationServiceTest
[INFO]
[INFO] Results:
[INFO]
[INFO] Tests run: 17, Failures: 0, Errors: 0, Skipped: 0
[INFO]
[INFO] --- jacoco:0.8.10:report (report) @ course-registration ---
[INFO] Loading execution data file C:\Users\m1330\Downloads\LAB2 REVIRE\Lab3-3\uca-course-registration\target\jacoco.exec
[INFO] Analyzed bundle 'UCA Course Registration (Refactored with Tests)' with 17 classes
[INFO] -----
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 3.777 s
[INFO] Finished at: 2025-10-30T22:22:42-05:00
[INFO] -----
```

UCA Course Registration (Refactored with Tests)

Element	Missed Instructions	Cov.	Missed Branches	Cov.	Missed	Cnty	Missed	Lines	Missed	Methods	Missed	Classes
edu.uca.registration.repository.impl	<div></div>	0%	<div></div>	0%	59	59	163	163	34	34	3	3
edu.uca.registration.app	<div></div>	0%	<div></div>	0%	27	27	109	109	15	15	1	1
edu.uca.registration.util	<div></div>	27%	<div></div>	14%	21	28	48	62	14	21	1	3
edu.uca.registration	<div></div>	0%	<div></div>	0%	6	6	30	30	3	3	1	1
edu.uca.registration.model	<div></div>	71%	<div></div>	56%	24	54	12	66	5	24	0	4
edu.uca.registration.service	<div></div>	97%	<div></div>	92%	2	44	2	112	0	31	0	5
Total	1,498 of 2,307	35%	114 of 174	34%	139	218	364	542	71	128	6	17

Created with JaCoCo 0.8.10.20230424095

```
m1330@DESKTOP-U1BQKC0 MINGW64 ~/Downloads/LAB2 REVIRE/Lab3-3/uca-course-registration (main)
$ mvn test
[INFO] T E S T S
[INFO] -----
[INFO] Running edu.uca.registration.model.CourseTest
[INFO] Tests run: 15, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.105 s -- in edu.uca.registration.model.CourseTest
[INFO] Running edu.uca.registration.model.StudentTest
[INFO] Tests run: 12, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.024 s -- in edu.uca.registration.model.StudentTest
[INFO] Running edu.uca.registration.performance.PerformanceTest
PT-03: 50 drops with promotions in 6ms
PT-06: 200 enrollments with queries in 4ms
PT-04: 50 enrollment info queries in 1ms
PT-07: Filled max capacity course in 9ms
PT-01: Added 1000 students in 8ms
PT-05: Memory used for 1000 students + 100 courses: 0MB
PT-02: Enrolled 500 students in 6ms
[INFO] Tests run: 7, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.138 s -- in edu.uca.registration.performance.PerformanceTest
[INFO] Running edu.uca.registration.service.RegistrationServiceTest
OpenJDK 64-Bit Server VM warning: Sharing is only supported for boot loader classes because bootstrap classpath has been appended
[INFO] Tests run: 17, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 1.660 s -- in edu.uca.registration.service.RegistrationServiceTest
[INFO] Running edu.uca.registration.system.SystemTest
[INFO] Tests run: 6, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.036 s -- in edu.uca.registration.system.SystemTest
[INFO]
[INFO] Results:
[INFO]
[INFO] Tests run: 57, Failures: 0, Errors: 0, Skipped: 0
[INFO]
[INFO]
[INFO] --- jacoco:0.8.10:report (report) @ course-registration ---
[INFO] Loading execution data file C:\Users\m1330\Downloads\LAB2 REVIRE\Lab3-3\uca-course-registration\target\jacoco.exec
[INFO] Analyzed bundle 'UCA Course Registration (Refactored with Tests)' with 17 classes
[INFO] -----
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 4.012 s
[INFO] Finished at: 2025-10-30T22:17:26-05:00
[INFO] -----
```

```
m1330@DESKTOP-U1BQKC0 MINGW64 ~/Downloads/LAB2 REVIRE/Lab3-3/uca-course-registration (main)
$ mvn test -Dtest=PerformanceTest
[INFO] Nothing to compile - all classes are up to date
[INFO]
[INFO] --- resources:3.3.1:testResources (default-testResources) @ course-registration ---
[INFO] skip non existing resourceDirectory C:\Users\m1330\Downloads\LAB2 REVIRE\Lab3-3\uca-course-registration\src\test\resources
[INFO]
[INFO] --- compiler:3.11.0:testCompile (default-testCompile) @ course-registration ---
[INFO] Nothing to compile - all classes are up to date
[INFO]
[INFO] --- surefire:3.1.2:test (default-test) @ course-registration ---
[INFO] Using auto detected provider org.apache.maven.surefire.junitplatform.JUnitPlatformProvider
[INFO]
[INFO] -----
[INFO] T E S T S
[INFO] -----
[INFO] Running edu.uca.registration.performance.PerformanceTest
PT-03: 50 drops with promotions in 9ms
PT-06: 200 enrollments with queries in 4ms
PT-04: 50 enrollment info queries in 1ms
PT-07: Filled max capacity course in 10ms
PT-01: Added 1000 students in 9ms
PT-05: Memory used for 1000 students + 100 courses: 0MB
PT-02: Enrolled 500 students in 6ms
[INFO] Tests run: 7, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.213 s -- in edu.uca.registration.performance.PerformanceTest
[INFO]
[INFO] Results:
[INFO]
[INFO] Tests run: 7, Failures: 0, Errors: 0, Skipped: 0
[INFO]
[INFO] --- jacoco:0.8.10:report (report) @ course-registration ---
[INFO] Loading execution data file C:\Users\m1330\Downloads\LAB2 REVIRE\Lab3-3\uca-course-registration\target\jacoco.exec
[INFO] Analyzed bundle 'UCA Course Registration (Refactored with Tests)' with 17 classes
[INFO] -----
[INFO] BUILD SUCCESS
[INFO] -----
```

```
m1330@DESKTOP-U1BQKC0 MINGW64 ~/Downloads/LAB2 REVIRE/Lab3-3/uca-course-registration (main)
$ mvn test -Dtest=SystemTest
[INFO] --- resources:3.3.1:resources (default-resources) @ course-registration ---
[INFO] skip non existing resourceDirectory C:\Users\m1330\Downloads\LAB2 REVIRE\Lab3-3\uca-course-registration\src\main\resources
[INFO]
[INFO] --- compiler:3.11.0:compile (default-compile) @ course-registration ---
[INFO] Nothing to compile - all classes are up to date
[INFO]
[INFO] --- resources:3.3.1:testResources (default-testResources) @ course-registration ---
[INFO] skip non existing resourceDirectory C:\Users\m1330\Downloads\LAB2 REVIRE\Lab3-3\uca-course-registration\src\test\resources
[INFO]
[INFO] --- compiler:3.11.0:testCompile (default-testCompile) @ course-registration ---
[INFO] Nothing to compile - all classes are up to date
[INFO]
[INFO] --- surefire:3.1.2:test (default-test) @ course-registration ---
[INFO] Using auto detected provider org.apache.maven.surefire.junitplatform.JUnitPlatformProvider
[INFO]
[INFO] -----
[INFO] T E S T S
[INFO] -----
[INFO] Running edu.uca.registration.system.SystemTest
[INFO] Tests run: 6, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.132 s -- in edu.uca.registration.system.SystemTest
[INFO]
[INFO] Results:
[INFO]
[INFO] Tests run: 6, Failures: 0, Errors: 0, Skipped: 0
[INFO]
[INFO] --- jacoco:0.8.10:report (report) @ course-registration ---
[INFO] Loading execution data file C:\Users\m1330\Downloads\LAB2 REVIRE\Lab3-3\uca-course-registration\target\jacoco.exec
[INFO] Analyzed bundle 'UCA Course Registration (Refactored with Tests)' with 17 classes
[INFO] -----
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 2.137 s
[INFO] Finished at: 2025-10-30T22:23:28-05:00
[INFO] -----
```


UCA-COURSE-REGISTRATION		
src		
main		
test\java\edu\uca\registration		
model		
CourseTest.java		U
StudentTest.java		4, U
performance		
PerformanceTest.java		U
service		
RegistrationServiceTest.java		U
system		
SystemTest.java		1, U
target		
classes		
generated-sources		
generated-test-sources		
maven-status		
site\jacoco		
edu.uca.registration		
edu.uca.registration.app		
edu.uca.registration.model		
edu.uca.registration.repository.impl		
edu.uca.registration.service		
edu.uca.registration.util		
jacoco-resources		
index.html		

```
$ mvn test -Dtest=StudentTest,CourseTest
```

```
[INFO]
[INFO] --- compiler:3.11.0:compile (default-compile) @ course-registration ---
[INFO] Nothing to compile - all classes are up to date
[INFO]
[INFO] --- resources:3.3.1:testResources (default-testResources) @ course-registration ---
[INFO] skip non existing resourceDirectory C:\Users\m1330\Downloads\LAB2 REVIRE\Lab3-3\uca-course-registration\src\test\resources
[INFO]
[INFO] --- compiler:3.11.0:testCompile (default-testCompile) @ course-registration ---
[INFO] Nothing to compile - all classes are up to date
[INFO]
[INFO] --- surefire:3.1.2:test (default-test) @ course-registration ---
[INFO] Using auto detected provider org.apache.maven.surefire.junitplatform.JUnitPlatformProvider
[INFO]
[INFO] -----
[INFO] T E S T S
[INFO] -----
[INFO] Running edu.uca.registration.model.CourseTest
[INFO] Tests run: 15, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.130 s -- in edu.uca.registration.model.CourseTest
[INFO] Running edu.uca.registration.model.StudentTest
[INFO] Tests run: 12, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.023 s -- in edu.uca.registration.model.StudentTest
[INFO]
[INFO] Results:
[INFO]
[INFO] Tests run: 27, Failures: 0, Errors: 0, Skipped: 0
[INFO]
[INFO]
[INFO] --- jacoco:0.8.10:report (report) @ course-registration ---
[INFO] Loading execution data file C:\Users\m1330\Downloads\LAB2 REVIRE\Lab3-3\uca-course-registration\target\jacoco.exec
[INFO] Analyzed bundle 'UCA Course Registration (Refactored with Tests)' with 17 classes
[INFO] -----
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 2.167 s
[INFO] Finished at: 2025-10-30T22:21:49-05:00
[INFO] -----
```

测试

筛选器(例如 text、!exclude、@tag)

15/15 887ms

Java

edu.uca.registration.model.CourseTest

edu.uca.registration.model.StudentTest

edu.uca.registration.performance.PerformanceTest

edu.uca.registration.service.RegistrationServiceTest

edu.uca.registration.system.SystemTest

Java Test 28ms

course-registration 28ms

28ms 中的 course-