COMSATS University Islamabad, Lahore Campus

COURSE HANDBOOK

1	**Course Title**	Formal Methods
2	**Course Code**	CSE356
3	**Credit Hours**	3(3,0)
4	**Semester**	Spring 2022
	Resource Person	Dr. Farooq Ahmad
	Supporting Team Members	N.A.
7	**Contact Hours (Theory)**	3 hours per week
8	**Contact Hours (Lab)**	N.A.
9	**Office Hours**	-
10	**Course Introduction**	

This course is designed to enable the students to study and understand the formal methods to model the software systems. The students would be able to understand the analysis and verification of the required specifications for a given software.

11	**Learning Objectives**

After completing this course the students will be able to:

- Specify, validate and verify the software systems in model oriented approaches. They will understand the meaning of software engineering and will be able to apply formal methods like Z notation and VDM (Vienna Development Methods).
- Also they will know usage of VDM toolbox, Z/Eves for the description and analysis of systems. At the end of the course, the students will be able to find a relationship between Z and VDM which will be one step forward in understanding systems development using integration of approaches.

12	**Course Contents**

Introduction to propositional and predicate logic, Equivalence of propositional and predicate logic, Formal specification, Specification analysis and proofs, Equality and definite description, Objects and its types, Sets and set types, Bags and types, Sequence and its type, Modelling with sequences and bags, Tuples and Cartesian product types, Generic and axiomatic definitions, Bindings and schema types, Modelling with relations and functions, Domain/range restrictions and subtractions, Notations and properties of relations and functions, Free types, Schemas: properties, type, declaration, predicate, operators. Generic constructions, The Z language, Syntactic conventions, Schema references, Schema texts, Schema expressions, Sequential systems, Modelling with mappings, Validation and verification techniques through Z/EVES tool. An Introduction to Specification in VDM-SL, Concept of net based formal methods, Modelling of a system through nets, structure of a net, Elementary nets, Place-transition nets, Formal definition of nets, Enabling rules of transitions, Generation of state graph.

13	**Lecture/Lab Schedule**

Weeks	Topic of Lecture	Reading Assignment
Week 1	Introduction to Formal methods, Its background, Why formal methods in software engineering	Ch # 1 and 2 of the text book.
Week 2	Introduction to propositional and predicate logic, Equivalence of propositional and predicate logic, valid and invalid arguments	Ch # 3 of the text book.
Week 3	Implications, Tautologies and Contradiction, Using predicates as constraints	Ch # 3
Week 4	Method of proofs in Z, Formal specification, Specification analysis	Ch # 3
Week 5	Sets in Z	Ch # 3
Week 6	Sessional - I	
Week 7-8	Relations in Z notation, domain restriction, range restriction, domain subtraction, range subtraction	Ch # 4
Week 9	Bags and types, Sequence and its type, Tuples and Cartesian product types, Generic and axiomatic definitions	Ch # 4
Week 10	Modelling with functions, total and partial functions, function overriding, Function definition by set comprehension	Ch # 4
Week 11	The Z language, States and operations, The declaration part, The predicate part Free types, Schemas: properties, type, declaration, predicate, operators	Ch # 4
Week 12	Schema disjunction, Schema conjunction, Generic constructions, Syntactic conventions,	Ch # 4
Week 13	Modelling with sequences and bags, Schema references, Schema texts, Schema expressions, Sequential systems, Schema calculus, Schemas and logical connectives, Schema quantification	Ch # 5
Week 14	The intrinsic types in VDM-SL, Specifying the operations in VDM, specifying a function explicitly and implicitly, Specifying a state invariant	Ch # 3 of reference book I
Week 15	An Introduction to Specification in VDM-SL, Declaring Sets in VDM-SL, Case Study of Sets in VDM-SL	Ch # 5 of reference book I
Week 16	Revision	

14	

The assessment of this module shall have following breakdown structure:

First Sessional Test	10%
Second Sessional Test	15%
Quizzes/Assignments	25%
Terminal Examination	50%

The minimum pass marks for each course shall be 50%. Students obtaining less than 50% marks in any course shall be deemed to have failed in that course. The correspondence between letter grades, credit points, and percentage marks at CUI shall be as follows:

Grades	Letter Grade	Credit Points	Percentage Marks
A	(Excellent)	4.0	90 and above
A-		3.7	85-89
B+		3.3	80-84
B	(Good)	3.0	75-79
B-		2.7	70-74
C+		2.3	65-69
C	(Average)	2.0	60-64
C-		1.7	55-59
D	(Minimum passing)	1.3	50-54
F	(Failing)	0.0	Less than 50

15.	**Format of Assignment**

Unless otherwise stated, all the assignments should be hand written, with typed front page according to following format.
Reg. # :_____
Name : _____
Course Title : _____
Section : _____
Assignment # : _____
Submitted to : _____
Date : _____
(Font size 16, Times New Roman)

16.	**Text Book**	J.B. Wordsworth, **Software Development with Z**: A practical approach to Formal Methods in Software Engineering; Eddison-Wesley Publishing co., 1992
17.	**Reference Books**	I. Formal Software Development by Quentin Charatan; Palgrave MacMillan, 2004 II. Understanding Petri nets, by Wolfgang Reisig; Springer-Verlag, 2013.
18.	**Plagiarism**	

Plagiarism involves the unacknowledged use of someone else's work, usually in coursework, and passing it off as if it were one's own. Many students who submit apparently plagiarised work probably do so inadvertently without realising it because of poorly developed study skills, including note taking, referencing and citations; this is poor academic practice rather than malpractice. Some students, particularly those from different cultures and educational systems, find UK academic referencing/acknowledgement systems and conventions awkward, and proof-reading is not always easy

for dyslexic students and some visually-impaired students. Study skills education within programmes of study should minimise the number of students submitting poorly referenced work. However, some students plagiarise deliberately, with the intent to deceive. This intentional malpractice is a conscious, pre-mediated form of cheating and is regarded as a particularly serious breach of the core values of academic integrity.

Plagiarism can include the following:
1. collusion, where a piece of work prepared by a group is represented as if it were the student's own;
2. commission or use of work by the student which is not his/her own and representing it as if it were, e.g.:
    a. purchase of a paper from a commercial service, including internet sites, whether pre-written or specially prepared for the student concerned
    b. submission of a paper written by another person, either by a fellow student or a person who is not a member of the university;
3. duplication (of one's own work) of the same or almost identical work for more than one module;
4. the act of copying or paraphrasing a paper from a source text, whether in manuscript, printed or electronic form, without appropriate acknowledgement (this includes quoting directly from another source with a reference but without quotation marks);
5. submission of another student's work, whether with or without that student's knowledge or consent;
6. Directly quoting from model solutions/answers made available in previous years;
7. cheating in class tests, e.g.
    a. when a candidate communicates, or attempts to communicate, with a fellow candidate or individual who is neither an invigilator or member of staff
    b. copies, or attempts to copy from a fellow candidate
    c. attempts to introduce or consult during the examination any unauthorised printed or written material, or electronic calculating, information storage device, mobile phones or other communication device
    d. personates or allows himself or herself to be impersonated.
8. Fabrication of results occurs when a student claims to have carried out tests, experiments or observations that have not taken place or presents results not supported by the evidence with the object of obtaining an unfair advantage.

These definitions apply to work in whatever format it is presented, including written work, online submissions, groupwork and oral presentations.

19.	**Attendance Policy**

Every student must attend 80% of the lectures/seminars delivered in this course and 80% of the practical/laboratory work prescribed for the respective courses. The students falling short of required percentage of attendance of lectures/seminars/practical/laboratory work, etc., shall not be allowed to appear in the terminal examination of this course and shall be treated as having failed this course.

20.	**Field Trips/Case Studies/Seminars/Workshop**

N.A.