COURSE HANDOUT

B.Tech- 4th Semester

Course Title: **THEORY OF COMPUTATION** Dated: 27-11-2017

Course Code: 16CS405 Academic Year: 2017-18

Course Structure: 3-1-0-4

Course coordinator : V.Srinadh

Instructor(s) : V.Srinadh, Ch.Chakradhara Rao, V.Mahalakshmi

Course Description:

The phrase *theory of computation* refers to a theoretical treatment of what can be computed and how fast it can be done. In the study of the mathematical foundations of computation: what is an appropriate mathematical model of a computer, what types of computations are possible in the model, what types are not, the inherent complexities of certain computations and so forth.

Department	CSE	**Contact Hours**			
Title of Course	THEORY OF COMPUTATION	**Lecture**	**Tutorial**	**Practical**	**Credits**
Course code	16CS405				
Designation	Required	3	1	0	4
Continuous Assessment	40 M	30 marks from 80% of best sessional +20% of other sessional 10 marks from comprehensive examination			
Final Examination	60 M	Semester end examination of three hours duration for 60 maximum marks			
Prerequisites	Mathematical foundations for Computer Science				

Scope and Objective:
The course content enables students to

- Understand the concept of Set Operations, Cardinality and Denumerable sets. Acquire knowledge to design, specify and test deterministic and nondeterministic finite automata that recognize regular languages.
- Understand tuple descriptions of Mealy and Moore finite-state machines, State diagrams, state tables and their relationship.
- Acquire the idea to write regular expressions and regular grammars that produce regular languages.
- Identify non-regular languages using the Pumping Lemma.

Text Books:

1. Introduction to Automata Theory Language and Computation by Jeffery D. Ullman and John E. Hopcroft, Narosa Publishing House.
2. Intoduction to Computer Theory, Daniel I.A cohen, John Wiley.

Reference books:

1. Theory of computer science -Automata language and computation - Mishra and Chandrashekaran, 2nd Edition, PHI.
2. Elements of theory of computation, Lewis H.P & Papadimitriou C.H, Pearson/ PHI

SYLLABUS:

UNIT – I **12+4 Hrs**

Finite Automata:

Symbol - String & their operation - DFA - NFA - Recognition of a language by an Automaton - Equivalence of DFA and NFA - Finite Automata with Null-Closure - Minimization of FA - Equivalence of FAs - Finite Automata with output: Mealy and Moore Machines;

Regular Languages: Regular Sets and Languages - Equivalence of FA & regular expression - Pumping Lemma for Regular Languages - Closure Properties of Regular Sets –Kleen‟s Theorem - Decision Algorithm.

Mealy machine to More machine conversion and vice versa

UNIT – II1 **11+4 Hrs**

Context-free Languages and Push-Down Automata

Non-regular Languages - CFLs - Closure Properties of CFLs - CFGs - derivation trees - Simplification – Ambiguity - Push-Down Automata - Normal Forms - Relationship between PDA and Context Free Languages; Pumping Lemma for CFL. Decision Algorithm;

Generation of CFG - simplification of CFG

UNIT-III **11+4 Hrs**

Chomsky Hierarchy and Turing Machines

Unrestricted Grammars - Context Sensitive Languages and Grammars - - Relations between Classes of languages The Turing Machine Model - Computable Languages and Functions - Turing Machines variants - Universal TMs -Church‟s Hypothesis - Turing Machines as Enumerators;

Linear Bounded Automata

Linear Bounded Automata

UNIT-IV

Undesirability and Complexity Classes

Recursive Functions and Sets - Recursively Enumerable Sets - properties of Recursive and Recursively Enumerable Languages - Rice‟s Theorem - Post Correspondence Problem - Halting Problem - Space and Time Complexity - P TIME - NP - P SPACE etc. - Polynomial Reducibility

P - NP - NP-Complete - and NP-Hard Problem **11+3 Hrs**

Course Outcomes:

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

- Write regular expressions and regular grammars that produce regular languages Illustrate problems that cannot be solved by computers.
- Define Chomsky and Greibach normal forms.
- Design, specify and test deterministic and nondeterministic finite automata that recognize regular languages
- Write State diagrams, state tables and their relationship
- Illustrate whether a specific language is decidable. In particular, that there exist un- computable functions and that some tasks are unsolvable (i.e. no algorithm exists).

Course Plan:

No. Lecture	Learning objectives	Topic(s) to be covered	Chapter in the textbook/reference
1	To know about Strings and their operations	**UNIT-I : Finite Automata** Symbol, Strings and their operations	T-2,C-1
2	To learn about DFA	DFA: Deterministic Finite Automata	T-1, C-2
3	To learn about NFA	NFA: Nondeterministic Finite Automata	T-1, C-2
4	Problems on DFA and NFA	Tutorial-1	
5	To learn inter conversion of NFA DFA	Equivalence of NFA and DFA	T-1, C-2
6	To learn about Finite automata with null transitions	Finite automata with null closure	T-1, C-2
7	To know how to minimize finite automata	Minimization of Finite automata	T-1, C-2
8	Problems on Minimization and Є-moves	Tutorial-2	
9	To know how to check equivalence of two FAs	Equivalence of finite automata	T-1, C-2
10	To know about finite automata with output	Mealy machine and moore machine	T-1, C-2
11	To learn about Regular grammars and regular expressions	Regular sets and grammar, equivalence of finite automata and Regular expressions.	T-1, C-3
12	Problems on equivalence of Finite automata, Mealy and Moore machines.	Tutorial-3	
13	To know about Pumping lemma for Regular Languages	Pumping Lemma for Regular Languages	T-2, C-3
14	To know about closure properties of regular sets.	Closure properties of regular sets	T-2, C-3

15	To know about Kleen's theorem, Decision Algorithm	Kleen's Theorem, Decision Algorithm	T-2, C-3
16	Problems on regular expressions	Tutorial-4	
17	To study the basics of context free languages	**UNIT-2: CFLS and PDA** CFLs	T-1, C-5
18	To study about the closure properties of CFLs	Closure properties of CFLs	T-1, C-5
19	To learn the concepts of converting RE to DFA and problems	CFGs	T-1, C-5
20	Problems on writing CFGs	Tutorial-5	
21	To learn about derivation tree and ambiguous grammar	Derivation tree and Ambiguity	T-1, C-4
22	To know about how to convert CFG into CNF	Chomsky Normal Form	T-1, C-4
23	To know about how to convert CFG into GNF	Greibach Normal form	T-1, C-4
24	Problems on CNF andGNF	Tutorial-6	
25	To learn about Push Down Automata model	Push Down Automata	
26	To learn about Push Down Automata design	Push Down Automata	T-1, C-5
27	To know the relation between PDA and CFL	Relationship between PDA vs CFL	T-1, C-5
28	Problems on Push Down Automata	Tutorial-7	
29	To learn pumping lemma for Context free languages	Pumping Lemma for CFLs	T-1, C-5
30	To Learn about Decision algorithm.	Decision Algorithm	T-1, C-5
31	To study about unrestricted grammars	**UNIT-3: Chomsky Hierarchy and Turing Machines** Unrestricted Grammars	T-1, C-9
32	Problems on pumping lemma	Tutorial-8	
33	To study the context sensitive grammars and languages	Context sensitive grammar and languages	T-1, C-9
34	To study about the classification of languages	Chomsky classification of languages	T-1, C-9
35	To study about the Turing machine model	Turing machine model	T-1, C-7
36	Problems on Grammars and languages	Tutorial-9	
37	To know how to design Turing machine.	Turing machine Design	T-1, C-7

38	To learn about computable languages and functions	Computable languages and functions	T-4, C-7
39	To study about the Turing machine variants	Turing machine variants	T-1, C-7
40	Problems on Turing machine	Tutorial-10	
41	To know about the working of Universal Turing Machine	Universal Turing machine	T-1, C-7
42	To know about the Church's hypothesis.	Church's hypothesis	T-1, C-7
43	To study Turing machine as enumerations	Turing machine as enumerators	T-5, C-7
44	Problems on Turing machine	Tutorial-11	
45	To study the concept of recursive Functions and sets	**UNIT-4: Undecidability and complex classes** Recursive functions and sets	T-1, C-9
46	To study the concept of Recursive Enumerable languages	Recursively enumerable sets	T-1, C-9
47	To know the construction of Turing machines – Examples	Properties of Recursive and Recursive enumerable Languages.	T-1, C-9
48	Problems on Recursive enumerable languages	Tutorial-12	
49	To learn about Rice's theorem	Rice's theorem	T-1, C-8
50	To know how to solve Post Correspondence Problem	Post correspondence problem	T-1, C-8
51	To know how to solve Post Correspondence Problem	Post correspondence problem	T-1, C-8
52	To study Halting problem	Halting problem	T-1, C-8
53	Problems on PCP	Tutorial-13	
54	To know how to compute time complexity of an algorithm.	Time complexity	T-1, C-13
55	To know how to compute space complexity of an algorithm.	Space Complexity	T-1, C-13
56	To know about P-Problems	P-problems	T-1, C-13
57	Problems on Time complexity and space complexity	Tutorial-14	
58	To learn about the Classes of P and NP – Problems solvable in Polynomial Time with examples	NP-Problems	T-1, C-13
59	To learn about the polynomial reducibility	Polynomial reducibility	T-1, C-13

60	Questions on P and NP problems	Tutorial-15	

Evaluation Procedure:

Component	Duration (minutes)	Marks	% of weightage	Date & Time	Venue
Sessional Test – 1	90	40	30 marks from 80% of best sessional +20% of other sessional	29.01.2018-03.02.2018 9:00-10:30 A.M	Block-5
Sessional Test – 2	90	40		26.03.2015-31.03.2018 9:00-10:30 A.M	Block-5
Comprehensive Examination	60	20	50	09.04.2018-14.04.2018	Block-5
Semester End Examination	180	60	100	23.04.2018-05.05.2018	Block-5

Chamber Consultation Hour:

Venue: CSE staff room-II

Notices: Main notice board

Signature of the Instructor **Signature of the course-coordinator**