COMSATS University Islamabad, Lahore Campus

Final Term Examination – SPRING 2022

Course Title:	Formal Methods				Course	CSE356	Credit Hours: 3(3,0)
Course Instructor/s:	Dr. Farooq Ahmad				Programme	BS Software Engineering	
Semester:	4th	Batch:	FA20	Section:	A, B	Date:	28th June, 2022
Time Allowed:	3 Hours				Maximum Marks:		50
Student's Name					Reg. No.		

Important Instructions / Guidelines:

- Answer all questions on the exam paper provided to you.
- Do not give multiple answers to a question. Cross out what you do not want me to read.
- Do not use the lead pencil.

Question 1: [CLO-2] **[Marks: 3+3+4 =10]**

Let [PEOPLE] be the set of all possible persons and [SUBJECT] the set of all possible subjects. A specification for a University has a state schema:

University

$students : \mathbb{P} PEOPLE$

$subjects : \mathbb{P} SUBJECT$

$enrolments : PEOPLE \leftrightarrow SUBJECT$

$\text{dom } enrolments \subseteq students$

$\text{ran } enrolments \subseteq subjects$

For the class *University*, specify following operations, write your answer below in the form of Schemas:

i) Writhe an operation schema *newStudent* such that a person (*pers?*) becomes a student.

ii) Write an operation schema *studentLeaves* such that a person (*pers?*) which is not enrolled in any subject, is discarded as a student.

iii) Write an operation schema *personSubjects* which outputs the set of subjects (*subjs!*) in which the person (*pers?*) is enrolled.

Question 2: [CLO-2] **[Marks: 3+3+4 = 10]**

The software is concerned recording the allocation of seats to passengers on an aircraft. The types involved here are the set of all possible persons, called PERSON, and the set of all seats on this aircraft, SEAT.

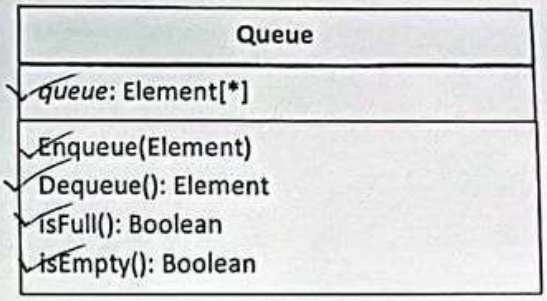
SeatBooking

$bookedTo : SEAT \pfun PERSON$

$\#\text{dom } bookedTo \leq Limit$

Question 5: [CLO-3] *[Marks: 4 + 6 =10]*

A queue is an ordered list that obeys a first-in-first-out (FIFO) protocol. Queue is conceptualized as having items entering from the tail or rear while items leave the queue to the front or head. The operations that add and remove items from a queue are known as enqueue and dequeue respectively. Further, isEmpty and isFull are the operations to know whether a queue is full or empty. Apply the restriction on the number of elements in the queue to an integer SIZE. The UML specification of the Queue class is given below.



Formally specify the Queue class in VDM-SL. A full explanation includes: data types, free data type, state, and operations.