FR. Conceicao Rodrigues College Of Engineering
Father Agnel Ashram, Bandstand, Bandra-west, Mumbai-50
Computer Engineering Department

T.E. (Computer) (semester V)
(2019-2021)
Course Outcomes & Assessment Plan

Course CSC405: Theoretical Computer Science **Credits: 04**

Syllabus

Course Objectives:

1. Acquire conceptual understanding of fundamentals of grammars and languages.
2. Build concepts of theoretical design of deterministic and non-deterministic finite automata and push down automata.
3. Develop understanding of different types of Turing machines and applications.
4. Understand the concept of Undecidability.

Prerequisite: Discrete Mathematics

Module No.	Unit No.	Topics	Theory Hrs.	Tutorial Hrs.
1.0		**Basic Concepts and Finite Automata**	09	03
	1.1	• Alphabets, Strings, Languages, Closure properties. • Finite Automata (FA) and Finite State machine (FSM).		
	1.2	• Deterministic Finite Automata (DFA) and Nondeterministic Finite Automata (NFA): Definitions, transition diagrams and Language recognizers • NFA to DFA Conversion • Equivalence between NFA with and without ε- transitions • Minimization of DFA • FSM with output: Moore and Mealy machines, Equivalence • Applications and limitations of FA		
2.0		**Regular Expressions and Languages**	06	02
	2.1	• Regular Expression (RE) • Equivalence of RE and FA, Arden's Theorem • RE Applications		
	2.2	• Regular Language (RL) • Closure properties of RLs • Decision properties of RLs • Pumping lemma for RLs		
3.0		**Grammars**	08	03
	3.1	• Grammars and Chomsky hierarchy		
	3.2	• Regular Grammar (RG)		

		• Equivalence of Left and Right linear grammar • Equivalence of RG and FA		
	3.3	**Context Free Grammars (CFG)** • Definition, Sentential forms, Leftmost and Rightmost derivations, Parse tree, Ambiguity. • Simplification and Applications. • Normal Forms: Chomsky Normal Forms (CNF) and Greibach Normal Forms (GNF). • CFLs - Pumping lemma, Closure properties		
4.0		**Pushdown Automata(PDA)**	**04**	**01**
	4.1	• Definition, Transitions ,Language of PDA • Language acceptance by final state and empty stack • PDA as generator, decider and acceptor of CFG. • Deterministic PDA , Non-Deterministic PDA • Application of PDA.		
5.0		**Turing Machine (TM)**	**09**	**03**
	5.1	• Definition, Transitions • Design of TM as generator, decider and acceptor. • Variants of TM: Multitrack, Multitape • Universal TM. • Equivalence of Single and Multi Tape TMs. • Applications, Power and Limitations of TMs. • Context Sensitivity and Linear Bound Automata.		
6.0		**Undecidability**	**03**	**01**
	6.1	• Decidability and Undecidability, • Recursive and Recursively Enumerable Languages. • Halting Problem, • Rice's Theorem, • Post Correspondence Problem,		
		Total	**39**	**13**

Assessment:

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed.

Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

TCS- Lecture Plan (2019-2020)

Modes of Content Delivery:

i	Class Room Teaching	v	Self-Learning Online Resources	ix	Industry Visit
ii	Tutorial	vi	Slides	x	Group Discuss.
iii	Remedial Coaching	vii	Simulations/Demonstrations	xi	Seminar
Iv	Lab Experiment	viii	Expert Lecture	xii	Case Study

No.	Portion to be covered	Planned date	Actual date	Content Delivery
1.	Importance of TCS, Course Outcomes	**01/07/2019**		Blackboard
2	Alphabets, Strings, Languages, Closure Properties.	**04/07/2019**		Blackboard
3	Finite Automata and Finite State Machine (Divide by 3 – FSM)	**05/07/2019**		Blackboard
4	DFA Definition, Transition Diagrams and Language recognizers examples	**08/07/2019**		Blackboard
5	DFA – Design problems	**09/07/2019**		Blackboard
6	NFA Definition and Design problems	**10/07/2019**		Blackboard
7	NFA to DFA conversion.	**11/07/2019**		
8	NFA with e-transitions and NFA equivalence	**12/07/2019**		Blackboard
9	NFA with e-transitions to DFA conversions	**15/07/2019**		
10	Minimization of DFA	**15/07/2019**		Blackboard
11	Minimization of DFA	**17/07/2019**		Blackboard
12 **13**	FSM with output: Moore Machine	**19/07/2019** **22/07/2019**		Blackboard
14	FSM with output: Mealy Machine	**22/07/2019**		Blackboard
15	Applications and Limitations of DFA	**24/07/2019**		Blackboard
16	Regular Expressions, RE and FA equivalence	**26/07/2019**		Blackboard
17	Arden's Theorem	**29/07/2019**		Blackboard
18	Regular Language (RL), Closure and desicion properties of RL	**29/07/2019**		Blackboard
19	Pumping Lemma of RL	**31/07/2019**		Blackboard
20	Turing Machine: Definition, Transitions	**02/08/2019**		Blackboard

21 **22**	Turing Machine as generator, decider	**05/08/2019** **05/08/2019**		Blackboard
23	Turing Machine as generator, acceptor	**07/08/2019**		Blackboard
24	Varients of Turing Machine, Universal TM	**09/08/2019**		Blackboard
25	Equivalence of single and Multitape TMs, Applications, Powers and Limitations	**12/08/2019**		Blackboard
26	Grammars and Chomsky hierarchy	**19/08/2019**		Blackboard
27	Regular Grammar(RG), Left linear and Right linear Grammar	**21/08/2019**		Blackboard
28	Equivalence of RG and FA	**23/08/2019**		Blackboard
29 **30**	Context Free Grammar: Design	**26/08/2019** **26/08/2019**		Blackboard
31 **32**	Parse tree and Ambiguity	**28/08/2019** **30/08/2019**		Blackboard
33	Simplification and Applications	**09/09/2019**		Blackboard
34	Chomsky Normal Form	**09/09/2019**		Blackboard
35	Greibach Normal Form	**11/09/2019**		Blackboard
36	CFLs- Pumping Lemma	**13/09/2019**		Blackboard
37	CFLs-Closure properties	**16/09/2019**		Blackboard
38	Push Down Automata :Definition, transitions, Applications	**16/09/2019**		Blackboard
39	PDA-as generator, decider	**18/09/2019**		Blackboard
40	PDA-as acceptor	**20/09/2019**		Blackboard
41 **42**	Deterministic PDA	**23/09/2019** **23/09/2019**		Blackboard
43	Non-deterministic PDA	**25/09/2019**		Blackboard
44	Decidability and Undecidability	**27/09/2019**		Blackboard
45 **46**	Halting Problem, Recursive and Recursively Enumerable Languages	**30/09/2019** **30/09/2019**		Blackboard
47	Rice's Theorm	**04/10/2019**		Blackboard
48	Post Correspondence Problem	**07/10/2019**		Blackboard

Total = 48

Assignments:

Sr.No.	Assignment Topic	Date
01	Finite State Machine Design Problems	15/07/2019
02	NFA and DFA and Equivalence	22/07/2019
03	Regular Expressions Writing	29/07/2019
04	Turing Machine Design problems	05/08/2019
05	Context Free Grammar Design and Ambiguity	26/08/2019
06	Push Down Automata Design Problems	23/10/2019

Text Books:

1. John E, Hopcroft, Rajeev Motwani, Jeffery D. Ullman, "Introduction of Automata Theory, Languages and Computation, Pearson Edition
2. Michael Siper, "Theory of Computation", Cengage Learning
3. Vivek Kulkarni, :Theory of Computation", Oxford University Press. India

Reference Books:

1. J. C. Martin, " Introduction to languages and Theory of Computation", Tata McGraw Hill.
2. Kavi Mahesh, " Theory of Computation: A Problem Solving Approach", Wiley-India.

Course Outcomes:

At the end of the course student will be able to

CSC504.1: Identify the central concepts in theory of computation and differentiate between deterministic and non deterministic automata, also obtain equivalence between NFA and DFA [Application/Analysis]

CSC504.2: Infer the equivalence of languages described by finite automata and regular expressions.[Comprehension]

CSC504.3: Devise regular, context free grammars while recognizing the strings and tokens [Synthesis]

CSC504.4: Design pushdown automata to recognize the language.[Synthesis]

CSC504.5: Develop an understanding of computation through Turing Machine. [Synthesis]

CSC504.6: Acquire fundamental understanding of decidability and undecidability. [Knowledge]

Mapping of CO with PO:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CSC504.1	3	3	3										3	3
CSC504.2	3	3	3	3									3	3
CSC504.3	3	3	3	3									3	3
CSC504.4	3	3	3										3	3
CSC504.5	3	3	3										3	3
CSC504.6	3	3								2		3	3	3
Mapping	**3**	**3**	**3**	**3**						**2**		**3**	**3**	**3**

Course Outcomes Target:

Upon completion of this course students will be able to:

CSC504.1: Identify the central concepts in theory of computation and differentiate between deterministic and non deterministic automata, also obtain equivalence between NFA and DFA. **Target level: 2.5**

CSC504.2: Infer the equivalence of languages described by finite automata and regular expressions.[Comprehension] **Target level: 2.5**

CSC504.3: Devise regular, context free grammars while recognizing the strings and tokens [Synthesis] **Target level: 2.5**

CSC504.4: Design pushdown automata to recognize the language. **Target level: 2.5**

CSC504.5: Develop an understanding of computation through Turing Machine. [Synthesis] **Target level: 2.5**

CSC504.6: Acquire fundamental understanding of decidability and undecidability. [Knowledge] **Target level: 2.5**

Content Beyond Syllabus:

Sr.No.	Content Beyond Syllabus	Action Plan	CO/PO Mapping
1	Recursive & Recursively Enumerable Languages	Planned one Guest lecture. (18-Sept 2019)	CO6/PO12
2	Undecidability & Halting Problem		
3	Research Paper study		PO12

CO Assessment Tools:

CSC504.1: **Test 1**: **20%** *(Total Marks = 10)*, **Assignment 1: 20%** (Total Marks = 10)
Assignment 2: 20% (Total Marks = 10) **End Sem Theory: 40%**

COdm = 0.2*Test1+0.2*Assign1+0.2*Asiign2+0.4*End Sem Marks-Th

CSC504.1= 0.8 * COdm + 0.2 COidm

CSC504.2: **Test 1**: **30%** *(Total Marks = 05)*, **Assignment 3: 30%** (Total Marks = 10)
End Sem Theory: 40%

COdm = 0.3*Test1+0.3*Assign3+0.4*End Sem Marks-Th

CSC504.2= 0.8 * COdm + 0.2 COidm

CSC504.3: **Test 2: 30%** *(Total Marks = 12)*, **Assignment 5: 30%** (Total Marks = 10)
End Sem Theory: 40%

COdm = 0.3*Test2+0.3*Assign5+0.4*End Sem Marks-Th

CSC504.3= 0.8 * COdm + 0.2 COidm

CSC504.4: **Test 2: 30%** *(Total Marks = 05)*, **Assignment 6: 30%** (Total Marks = 20)
End Sem Theory: 40%

COdm = 0.3*Test2+0.3*Assign6+0.4*End Sem Marks-Th

CSC504.4= 0.8 * COdm + 0.2 COidm

CSC504.5: **Test 1: 30%** *(Total Marks = 05)*, **Assignment 4: 30%** (Total Marks = 20)
End Sem Theory: 40%

COdm = 0.3*Test2+0.3*Assign4+0.4*End Sem Marks-Th

CSC504.5= 0.8 * COdm + 0.2 COidm

CSC504.6: **Test 2: 20%** *(Total Marks = 03)*, **Quiz: 30%** (Total Marks = 20)
End Sem Theory: 50%

COdm = 0.2*Test2+0.3*Quiz+0.5*End Sem Marks-Th

CSC504.6= 0.8 * COdm + 0.2 COidm
