Daffodil International University

Department of Software Engineering (SE)
Faculty of Science and Information Technology (FSIT)
Daffodil International University (DIU)
(Version 2.0)

Course Code: SE 311		**CIE Marks:** 60
ISCED: 0613-311		**SEE Marks:** 40
Course Title: Design Pattern		**Total Marks:** 100
Semester: Spring 2024		
Credit Value: 3 (Theory)	**Contact Hours:** 2.5 (Total weeks: 18)	
Prerequisite: SE 221		
Course Type: Core		
Level: 3	**Term: 2**	**Section:**

CIE: Continuous Internal Evaluation
SEE: Semester End Examination

Instructor Details

Name:	
Employee ID:	
Designation:	
Department:	
Office Address:	
Telephone/Extension:	
Mobile:	
Website:	
GTA/UTA(If Any):	

Class Schedule with Counseling Hour

Time/ Date	8:30 AM- 9:45 AM	9:45 AM- 11:00 AM	11:00 AM- 12:15 PM	12:15 PM- 1:30 PM	1:30 PM- 2:45 PM	2:45 PM- 4:00 PM	4:00 PM- 5:15 PM	5:15 PM- 6:30 PM
Saturday								
Sunday								
Monday								
Tuesday								
Wednesday								
Thursday								

Course Content (from syllabus)

The four pillars of object-oriented programming – Abstraction, Encapsulation, Inheritance, Polymorphism. Abstract class and interface. Definition of Refactoring and Code Smells. Different types

of code smells and refactoring techniques. Use of different refactoring techniques for different purposes. Introduction to Design Patterns. Definition and classification of design patterns. Definition, Use Case, Code examples of Creational Patterns – Singleton, Factory Method, Abstract Factory, Prototype, Builder. Definition, Use Case, Code examples of Creational Patterns – Adapter Pattern, Bridge Pattern, Composite Pattern, Decorator Pattern, Facade Pattern, Flyweight Pattern, Proxy Pattern. Definition, Use Case, Code examples of Creational Patterns – Chain of Responsibility Pattern, Command Pattern, Interpreter Pattern, Iterator Pattern, Mediator Pattern, Memento Pattern, Observer Pattern, State Pattern, Strategy Pattern, Template Pattern, Visitor Pattern. Design principles (SOLID)- Single Responsibility Principle, Open Close Principle, Liskov Substitution Principle, Interface Segregation Principle, Dependency Inversion Principle.

Rationale of the Course

The course "Design Pattern" is designed to empower the students with a comprehensive, well-structured, maintainable, and adaptable software system by delving into the core concepts of object-oriented programming, refactoring techniques, and the practical application of design patterns. It fosters a deep understanding of the four pillars of OOP (abstraction, encapsulation, inheritance, polymorphism) and solidifies a grasp of abstract classes and interfaces. It then equips students with the ability to identify and address code smells through various refactoring techniques, enhancing code quality and readability. The course's heart lies in exploring a wide array of creational, structural, and behavioral design patterns, providing hands-on experience with their implementation and use cases. These patterns offer reusable solutions to common software design challenges, promoting code flexibility, reusability, and testability. To further reinforce best practices, the course delves into SOLID principles (Single Responsibility, Open-Closed, Liskov Substitution, Interface Segregation, and Dependency Inversion), guiding learners towards crafting well-architected and maintainable codebases.

Course Objectives

The goal of this course is to introduce the students to the concept of modern operating system principles. The main objectives of this course are,
- To Recognize the inherent and accidental complexities involved with developing object-oriented software.
- To Understand how pattern-oriented software architecture techniques can and cannot help to alleviate this complexity.
- To Apply key pattern-oriented software architecture techniques to develop reusable object-oriented software infrastructure and apps.
- To Utilize Java programming language features and libraries to object-oriented software.

Course Learning Outcomes (CLOs) with Mappings

At the end of the course, students will be able to:

CLOs	CLO Descriptions	Program Learning Outcomes (PLOs)	Learning Domains (C, P, A)	BNQF Skill
CLO1	**Explain** the OOP design norms and refactoring processes.	PLO1	C3	Fundamental Domain

CLO2	**Identify** Different code smells, and refactoring techniques.	PLO1	C4	Fundamental Domain
CLO3	**Apply** the concepts of creational design patterns.	PLO3	C3	Fundamental Domain
CLO4	**Solve** software design problems using the concept of structural design patterns.	PLO4	C3	Fundamental Domain
CLO5	**Construct** classes according to the concept of behavioral design patterns.	PLO4	C6	Fundamental Domain

Mapping of CLOs with PLOs

Course Learning Outcome	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√											
CLO2	√											
CLO3			√									
CLO4				√								
CLO5				√								

Course plan specifying content, CLOs, co-curricular activities (if any), teaching learning and assessment strategy mapped with CLOs:

Week/ Lesson (hour)	Lesson Topic	Teaching Learning Strategy	Assessment Strategy	Corresponding CLOs
Week-1 Lesson 1 & 2 [2.5 Hours]	Lesson 1: Discussion on OBE of Design Pattern	Brainstorming sessions, Classroom discussion, Open discussion.	None	None
	Lesson 2: Class & Object, Encapsulation, Inheritance, Polymorphism.	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Class Test, Midterm exam	CLO1
Week-2 Lesson 1 & 2 [2.5 Hours]	Lesson 1: Inheritance, Polymorphism	Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Class Test, Midterm exam	CLO1
	Lesson 2: Key words, Exception Handling, Constructor	Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Class Test, Midterm exam	CLO1
Week-3 Lesson 1 & 2 [2.5 Hours]	Lesson 1: Collection Framework, Interface , Abstract Class	Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Class Test, Midterm exam	CLO1
	Lesson 2: Code Smells & Refactoring, Types of Code smells & Refactoring	Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Class Test, Assignment, Midterm exam	CLO1

	Class Test -1			
Week-4 Lesson 1 & 2 [2.5 Hours]	Lesson 1: Inappropriate Naming, Commenting, Long Class, Long Method, Lazy Class	Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Class Test, Assignment, Midterm exam	CLO1
	Lesson 2: Refused Bequest, Feature Envy, Black Sheep, Speculative Generality, Long Parameter List	Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Class Test, Assignment, Midterm exam	CLO1
Week-5 Lesson 1 & 2 [2.5 Hours]	Lesson 1:Extraction method, Naming Convention, Duplicate Code, Types of duplication, Switch Statements	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Class Test, Assignment, Midterm exam	CLO1
	Lesson 2: Introduction to Design Pattern, What is Design Pattern, Design Pattern in Smalltalk MVC, Describing Design Patterns, The Catalog of Design Patterns	Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Class Test, Assignment, Midterm exam	CLO1, CLO2
Week-6 Lesson 1 & 2 [2.5 Hours]	Lesson 1: Organizing the Catalog, How Design Patterns Solve Design Problems, How to Select a Design Pattern, How to Use a Design Pattern.	Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Class Test, Assignment, Midterm exam	CLO1, CLO2
	Lesson 2: Creational Patterns, What is creational pattern, Types of Creation pattern, Where creation pattern can be use	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Class Test, Assignment, Midterm exam, Final Exam	CLO1, CLO2
Week-7 Lesson 1 & 2 [2.5 Hours]	Lesson 1: Singleton Pattern, What is singleton pattern & its principle, Single object, Why it is necessary	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Class Test, Assignment, Midterm exam, Final Exam	CLO1, CLO2
	Lesson 2: Where it can implement, How it is implemented, Real life problem and its necessity **Class Test -2**	Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Class Test, Assignment, Midterm exam, Final Exam	CLO1, CLO2
Week-8 Lesson 1 & 2 [2.5 Hours]	Lesson 1: Factory Pattern, What is factory pattern, Principle of factory pattern, Why it is necessary	Voice over PPT, Lecture video, Lecture note, Open discussion.	Class Test, Assignment, Midterm exam, Final Exam	CLO1, CLO2

	Lesson 2: Where it can implement, How it is implemented, Real life problem and its necessity	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Class Test, Assignment, Midterm exam, Final Exam	CLO1, CLO2
Week-9 Lesson 1 & 2 [2.5 Hours]	Lesson 1: Prototype Pattern, What is factory pattern, Principle of factory pattern, Why it is necessary, Where it can implement, How it is implemented, Real life problem and its necessity	Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Class Test, Assignment, Final exam	CLO1, CLO3
	Lesson 2: Structural design patterns, What is a structural pattern, Types of structural patterns, Where structural patterns can be used	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Class Test, Assignment, Final exam	CLO1, CLO3
Week-10 Lesson 1 & 2 [2.5 Hours]	Lesson 1: Adapter Design Pattern, What is adapter pattern & its principle, interface, abstract class, Why it is necessary, Where it can implement, How it is implemented, Real life problem and its necessity	Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Class Test, Assignment, Final exam	CLO1, CLO3
	Lesson 2: Decorator Design Pattern, What is decorator pattern & its principle, interface, abstract class, Why it is necessary	Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Class Test, Assignment, Final exam	CLO1, CLO3
Week-11 Lesson 1 & 2 [2.5 Hours]	Lesson 1: Where it can implement, How it is implemented, Real life problem and its necessity	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Class Test, Assignment, Final exam	CLO1, CLO3
	Lesson 2: Facade Design Pattern, What is facade pattern & its principle, interface, abstract class, Why it is necessary	Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Class Test, Assignment, Final exam	CLO1, CLO3
Week-12 Lesson 1 & 2 [2.5 Hours]	Lesson 1: Where it can implement, How it is implemented, Real life problem and its necessity	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Class Test, Assignment, Final exam	CLO1, CLO3
	Lesson 2: Behavioral Design Patterns, What is a behavioral pattern, Types of behavioral patterns, Where behavioral patterns can be used	Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Class Test, Assignment, Final exam	CLO1, CLO3
Week-13	Lesson 1: Observer Design Pattern, What is observer pattern & its	Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Class Test, Assignment, Final exam	CLO1, CLO3

Lesson 1 & 2 [2.5 Hours]	principle, interface, abstract class, Why it is necessary **Class Test -3**			
	Lesson 2: Where it can implement, How it is implemented, Real life problem and its necessity	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Class Test, Assignment, Final exam	CLO1, CLO4
Week-14 Lesson 1 & 2 [2.5 Hours]	Lesson 1: Chain of Responsibility Pattern, What is Chain of Responsibility pattern & its principle, interface, abstract class, Why it is necessary	Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Class Test, Assignment, Final exam	CLO1, CLO4
	Lesson 2: Where it can implement, How it is implemented, Real life problem and its necessity	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Class Test, Assignment, Final exam	CLO1, CLO4
Week-15 Lesson 1 & 2 [2.5 Hours]	Lesson 1: State Pattern, What is State pattern & its principle, interface, abstract class, Why it is necessary	Voice over PPT, Lecture note, Open discussion.	Assignment, Final exam	CLO1, CLO4
	Lesson 2: Where it can implement, How it is implemented, Real life problem and its necessity	Voice over PPT, Lecture note, Open discussion.	Assignment, Final exam	CLO1, CLO4
Week-16 Lesson 1 & 2 [2.5 Hours]	Lesson 1: Template Pattern, What is template pattern & its principle, interface, abstract class, Why it is necessary, Where it can implement, How it is implemented, Real life problem and its necessity	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Assignment, Final exam	CLO1, CLO4
	Lesson2: Design Principles (SOLID), Single Responsibility Principle, Open Close Principle	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Final exam	CLO1, CLO4
Week-17 Lesson 1 & 2 [2.5 Hours]	Lesson 1: Design Principles (SOLID), Liskov Substitution Principle, Interface Segregation Principle	Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Final exam	CLO1, CLO4
	Lesson 2: Design Principles (SOLID), Dependency Inversion Principle, Design Patterns Principles real life uses	Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture note, Open discussion.	Final exam	CLO1, CLO3, CLO4

Week-18 Lesson 1 & 2 [2.5 Hours]	Lesson 2: Review class on final exam syllabus. Presentation on a given topic.	Brainstorming sessions, Classroom discussion, Lecture note, Open discussion.	Final exam	CLO1
	Lesson 1: Review class on final exam syllabus.	Brainstorming sessions, Classroom discussion, Lecture note, Open discussion.	Final exam	CLO1

Overall Assessment Scheme

Assessment Task	CLO's				Mark (Total=100)	PLO's			Mark (Total =65)
	CLO1	CLO2	CLO3	CLO4		PLO1	PLO3	PLO4	
Attendance	--	--	--	--	7				
Class Test 1	5(15)				Avg 15				
Class Test 2		5(15)							
Class Test 3			5(15)						
Assignment			5		5				
Presentation				8	8				
Midterm Exam	15	10			25	25			25
Final exam		15	15	10	40	15	15	10	40

Marks Distribution

Class attendance	7
Assignment	5
Presentation (Mandatory)	8
3 Quizzes	15
Midterm Test	25
Semester Final Examination	40
Total	100

Evaluation Policy (Grading Policy)

Marks obtained out of 100	Grade	Grade point equivalent	Remarks
80% and above	A+	4.00	Outstanding
75% to less than 80%	A	3.75	Excellent
70% to less than 75%	A-	3.50	Very Good
65% to less than 70%	B+	3.25	Good
60% to less than 65%	B	3.00	Satisfactory
55% to less than 60%	B-	2.75	Above Average
50% to less than 55%	C+	2.50	Average

45% to less than 50%	C	2.25	Below Average
40% to less than 45%	D	2.00	Pass
Less than 40%	F	0.00	Fail

Class Make-up Procedure

Missed class will be taken at convenient free class hour.

Textbook/Recommended Readings

Design Pattern – Elements of Reusable Object-Oriented Software by Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides.

Reference Books/ Other Supplementary Readings

1. https://refactoring.guru/design-patterns
2. https://www.tutorialspoint.com/design_pattern/design_pattern_overview.htm

Course Materials and Slides

All course materials and slides will be available in DIU Blended Learning Center, and Google classroom. (Everyone is requested to join google classroom and BLC account).

Software/Tools used

Netbeans IDE, Java Online Compiler

Exam Dates

According to the Examination Schedule

Academic Code of Conduct

Academic Integrity:
Academic offenses under the Academic Code of Conduct include plagiarism, personification, physical and online cheating, falsification of a document, and any other dishonest behavior related to gaining academic gain or avoiding evaluation exercises by a student. The university's Disciplinary Committee may decide to impose severe penalties for these offenses.

Special Instructions:
- Attendance at all classes and exams is required of the students. To take the final test, a student needs to have attended at least 70% of classes.
- After ten minutes of the scheduled start time, students will not be permitted to enter the classroom.
- Plagiarism will automatically result in a zero on that exam or assignment.
- There won't often be a make-up exam. However, if a student misses an exam due to a serious sickness, the death of a family member, an emergency involving the family, or humanitarian reasons, they MUST request permission to make up the exam in writing through the course instructor to the chairperson within 48 hours of the exam date. The application must be submitted with the appropriate supporting documentation for the reason(s) for the absence from the exam.

- There won't be a makeup exam for the final exam. However, if a student is unable to attend the final exam due to a serious illness, a family member's death, an emergency, or humanitarian reasons, they MUST request an incomplete grade in writing from the course instructor via the chairperson within 48 hours of the exam date. Along with the application, appropriate supporting documentation for the reason(s) for missing the final exam must be provided. It is the student's duty, in consultation with the course instructor, to schedule an incomplete exam by the deadline specified in the academic calendar.
- It is required that all cell phones be in silent mode during class and test times.
- Exam cheating is not tolerated at all. Examinees will be penalized for cheating if they are found in possession of cheat sheets, used or not; if they write on their palms, the backs of calculators, chairs, or adjacent walls; if they copy from cheat sheets or other sources; if they copy from other examiners, etc. Cheating only carries a single, multi-semester expulsion, as determined by the university's disciplinary committee.

Appendix

Program Learning Outcomes (POs)

No.	Program Learning Outcomes
PLO1	Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO2	Identify, formulate, research and analyze complex engineering problems and reach substantiated conclusions using the principles of mathematics, the natural sciences and the engineering sciences.
PLO3	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety and of cultural, societal and environmental concerns.
PLO4	Conduct investigations of complex problems, considering experimental design, data analysis and interpretation and information synthesis to provide valid conclusions.
PLO5	Create, select and apply appropriate techniques, resources and modern engineering and IT tools, including prediction and modeling, to complex engineering activities with an understanding of their limitations.
PLO6	Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.
PLO7	Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PLO8	Apply ethical principles and commit to the professional ethics, responsibilities and the norms of the engineering practice.
PLO9	Function effectively as an individual and as a member or leader of diverse teams and in multidisciplinary settings.
PLO10	Communicate effectively about complex engineering activities with the engineering community and with society at large. Be able to comprehend and write effective reports, design documentation, make effective presentations and give and receive clear instructions.
PLO11	Demonstrate knowledge and understanding of engineering and management principles and apply these to one's work as a team member or a leader to manage projects in multidisciplinary environments.
PLO12	Recognize the need for and have the preparation and ability to engage in independent, life-long learning in the broadest context of technological change.

Learning Domain

Cognitive Domain (Knowledge):

The cognitive domain aims to develop the mental skills and the acquisition of knowledge of the individual.

Levels	Definition
Remember (C1)	Retrieving, recalling, or recognizing information from memory.

Understand(C2)	Changing from one form of representation to another; illustrating a concept; drawing conclusions; determining cause and effect
Apply(C3)	Using learned materials, students can use/apply information in a new way.
Analyze(C4)	Breaking material or concepts into parts, determining how the parts related or interrelated to one another or to an overall structure or purpose.
Evaluate(C5)	Assessing, making judgments and drawing conclusions from ideas, information, or data.
Create(C6)	Developing a hypothesis; devising a procedure; inventing a product

Affective Domain:

The affective domain includes how learners deal with things emotionally, such as feelings, values, appreciation, enthusiasms, motivations, and attitudes.

Level	Definition:
Receiving (A1)	Being aware of or attending to something in the environment.
Responding(A2)	Showing some new behaviors as a result of experience.
Valuing(A3)	Showing some definite involvement or commitment.
Organization(A4)	Integrating a new value into one's general set of values, giving it some ranking among one's general priorities.
Characterization by value(A5)	Acting consistently with the new value.

Psychomotor Domain:

Includes physical movement, coordination, and use of the motor-skill areas.

Level	Definition:
Imitating (P1)	Attempted copying of a physical behavior
Manipulation(P2)	Reproducing activity from instruction or memory
Precision(P3)	Fine tuning. Making minor adjustments in the physical activity in order to perfect it.
Articulation(P4)	Adapting and integrating expertise to satisfy a non- standard objective
Naturalization(P5)	Automated, unconscious mastery of activity and related skills at strategic level

Knowledge Profile:

Level	Definition:
Natural Sciences(KP1)	A systematic, theory-based understanding of the natural sciences applicable to the discipline
Mathematics(KP2)	Conceptually based mathematics, numerical analysis, statistics and formal aspects of computer and information science to support analysis and modeling applicable to the discipline
Engineering Fundamentals(KP3)	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline
Engineering specialist knowledge(KP4)	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline

Engineering Design(KP5)	Knowledge that supports engineering design in a practice area
Engineering practice(KP6)	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline
Comprehension(KP7)	Comprehension of the role of engineering in society and of the identified issues in engineering practice in the discipline: ethics and the engineer's professional responsibility to public safety; the impacts of engineering activity in economic, social, cultural, environmental and sustainability terms
Research Literature(KP8)	Engagement with selected knowledge in the research literature of the discipline

BNQF Skill (4 year's Bachelors):

Fundamental Skills:
- Demonstrate knowledge and critical understanding of the well-established principles of his/her field of study, and of the way in which those principles have developed.
- Apply underlying concepts and principles outside the context in which they were first studied, including, where appropriate, the application of those principles in an employment context.
- Apply knowledge and skills in addressing issues/solving problems with minimal supervision.
- Evaluate critically the appropriateness of different approaches to solving problems in his/her field of study.
- Support supervision of junior staff via a mentor or a leader/manager.
- Display advanced digital literacy which is adequate to perform complex tasks and bring about solutions.

Social Skills:
- Communicate and interact effectively and clearly, ideas, information, problems and solutions as a team to peers, experts and non-experts in Bangla and English.
- Express her/himself fluently and spontaneously in English and Bangla.
- Use language flexibly and effectively for social, academic and professional purposes.
- Produce clear, well structured, detailed text on complex subjects, showing controlled use of organizational patterns, connectors and cohesive devices in advanced proficiency level of Bangla and English.
- Demonstrate the ability to incorporate entrepreneurial skills in planning daily activities.
- Display advanced civic literacy and knowledge, exercising civic rights and obligations at all levels as well as participating in changes for the improvement of Bangladesh society.

Thinking Skills
- Exercise very substantial degree of autonomy and often significant responsibility in making
- Judgments / decisions towards the management of self, others and for the allocation of substantial resources.
- Demonstrate professional knowledge and practical skills in both technical and management to lead a team in an inexperienced environment.

Personal Skills

- Engage in self-direction and self-enterprise skills.
- Demonstrate social, professional, environmental and ethical practice/ values.
- Show-case global knowledge and competencies to fulfill employment, entrepreneurial and lifelong learning skills; and contribute significantly to the society.