AMERICAN INTERNATIONAL UNIVERSITY-BANGLADESH (AIUB)

Faculty of Science and Technology (FST)
Department of Computer Science (CS)
Undergraduate Program

COURSE PLAN

Spring 2020- 2021 SEMESTER

I. Course Core and Title

CSC 3113: Theory of Computation

II. Credit

3 credit hours (3 hours of theory per week)

III. Nature

Core Course for CS, CSE, CSSE, SE

IV. Prerequisite

CSC 2105: Data Structure

V. Vision:
Our vision is to be the preeminent Department of Computer Science through creating recognized professionals who will provide innovative solutions by leveraging contemporary research methods and development techniques of computing that is in line with the national and global context.

VI. Mission:
The mission of the Department of Computer Science of AIUB is to educate students in a student-centric dynamic learning environment; to provide advanced facilities for conducting innovative research and development to meet the challenges of the modern era of computing, and to motivate them towards a life-long learning process.

VII - Course Description:

- Basic notations used in computer science literature
- Understand the mathematical model of Computation.
- Use of Computational models to solve problems
- Understand Computability
- Determine Complexity of problems

VIII – Course outcomes (CO) Matrix and Program Outcome (PO) Matrix:

By the end of this course, students should be able to:

		Level of Domain*				PO Assessed**
		C	P	A	S	
CO1	Describe different computational model and mathematical notations	2				PO1.1
CO2	Give original example of different computational model and mathematical notations	2				PO1.2
CO3	Design a solution for a complex problem using the principles of existing computational models		6			PO3.1
CO4	Modify a solution using the principles of existing computational model.		6			PO3.2

C: Cognitive; P: Psychomotor; A: Affective; S: Soft-skills (CT: Critical Thinking, TS: Teamwork)
**The numbers under the 'Level of Domain' columns represent the level of Bloom's Taxonomy each CO corresponds to.*
*** The numbers under the 'PO Assessed' column represent the PO each CO corresponds to.*

PO1				
Name:	**Engineering Knowledge**			
Objective:	Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.			
Components:	**DESCRIPTION**	**BLOOMS LEVEL**	**BLOOMS LEARNING LEVEL**	**ASSESSMENT METHOD**
1.1	Apply the knowledge of mathematics, science, engineering fundamentals to the solution of complex engineering problems.	2	C	QUIZ
1.2	Apply the knowledge of an engineering specialization to the solution of complex engineering problems	2	C	QUIZ

PO3				
Name:	**Design/Development of solution**			
Objective:	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			
Components:	**DESCRIPTION**	**BLOOMS LEVEL**	**BLOOMS LEARNING LEVEL**	**ASSESSMENT METHOD**
3.1	Design solution for complex engineering problems.	6	P	MID
3.2	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	6	P	MID

IX – Topics to be covered in Theory class*:

TOPICS	Specific Objective(s)	Time Frame	Suggested Activities	Teaching Strategy(s)
Mission & Vision of AIUB, Basic Mathematical Concepts	To make students understand about the Mission & Vision of the university, Course objective, Outcome, Outline, Class & Course Policies, Exam & Evaluation Policies. Introduction to Theory of Computation.	Week 1 Lecture 1	Discussion on Mission & Vision of AIUB, Introduction to Theory of Computation Review of Pre-requisite study materials.	Lecture, Group Discussion
Finite Automaton, Deterministic Finite Automaton (DFA)	Basic Model of Computation, Formal Definition of a finite automaton, DFA, Designing DFA	Week 1 Lecture 2	Discussion, Group study and perform of exercises.	Lecture, Group study Homework Quiz 1
DFA	Designing DFA continued, Regular Language, Closure under regular operation	Week 2 Lecture 1	Discussion, Group study and perform of exercises.	Lecture, Group study Homework
Non-determinism and Non-regular languages	Understanding NFA, Designing NFA, Equivalence of NFAs and DFAs	Week 2 Lecture 2	Discussion, Group study and perform of exercises	Lecture, Group study Homework Quiz 2
Closure	Designing NFA continued, Closure under the regular operations	Week 3 Lecture 1	Discussion, Group study and perform of exercises	Lecture, Group study Homework
Regular Expression	Understanding RE, Designing RE, Equivalence with FA, Conversion of RE to NFA, DFA to RE	Week 3 Lecture 2	Discussion, Group study and perform of exercises	Homework Quiz 3
Regular Expression	Conversion of DFA to RE continued, Closure, Non-regular Language, Pumping Lemma	Week 4 Lecture 1	Discussion, Group study and perform of exercises	Lecture PPT Slides Board Work Homework
Context free Languages	Learning powerful representation of Languages. Designing context-free grammars.	Week 4 Lecture 2	Discussion, Group study and perform of exercises	Lecture PPT Slides Board Work Homework Quiz 4
Context Free Grammar (CFG)	Designing context-free grammars continued	Week 5 Lecture 1	Discussion, Group study and perform of exercises	Lecture PPT Slides Board Work Homework

Ambiguous Grammar, Chomsky Normal Form	Understanding ambiguity and Chomsky normal form of CFG	Week 5 Lecture 2	Discussion, Group study and perform of exercises	Lecture PPT Slides Board Work Homework Quiz 5
Push Down Automata	Understanding PDA, equivalence with context-free grammars.	Week 6 Lecture 1	Discussion, Group study and perform of exercises	Lecture PPT Slides Board Work Homework
REVIEW Assignment Submission + Viva		Week 6 Lecture 2	Submission, Discussion	Viva, Presentation
Mid Semester Assessment (Week 7)				
Turing Machine	Understanding Computability and Formal Definition TM, State Diagram Representation, terminology, acceptable	Week 8 Lecture 1	Discussion, Group study and perform of exercises	Lecture PPT Slides Board Work Homework
Turing Machine	Designing TM, Multi tape TM, k-tape TM, Nondeterministic TM,	Week 8 Lecture 2	Discussion, Group study and perform of exercises	Lecture PPT Slides Board Work Homework Quiz 1
Turing Machine	Designing TM continued, Algorithms	Week 9 Lecture 1	Discussion, Group study and perform of exercises	Lecture PPT Slides Board Work Homework
Turing Machine	Empty ness Testing, DFA-Equivalence, Deciding Languages, Universal TM	Week 9 Lecture 2	Discussion, Group study and perform of exercises	Lecture PPT Slides Board Work Homework Quiz 2
Turing Machine	Halting Problem, Countable, Uncountable problem	Week 10 Lecture 1	Discussion, Group study and perform of exercises	Lecture PPT Slides Board Work Homework
Decidability and Undecidability	Getting the concept of Decidable language, Church-Turing thesis	Week 10 Lecture 2	Discussion, Group study and perform of exercises	Lecture PPT Slides Board Work Homework Quiz 3
Decidability and Undecidability	Church-Turing thesis continued	Week 11 Lecture 1	Discussion, Group study and perform of exercises	Lecture PPT Slides Board Work Homework

Theory of NP completeness	Getting the idea of complexity of problems, NP completeness of some problems, Cook-Levin theorem	Week 11 Lecture 2	Discussion, Group study and perform of exercises	Lecture PPT Slides Board Work Homework Quiz 4
NP Completeness	NP completeness continued,	Week 12 Lecture 1	Discussion, Group study and perform of exercises	Lecture PPT Slides Board Work Homework
Time/Space complexity	Understanding PSPACE and Savitch's theorem	Week 12 Lecture 2	Discussion, Group study and perform of exercises	Lecture PPT Slides Board Work Homework Quiz 5
Time/Space complexity	Understanding PSPACE and Savitch's theorem continued	Week 13 Lecture 1	Discussion, Group study and perform of exercises	Lecture PPT Slides Board Work Homework
Review Assignment Submission + Viva		Week 13 Lecture 2	Submission, Discussion	Viva, Presentation
End Semester Assessment (Week 14)				

* The faculty reserves the right to change, amend, add or delete any of the contents.

XI- Course Requirements

At least **80% class attendance** is necessary to sit for the exam. If there is any assignment given to the students, they must submit it before the deadline decided by the course teacher.

XII – Evaluation & Grading System

The following grading system will be strictly followed in this class

Evaluation				
Attendance		10		Final Grade
Quiz/Viva	3 x 10	30		Mid Semester Assessment: 50%
Assignment/Viva	10+10	20		Final Term Assessment: 50%
Term Assessment				
Exam		20		Grand Total: 100%
Viva		20		
Total		100		

Numerical %	Letter	Grade Point
90-100	A+	4.00
85 - < 90	A	3.75
80 - < 85	B+	3.50
75 - < 80	B	3.25
70 - < 75	C+	3.00
65 - < 70	C	2.75
60 - < 65	D+	2.50
50 - < 60	D	2.25
< 50	F	0.00

Grand Total - - - - - - - -50% of Midterm + 50% of Final Term

The evaluation system will be strictly followed as par the AIUB grading policy.

XIII – Teaching Methods

Maximum topics will be covered from the textbook. For the rest of the topics, reference books will be followed. Some Class notes will be uploaded on the web. White board will be used for most of the time.
For some cases, multimedia projector will be used for the convenience of the students.
Students must study up to the last lecture before coming to the class and it is suggested that they should go through the relevant chapter before coming to the class. Just being present in the class is not enough- students must participate in classroom discussions.

XIV – Textbook/ References

1. Introduction to the Theory of Computation (Latest Edition)
   by Michael Sipser
2. Introduction to Automata Theory, Languages, and Computation (Latest Edition)
   by John E. Hopcroft, et al
3. Elements of the Theory of Computation (Latest Edition)
   by Harry R. Lewis, Christos H. Papadimitriou