COURSE FILE - CONTENTS (THEORY)

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Proposed by:

ANEESH CHANDRAN
Assistant Professor
Computer Science and Engineering

Approved by:

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Jyothi Engineering College
Cheruthuruthy P.O.

Prof. Fr. Dr. A.K. George
Head of the Department
Computer Science and Engineering

PREFACE OF THE SUBJECT

Name of the Faculty	**: ANEESH CHANDRAN**
Designation	**: Assistant Professor**
Name of the Subject	**: THEORY OF COMPUTATION**
Subject Code	**: CS301**
Year	**: 2019**
Semester	**: S5**
Academic Year	**: 2019-2020**
Regulation	**: KTU**

Proposed by:

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Computer Science and Engineering

Approved by:

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Institute Vision & Mission

VISION

Creating eminent and ethical leaders through quality professional education with emphasis on holistic excellence.

MISSION

- To emerge as an institution par excellence of global standards by imparting quality engineering and other professional programmes with state-of-the-art facilities.
- To equip the students with appropriate skills for a meaningful career in the global scenario.
- To inculcate ethical values among students and ignite their passion for holistic excellence through social initiatives.
- To participate in the development of society through technology incubation, entrepreneurship and industry interaction.

Department Vision & Mission

VISION

Creating eminent and ethical leaders in the domain of Computational Sciences through quality professional education with a focus on holistic learning and excellence.

MISSION

- To emerge as a leader in education in the region by encouraging teaching, learning, industry and societal connect.
- To instill Entrepreneurial Orientation and research motivation among the students of the department.
- To prepare students for careers in industry, academia and the Government.
- To create technically competent and ethically conscious graduates in the field of Computer Science and Engineering by encouraging holistic learning and excellence.

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PROGRAMME EDUCATIONAL OBJECTIVES

- The graduates shall be able to communicate effectively and work in multidisciplinary teams with team spirit demonstrating value driven and ethical leadership.
- The graduates shall be able to establish themselves as practicing professionals, researchers or Entrepreneurs in computer science or allied areas and shall also be able to pursue higher education in reputed institutes.
- The graduates shall have sound knowledge of Mathematics, Science, Engineering and Management to be able to offer practical software and hardware solutions for the problems of industry and society at large.

PROGRAMME SPECIFIC OUTCOMES

- An ability to understand concepts involved in modeling and design of computer science applications in a way that demonstrates comprehension of the fundamentals and trade-offs involved in design choices.
- An ability to apply design, development, maintenance or evaluation of software engineering principles in the construction of computer and software systems of varying complexity and quality.
- An ability to apply knowledge of operating systems, programming languages, data management, or networking principles to computational assignments.
- An ability to apply knowledge of data structures and algorithms appropriate to computational problems.

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PROGRAMME OUTCOMES

1. Engineering knowledge: Apply the knowledge of mathematics &, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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SEMESTER PLAN

Module	Planned			Actually Held			Remarks if any
	No. of Hours	Starting Date	Ending Date	Starting Date	Ending Date	No. of Hours	
1	9	1/8/19	19/8/19	1/8/19	22/8/19	11	
2	9	21/8/19	2/9/19	22/8/19	26/9/19	12	
3	11	29/8/19	13/9/19	28/9/19	15/10/19	11	
4	7	16/9/19	23/9/19	16/10/19	31/10/19	9.	
5	8	24/9/19	3/10/19	31/10/19	1/11/19	8	
6	9	7/10/19	16/10/19	12/11/19	21/11/19	9	

VERIFICATION REPORT FROM HOD

	Dated Signature of faculty	Remarks By HOD after verification	Dated signature of HOD
End of module 1	[signature] 22/8/19	Completed	[signature]
End of module 2	[signature] 26/9/19	Completed	[signature] 26/9/19
End of module 3	[signature] 15/10/19	Completed	[signature] 15/10/19
End of module 4	[signature] 31/10/19	Completed	[signature] 30/10/19.
End of module 5	[signature] 1/11/19	Completed	[signature] 11/11/19
End of module 6	[signature] 20/11/19	Completed	[signature] 21/11/19

Date of First Class in the Subject : 1/8/19

Date of ~~First~~ Last Class in the Subject : 21/11/19

Total Hours Engaged in the Subject : 60

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SEMESTER PLAN - B

Module	Planned: No. of Hours	Planned: Starting Date	Planned: Ending Date	Actually Held: Starting Date	Actually Held: Ending Date	Actually Held: No. of Hours	Remarks if any
1	9	2/8/19	13/8/19	2/8/19	22/8/19	9	
2	9	14/8/19	28/8/19	26/8/19	24/9/19	9 [signature]	
3	4	30/8/19	13/9/19	20/9/19	15/10/19	4	
4	7	16/9/19	24/9/19	16/10/19	30/10/19	9	
5	8	24/9/19	4/10/19	5/11/19	13/11/19	8	
6	9	7/10/19	16/10/19	15/11/19	23/11/19	8	

VERIFICATION REPORT FROM HOD

	Dated Signature of faculty	Remarks By HOD after verification	Dated signature of HOD
End of module 1	[signature] 23/8/19	completed	[signature] 22/8/19
End of module 2	[signature] 24/9/19	completed	[signature] 24/9/19
End of module 3	[signature] 15/10/19	Completed	[signature] 15/10/19
End of module 4	[signature] 31/10/19	completed	[signature] 30/10/19
End of module 5	[signature] 13/11/19	completed	[signature] 13/11/19
End of module 6	[signature] 23/11/19	Completed	[signature] 23/11/19

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Date of First Class in the Subject : 2/8/19

Date of ~~First~~ Class in the Subject : 23/11/19

Total Hours Engaged in the Subject : 54

[signature]

SCHEDULE OF ASSESSMENTS

Series Tests		Assignments			Date of Continuous Evaluation (Class Tests if any)
Held Date	Date of Return after Valuation	Date of Assignment Given	Date of Submission	Date of Return after Valuation	
6/9/19	18/9/19	2/9/19	27/9/19	3/10/19	
28/10/19	5/11/19	1/11/19	5/11/19	15/11/19	
University Examination Date					

SCHEDULE OF WORK

Days	1	2	3	4	5	6	7
Monday		S5 B		S5 A		S5 A	
Tuesday	S5 B				S5 A	S5 B	
Wednesday		S5 A			S5 B		
Thursday			S5 A				
Friday		S5 B					

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Average Performance Analysis of Internal Tests Conducted

Internal Assessments	Date of Test	Number of Students							Class Average %	Remarks with Dated Signature	
		Appeared	Absent	Failed	Marks >=45%	Marks between 60% & 80%	Marks >=80%	Pass %		Faculty	H.O.D
Test 1	9/6/19	B) 48	5	6	42	21	14	87.5	33.13	[signature]	[signature]
		A) 49	3	8	41	20	10	83.67	31.41		
Test 2	28/10/19	50	8	6	44	15	2	88%	54.56%	[signature]	[signature]
		46	1	9	37	20	5	80%.	57.4%.		
Retest (If any)											

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[signature]

Jyothi Engineering College

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
DEPARTMENT CALENDER 2019-20 ODD SEMESTER

AUGUST			SPETEMBER			OCTOBER			NOVEMBER		
1	THU	Commencement ofClasses for S1-S7	1	SUN		1	TUE	Submission of Department Report 2nd Assignment HS 200,CS 301,CS405	1	FRI	Remedial Class for labs to finish
2	FRI		2	MON	1 st sessional exams begin Submission of Department Report	2	WED	Gandhi Jayanthi	2	SAT	Completion of 5th module
3	SAT		3	TUE	Seminar Presentation to be started	3	THU	2nd Assignment CS207CS 307 CS465,	3	SUN	
4	SUN		4	WED	CESA Inauguration 1st Assignment SubmissionCS201,CS 301,CS403	4	FRI	2nd Assignment HS 200,CS 301,CS405	4	MON	
5	MON		5	THU	1st Assignment SubmissionCS205,CS305,CS407,CS409	5	SAT	2nd Assessment of Project by GuideCommittee completion, 2nd	5	TUE	Submission of Department Report
6	TUE	Department report Submission	6	FRI	1st Assignment SubmissionCS207,CS 307, CS465, CS453,HS 200,CS 301,CS405	6	SUN		6	WED	
7	WED		7	SAT	First Assessment of Project by Guide/Committee to be Completed	7	MON	Mahanavami	7	THU	
8	THU	1st Assignment CS361, CS367, CS 309, CS401	8	SUN		8	TUE	Vijayadhashami	8	FRI	Submission of Phase -1 Project Report Third Assessment of Project
9	FRI	Course Committee/Class Committe S3,S5,S7 1st Assignment CS201,CS 301 CS403	9	MON	MUHARAM	9	WED	Zeroth Presentation of S7 Project to be completed	9	SAT	
10	SAT		10	TUE	1st Onam	10	THU	2nd Assignment Submission CS361, CS367, CS 309, CS401	10	SUN	
11	SUN		11	WED	Thiruvonam	11	FRI	2nd Assignment SubmissionCS201,CS 301,CS403	11	MON	
12	MON	1st Assignment CS205,CS305,CS407,CS409 Last Date of Submission of Seminar and Project Topic & Design Project Topic (S5), Mtech S3	12	THU	3rd onam	12	SAT	2nd Assignment SubmissionCS205,CS305,CS407,CS409	12	TUE	Practical Examinations
13	TUE		13	FRI	SN Guru jayanthi	13	SUN		13	WED	Publish Test 2 Marks Practical Examinations
14	WED	Completion of 1st module 1st Assignment CS207CS 307 CS465, CS453	14	SAT		14	MON	2nd Assignment SubmissionCS207,CS 307, CS465	14	THU	Practical Examinations
15	THU	Independence Day	15	SUN	onam vacation ends	15	TUE	Completion of 4th module 2nd Assignment SubmissionCS453,HS 200,CS 301,CS405	15	FRI	Final Seminar Presentation to be completed Practical Examinations Final Assessment by Guide/ Committee (Project Phase-1) Design Project Presentation Ends(S5)
16	FRI	1st Assignment HS 200,CS 301,CS405	16	MON	Classes Re-open (S7) Seminar Presentation to bestarted	16	WED	Last Date ofAssignment .2	16	SAT	
17	SAT	1st Assignment MA 201 CS303, CS 307, CS203, CS209	17	TUE	Last date ofAssignment No. 1 (S1)	17	THU	3rd and 4th Module Revision	17	SUN	
18	SUN		18	WED	First Internal Exam Starts (S1)	18	FRI		18	MON	
19	MON	Completion of 1st module(S1) 1st Assignment Submission CS361, CS367, CS 309, CS401	19	THU	Allocation of Project by Guide/ Committee to be Completed (S7class) Allocation of Design Project Topic (S5)	19	SAT		19	TUE	
20	TUE		20	FRI		20	SUN		20	WED	Completion of 6th module
21	WED		21	SAT	First Internal Exam Ends (S1)	21	MON	Internal test 2 Start	21	THU	5th and 6th Module Revision
22	THU		22	SUN		22	TUE		22	FRI	Revision/Remedial Submission of Completed Seminar Report (S7 Class)
23	FRI	Sree Krishna Jayanthi	23	MON	PAT meeting Starting Date Add-on /Foundation courses start	23	WED		23	SAT	Final Assessment of Project (Phase 1) Submission of Completed Seminar Report
	SAT		24	TUE		24	THU		24	SUN	
	SUN		25	WED	Completion of 3rd module	25	FRI	Last date ofAssignment No. 2 (S1)	25	MON	Closing of Semester
26	MON		26	THU		26	SAT	Internal test 2 End	26	TUE	
27	TUE	Completion of 2 nd module Last date of Assignment No. 1	27	FRI	PAT meeting Ending Date	27	SUN	Deepavali	27	WED	
28	WED	Ayyankali Jayanthi/ ML workshop	28	SAT	2nd Assignment CS361, CS367, CS 309, CS401	28	MON	Remedial Class for labs to begin	28	THU	
29	THU	Revision/ Remedial	29	SUN		29	TUE		29	FRI	
30	FRI	Revision/ Remedial	30	MON		30	WED	Assessment of Project by Guide/ Committee to be completed	30	SAT	
31	SAT	Revision/ Remedial				31	FRI				

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COURSE INFORMATION SHEET

PROGRAMME: Computer Science and Engineering(A)	**DEGREE:** B.TECH
COURSE: THEORY OF COMPUTATION	**SEMESTER:** S5 **CREDITS:** 4
COURSE CODE: CS301 **REGULATION:** KTU	**COURSE TYPE:** Theory
COURSE AREA/DOMAIN: Compilers	**CONTACT HOURS:** 5
CORRESPONDING LAB COURSE CODE (IF ANY): -	**LAB COURSE NAME:**

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SYLLABUS:

UNIT	DETAILS	HOURS
1	Introduction to Automata Theory and its significance. Type 3 Formalism:Finite state automata .Properties of transition functions. Designing finite automata. NFA. Finite Automata with Epsilon Transitions. Equivalence of NFA and DFA. Conversion of NFA to DFA. Equivalence and Conversion of NFA with and without Epsilon Transitions.	9
2	Myhill-Nerode Theorem. Minimal State FA Computation. Finite State Machines with Output- Mealy and Moore machine (Design Only). Two- Way Finite Automata. Regular Grammar. Regular Expressions. Equivalence of regular expressions and NFA with epsilon transitions. Converting Regular Expressions to NFA with epsilon transitions. Equivalence of DFA and regular expressions. converting DFA to Regular Expressions.	9
3	Pumping Lemma for Regular Languages. Applications of Pumping Lemma. Closure Properties of Regular sets (Proofs not required). Decision Problems related with Type 3 Formalism. Type 2 Formalism:- Context-Free Languages (CFL). Context-Free Grammar (CFG). Derivation trees. Ambiguity. Simplification of CFG. Chomsky Normal Form. Greibach normal forms.	8
4	Non-Deterministic Pushdown Automata (NPDA) design. Equivalence of acceptance by final state and empty stack in PDA. Equivalence between NPDA and CFG. Deterministic Push Down Automata. Closure properties of CFLs (Proof not required). Decision Problems related with Type 3 Formalism.	7
		8

	Context-sensitive Grammar. Linear Bounded Automata (Design not required). Type 0 Formalism:Turing Machine (TM) – Basics and formal definition. TMs as language acceptors. TMs as Transducers. Designing Turing Machines.	
6	Variants of TMs -Universal Turing Machine. Multi-tape TMs. Non Deterministic TMs. Enumeration Machine (Equivalence not required). Recursively Enumerable Languages. Recursive languages. Properties of Recursively Enumerable Languages and Recursive Languages. Decidability and Halting Problem. Chomsky Hierarchy.	7

TEXT / REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
1	Dexter C. Kozen, Automata and Computability, Springer1999.
1	John E Hopcroft, Rajeev Motwani and Jeffrey D Ullman, Introduction to Automata Theory, Languages, and Computation, 3/e, Pearson Education, 2007
2	An Introduction to Automata theory and formal languages, Adesh Pandy
2	John C Martin, Introduction to Languages and the Theory of Computation, TMH, 2007
3	Theory of Computation, Sachin Agarwal
3	Michael Sipser, Introduction To Theory of Computation, Cengage Publishers, 2013
4	Theory of Computation, B. Patel

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
CS201	DISCREET COMPUTATIONAL STRUCTURES		S3

COURSE OBJECTIVES:

Sl.No	DESCRIPTION
1	Introduce the concept of formal languages.
2	Discuss the Chomsky classification of formal languages with discussion on grammar and automata for regular, context-free, context sensitive and unrestricted languages.
3	Discuss the notions of decidability and halting problem.

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COURSE OUTCOMES:

Sl.No	DESCRIPTION	PO & PSO MAPPING
C301.1	Classify formal languages into regular, context-free, context sensitive and unrestricted languages.	PO1,PO2,PO3,PO4,PO5,PO12,PSO1,PSO2,PSO3,PSO4
C301.2	Design finite state automata, regular grammar, regular expression and Myhill-Nerode relation	PO1,PO2,PO3,PO4,PO5,PO12,PSO1,PSO2,PSO3,PSO4
C301.3	Representations for regular languages	PO1,PO2,PO3,PO4,PO5,PO12,PSO1,PSO2,PSO3,PSO4
C301.4	Design push-down automata and context-free grammar representations for context-free languages.	PO1,PO2,PO3,PO4,PO5,PO12,PSO1,PSO2,PSO3,PSO4
C301.5	Design Turing Machines for accepting recursively enumerable languages.	PO1,PO2,PO3,PO4,PO5,PO12,PSO1,PSO2,PSO3,PSO4
C301.6	Understand the notions of decidability and undecidability of problems, Halting problem	PO1,PO2,PO3,PO4,PO5,PO12,PSO1,PSO2,PSO3,PSO4

COURSE OUTCOMES VS PO MAPPING:

Sl.No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C301.1	3	3	3	3	1	-	-	-	-	-	-	2
C301.2	3	3	3	3	1	-	-	-	-	-	-	2
C301.3	3	3	3	3	1	-	-	-	-	-	-	2
C301.4	3	3	3	3	1	-	-	-	-	-	-	2
C301.5	3	3	3	3	1	-	-	-	-	-	-	2
C301.6	3	3	3	3	1	-	-	-	-	-	-	2
Avg	3	3	3	3	1	-	-	-				2

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COURSE OUTCOMES VS PSO MAPPING:

Sl.No	PSO1	PSO2	PSO3	PSO4
C301.1	3	3	2	2
C301.2	3	3	2	2
C301.3	3	3	2	2
C301.4	3	3	2	2
C301.5	3	3	2	2
C301.6	3	3	2	2
Avg	3	3	2	2

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JUSTIFICATION FOR MAPPING:

Sl.No	PO & PSO MAPPED	JUSTIFICATION
C301.1	PO1, PO2, PO3, PO4, PO5, PO12, , PSO1, PSO2, PSO3, PSO4,	
C301.2	PO1, PO2, PO3, PO4, PO5, PO12, , PSO1, PSO2, PSO3, PSO4,	
C301.3	PO1, PO2, PO3, PO4, PO5, PO12, , PSO1, PSO2, PSO3, PSO4,	
C301.4	PO1, PO2, PO3, PO4, PO5, PO12, , PSO1, PSO2, PSO3, PSO4,	
C301.5	PO1, PO2, PO3, PO4, PO5, PO12, , PSO1, PSO2, PSO3, PSO4,	
C301.6	PO1, PO2, PO3, PO4, PO5, PO12, , PSO1, PSO2, PSO3, PSO4,	

GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

Sl.No	DESCRIPTION	PROPOSED ACTIONS	
2	Conversion between NFA and regular expressions	Arden's theorem	class
1	Introduction to formal proof (needed for proving	class	

	equivalence).	NPTEL

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

Sl.No	DESCRIPTION
1	NP complete problems

WEB SOURCE REFERENCES:

Sl.No	DESCRIPTION
4	https://courses.cs.washington.edu/courses/cse322/05wi/handouts/MyhillNerode.pdf
3	http://www.iannauniversity.com/2012/06/cs2303-theory-of-computation-lecture.html
2	http://nptel.ac.in/courses/106104028/
1	https://www.youtube.com/user/nesoacademy

DELIVERY / INSTRUCTIONAL METHODOLOGIES:

☑CHALK & TALK	☑STUD. ASSIGNMENT	☑WEB RESOURCES	☑NPTEL/OTHERS
☑LCD/SMART BOARDS	☑STUD. SEMINARS	☐ADD-ON COURSES	☑WEBNIARS

ASSESSMENT METHODOLOGIES-DIRECT:

☑ASSIGNMENTS	☑STUD. SEMINARS	☑TESTS/MODEL EXAMS	☑UNIV. EXAMINATION
☐STUD. LAB PRACTICES	☐STUD. VIVA	☐MINI/MAJOR PROJECTS	☐CERTIFICATIONS
☐ADD-ON COURSES	☐Others		

ASSESSMENT METHODOLOGIES-INDIRECT:

☐ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK,ONCE)	☑STUDENT FEEDBACK ON FACULTY (TWICE)
☐ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐Others

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INNOVATIONS IN TEACHING/LEARNING/EVALUATION PROCESSES:

Sl.No	DESCRIPTION
	NIL

Proposed by:

ANEESH CHANDRAN
Assistant Professor
Computer Science and Engineering

Approved by:

Prof. Fr. Dr. A.K. George
Head of the Department
Computer Science and Engineering

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COURSE PLAN A

Sl. No.	Unit	Topics to be covered	Planned Date & Hour	Actual Date & Hour
1	1	Introduction to Automata Theory and its significance	01-08-2019 Hour: 3	1/8/19 (3)
2	1	Type 3 Formalism:Finite state automata	05-08-2019 Hour: 4	5/8/19 (4)
3	1	Properties of transition functions	05-08-2019 Hour: 6	6/8/19 (5)
4	1	Designing finite automata	06-08-2019 Hour: 5	7/8/19 (2)
5	1	NFA	07-08-2019 Hour: 2	8/8/19 (3) 12/8/19 (4)
6	1	Finite Automata with Epsilon Transitions	08-08-2019 Hour: 3	12/8/19 (6)
7	1	Equivalence of NFA and DFA	12-08-2019 Hour: 4	14/8/19 (4) 19/8/19 (6)
8	1	Conversion of NFA to DFA	12-08-2019 Hour: 6	21/8/19 (2)
9	1	Equivalence and Conversion of NFA with and without Epsilon Transitions	13-08-2019 Hour: 5	22/8/19 (3)
10	2	Myhill-Nerode Theorem	14-08-2019 Hour: 2	22/8/19 (5) 29/8/19 (3,4)
11	2	Minimal State FA Computation	15-08-2019 Hour: 3	2/9/19 (4,6)
12	2	Finite State Machines with Output- Mealy and Moore machine (Design Only)	19-08-2019 Hour: 4	3/9/19 (5)
13	2	Two- Way Finite Automata	19-08-2019 Hour: 6	4/9/19 (2)

26/8/19, 7/9/19 Tutorial.

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14	2	Regular Grammar	20-08-2019 Hour: 5	18/9/19
15	2	Regular Expressions	21-08-2019 Hour: 2	18/9/19
16	2	Equivalence of regular expressions and NFA with epsilon transitions	22-08-2019 Hour: 3	19/9/19
17	2	Converting Regular Expressions to NFA with epsilon transitions	26-08-2019 Hour: 4	23/9/19
18	2	Equivalence of DFA and regular expressions	26-08-2019 Hour: 6	24/9/19
19	2	Converting DFA to Regular Expressions	27-08-2019 Hour: 5	25/9/19
20	2	Tutorial	28-08-2019 Hour: 2	26/9/19
21	3	Pumping Lemma for Regular Languages	29-08-2019 Hour: 3	28/9/19
22	3	Applications of Pumping Lemma	02-09-2019 Hour: 4	30/9/19 30/9/19
23	3	Closure Properties of Regular sets (Proofs not required)	02-09-2019 Hour: 6	4/10/19
24	3	Decision Problems related with Type 3 Formalism	03-09-2019 Hour: 5	3/10/19
25	3	Type 2 Formalism:- Context-Free Languages (CFL)	04-09-2019 Hour: 2	5/10/19
26	3	Context-Free Grammar (CFG)	05-09-2019 Hour: 3	9/10/19
27	3	Derivation trees	09-09-2019 Hour: 4	10/10/19
28	3	Ambiguity	09-09-2019 Hour: 6	10/10/19

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29	3	Simplification of CFG	10-09-2019 Hour: 5	24/10/19
30	3	Chomsky Normal Form	11-09-2019 Hour: 2	24/10/19
31	3	Greibach normal forms	12-09-2019 Hour: 3	25/10/19
32	4	Non-Deterministic Pushdown Automata (NPDA)	16-09-2019 Hour: 4	26/10/19 27/10/19 (Ext)
33	4	Design	16-09-2019 Hour: 6	21/10/19
34	4	Equivalence of acceptance by final state and empty stack in PDA	17-09-2019 Hour: 5	23/10/19
35	4	Equivalence between NPDA and CFG	18-09-2019 Hour: 2	24/10/19
36	4	Deterministic Push Down Automata	19-09-2019 Hour: 3	26/10/19
37	4	Closure properties of CFLs (Proof not required)	23-09-2019 Hour: 4	28/10/19
38	4	Decision Problems related with Type 3 Formalism	23-09-2019 Hour: 6	29/10/19 30/10/19
39	5	Pumping Lemma for CFLs	24-09-2019 Hour: 5	31/10/19
40	5	Applications of Pumping Lemma	25-09-2019 Hour: 2	31/10/19
41	5	Type 1 Formalism: Context-sensitive Grammar	26-09-2019 Hour: 3	5/11/19
42	5	Linear Bounded Automata (Design not required)	30-09-2019 Hour: 4	6/11/19

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43	5	Type 0 Formalism:Turing Machine (TM) – Basics and formal definition	30-09-2019 Hour: 6	7/11/19
44	5	TMs as language acceptors	01-10-2019 Hour: 5	11/11/19
45	5	TMs as Transducers	02-10-2019 Hour: 2	11/11/19
46	5	Designing Turing Machines	03-10-2019 Hour: 3	11/11/19
47	6	Variants of TMs -Universal Turing Machine	07-10-2019 Hour: 4	12/11/19
48	6	Multi-tape TMs	07-10-2019 Hour: 6	13/11/19
49	6	Non Deterministic TMs	08-10-2019 Hour: 5	14/11/19
50	6	Enumeration Machine (Equivalence not required)	09-10-2019 Hour: 2	16/11/19
51	6	Recursively Enumerable Languages	10-10-2019 Hour: 3	16/11/19
52	6	Recursive languages	14-10-2019 Hour: 4	18/11/19
53	6	Properties of Recursively Enumerable Languages and Recursive Languages	14-10-2019 Hour: 6	18/11/19
54	6	Decidability and Halting Problem	15-10-2019 Hour: 5	18/11/19
55	6	Chomsky Hierarchy	16-10-2019 Hour: 2	21/11/19

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NBA Accredited B.Tech Programmes in Computer Science & Engineering, Electronics & Communication Engineering, Electrical & Electronics Engineering and Mechanical Engineering valid for Academic Years 2016-2017 to 2018-2019
www.jecc.ac.in | E-mail : info@jecc.ac.in

COURSE PLAN B

Sl. No.	Unit	Topics to be covered	Planned Date & Hour	Actual Date & Hour
1	1	Introduction to Automata Theory and its significance	02-08-2019 Hour: 2	2/8/19 (2)
2	1	Type 3 Formalism:Finite state automata	05-08-2019 Hour: 2	5/8/19 (2)
3	1	Properties of transition functions	06-08-2019 Hour: 1	6/8/19 (1)
4	1	Designing finite automata	06-08-2019 Hour: 6	6/8/19 (6)
5	1	NFA	07-08-2019 Hour: 6	7/8/19 (6)
6	1	Finite Automata with Epsilon Transitions	09-08-2019 Hour: 2	16/8/19 (2) 17/8/19 (2)
7	1	Equivalence of NFA and DFA	12-08-2019 Hour: 2	19/8/19 (2)
8	1	Conversion of NFA to DFA	13-08-2019 Hour: 1	21/8/19 (6)
9	1	Equivalence and Conversion of NFA with and without Epsilon Transitions	13-08-2019 Hour: 6	22/8/19 (3)
10	2	Myhill-Nerode Theorem	14-08-2019 Hour: 6	26/8/19 (3)
11	2	Minimal State FA Computation	16-08-2019 Hour: 2	27/8/19 (4,6)
12	2	Finite State Machines with Output- Mealy and Moore machine (Design Only)	19-08-2019 Hour: 2	30/8/19 (2) 2/9/19 (2)
13	2	Two- Way Finite Automata	20-08-2019 Hour: 1	3/9/19 (1,6)

20/8/19, 7/9/19 - Tutorial.

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14	2	Regular Grammar	20-08-2019 Hour: 6	18/9/19
15	2	Regular Expressions	21-08-2019 Hour: 6	20/9/19
16	2	Equivalence of regular expressions and NFA with epsilon transitions	23-08-2019 Hour: 2	23/9/19
17	2	Converting Regular Expressions to NFA with epsilon transitions	26-08-2019 Hour: 2	24/9/19
18	2	Equivalence of DFA and regular expressions	27-08-2019 Hour: 1	25/9/19
19	2	Converting DFA to Regular Expressions	27-08-2019 Hour: 6	27/9/19
20	2	Tutorial	28-08-2019 Hour: 6	24/9/19
21	3	Pumping Lemma for Regular Languages	30-08-2019 Hour: 2	28/9/19
22	3	Applications of Pumping Lemma	02-09-2019 Hour: 2	30/9/19
23	3	Closure Properties of Regular sets (Proofs not required)	03-09-2019 Hour: 1	1/10/19
24	3	Decision Problems related with Type 3 Formalism	03-09-2019 Hour: 6	3/10/19
25	3	Type 2 Formalism:- Context-Free Languages (CFL)	04-09-2019 Hour: 6	4/10/19
26	3	Context-Free Grammar (CFG)	06-09-2019 Hour: 2	9/10/19
27	3	Derivation trees	09-09-2019 Hour: 2	10/10/19
28	3	Ambiguity	10-09-2019 Hour: 1	10/10/19

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29	3	Simplification of CFG	10-09-2019 Hour: 6	14/10/19
30	3	Chomsky Normal Form	11-09-2019 Hour: 6	15/10/19
31	3	Greibach normal forms	13-09-2019 Hour: 2	15/10/19(cut) 16/10/19
32	4	Non-Deterministic Pushdown Automata (NPDA)	16-09-2019 Hour: 2	21/10/19
33	4	Design	17-09-2019 Hour: 1	23/10/19
34	4	Equivalence of acceptance by final state and empty stack in PDA	17-09-2019 Hour: 6	25/10/19
35	4	Equivalence between NPDA and CFG	18-09-2019 Hour: 6	26/10/19
36	4	Deterministic Push Down Automata	20-09-2019 Hour: 2	29/10/19
37	4	Closure properties of CFLs (Proof not required)	23-09-2019 Hour: 2	30/10/19
38	4	Decision Problems related with Type 3 Formalism	24-09-2019 Hour: 1	30/10/19
39	5	Pumping Lemma for CFLs	24-09-2019 Hour: 6	5/11/19
40	5	Applications of Pumping Lemma	25-09-2019 Hour: 6	5/11/19
41	5	Type 1 Formalism: Context-sensitive Grammar	27-09-2019 Hour: 2	6/11/19
42	5	Linear Bounded Automata (Design not required)	30-09-2019 Hour: 2	8/11/19

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43	5	Type 0 Formalism:Turing Machine (TM) Basics and formal definition	01-10-2019 Hour: 1	11/11/19
44	5	TMs as language acceptors	01-10-2019 Hour: 6	12/11/19
45	5	TMs as Transducers	02-10-2019 Hour: 6	12/11/19
46	5	Designing Turing Machines	04-10-2019 Hour: 2	13/11/19
47	6	Variants of TMs -Universal Turing Machine	07-10-2019 Hour: 2	15/11/19
48	6	Multi-tape TMs	08-10-2019 Hour: 1	16/11/19
49	6	Non Deterministic TMs	08-10-2019 Hour: 6	18/11/19
50	6	Enumeration Machine (Equivalence not required)	09-10-2019 Hour: 6	19/11/19
51	6	Recursively Enumerable Languages	11-10-2019 Hour: 2	19/11/19
52	6	Recursive languages	14-10-2019 Hour: 2	20/11/19
53	6	Properties of Recursively Enumerable Languages and Recursive Languages	15-10-2019 Hour: 1	20/11/19
54	6	Decidability and Halting Problem	15-10-2019.Hour: 6	23/11/19
55	6	Chomsky Hierarchy	18/10/19	28/11/19

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Nominal Roll Semester V - COMPUTER SCIENCE & ENGINEERING - A

YEAR OF ADMISSION : 2017 (COMMENCEMENT OF CLASS - 01.08.2019)

SL. NO.	NAME OF STUDENT	REGISTER NO.	REMARKS
1	AAYUSH P REJI	JEC17CS001	
2	ABHIJITH E MORRIES	JEC17CS002	Year out
3	ABHIJITH V J	JEC17CS003	
4	ABHIRAM BHASKAR	JEC17CS004	
5	ABIN M K	JEC17CS005	
6	ADITHYAN K	JEC17CS006	
	ADNAN ABDUL AZEEZ	JEC17CS007	TC issued on 19/04/2018
7	AISWARYA SAJEEV	JEC17CS008	
8	AISWARYA SURESH	JEC17CS009	
9	AJIN N D	JEC17CS010	
10	AJITH SANKAR O	JEC17CS011	
11	AKASH KUMAR	JEC17CS012	Year out
12	AKHIL MR	JEC17CS013	
13	ALEENA SHAJI	JEC17CS014	
14	ALPHIN GEORGE ANSON	JEC17CS015	
15	AMALA K S	JEC17CS016	
16	AMALA MARIA NELSON	JEC17CS017	
17	AMAL TOM	JEC17CS018	
18	ANAGHA N M	JEC17CS019	
19	ANAKHA K R	JEC17CS020	
20	ANILA T A	JEC17CS021	
21	ANILJITH MS	JEC17CS022	
22	ANJALI ANNE PRATHAP	JEC17CS023	
23	ANJITHA M J	JEC17CS024	
24	ANJU VINCENT V	JEC17CS025	
	ANTONY FRANCIS	JEC17CS026	TC ISSUED
25	ARCHANA C K	JEC17CS027	
26	ARCHANA S	JEC17CS028	
27	ARJUN J	JEC17CS029	

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SL. NO.	NAME OF STUDENT	REGISTER NO.	REMARKS
28	ARNOLD MANUEL JOSEPH	JEC17CS030	
29	ARUN RAJU	JEC17CS031	
30	ARYA MANOJ	JEC17CS032	
31	ASHIK A U	JEC17CS033	
32	ATHIRA C	JEC17CS034	TFW
33	AVIN JOSEPH	JEC17CS035	
34	BIBIN THOMAS	JEC17CS036	
35	BINWIN VIJU	JEC17CS037	
36	BIVIN BABU CHALISSERY	JEC17CS038	
37	CECILIA JOE	JEC17CS039	
38	CHARLES JOSHY	JEC17CS040	
39	CHRISTY SUNIL	JEC17CS041	TFW
40	DEEPAK K V	JEC17CS042	Year out
41	DHANYA R	JEC17CS043	
42	DIVYA PETER	JEC17CS044	
43	ELJO JOY	JEC17CS045	
44	GLADEES C B	JEC17CS046	
45	GODSTIN PAUL	JEC17CS047	
46	HANEENAH V. A	JEC17CS048	
47	HARIPRASAD C	JEC17CS049	
48	HARISH S	JEC17CS050	
49	HIMA T	JEC17CS051	
50	JACKSON JAMES	JEC17CS052	
51	JAICOB JOHN A	JEC17CS053	
52	JASMINE SHAJ	JEC17CS054	

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Nominal Roll Semester V - COMPUTER SCIENCE & ENGINEERING - B

YEAR OF ADMISSION : 2017 (COMMENCEMENT OF CLASS - 01.08.2019)

SL. NO.	NAME OF STUDENT	REGISTER NO:	REMARKS
1	JEVIN PAULY KURISSERY	JEC17CS055	
2	JIJO ROJI	JEC17CS056	Year out
3	JOSEPH JOEL C P	JEC17CS057	TFW
	JOSHNA JOHNSON	JEC17CS058	TC Issued on 29.03.2019
4	JOSHUA JOSEPH	JEC17CS059	
5	JOSIN GEORGE	JEC17CS060	Attended Summer Course
6	KARTHIK PC	JEC17CS061	
	MANEESHA K.R	JEC17CS062	TC issued on 11.05.2018
7	MANEESH MANOJ	JEC17CS063	
8	MARY JOSE	JEC17CS064	
9	M DEEPA	JEC17CS065	Year out
10	MEERA E THIMOTHY	JEC17CS066	
11	MELVIN THOMAS	JEC17CS067	Attended Summer Course
12	MOHAMED NAJEEB	JEC17CS068	
13	M P ADITHYA VIJAYAN	JEC17CS069	
14	MUHAMMED AFTHAB V U	JEC17CS070	
15	MUHAMMED RANEESH CM	JEC17CS071	
16	NAIR ANJALI VALSALAN	JEC17CS072	
17	NAVEEN P R	JEC17CS073	
18	NEETHUU N	JEC17CS074	
19	NITHIN PETER	JEC17CS075	
20	NITHIN P V	JEC17CS076	Year out
21	NIVA DILEEP	JEC17CS077	TFW
22	NOVA DILEEP	JEC17CS078	TFW
23	RASHI M	JEC17CS079	
24	RASMIYA C U	JEC17CS080	TFW
25	RESHMA R	JEC17CS081	
26	ROMISH T R	JEC17CS082	

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SL. NO.	NAME OF STUDENT	REGISTER NO.	REMARKS
27	RONDY THOMAS K	JEC17CS083	
28	SANDRA DAVID	JEC17CS084	
29	SANDRA P S	JEC17CS085	Year out
30	SANGEETHA C P	JEC17CS086	
31	SANGEETHA PRATAPAN	JEC17CS087	
32	SANJANA S	JEC17CS088	
33	SAN JOSE	JEC17CS089	
34	SARANYA KAYARAT	JEC17CS090	
35	SAURAV MUNDANATT SATHEESH KUMAR	JEC17CS091	
36	SHIBANA	JEC17CS092	
37	SHILPA SIVADAS	JEC17CS093	
38	SHINOZ MOHAMMED P P	JEC17CS094	
39	SIDHARTH U	JEC17CS095	
40	SIJIN K	JEC17CS096	
41	SREEHARI	JEC17CS097	
42	SREELAKSHMI C	JEC17CS098	
43	SREERAG R NANDAN	JEC17CS099	
44	SRUTHI ELSA SHAJI	JEC17CS100	
45	TEENA JOY P J	JEC17CS101	
46	TESSA SHYJU	JEC17CS102	
47	THUSHARA P	JEC17CS103	
48	VINCY ANTO	JEC17CS104	
49	V J VISHNU	JEC17CS105	
50	YASHIF V S	JEC17CS106	
51	JUSTIN SIBI (REJOIN)	**JEC16CS066**	Year out
52	ANN MARIYA	JEC16CS026	

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Jyothi Engineering College, Cheruthuruthy

Department of Computer Science Engineering

CO Analysis - Internal Marks : First Internal Exam 09-06-19

S5 CS CS301 THEORY OF COMPUTATION 2019-20

Register No.	Name of Student	Total Marks (50)	Category
JEC17CS001	AAYUSH P REJI	23	AVERAGE
JEC17CS002	ABHIJITH E MORRIES	A	ABSENT
JEC17CS003	ABHIJITH V J	36	GOOD
JEC17CS004	ABHIRAM BHASKAR	26	AVERAGE
JEC17CS005	ABIN M K	23	AVERAGE
JEC17CS006	ADITHYAN K	24	AVERAGE
JEC17CS008	AISWARYA SAJEEV	11	POOR
JEC17CS009	AISWARYA SURESH	39	GOOD
JEC17CS010	AJIN N D	37	GOOD
JEC17CS011	AJITH SANKAR O	42	EXCELLENT
JEC17CS012	AKASH KUMAR	27	AVERAGE
JEC17CS013	AKHIL MR	25	AVERAGE
JEC17CS014	ALEENA SHAJI	45	EXCELLENT
JEC17CS015	ALPHIN GEORGE ANSON	30	GOOD
JEC17CS016	AMALA.K.S	49	EXCELLENT
JEC17CS017	AMALA MARIA NELSON	33	GOOD
JEC17CS018	AMAL TOM	49	EXCELLENT
JEC17CS019	ANAGHA N M	45	EXCELLENT
JEC17CS020	ANAKHA. K. R	37	GOOD
JEC17CS021	ANILA T A	32	GOOD
JEC17CS022	ANILJITH MS	34	GOOD
JEC17CS023	ANJALI ANNE PRATHAP	45	EXCELLENT
JEC17CS024	ANJITHA M J	36	GOOD
JEC17CS025	ANJU VINCENT V	19	POOR
JEC17CS027	ARCHANA C K	13	POOR
JEC17CS028	ARCHANA S	34	GOOD
JEC17CS029	ARJUN J	44	EXCELLENT
JEC17CS030	ARNOLD MANUEL JOSEPH	47	EXCELLENT
JEC17CS031	ARUN RAJU	34	GOOD
JEC17CS032	ARYA MANOJ	26	AVERAGE
JEC17CS033	ASHIK A U	18	POOR
JEC17CS034	ATHIRA. C	A	ABSENT
JEC17CS035	AVIN JOSEPH	36	GOOD
JEC17CS036	BIBIN THOMAS	39	GOOD
JEC17CS037	BINWIN VIJU	[illegible]	AVERAGE
JEC17CS038	BIVIN BABU CHALISSERY	26	AVERAGE
JEC17CS039	CECILIA JOE	35	GOOD
JEC17CS040	CHARLES JOSHY	31	GOOD
JEC17CS041	CHRISTY SUNIL	42	EXCELLENT
JEC17CS042	DEEPAK.K.V	12	POOR
JEC17CS043	DHANYA R	39	GOOD
JEC17CS044	DIVYA PETER	47	EXCELLENT

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Cheruthuruthy P.O. - 679 531

JEC17CS045	ELJO JOY	20	POOR
JEC17CS046	GLADEES C B	A	ABSENT
JEC17CS047	GODSTIN PAUL	36	GOOD
JEC17CS048	HANEENAH V A	37	GOOD
JEC17CS049	HARIPRASAD C	23	AVERAGE
JEC17CS050	HARISH S	4	POOR
JEC17CS051	HIMA T.	36	GOOD
JEC17CS052	JACKSON JAMES	11	POOR
JEC17CS053	JAICOB JOHN A	23	AVERAGE
JEC17CS054	JASMINE SHAJ	30	GOOD

Total Number of Students	52	
Number of Students Absent	3	
Total Number of Students attended	49	
Number of Students with Marks less than 45%	8	POOR
Number of Students with Marks betweeen 45% to 60%	11	AVERAGE
Number of Students with Marks betweeen 60% to 80%	20	GOOD
Number of Students with Marks greater than 80%	10	EXCELLENT
Class Average	31.41	
Pass Percentage	83.67	

Name of Faculty : ANEESH CHANDRAN

Dated Signature :

Dr. SUNNY JOSEPH KALAYATHANKAL
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Jyothi Engineering College, Cheruthuruthy

Department of Computer Science Engineering

CO Analysis - Internal Marks : First Internal Exam 06\09\19

S5 CS CS301 THEORY OF COMPUTATION 2019-20

Register No.	Name of Student	Total Marks (50)	Category
JEC16CS026	ANN MARIYA	29	AVERAGE
JEC16CS066	JUSTIN SIBI	A	ABSENT
JEC16CS102	SANALNADH M	43	EXCELLENT
JEC17CS055	JEVIN PAULY KURISSERY	25	AVERAGE
JEC17CS056	JIJO ROJI	A	ABSENT
JEC17CS057	JOSEPH JOEL C P	35	GOOD
JEC17CS059	JOSHUA JOSEPH	43	EXCELLENT
JEC17CS060	JOSIN GEORGE	26	AVERAGE
JEC17CS061	KARTHIK PC	19	POOR
JEC17CS063	MANEESH MANOJ	48	EXCELLENT
JEC17CS064	MARY JOSE	37	GOOD
JEC17CS065	M DEEPA	A	ABSENT
JEC17CS066	MEERA E THIMOTHY	38	GOOD
JEC17CS067	MELVIN THOMAS	20	POOR
JEC17CS068	MOHAMED NAJEEB V K	23	AVERAGE
JEC17CS069	M P ADITHYA VIJAYAN	35	GOOD
JEC17CS070	MUHAMMED AFTHAB V U	31	GOOD
JEC17CS071	MUHAMMMED RANEESH CM	41	EXCELLENT
JEC17CS072	NAIR ANJALI VALSALAN	33	GOOD
JEC17CS073	NAVEEN P R	34	GOOD
JEC17CS074	NEETHUU N	A	ABSENT
JEC17CS075	NITHIN PETER	41	EXCELLENT
JEC17CS076	NITHIN P V	A	ABSENT
JEC17CS077	NIVA DILEEP	47	EXCELLENT
JEC17CS078	NOVA DILEEP	48	EXCELLENT
JEC17CS079	RASHI M	44	EXCELLENT
JEC17CS080	RASMIYA C U	24	AVERAGE
JEC17CS081	RESHMA R	33	GOOD
JEC17CS082	ROMISH T R	26	AVERAGE
JEC17CS083	RONDY THOMAS K	30	GOOD
JEC17CS084	SANDRA DAVID	39	GOOD
JEC17CS085	SANDRA P S	12	POOR
JEC17CS086	SANGEETHA C P	42	EXCELLENT
JEC17CS087	SANGEETHA P	37	GOOD
JEC17CS088	SANJANA S	41	EXCELLENT
JEC17CS089	SAN JOSE	14	POOR
JEC17CS090	SARANYA . K	31	GOOD
JEC17CS091	SAURAV MUNDANATT SATHEESH KUMAR	31	GOOD
JEC17CS092	SHIBANA	43	EXCELLENT
JEC17CS093	SHILPA SIVADAS	40	EXCELLENT
JEC17CS094	SHINOZ MOHAMMED P P	36	GOOD
JEC17CS095	SIDHARTH U	32	GOOD

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JEC17CS096	SIJIN.K	30	GOOD
JEC17CS097	SREEHARI	39	GOOD
JEC17CS098	SREELAKSHMI.C	46	EXCELLENT
JEC17CS099	SREERAG R NANDAN	21	POOR
JEC17CS100	SRUTHI ELSA SHAJI	30	GOOD
JEC17CS101	TEENA JOY PJ	39	GOOD
JEC17CS102	TESSA SHYJU	43	EXCELLENT
JEC17CS103	THUSHARA P	9	POOR
JEC17CS104	VINCY ANTO	35	GOOD
JEC17CS105	V J VISHNU	33	GOOD
JEC17CS106	YASHIF V S	24	AVERAGE

Total Number of Students	53	
Number of Students Absent	5	
Total Number of Students attended	48	
Number of Students with Marks less than 45%	6	POOR
Number of Students with Marks betweeen 45% to 60%	7	AVERAGE
Number of Students with Marks betweeen 60% to 80%	21	GOOD
Number of Students with Marks greater than 80%	14	EXCELLENT
Class Average	33.13	
Pass Percentage	87.5	

Name of Faculty : ANEESH CHANDRAN

Dated Signature :

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JYOTHI ENGINEERING COLLEGE			
STATEMENT OF SESSIONAL TEST2 MARKS			
Name of Teacher	: ANEESH CHANDRAN	Semester	: S5
Designation & Dept	: Assistant Professor, Computer Science and Engineering(A)	Month & Year	:
Subject & Code	: CS301, THEORY OF COMPUTATION	Max Marks	: 50
Reg No	**Name**	**Marks**	**Remarks**
JEC17CS001	AAYUSH P REJI	26	-
JEC17CS002	ABHIJITH E MORRIES	A	Absent
JEC17CS003	ABHIJITH V J	26	-
JEC17CS004	ABHIRAM BHASKAR	23	-
JEC17CS005	ABIN M K	9	F
JEC17CS006	ADITHYAN K	24	-
JEC17CS008	AISWARYA SAJEEV	15	F
JEC17CS009	AISWARYA SURESH	29	-
JEC17CS010	AJIN N D	35	-
JEC17CS011	AJITH SANKAR O	25	-
JEC17CS012	AKASH KUMAR	14	F
JEC17CS013	AKHIL MR	24	-
JEC17CS014	ALEENA SHAJI	30	-
JEC17CS015	ALPHIN GEORGE ANSON	33	-
JEC17CS016	AMALA.K.S	36	-
JEC17CS017	AMALA MARIA NELSON	24	-
JEC17CS018	AMAL TOM	38	-
JEC17CS019	ANAGHA N M	29	-
JEC17CS020	ANAKHA. K. R	26	-
JEC17CS021	ANILA T A	23	-
JEC17CS022	ANILJITH MS	26	-
JEC17CS023	ANJALI ANNE PRATHAP	34	-
JEC17CS024	ANJITHA M J	24	-
JEC17CS025	ANJU VINCENT V	25	-
JEC17CS027	ARCHANA C K	24	-
JEC17CS028	ARCHANA S	37	-
JEC17CS029	ARJUN J	34	-
JEC17CS030	ARNOLD MANUEL JOSEPH	27	-
JEC17CS031	ARUN RAJU	27	-
JEC17CS032	ARYA MANOJ	30	-
JEC17CS033	ASHIK A U	20	F
JEC17CS034	ATHIRA. C	41	-
JEC17CS035	AVIN JOSEPH	43	-
JEC17CS036	BIBIN THOMAS	34	-
JEC17CS037	BINWIN VIJU	30	-
JEC17CS038	BIVIN BABU CHALISSERY	27	-
JEC17CS039	CECILIA JOE	34	-
JEC17CS040	CHARLES JOSHY	21	F
JEC17CS041	CHRISTY SUNIL	25	-
JEC17CS042	DEEPAK.K.V	23	-

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JEC17CS043	DHANYA R	31	-
JEC17CS044	DIVYA PETER	25	-
JEC17CS045	ELJO JOY	29	-
JEC17CS046	GLADEES C B	6	F
JEC17CS047	GODSTIN PAUL	8	F
JEC17CS048	HANEENAH V A	27	-
JEC17CS049	HARIPRASAD C	28	-
JEC17CS050	HARISH S	28	-
JEC17CS051	HIMA T.	34	-
JEC17CS052	JACKSON JAMES	14	F
JEC17CS053	JAICOB JOHN A	A	Absent
JEC17CS054	JASMINE SHAJ	23	-
	Class Average	**26.56**	
	Class Average (%)	**53.12**	
	Total Number of Students Attended (Out of 52)	**50**	
	Number of Students Failed (Marks <45%)	**8**	
	Number of Students Passed (Marks >=45%)	**42**	
	Number of Students between 45 and 60%	**26**	
	Number of Students between 60 and 80%	**14**	
	No of students >= 80%	**2**	
	Pass Percentage	**84**	

JYOTHI ENGINEERING COLLEGE			
STATEMENT OF SESSIONAL TEST2 MARKS			
Name of Teacher	: ANEESH CHANDRAN	Semester	: S5
Designation & Dept	: Assistant Professor, Computer Science and Engineering(B)	Month & Year	:
Subject & Code	: CS301, THEORY OF COMPUTATION	Max Marks	: 50
Reg No	Name	Marks	Remarks
JEC16CS026	ANN MARIYA	17	F
JEC16CS102	SANALNADH M	33	-
JEC17CS055	JEVIN PAULY KURISSERY	37	-
JEC17CS057	JOSEPH JOEL C P	37	-
JEC17CS059	JOSHUA JOSEPH	36	-
JEC17CS060	JOSIN GEORGE	15	F
JEC17CS061	KARTHIK PC	38	-
JEC17CS063	MANEESH MANOJ	35	-
JEC17CS064	MARY JOSE	A	Absent
JEC17CS066	MEERA E THIMOTHY	31	-
JEC17CS067	MELVIN THOMAS	21	F
JEC17CS068	MOHAMED NAJEEB V K	24	-
JEC17CS069	M P ADITHYA VIJAYAN	36	-
JEC17CS070	MUHAMMED AFTHAB V U	7	F
JEC17CS071	MUHAMMMED RANEESH CM	41	-
JEC17CS072	NAIR ANJALI VALSALAN	31	-
JEC17CS073	NAVEEN P R	29	-
JEC17CS074	NEETHUU N	29	-
JEC17CS075	NITHIN PETER	32	-
JEC17CS077	NIVA DILEEP	43	-
JEC17CS078	NOVA DILEEP	40	-
JEC17CS079	RASHI M	47	-
JEC17CS080	RASMIYA C U	29	-
JEC17CS081	RESHMA R	24	-
JEC17CS083	RONDY THOMAS K	38	-
JEC17CS084	SANDRA DAVID	36	-
JEC17CS086	SANGEETHA C P	32	-
JEC17CS087	SANGEETHA P	23	-
JEC17CS088	SANJANA S	31	-
JEC17CS089	SAN JOSE	27	-
JEC17CS090	SARANYA . K	31	-
JEC17CS091	SAURAV MUNDANATT SATHEESH KUMAR	9	F
JEC17CS092	SHIBANA	34	
JEC17CS093	SHILPA SIVADAS	32	
JEC17CS094	SHINOZ MOHAMMED P P	23	
JEC17CS095	SIDHARTH U	10	F
JEC17CS096	SIJIN.K	23	-
JEC17CS097	SREEHARI	27	-
JEC17CS098	SREELAKSHMI.C	45	-

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JEC17CS099	SREERAG R NANDAN	39	-
JEC17CS100	SRUTHI ELSA SHAJI	30	-
JEC17CS101	TEENA JOY PJ	23	-
JEC17CS102	TESSA SHYJU	33	-
JEC17CS103	THUSHARA P	0	F
JEC17CS104	VINCY ANTO	15	F
JEC17CS105	V J VISHNU	9	F
JEC17CS106	YASHIF V S	13	F
	Class Average	**28.15**	
	Class Average (%)	**56.3**	
	Total Number of Students Attended (Out of 47)	**46**	
	Number of Students Failed (Marks <45%)	**10**	
	Number of Students Passed (Marks >=45%)	**36**	
	Number of Students between 45 and 60%	**11**	
	Number of Students between 60 and 80%	**20**	
	No of students >= 80%	**5**	
	Pass Percentage	**78.26**	

Jyothi Engineering College, Cheruthuruthy

Department of Computer Science Engineering

CO Analysis - Internal Marks : Assignment - 1   30/09/19

S5 CS   CS301 THEORY OF COMPUTATION   2019-20

Register No.	Name of Student	Qn. No.	1	2	Total Marks (10)
		CO's	CO1, CO2		
		Blooms Taxonom y Lavel	1, 2, 3, 4, 5, 6		
		Max. Marks	10		
		Difficulty Level in %	60	60	
JEC17CS001	AAYUSH P REJI		7		7
JEC17CS002	ABHIJITH E MORRIES				
JEC17CS003	ABHIJITH V J		8		8
JEC17CS004	ABHIRAM BHASKAR		7		7
JEC17CS005	ABIN M K		7		7
JEC17CS006	ADITHYAN K		8		8
JEC17CS008	AISWARYA SAJEEV		6		6
JEC17CS009	AISWARYA SURESH		5		5
JEC17CS010	AJIN N D		8		8
JEC17CS011	AJITH SANKAR O		6		6
JEC17CS012	AKASH KUMAR		6		6
JEC17CS013	AKHIL MR		8		8
JEC17CS014	ALEENA SHAJI		8		8
JEC17CS015	ALPHIN GEORGE ANSON		8		8
JEC17CS016	AMALA.K.S		8		8
JEC17CS017	AMALA MARIA NELSON		8		8
JEC17CS018	AMAL TOM		8		8
JEC17CS019	ANAGHA N M		8		8
JEC17CS020	ANAKHA. K. R		5		5
JEC17CS021	ANILA T A		7		7
JEC17CS022	ANILJITH MS		8		8
JEC17CS023	ANJALI ANNE PRATHAP		8		8
JEC17CS024	ANJITHA M J		8		8
JEC17CS025	ANJU VINCENT V		8		8
JEC17CS027	ARCHANA C K		7		7
JEC17CS028	ARCHANA S		8		8
JEC17CS029	ARJUN J		6		6
JEC17CS030	ARNOLD MANUEL JOSEPH		8		8

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Cheruthuruthy P.O. [illegible]79531

JEC17CS031	ARUN RAJU		8		8
JEC17CS032	ARYA MANOJ		8		8
JEC17CS033	ASHIK A U		6		6
JEC17CS034	ATHIRA. C		8		8
JEC17CS035	AVIN JOSEPH		8		8
JEC17CS036	BIBIN THOMAS		8		8
JEC17CS037	BINWIN VIJU		8		8
JEC17CS038	BIVIN BABU CHALISSERY		8		8
JEC17CS039	CECILIA JOE		8		8
JEC17CS040	CHARLES JOSHY		7		7
JEC17CS041	CHRISTY SUNIL		8		8
JEC17CS042	DEEPAK.K.V		7		7
JEC17CS043	DHANYA R		8		8
JEC17CS044	DIVYA PETER		7		7
JEC17CS045	ELJO JOY		6		6
JEC17CS046	GLADEES C B		6		6
JEC17CS047	GODSTIN PAUL		8		8
JEC17CS048	HANEENAH V A		7		7
JEC17CS049	HARIPRASAD C		8		8
JEC17CS050	HARISH S		7		7
JEC17CS051	HIMA T.		8		8
JEC17CS052	JACKSON JAMES		8		8
JEC17CS053	JAICOB JOHN A		8		8
JEC17CS054	JASMINE SHAJ		8		8

Total Marks scored for the Question	378	0
No. of Students who attended the Question	51	0
Difficulty Level marks of the Question	6	
No. of Students who scored above the Difficulty Level	49	
% of Students who scored above the Difficulty Level	96.08	

Total Attainment level for CO1 : 3

Total Attainment level for CO2 : 3

Total Attainment level for CO3 :

Total Attainment level for CO4 :

Total Attainment level for CO5 :

Total Attainment level for CO6 :

Attainment Level 1: 60% students scoring more than 60% of the Total Marks
Attainment Level 2: 70% students scoring more than 60% of the Total Marks
Attainment Level 3: 80% students scoring more than 60% of the Total Marks

Name of Faculty : ANEESH CHANDRAN

Dated Signature : [signature] 30/10/19

Jyothi Engineering College, Cheruthuruthy

Department of Computer Science Engineering

CO Analysis - Internal Marks : Assignment - 1 11-02-18

S5 CS CS301 THEORY OF COMPUTATION 2019-20

Register No.	Name of Student	Qn. No.	1		Total Marks (10)
		CO's	CO1, CO2		
		Blooms Taxonomy Lavel	1, 2, 3, 4, 5, 6		
		Max. Marks	10		
		Difficulty Level in %	60		
JEC16CS026	ANN MARIYA		7		7
JEC16CS066	JUSTIN SIBI				
JEC16CS102	SANALNADH M		9		9
JEC17CS055	JEVIN PAULY KURISSERY		7		7
JEC17CS056	JIJO ROJI				
JEC17CS057	JOSEPH JOEL C P		8		8
JEC17CS059	JOSHUA JOSEPH		7		7
JEC17CS060	JOSIN GEORGE				
JEC17CS061	KARTHIK PC		7		7
JEC17CS063	MANEESH MANOJ		9		9
JEC17CS064	MARY JOSE		7		7
JEC17CS065	M DEEPA		7		7
JEC17CS066	MEERA E THIMOTHY		8		8
JEC17CS067	MELVIN THOMAS		6		6
JEC17CS068	MOHAMED NAJEEB V K		7		7
JEC17CS069	M P ADITHYA VIJAYAN		8		8
JEC17CS070	MUHAMMED AFTHAB V U		8		8
JEC17CS071	MUHAMMMED RANEESH CM		8		8
JEC17CS072	NAIR ANJALI VALSALAN		8		8
JEC17CS073	NAVEEN P R		9		9
JEC17CS074	NEETHUU N		9		9
JEC17CS075	NITHIN PETER		7		7
JEC17CS076	NITHIN P V				
JEC17CS077	NIVA DILEEP		9		9
JEC17CS078	NOVA DILEEP		7		7
JEC17CS079	RASHI M		8		8
JEC17CS080	RASMIYA C U		7		7
JEC17CS081	RESHMA R		9		9

JEC17CS082	ROMISH T R				
JEC17CS083	RONDY THOMAS K		9		9
JEC17CS084	SANDRA DAVID		7		7
JEC17CS085	SANDRA P S				
JEC17CS086	SANGEETHA C P		9		9
JEC17CS087	SANGEETHA P		9		9
JEC17CS088	SANJANA S		9		9
JEC17CS089	SAN JOSE		7		7
JEC17CS090	SARANYA . K		9		9
JEC17CS091	SAURAV MUNDANATT SATHEESH KUMAR		9		9
JEC17CS092	SHIBANA		9		9
JEC17CS093	SHILPA SIVADAS		7		7
JEC17CS094	SHINOZ MOHAMMED P P		8		8
JEC17CS095	SIDHARTH U		9		9
JEC17CS096	SIJIN.K		8		8
JEC17CS097	SREEHARI		8		8
JEC17CS098	SREELAKSHMI.C		10		10
JEC17CS099	SREERAG R NANDAN		8		8
JEC17CS100	SRUTHI ELSA SHAJI		7		7
JEC17CS101	TEENA JOY PJ		7		7
JEC17CS102	TESSA SHYJU		8		8
JEC17CS103	THUSHARA P		6		6
JEC17CS104	VINCY ANTO		8		8
JEC17CS105	V J VISHNU		5		5
JEC17CS106	YASHIF V S		8		8

Total Marks scored for the Question 370
No. of Students who attended the Question 47
Difficulty Level marks of the Question 6
No. of Students who scored above the Difficulty Level 46
% of Students who scored above the Difficulty Level 97.87

Total Attainment level for CO1 : 3
Total Attainment level for CO2 : 3
Total Attainment level for CO3 :
Total Attainment level for CO4 :
Total Attainment level for CO5 :
Total Attainment level for CO6 :

Attainment Level 1: 60% students scoring more than 60% of the Total Marks
Attainment Level 2: 70% students scoring more than 60% of the Total Marks
Attainment Level 3: 80% students scoring more than 60% of the Total Marks

Name of Faculty : ANEESH

Total Pages: 2

Reg No.:________________ Name:______________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2017

Course Code: CS301

Course Name: THEORY OF COMPUTATION (CS)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks. Marks

1 Define Non Deterministic Finite Automata? Compare its ability with Deterministic Finite Automata in accepting languages. (3)

2 Write the notations for the language accepted by DFA, NFA, ϵ-NFA (3)

3 Can we use finite state automata to evaluate 1's complement of a binary number? Design a machine to perform the same. (3)

4 Define Two-way finite automata (3)

PART B

Answer any two full questions, each carries 9 marks.

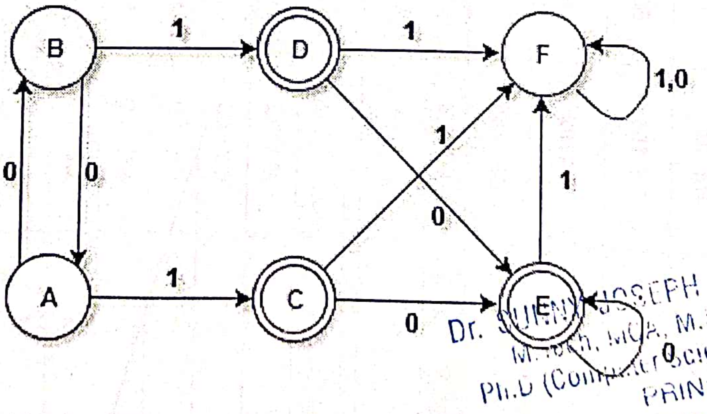
5 a) Design a Finite state automata which accepts all strings over {0,1} with odd number of 1's and even number of 0's. (5)

b) Show the changes needed to convert the above designed automata to accept even number of 1's and odd number of 0's (4)

6 a) Construct Regular grammar for the regular expression : (5)
L = (a + b)*(aa + bb)(a + b)*

b) List the closure properties of Regular sets. (4)

7 State Myhill-Nerode theorem. Minimize the following DFA by table filling method using Myhill-Nerode theorem describing the steps in detail. (9)



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PART C

Answer all questions, each carries 3 marks.

8 Which Normal Form representation of CFG will you prefer in converting CFG to NPDA? Why? (3)

9 What do you mean by useless symbol in a grammar? Show the elimination of useless symbols with an example. (3)

10 Explain the different methods by which a PDA accepts a language. (3)

11 Can we construct a Deterministic PDA for the language ww^R?Justify your answer. Otherwise how can we modify this language to make it accepted by DPDA. (3)

PART D

Answer any two full questions, each carries 9 marks.

12 Define CFG for the following languages over the alphabets {a,b} (9)

i. $L = \{ a^{m+n}b^m c^n, n,m>0 \}$

ii. L contains all odd length strings only

iii. $L = \{ 0^n 1^n 2^n \ \ n>0 \}$

13 Design a Push Down Automata for the language $L= \{a^n b^{2n} \mid n>0\}$ Trace your PDA with n=3. (9)

14 Prove that the following languages are not regular (9)

i. $L = \{0^{i^2} \text{ such that } i \geq 1\}$ is not regular

ii. $L = \{a^p \text{ such that } p \text{ is a prime n umber}$

PART E

Answer any four full questions, each carries 10 marks.

15 State and prove pumping lemma for Context Free Languages. (10)

16 Construct a Turing machine that recognizes the language $L = \{ a^n b^n c^n \mid \ n>0 \}$ (10)

17 a) What is a Context sensitive grammar(CSG). Design a CSG to accept the language $L = \{ 0^n 1^n 2^n \mid \ n>0 \}$ (6)

b) Define Linear Bound Automata (4)

18 a) Write a note on Recursive Enumerable Languages (5)

b) Discuss about Universal Turing Machines (5)

19 a) Explain Chomsky's Hierarchy of Languages (6)

b) Let$L = \{x / x \in (a+b+c)^* \text{ and } |x|_a = |x|_b = |x|_c\}$. What class of language does Lbelong? Why? What modification will you suggest in the grammar to accept this language? (4)

20 Discuss the Undecidable Problems About Turing Machines (10)

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FIFTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2017

Course Code: CS301

Course Name: THEORY OF COMPUTATION

Answers

PART A

			Marks

1		An **NFA** can be represented by a 5-tuple (Q, ∑, δ, q0, F) where –
		• Q is a finite set of states.
		• ∑ is a finite set of symbols called the alphabets.
		• δ is the transition function where δ: Q × ∑ → 2Q
		(Here the power set of Q (2Q) has been taken because in case of NDFA, from a state, transition can occur to any combination of Q states)
		• q0 is the initial state from where any input is processed (q0 ∈ Q).
		• F is a set of final state/states of Q (F ⊆ Q).
		▪ Deterministic Finite Automata (DFA)
		  ▪ No choice of which transition to take
		  ▪ In particular, no ε transitions
		  ▪ No *guessing*
		▪ Non-deterministic Finite Automata (NFA)
		  ▪ Choice of transition in at least one case
		  ▪ Accepts if some way to reach final state on given input
		  ▪ Reject if no possible way to final state
		  ▪ How to implement in software?
			(3)

2		A **DFA** can be represented by a 5-tuple (Q, ∑, δ, q0, F) where – • Q is a finite set of states. • ∑ is a finite set of symbols called the alphabet. • δ is the transition function where δ: Q × ∑ → Q • q0 is the initial state from where any input is processed (q0 ∈ Q). • F is a set of final state/states of Q (F ⊆ Q). An **NFA** can be represented by a 5-tuple (Q, ∑, δ, q0, F) where • Q is a finite set of states. • ∑ is a finite set of symbols called the alphabets. • δ is the transition function where δ: Q × ∑ → 2Q	(3)

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(Here the power set of Q (2Q) has been taken because in case of NDFA, from a state, transition can occur to any combination of Q states)

- q0 is the initial state from where any input is processed (q0 ∈Q).
- F is a set of final state/states of Q (F ⊆Q).

A **ε-NFA** is a quintuple

A=(Q,Σ,δ,q0,F)

where

– Q is a set of states

– Σ is the alphabet of input symbols

– q0∈Q is the initial state

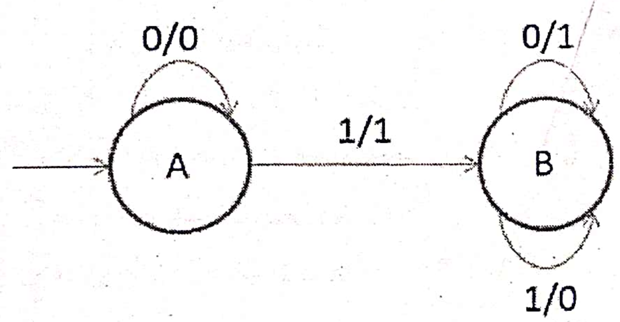
– F ⊆ Q is the set of final states

– δ: Q × Σε → P(Q) is the transition function

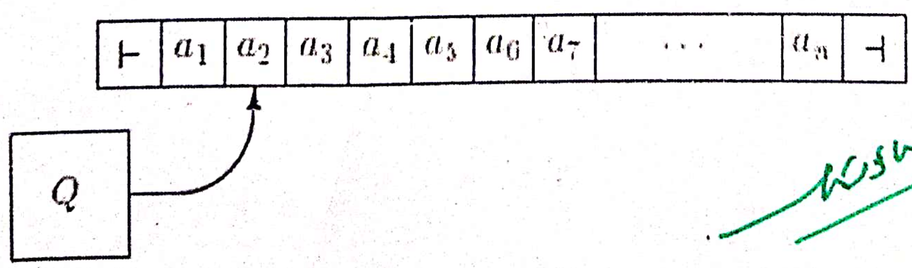
• Note ε is never a member of Σ

• Σε is defined to be (Σ ∪ ε)

3 No, Finite State Automata with Output (Mealy/Moore Machine) is needed to perform this operation. Finite State Automata (DFA, NFA or ϵ-NFA) can't perform calculations but rather accepts or rejects a regular language. (3)



4 2DFA ' Can read the input back and forth with no limit on how many times an input symbol can be read. ' As in the case of DFA, the 2DFA decides whether a given input is accepted or rejected. (3)



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Formally, a 2DFA is an octuple

$$M = (Q, \Sigma, \vdash, \dashv, \delta, s, t, r).$$

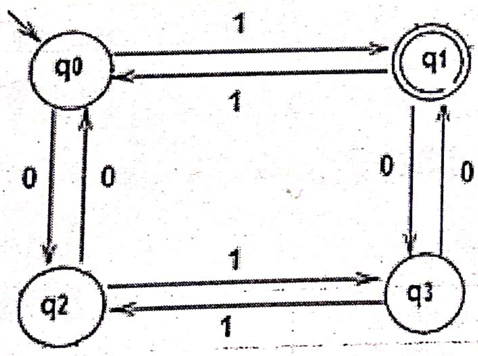
where

- Q is a finite set (the *states*),
- Σ is a finite set (the *input alphabet*),
- $\vdash$ is the *left endmarker*, $\vdash \notin \Sigma$,
- $\dashv$ is the *right endmarker*, $\dashv \notin \Sigma$,
- $\delta : Q \times (\Sigma \cup \{\vdash, \dashv\}) \to (Q \times \{L, R\})$ is the *transition function* (L, R stand for left and right, respectively),
- $s \in Q$ is the *start state*,
- $t \in Q$ is the *accept state*, and
- $r \in Q$ is the *reject state*, $r \neq t$,

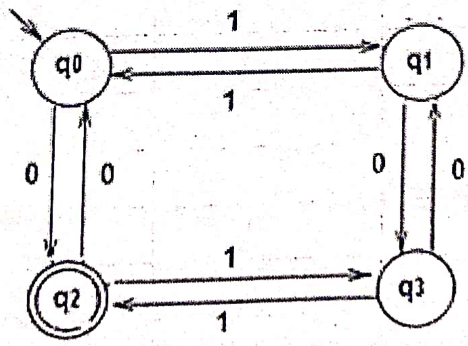
PART B

Answer any two full questions, each carries 9 marks.

5 a) (9)



b)



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6 a) (5)

S → ABA

A → aA / bA / ε

B → aa /

b) **Properties of Regular Sets** (4)

Property 1. The union of two regular set is regular.

Proof –

Let us take two regular expressions

RE1 = a(aa)* and RE2 = (aa)*

So, L1 = {a, aaa, aaaaa,.....} (Strings of odd length excluding Null)

and L2 ={ ε, aa, aaaa, aaaaaa,.......} (Strings of even length including Null)

$L1 \cup L2$ = { ε, a, aa, aaa, aaaa, aaaaa, aaaaaa,.......}

(Strings of all possible lengths including Null)

RE ($L1 \cup L2$) = a* (which is a regular expression itself)

Hence, proved.

Property 2. The intersection of two regular set is regular.

Proof –

Let us take two regular expressions

RE1 = a(a*) and RE2 = (aa)*

So, L1 = { a,aa, aaa, aaaa, ...} (Strings of all possible lengths excluding Null)

L2 = { ε, aa, aaaa, aaaaaa,.......} (Strings of even length including Null)

$L1 \cap L2$ = { aa, aaaa, aaaaaa,.......} (Strings of even length excluding Null)

RE ($L1 \cap L2$) = aa(aa)* which is a regular expression itself.

Hence, proved.

Property 3. The complement of a regular set is regular.

Proof –

Let us take a regular expression –

RE = (aa)*

So, L = {ε, aa, aaaa, aaaaaa, ...} (Strings of even length including Null)

Complement of L is all the strings that is not in L.

So, L' = {a, aaa, aaaaa, ...} (Strings of odd length excluding Null)

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RE (L') = a(aa)* which is a regular expression itself.

Hence, proved.

Property 4. The difference of two regular set is regular.

Proof –

Let us take two regular expressions –

RE1 = a (a*) and RE2 = (aa)*

So, L1 = {a, aa, aaa, aaaa, ...} (Strings of all possible lengths excluding Null)

L2 = { ε, aa, aaaa, aaaaaa,.......} (Strings of even length including Null)

L1 – L2 = {a, aaa, aaaaa, aaaaaaa, ...}

(Strings of all odd lengths excluding Null)

RE (L1 – L2) = a (aa)* which is a regular expression.

Hence, proved.

Property 5. The reversal of a regular set is regular.

Proof –

We have to prove LR is also regular if L is a regular set.

Let, L = {01, 10, 11, 10}

RE (L) = 01 + 10 + 11 + 10

LR = {10, 01, 11, 01}

RE (LR) = 01 + 10 + 11 + 10 which is regular

Hence, proved.

Property 6. The closure of a regular set is regular.

Proof –

If L = {a, aaa, aaaaa, ...} (Strings of odd length excluding Null)

i.e., RE (L) = a (aa)*

L* = {a, aa, aaa, aaaa , aaaaa,……………} (Strings of all lengths excluding Null)

RE (L*) = a (a)*

Hence, proved.

Property 7. The concatenation of two regular sets is regular.

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Proof –

Let RE1 = (0+1)*0 and RE2 = 01(0+1)*

Here, L1 = {0, 00, 10, 000, 010, ...} (Set of strings ending in 0)

and L2 = {01, 010,011,.....} (Set of strings beginning with 01)

Then, L1 L2 = {001,0010,0011,0001,00010,00011,1001,10010,.............}

Set of strings containing 001 as a substring which can be represented by an RE – (0 + 1)*001(0 + 1)*

Hence, proved.

7 **Myhill-Nerode theorem definition -** 9

Algorithm

Input – DFA

Output – Minimized DFA

Step 1 – Draw a table for all pairs of states (Qi, Qj) not necessarily connected directly [All are unmarked initially]

Step 2 – Consider every state pair (Qi, Qj) in the DFA where Qi ∈ F and Qj □ F or vice versa and mark them. [Here F is the set of final states]

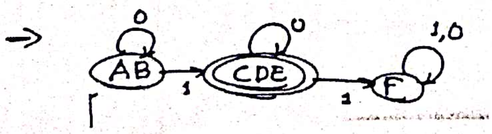
Step 3 – Repeat this step until we cannot mark anymore states –

If there is an unmarked pair (Qi, Qj), mark it if the pair {δ (Qi, A), δ (Qi, A)} is marked for some input alphabet.

Step 4 – Combine all the unmarked pair (Qi, Qj) and make them a single state in the reduced DFA.

	A	B	C	D	E
B					
C	✓	✓			
D	✓	✓			
E	✓	✓			
F	✓	✓	✓	✓	✓

- Combining unmarked pairs and drawing minimized automata – 2 Marks



*State AB is the new start state

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PART C

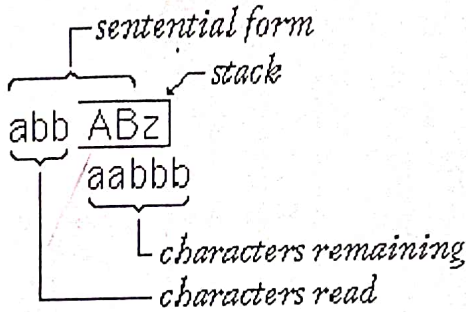
8 **GNF (Greibatch Normal Form)** (3)

For any context-free grammar in Greibach Normal Form we can build an equivalent nondeterministic pushdown automaton. This establishes that an npda is at least as powerful as a cfg.

Key idea: Any string of a context-free language has a leftmost derivation. We set up the npda so that the stack contents "correspond" to this sentential form; every move of the npda represents one derivation step.

The sentential form is:

- the characters already read,
- PLUS the symbols on the stack
- MINUS the final z (the initial stack symbol).



In the npda we will construct, the states are hardly important at all. All the real work is done on the stack. In fact, we will use only the following three states, regardless of the complexity of the grammar:

- Start state q0 just gets things initialized. We use the transition from q0 to q1 to put the grammar's start symbol on the stack.

$$\delta(q0, \lambda, z) \rightarrow \{(q1, Sz)\}$$

- State q1 does the bulk of the work. We represent every derivation step as a move from q1 to q1.
- We use the transition from q1 to qf to accept the string.

$$\delta(q1, \lambda, z) \rightarrow \{(qf, z)\}$$

9 Removal of Unit Productions (3)

Any production rule in the form A → B where A, B ∈ Non-terminal is called unit production..

Removal Procedure –

Step 1 – To remove A → B, add production A → x to the grammar rule whenever B → x occurs in the grammar. [x ∈ Terminal, x can be Null]

Step 2 – Delete A → B from the grammar.

Step 3 – Repeat from step 1 until all unit productions are removed.

Problem

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Remove unit production from the following −

$S \rightarrow XY, X \rightarrow a, Y \rightarrow Z \mid b, Z \rightarrow M, M \rightarrow N, N \rightarrow a$

Solution −

There are 3 unit productions in the grammar −

$Y \rightarrow Z, Z \rightarrow M$, and $M \rightarrow N$

At first, we will remove $M \rightarrow N$.

As $N \rightarrow a$, we add $M \rightarrow a$, and $M \rightarrow N$ is removed.

The production set becomes

$S \rightarrow XY, X \rightarrow a, Y \rightarrow Z \mid b, Z \rightarrow M, M \rightarrow a, N \rightarrow a$

Now we will remove $Z \rightarrow M$.

As $M \rightarrow a$, we add $Z \rightarrow a$, and $Z \rightarrow M$ is removed.

The production set becomes

$S \rightarrow XY, X \rightarrow a, Y \rightarrow Z \mid b, Z \rightarrow a, M \rightarrow a, N \rightarrow a$

Now we will remove $Y \rightarrow Z$.

As $Z \rightarrow a$, we add $Y \rightarrow a$, and $Y \rightarrow Z$ is removed.

The production set becomes

$S \rightarrow XY, X \rightarrow a, Y \rightarrow a \mid b, Z \rightarrow a, M \rightarrow a, N \rightarrow a$

Now Z, M, and N are unreachable, hence we can remove those.

The final CFG is unit production free −

$S \rightarrow XY, X \rightarrow a, Y \rightarrow a \mid b$

Removal of Null Productions

In a CFG, a non-terminal symbol 'A' is a nullable variable if there is a production $A \rightarrow \varepsilon$ or there is a derivation that starts at A and finally ends up with

$\varepsilon: A \rightarrow \dots\dots\dots \rightarrow \varepsilon$

Removal Procedure

Step 1 − Find out nullable non-terminal variables which derive ε.

Step 2 − For each production $A \rightarrow a$, construct all productions $A \rightarrow x$ where xis obtained from 'a' by removing one or multiple non-terminals from Step 1.

Step 3 − Combine the original productions with the result of step 2 and remove ε -

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productions.

Problem

Remove null production from the following –

S → ASA | aB | b, A → B, B → b | ∈

Solution –

There are two nullable variables – A and B

At first, we will remove B → ε.

After removing B → ε, the production set becomes –

S→ASA | aB | b | a, A ε B| b | &epsilon, B → b

Now we will remove A → ε.

After removing A → ε, the production set becomes –

S→ASA | aB | b | a | SA | AS | S, A → B| b, B → b

This is the final production set without null transition.

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10 **Acceptance by final state –** (3)

For a PDA (Q, ∑, S, δ, q0, I, F), the language accepted by the set of final states F is –

L(PDA) = {w | (q0, w, I) □* (q, ε, x), q ∈F}

for any input stack string x.

Acceptance by empty stack –

For a PDA (Q, ∑, S, δ, q0, I, F), the language accepted by the empty stack is –

L(PDA) = {w | (q0, w, I) □* (q, ε, ε), q ∈Q}

11 (3)

- No, we can construct only NPDA for this language
- The language is implemented in PDA by pushing the first half (w) of input and comparing the second half (w^R) with popped values from the stack. But in this language there is no way for DPDA to determine the middle point of input string. So no DPDA is possible.
- If the string included with a special symbol as middle point marker, it can be accepted by a DPDA. Eg: wcw^R

PART D

Answer any two full questions, each carries 9 marks.

12 (9)

1 $S \rightarrow aSc / aAc$

$A \rightarrow aAb / \epsilon$

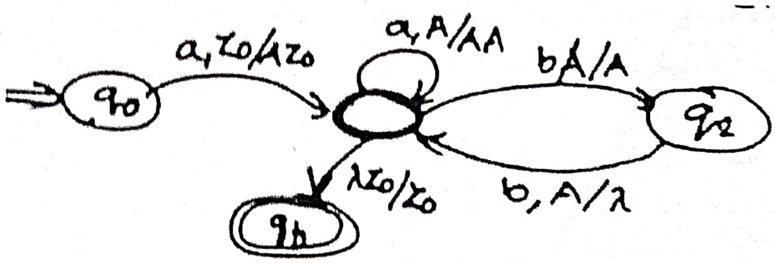
2 $S \rightarrow BS / a / b$

$B \rightarrow AA$

$A \rightarrow a/b$

Identified that the language is not CFL so no CFG productions possible

13 (9)



14 (9)

L = { 0 | i ≥ 0 } is not regular.

Proof.

For contradiction, suppose L is regular. So,

L=L(M) for some DFA M.

Suppose M has m states. Consider 0 .

By Pumping Lemma, 0   = uvw such that

v ≠ ε and for n ≥ 0, uv w in L.

Set a=|v| and b=|uw|. Then a > 0 and for n ≥ 0,

an+b is a square.

Specially, when n=0, b is a square. Set b = cc.

When n = a+2c, an+cc = (a+c) .

Now, consider n=a+2c+1Note that an+b = (a+c) +a.

But, (a+c+1) = (a+c)   + 2(a+c) + 1 > (a+c) + a.

Hence, (a+c) +a cannot be a square.

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PART E

Answer any four full questions, each carries 10 marks.

15 (10)

Lemma

If L is a context-free language, there is a pumping length p such that any string w ∈ L of length ≥ p can be written as w = uvxyz, where vy ≠ ε, |vxy| ≤ p, and for all i ≥ 0, uvixyiz ∈ L.

Applications of Pumping Lemma

Pumping lemma is used to check whether a grammar is context free or not. Let us take an example and show how it is checked.

Problem

Find out whether the language $L = \{xnynzn \mid n \geq 1\}$ is context free or not.

Solution

Let L is context free. Then, L must satisfy pumping lemma.

At first, choose a number n of the pumping lemma. Then, take z as 0n1n2n.

Break z into uvwxy, where

$|vwx| \leq n$ and $vx \neq \varepsilon$.

Hence vwx cannot involve both 0s and 2s, since the last 0 and the first 2 are at least (n+1) positions apart. There are two cases –

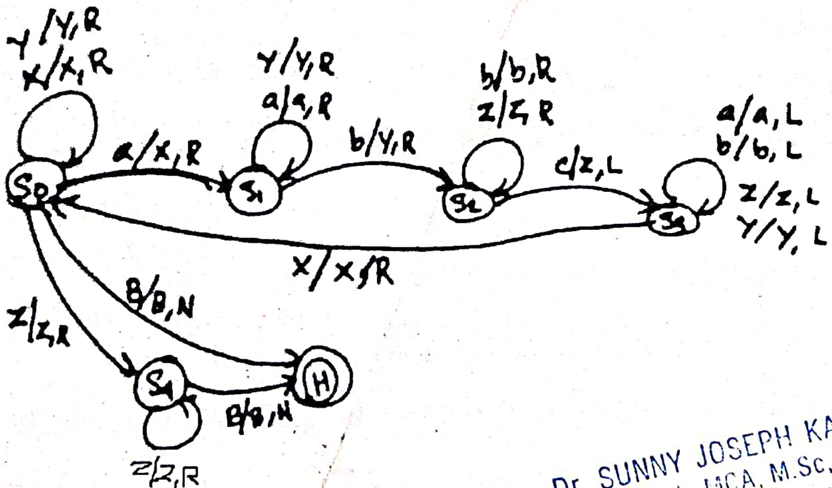
Case 1 – vwx has no 2s. Then vx has only 0s and 1s. Then uwy, which would have to be in L, has n 2s, but fewer than n 0s or 1s.

Case 2 – vwx has no 0s.

Here contradiction occurs.

Hence, L is not a context-free language.

16 (10)



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17 a) A context-sensitive grammar is a formal grammar in which the left-hand sides and right-hand sides of any production rules may be surrounded by a context of terminal and nonterminal symbols. (6)

CSG to accept the language $L = \{ 0^n 1^n 2^n \mid n>0 \}$

S→ aSBc / aBC

CB → BC

aB → ab

bB → bb

bB → bc

cC → cc

b) A linear bounded automaton is a multi-track non-deterministic Turing machine with a tape of some bounded finite length. (4)

Length = function (Length of the initial input string, constant c)

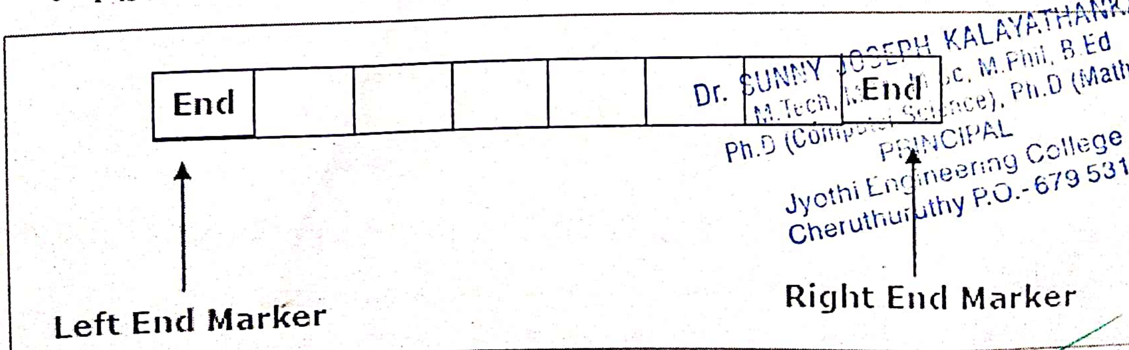
Here,

Memory information ≤ c × Input information

The computation is restricted to the constant bounded area. The input alphabet contains two special symbols which serve as left end markers and right end markers which mean the transitions neither move to the left of the left end marker nor to the right of the right end marker of the tape.

A linear bounded automaton can be defined as an 8-tuple (Q, X, ∑, q0, ML, MR, δ, F) where –

- Q is a finite set of states
- X is the tape alphabet
- ∑ is the input alphabet
- q0 is the initial state
- ML is the left end marker
- MR is the right end marker where MR ≠ ML
- δ is a transition function which maps each pair (state, tape symbol) to (state, tape symbol, Constant 'c') where c can be 0 or +1 or -1
- F is the set of final states



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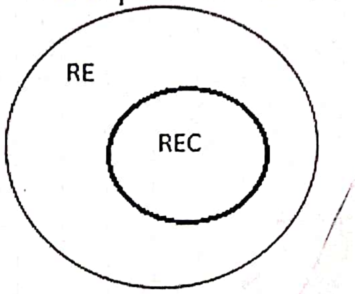
A deterministic linear bounded automaton is always context-sensitive and the linear bounded automaton with empty language is undecidable..A

18 a) **Recursive Enumerable (RE) or Type -0 Language** (5)

RE languages or type-0 languages are generated by type-0 grammars. An RE language can be accepted or recognized by Turing machine which means it will enter into final state for the strings of language and may or may not enter into rejecting state for the strings which are not part of the language. It means TM can loop forever for the strings which are not a part of the language. RE languages are also called as Turing recognizable languages.

Recursive Language (REC)

A recursive language (subset of RE) can be decided by Turing machine which means it will enter into final state for the strings of language and rejecting state for the strings which are not part of the language. e.g.; L= {anbncn|n>=1} is recursive because we can construct a turing machine which will move to final state if the string is of the form anbncn else move to non-final state. So the TM will always halt in this case. REC languages are also called as Turing decidable languages. The relationship between RE and REC languages can be shown in Figure



Closure Properties of Recursive Languages

- Union: If L1 and If L2 are two recursive languages, their union L1 UL2 will also be recursive because if TM halts for L1 and halts for L2, it will also halt for L1 UL2.
- Concatenation: If L1 and If L2 are two recursive languages, their concatenation L1.L2 will also be recursive. L1 says n no. of a's followed by n no. of b's followed by n no. of c's. L2 says m no. of d's followed by m no. of e's followed by m no. of f's. Their concatenation first matches no. of a's, b's and c's and then matches no. of d's, e's and f's. So it can be decided by TM.
- Kleene Closure: If L1is recursive, its kleene closure L1* will also be recursive.
- Intersection and complement: If L1 and If L2 are two recursive languages, their intersection L1 ∩ L2 will also be recursiveL1 says n no. of a's followed by n no. of b's followed by n no. of c's and then any no. of d's. L2 says any no. of a's followed by n no. of b's followed by n no. of c's followed by n no. of d's. Their intersection says n no. of a's followed by n no. of b's followed by n no. of c's followed by n no. of d's. So it can be decided by turing machine, hence recursive. Similarly, complementof recursive language L1 which is ∑*-L1, will also be recursive.

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b) (5)

THE UNIVERSAL TURING MACHINE

The UTM has a tape infinite in both ends to hold the input and perform the computation. It also has a r other tapes also that are used for the processing. The first tape holds the description of the original Turing

The input to the UTM, Tu, is given in the form <Tm, ω> where Tm is the Turing machine that is to b

Turing machine is specified by transition rules or delta rules. Each transition is of the form:

Ã¯Â Â¤ (qi, a) = (qj, b, R)

where qi = the initial state

a = the current read symbol

qj = the next state final state

b = the write symbol

R = the direction to which the tape head has to move (i.e., left or right)

The tape head of the Turing machine and that of the UTM can move in either direct, move left specified position, this is specified by S. The encoded input is given to the UTM. The tape head scans the content the transition rules stored in the description tape and performs the operation as specified in the transitio the final state, check section and performs the same as Tm. The internal structure of universal Turing ma

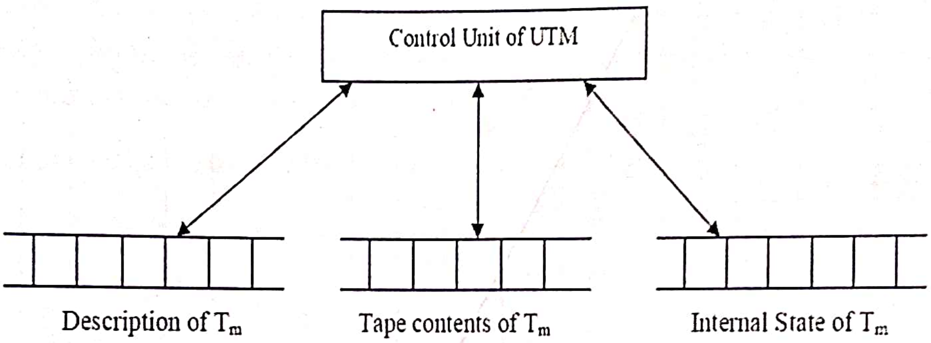

Fig. 1: A Universal Turing Machine

19 a) According to Noam Chomosky, there are four types of grammars − Type 0, Type 1, Type 2, and Type 3. The following table shows how they differ from each other − (6)

Grammar Type	Grammar Accepted	Language Accepted	Automaton
Type 0	Unrestricted grammar	Recursively enumerable language	Turing Machine
Type 1	Context-sensitive grammar	Context-sensitive language	Linear-bounded automaton
Type 2	Context-free grammar	Context-free language	Pushdown automa
Type 3	Regular grammar	Regular language	Finite state autom

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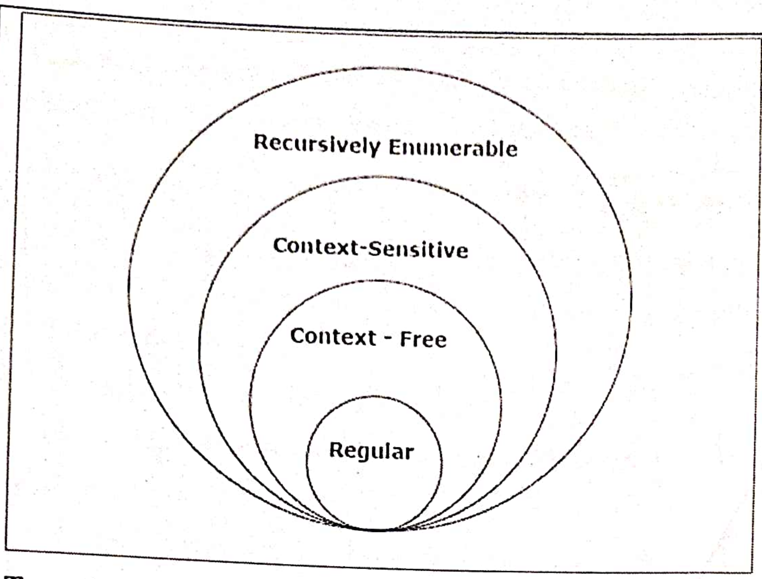

Type-3 grammars generate regular languages. Type-3 grammars must have a single non-terminal on the left-hand side and a right-hand side consisting of a single terminal or single terminal followed by a single non-terminal.

The productions must be in the form $X \rightarrow a$ or $X \rightarrow aY$

where $X, Y \in N$ (Non terminal)

and $a \in T$ (Terminal)

The rule $S \rightarrow \varepsilon$ is allowed if S does not appear on the right side of any rule.

Type-2 grammars generate context-free languages.

The productions must be in the form $A \rightarrow \gamma$

where $A \in N$ (Non terminal)

and $\gamma \in (T \cup N)^*$ (String of terminals and non-terminals).

These languages generated by these grammars are be recognized by a non-deterministic pushdown automaton.

Type-1 grammars generate context-sensitive languages. The productions must be in the form

$\alpha A \beta \rightarrow \alpha \gamma \beta$

where $A \in N$ (Non-terminal)

and $\alpha, \beta, \gamma \in (T \cup N)^*$ (Strings of terminals and non-terminals)

The strings α and β may be empty, but γ must be non-empty.

The rule $S \rightarrow \varepsilon$ is allowed if S does not appear on the right side of any rule. The languages generated by these grammars are recognized by a linear bounded automaton.

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Type-0 grammars generate recursively enumerable languages. The productions have no restrictions. They are any phase structure grammar including all formal grammars.

They generate the languages that are recognized by a Turing machine.

The productions can be in the form of $\alpha \rightarrow \beta$ where α is a string of terminals and nonterminals with at least one non-terminal and α cannot be null. β is a string of terminals and non-terminals.

b) - L belongs to Context sensitive grammar (4)

- Since a PDA with stack with its strict FIFO policy, not able to accept this language but a LBA with tape can accept the same it is CSG-

- A CFG can't represent this language because of its restriction on LHS of productions. If LHS of productions allowed to include multiple symbols (Terminals or variables) then the grammar will be able to accept this language

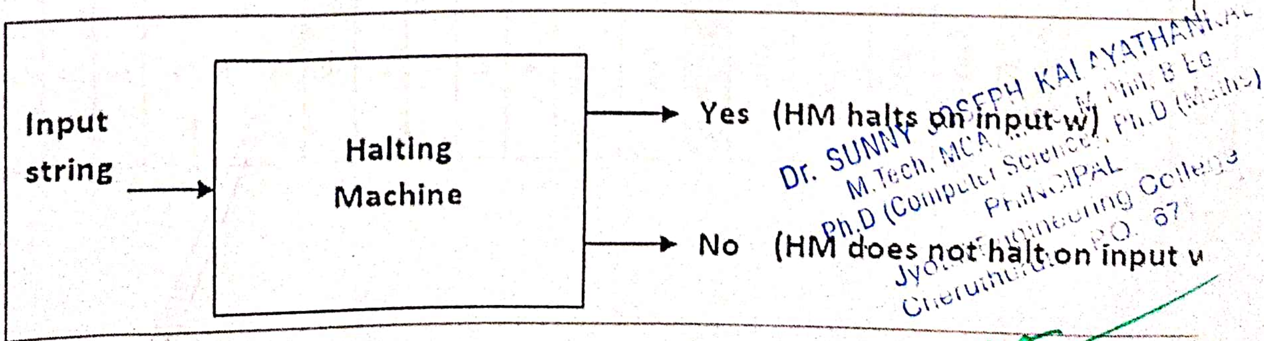
20 Definition: A **decision problem** is a problem that requires a yes or no answer. (10)

Definition: A decision problem that admits no algorithmic solution is said to be **undecidable.**

- No undecidable problem can ever be solved by a computer or computer program of any kind. In particular, there is no Turing machine to solve an undecidable problem.
- We have not said that undecidable means we don't know of a solution today but might find one tomorrow. It means we can **never** find an algorithm for the problem.
- It is not obvious how to show no solution can exist.
  - o We can do so by constructing a logical paradox.
  - o Once we've seen one problem that is undecidable, it is often easy to show that other similar problems must also be undecidable.

Halting Problem – Does the Turing machine finish computing of the string w in a finite number of steps? The answer must be either yes or no.

Proof – At first, we will assume that such a Turing machine exists to solve this problem and then we will show it is contradicting itself. We will call this Turing machine as a **Halting machine** that produces a 'yes' or 'no' in a finite amount of time. If the halting machine finishes in a finite amount of time, the output comes as 'yes', otherwise as 'no'. The following is the block diagram of a Halting machine –



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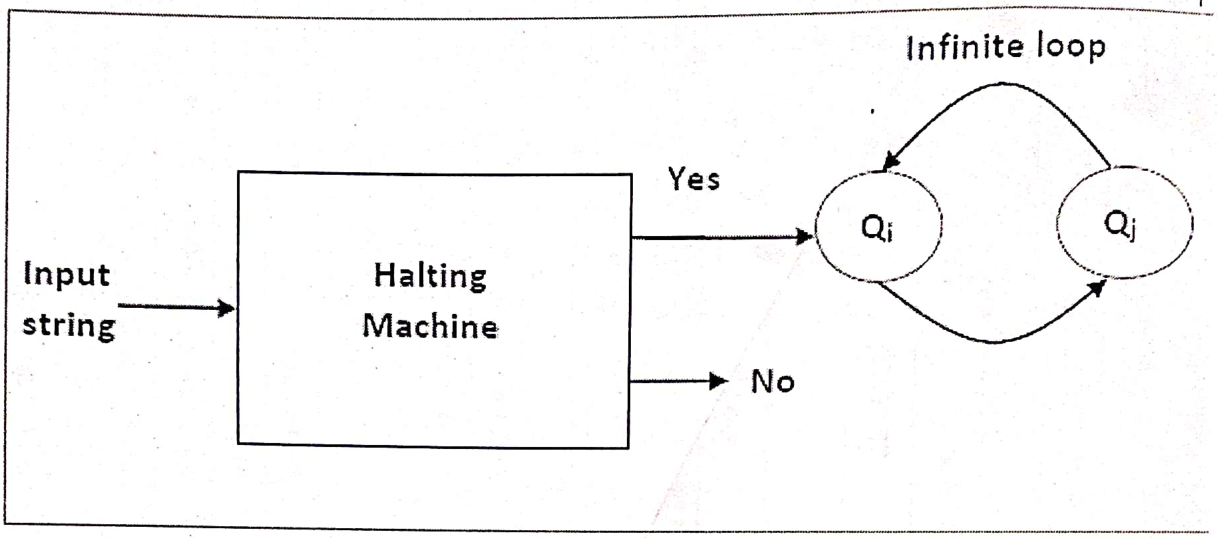
Now we will design an **inverted halting machine (HM)'** as –

- If **H** returns YES, then loop forever.
- If **H** returns NO, then halt.

The following is the block diagram of an 'Inverted halting machine' –



Further, a machine **(HM)₂** which input itself is constructed as follows –

- If $(HM)_2$ halts on input, loop forever.
- Else, halt.

Here, we have got a contradiction. Hence, the halting problem is **undecidable**.

****

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Jyothi Engineering College, Cheruthuruthy

FIRST SESSIONAL EXAMINATION

Semester 5, September 2019

(Department of Computer Science & Engineering)

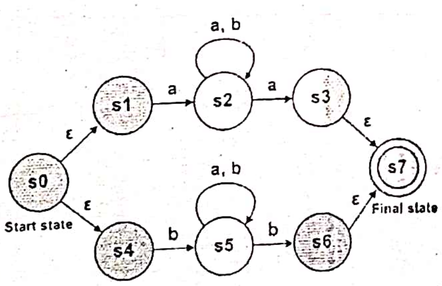
CS301: Theory of Computation

(KTU Scheme)

Time: 90 minutes *Max Marks: 50*

PART A

(Answer any 3 questions out of 4)

Q No.	Questions	Marks	CO	Bloom's Taxonomy level
1	Write a short note on a) Transition diagram b) Transition table	4	1	6
2	Find ECLOSE of all states of the following ε-NFA  	4	1	2
3	Write a short note on Two way Automata	4	2	1
4	Explain the extended transition function of an ε-NFA	4	1	1

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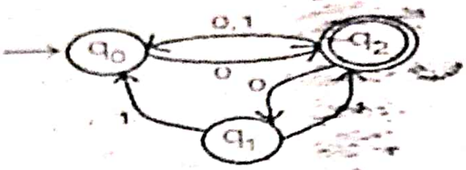
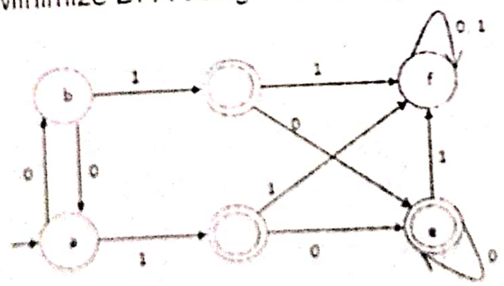
PART B

(Answer ...2...questions out of ....3...)

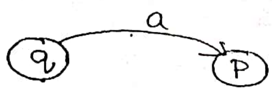
5	Construct a DFA that accepts the set of strings which contains even number of 1s and odd number of 0s.	9	1	6
6	Convert NFA to DFA 	9	1	5
7	a) Design a DFA which accept L={w|w ∈(0,1)*, where every '0' in w has '1' immediately to its right} b)Design a NFA that accepts L={x ∈ {a, b}| x ends with 'aab'}	9	1	5

PART C

(Answer ...2...questions out of ....3...)

8	Construct a mealy machine that prints a whenever the sequence '01' encountered in any input binary string	10	2	6
9	a) Design an NFA that accepts a set of all strings containing 1101 as a substring. b)Convert above NFA to equivalent DFA	10	1	5
10	Minimize DFA using Table filling method 	10	2	5

If q is a state and a is an input symbol the $\delta(q, a)$ is that state p such that there is an arc btw labelled a from q to p.



$\delta(q, a) = p$

or

$$\delta : Q \times \Sigma \rightarrow Q$$

4. A <u>start state</u>, one of the states in Q (denoted as q_0)

5. A set of <u>final or accepting states</u> F. The set F is a subset of Q. ie: $F \subseteq Q$

ie;

DFA is a 5 tuple $A = (Q, \Sigma, \delta, q_0, F)$

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ANSWER KEY

CS301 THEORY OF COMPUTATION

2. ECLOSE (s_0) → {s_0, s_1, s_2}

ECLOSE (s_1) → {s_1} ✓

ECLOSE (s_2) → {s_2} ✓

ECLOSE (s_3) → {s_3, s_7} ✓

ECLOSE (s_4) → {s_4} ✓

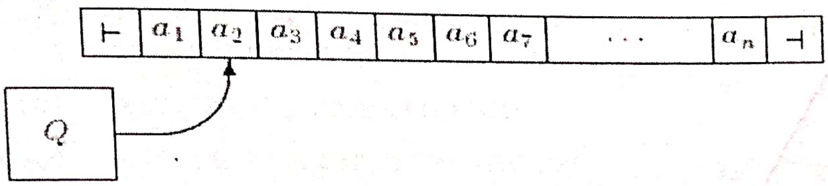
ECLOSE (s_5) → {s_5} ✓

3 ECLOSE (s_6) → {s_6, s_7} ✓

ECLOSE (s_7) → {s_7} ✓

. ECLOSE of a state is that state from which the ε transisissions occur.

3. 2DFA ' Can read the input back and forth with no limit on how many times an input symbol can be read. ' As in the case of DFA, the 2DFA decides whether a given input is accepted or rejected.



4.The Extended Transition Function of an NFAAs with a DFA, we can define theextended transition functionof an NFA. If the transitionfunction isδ, we usually denote the extended transition function by^δ. The basis is that^δ(q, a) :={q}.For the induction step, letSbe^δ(q, x). Then^δ(p, xa) :=UpESδ(p. a).

Formally, a 2DFA is an octuple

$$M = (Q, \Sigma, \vdash, \dashv, \delta, s, t, r).$$

where

- Q is a finite set (the *states*),
- Σ is a finite set (the *input alphabet*),
- $\vdash$ is the *left endmarker*, $\vdash \notin \Sigma$,
- $\dashv$ is the *right endmarker*, $\dashv \notin \Sigma$,
- $\delta : Q \times (\Sigma \cup \{\vdash, \dashv\}) \to (Q \times \{L, R\})$ is the *transition function* (L, R stand for left and right, respectively),
- $s \in Q$ is the *start state*,
- $t \in Q$ is the *accept state*, and
- $r \in Q$ is the *reject state*, $r \neq t$.

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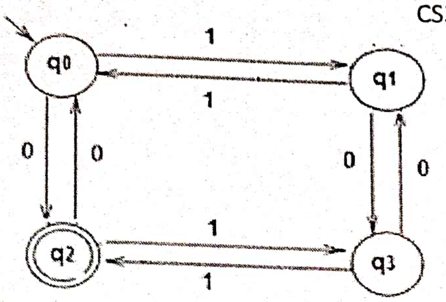
4.The Extended Transition Function of an NFAAs with a DFA, we can define theextended transition functionof an NFA. If the transitionfunction isδ, we usually denote the extended transition function by^δ. The basis is that^δ(q, a) :={q}.For the induction step, letSbe^δ(q, x). Then^δ(p, xa) :=UpESδ(p. a).

5.

ANSWER KEY
CS301 THEORY OF COMPUTATION



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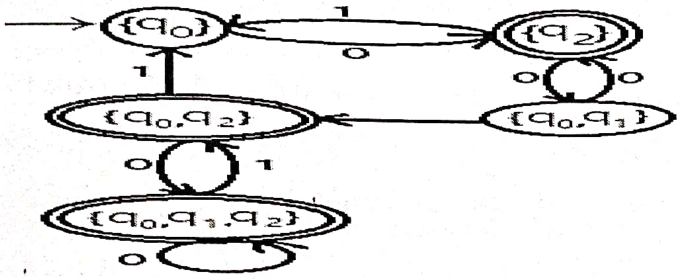

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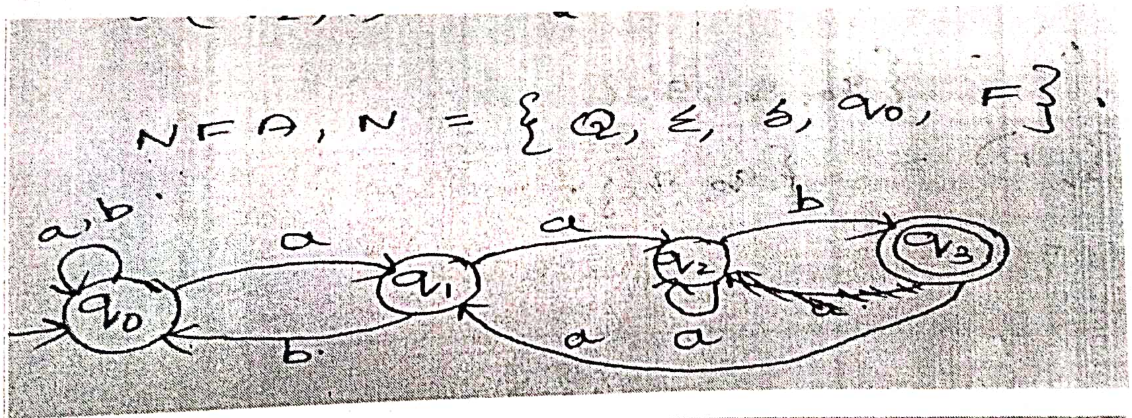

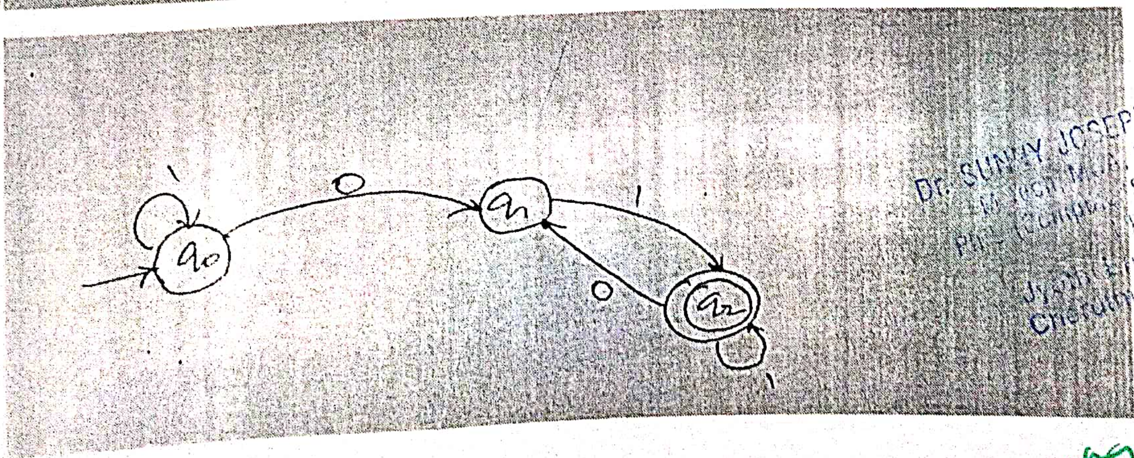

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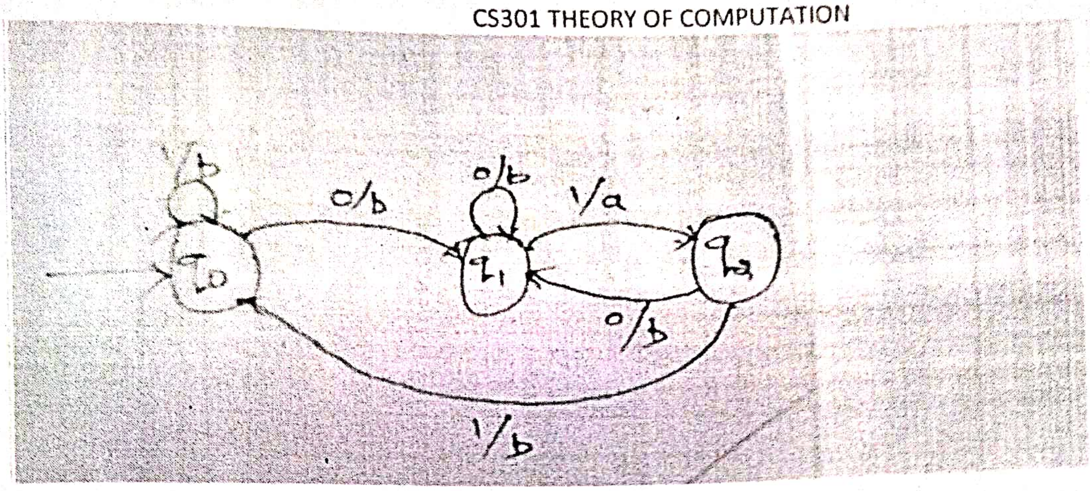
8.



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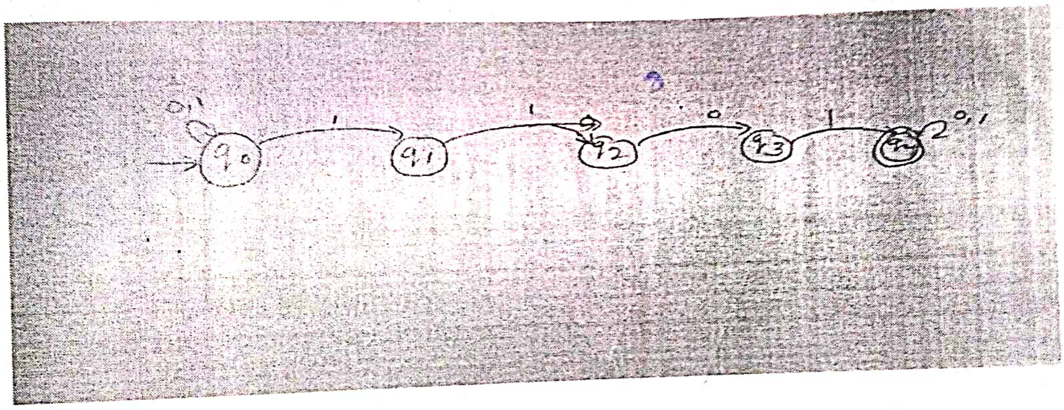

10.Myhill-Nerode theorem definition -

Algorithm

Input – DFA

Output – Minimized DFA

Step 1 – Draw a table for all pairs of states (Qi, Qj) not necessarily connected directly [All are unmarked initially]

Step 2 – Consider every state pair (Qi, Qj) in the DFA where Qi ∈ F and Qj F or vice versa and mark them. [Here F is the set of final states]

Step 3 – Repeat this step until we cannot mark anymore states –

If there is an unmarked pair (Qi, Qj), mark it if the pair {δ (Qi, A), δ (Qi, A)} is marked for some input alphabet.

Step 4 – Combine all the unmarked pair (Qi, Qj) and make them a single state in the reduced DFA.

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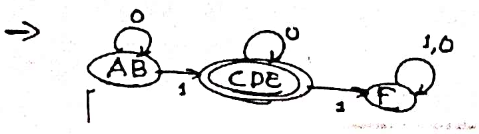
ANSWER KEY
CS301 THEORY OF COMPUTATION

B					
C	✓	✓			
D	✓	✓			
E	✓	✓			
F	✓	✓	✓	✓	✓
	A	B	C	D	E

- Combining unmarked pairs and drawing minimized automata – 2 Marks



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Jyothi Engineering College, Cheruthuruthy

SECOND SESSIONAL EXAMINATION

October 28, 2019

(Department of Computer Science & Engineering)

CS301: Theory of Computation

(KTU Scheme)

Time: 90 minutes *Max Marks:50*

PART A

(Answer any 3 questions out of 4)

Q No.	Questions	Marks	CO	PO	Bloom's Taxonomy level
1	List closure properties of Regular sets.	4	3	1,2,3,4, 5	1
2	What do you mean by useless symbols in grammar? Show the elimination of useless symbols for $A \rightarrow abc \mid Xbcc$ $X \rightarrow Xc \mid aYc$ $Y \rightarrow bYb \mid Xc$ $Z \rightarrow Zb \mid c$	4	3	1,2,3,4, 5	2
3	Convert the given regular expression to an automata. (0+1)01	4	2	1,2,3,4, 5	5
4	How can we eliminate left recursion?	4	3	1,2,3,4, 5	1

PART B

(Answer ...2...questions out of ....3...)

<table>
<tr><td>5</td><td><table><tr><td></td><td>0</td><td>1</td></tr><tr><td>→q1</td><td>q2</td><td>q1</td></tr><tr><td>q2</td><td>q3</td><td>q1</td></tr><tr><td>*q3</td><td>q3</td><td>q2</td></tr></table>Give all the regular expression for $R_{ij}^{(2)}$.Simplify as much</td><td>9</td><td>2</td><td>1,2,3,4, 5</td><td>5</td></tr>
</table>

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	as possible				
6	What are the steps used to reduce the production rules of a CFG? Explain with the following example. S→ bA|aBC/C A→ bAA|aS|a B→ aBB|bS|b C→ a\ ε D→ ε	9	3	1,2,3,4,5	4
7	Do the following a) Derive any two representative strings with minimum length 4 for the following CFG G=({S,A,B},{a,b},P,S) S→ bA|aB A→ bAA|aS|a B→ aBB|bS|b b) Draw derivation tree corresponding to string aabbab with respect to aforementioned grammar	9	3	1,2,3,4,5	4

PART C

(Answer ...2...questions out of ....3...)

8	Design a Push Down automata for the language $L=\{ a^n b^{2n} \mid n>0\}$. Trace your PDA with n=3	10	4	1,2,3,4,5	6
9	Prove that a) $L=\{ a^P \mid p \text{ is prime}\}$ is not regular b) $L=\{ 0^i 1^i \mid i\geq 1\}$ is not regular	10	3	1,2,3,4,5	4
10	a) Construct a CFG for the language $L=\{ 0^n 1^m \mid n\leq m\leq 2n\}$ b) Convert the corresponding grammar to PDA accepting by empty stack	10	3,4	1,2,3,4,5	6

Jyothi Engineering College, Cheruthuruthy
SECOND SESSIONAL EXAMINATION

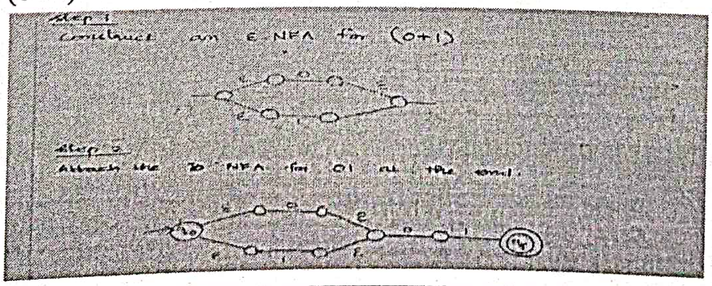
October 28, 2019

(Department of Computer Science & Engineering)
CS301: Theory of Computation
(KTU Scheme)

Time: 90 minutes *Max Marks:50*

(Answer key)

PART A

Q No.	Questions
1	List closure properties of Regular sets. Closure under Union. If L and M are regular languages, so is L UM. ... Closure under Concatenation and Kleene Closure. ... Closure under intersection. ... Closure under Difference. ... Closure under Concatenation. ... Closure under Reversal. ... Closure under homomorphism. ... Closure under inverse homomorphism.
2	What do you mean by useless symbols in grammar? Show the elimination of useless symbols for $A \rightarrow abc \vert Xbcc$ $X \rightarrow Xc \vert aYc$ $Y \rightarrow bYb \vert Xc$ $Z \rightarrow Zb \vert c$ Ans: $A \rightarrow abc$
3	Convert the given regular expression to an automata. (0+1)01 
4	How can we eliminate left recursion? $A \rightarrow A\alpha / \beta$ $A \rightarrow \beta A'$

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	A' → αA' / ∈

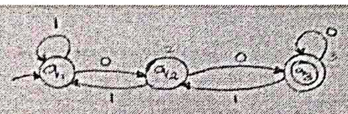
PART B

5	see below

5

	0	1
→q1	q2	q1
q2	q2	q3
*q3	q3	q2

Give all the regular expression for $R_{ij}^{(2)}$.Simplify as much as possible



k=0

$R_{11}^{(0)}$	ε + 1
$R_{12}^{(0)}$	0
$R_{13}^{(0)}$	∅
$R_{21}^{(0)}$	1
$R_{22}^{(0)}$	ε
$R_{23}^{(0)}$	0
$R_{31}^{(0)}$	∅
$R_{32}^{(0)}$	1
$R_{33}^{(0)}$	0 + ε

K=1

$R_{11}^{(1)}$	1*
$R_{12}^{(1)}$	1* 0
$R_{13}^{(1)}$	∅
$R_{21}^{(1)}$	11*
$R_{22}^{(1)}$	11* 0
$R_{23}^{(1)}$	0
$R_{31}^{(1)}$	∅
$R_{32}^{(1)}$	1
$R_{33}^{(1)}$	0

Regular expressions ~~[illegible]~~ for $R_{ij}^{(2)}$ is listed below

K=2

$R_{11}^{(2)}$	1*+(1*0(11*0)1*)
$R_{12}^{(2)}$	1*0(11*0)*
$R_{13}^{(2)}$	1*0(11*0)*0
$R_{21}^{(2)}$	(11*0)* 11*
$R_{22}^{(2)}$	(11*0)*
$R_{23}^{(2)}$	(11*0)* 0
$R_{31}^{(2)}$	1(11*0)* 11*
$R_{32}^{(2)}$	1(11*0)*
$R_{33}^{(2)}$	0+(1(11*0)*0)

6 What are the steps used to reduce the production rules of a CFG? Explain with the following example.

S→ bA|aBC/C

A→ bAA|aS|a

B→ aBB|bS|b

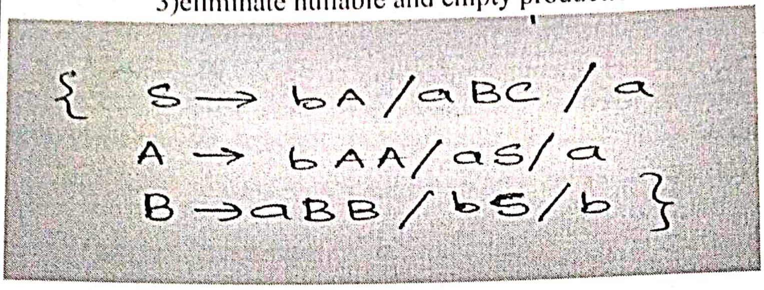
C→ a\ ε

D→ ε

Ans:1)eliminate useless symbols.

2)eliminate unit production

3)eliminate nullable and empty productions



{ S → bA / aBC / a

A → bAA / aS / a

B → aBB / bS / b }

7 Do the following

a) Derive any two representative strings with minimum length 4 for the following CFG

G=({S,A,B},{a,b},P,S)

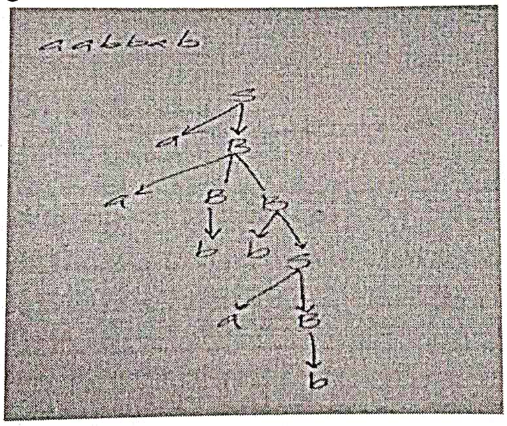
S→ bA|aB

A→ bAA|aS|a

B→ aBB|bS|b

Ans:bbab,abab

b) Draw derivation tree corresponding to string aabbab with respect to aforementioned grammar.



c)

PART C

8 Design a Push Down automata for the language

L={ $a^n b^{2n}$ | n>0}. Trace your PDA with n=3

∂ (q0, a, z) ├ (q0, az)

∂ (q0, a, a) ├ (q0, aa)

[Indicates no operation only state change]

∂ (q0, b, a) ├ (q1, a)

[Indicates pop operation for alternate 'b']

∂(q1, b, a) ├ (q2, \epsilon)

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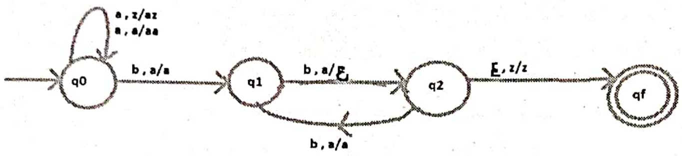
[Indicates no operation only state change]
∂(q2, b, a) $\vdash$(q1, a)

[Indicates pop operation for alternate 'b']
∂(q1, b, a) $\vdash$ (q2, \epsilon)
∂(q2, \epsilon, z) $\vdash$ (qf, z)



Required PDA

n = 3, String : aaabbbbbb

State	I/P ω	Transition no.	Stack
q_0	aaabbbbbb		z_0
q_0	aabbbbbb	①	az_0
q_0	abbbbbb	②	aa
q_0	bbbbbb	②	aaa
q_1	bbbbb	③	aa
q_1	bbbb	③	a
q_1	bbb	③	z_0
q_1	bb	④	b
q_1	b	④	bb
q_1	ε	④	bbb
q_2	ε	⑤	bb
q_2	ε	⑥	b
q_2	ε	⑥	ε
q_3	ε	⑦	ε

9 Prove that

a) L={ a^P | p is prime} is not regular

As a reminder and clarification of notation: The pumping lemma states that any word w∈L with |w|>n for a specific n can be split into three parts w=abc so that:

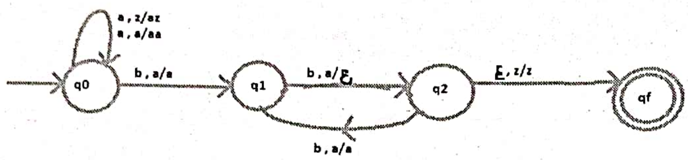
|ab|≤n
|b|>0
∀i∈N:abic∈L

Suppose there exists such an n (which must be true if L is regular). Then there is also a partition of any word z=abc with |z|>n which fulfills the above criteria.

It is clear that the word zi=abic is of length
|zi|=|ac|+i|b|
and thus
|zi|≡|ac| (mod |b|)

[Indicates no operation only state change]
∂(q2, b, a) ⊢(q1, a)

[Indicates pop operation for alternate 'b']
∂(q1, b, a) ⊢ (q2, \epsilon)
∂(q2, \epsilon, z) ⊢ (qf, z)



Required PDA

n = 3, String : aaabbbbbb

State	St ω	Transition no	Stack
q0	aaabbbbbb		z0
q0	aabbbbbb	1	az0
q0	abbbbbb	2	aa
q0	bbbbbb	2	aaa
q1	bbbbb	3	aa
q1	bbbb	3	a
q1	bbb	3	z0
q1	bb	4	b
q1	b	4	bb
q1	ε	4	bbb
q2	ε	5	bb
q2	ε	6	b
q2	ε	6	ε
qf	ε	7	ε

9 Prove that

a) L={ a^P | p is prime} is not regular

As a reminder and clarification of notation: The pumping lemma states that any word w∈L with |w|>n for a specific n can be split into three parts w=abc so that:

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Suppose there exists such an n (which must be true if L is regular). Then there is also a partition of any word z=abc with |z|>n which fulfills the above criteria.

It is clear that the word zi=abic is of length
|zi|=|ac|+i|b|
and thus
|zi|≡|ac| (mod |b|)

and

$|zi| \equiv |ac| - i \pmod{|b|+1}$

. In the case $i = |ac|$,

$|zi| \equiv 0 \pmod{|b|+1}$

holds true. In other words, $|z|ac||$ would be divisible by $|b|+1$.

Obviously, $|zi| \neq |b|+1$ in the general case, so $z|ac|$ would therefore not be prime and could not possibly be element of L. So there has to exist a word z=abc with $|z|>n$ for which abic is not in the language, independently of n or the choice of a, b and c. Therefore, L can not be regular.

b) $L=\{ 0^i 1^i \mid i \geq 1\}$ is not regular

For any regular language L, there exists an integer n, such that for all $x \in L$ with $|x| \geq n$, there exists $u, v, w \in \Sigma*$, such that $x = uvw$, and

(1) $|uv| \leq n$

(2) $|v| \geq 1$

(3) for all $i \geq 0$: $uviw \in L$

In simple terms, this means that if a string v is 'pumped', i.e., if v is inserted any number of times, the resultant string still remains in L.

Pumping Lemma is used as a proof for irregularity of a language. Thus, if a language is regular, it always satisfies pumping lemma. If there exists at least one string made from pumping which is not in L, then L is surely not regular.

The opposite of this may not always be true. That is, if Pumping Lemma holds, it does not mean that the language is regular.

For example, let us prove L01 = $\{0n1n \mid n \geq 0\}$ is irregular.

Let us assume that L is regular, then by Pumping Lemma the above given rules follow.

Now, let $x \in L$ and $|x| \geq n$. So, by Pumping Lemma, there exists u, v, w such that (1) – (3) hold.

We show that for all u, v, w, (1) – (3) does not hold.

If (1) and (2) hold then $x = 0n1n = uvw$ with $|uv| \leq n$ and $|v| \geq 1$.

So, $u = 0a$, $v = 0b$, $w = 0c1n$ where : $a + b \leq n$, $b \geq 1$, $c \geq 0$, $a + b + c = n$

But, then (3) fails for $i = 0$

$uv0w = uw = 0a0c1n = 0a + c1n \notin L$, since $a + c \neq n$.

10

a) Construct a CFG for the language $L=\{ 0^n 1^m \mid n \leq m \leq 2n\}$

S → aSbb | B

B → aBb | €

Convert the corresponding grammar to PDA accepting by empty stack

∂(q, €,S) →{(q,aSbb), (q,B)}

∂(q, €,B) →{(q,aBb),(q, €)}

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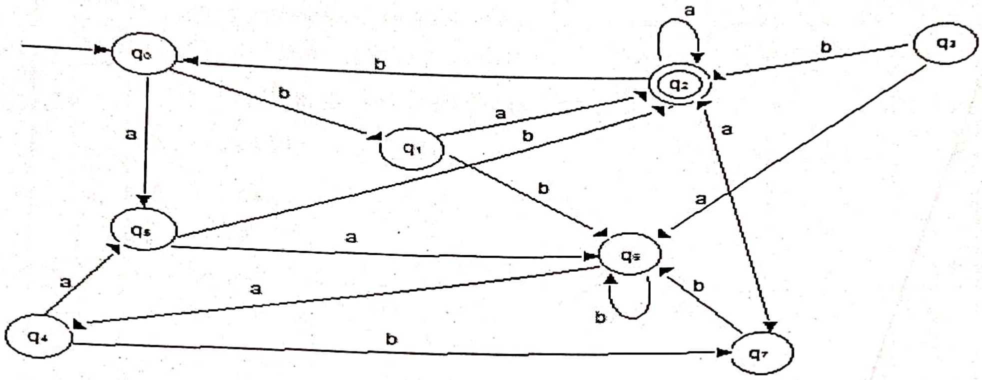
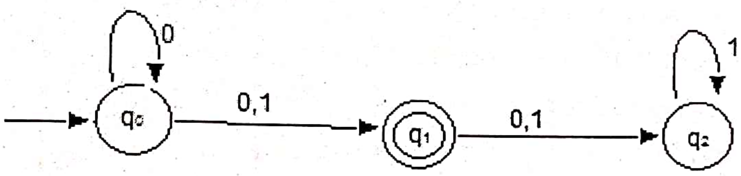
ASSIGNMENT I

1) Minimize the given DFA.(CO2, blooms taxonomy level 5)

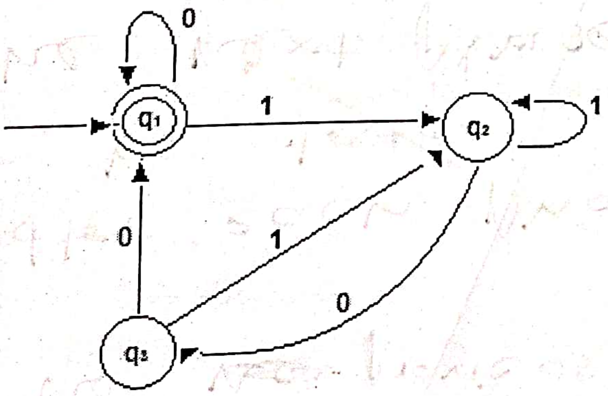


1) Convert the following NFA into DFA.(CO1, blooms taxonomy level 5)

2)



2) Construct a regular expression corresponding to the automata given below.(CO2, blooms taxonomy level 5)



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3) Derive a regular expression for the language containing strings ending in 1 but not containing substring 00. .(CO2, blooms taxonomy level 4)

4) Design a NFA for the following language: .(CO2, blooms taxonomy level 4)

1. L = (ab)* (ba)* U aa*
2. L = all strings over {0, 1} that have at least two consecutive 0's or 1's

Sub. Date 27/9/19

ASSIGNMENT-2

Q No.	Questions	CO	PO	Bloom's Taxonomy level
1	Derive the string "00101" using Recursive Inference for the CFG given by $S \rightarrow A1B$ $A \rightarrow 0A \mid \varepsilon$ $B \rightarrow 0B \mid 1B \mid \varepsilon$	3	1,2,3,4,5	5
2	Convert to CNF $S \rightarrow ABa$ $A \rightarrow aab$ $B \rightarrow Ac$	3	1,2,3,4,5	5
3	Write context free grammar for the following a) $L=\{a^n b^m \mid 2n \le m \le 3n\}$ for $n,m \ge 0$ b) $L=\{a^n b^m \mid n \ge m+3\}$ for $n,m \ge 0$ c) For the regular expression $(110+11)^*(10)^*$	3	1,2,3,4,5	6
4	Prove the equivalence of acceptance by final state and empty stack in PDA	4	1,2,3,4,5	4
5	Do the following a) Derive any two representative strings with minimum length 4 for the following CFG $G=(\{S,A,B\},\{a,b\},P,S)$ $S \rightarrow bA \mid aB$ $A \rightarrow bAA \mid aS \mid a$ $B \rightarrow aBB \mid bS \mid b$ b) Draw derivation tree corresponding to string aabbab with respect to aforementioned grammar	3	1,2,3,4,5	4
6	Design a Push Down automata for the language $L=\{a^n c^n b^{2n} \mid n>0\}$. Trace your PDA with n=3	4	1,2,3,4,5	6

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7	a) Explain Greibach Normal Form b) Convert the following grammar into GNF S → AB|aB A → aab|ε B → bbA	3	1,2,3, 4,5	2,4
8	Find the equivalent useless grammar from the given grammar A -> xyz / Xyzz X -> Xz / xYz Y -> yYy / Xz Z -> Zy / z	3	1,2,3, 4,5	6

Submission date-5-11-19.

THEORY COURSES & CONTENTS BEYOND SYLLABUS

Programme: B.Tech in COMPUTER SCIENCE			
SEM:V		Syllabus Version: 2015	
Theory Course: Theory of Computation			
Course handled by: Aneesh Chandran			
Module	**Prescribed Topics**	**Proposed topics**	**Reason for Introduction**
6	Halting problem	NP completeness	It is needed to prove the power of turing machine

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

DETAILS OF REMDIAL CLASSES

Semester and Branch : S5 CSE

Course Code and Name : CS301 Theory of Computation.

Date and Time	Topic	Reason for arranging	Roll No. of students present	Total count
15/10/19 1pm to 1:30pm	CFG	Students Request	8, 25, 27, 33, 42, 45, 50, 52 61, 99, 103	11
24/10/19 1 to 1:30	PDA	students Request	1, 4, 8, 25, 54, 61, 99, 103	8
25/10/19	Problem in PDA	students Request	33, 105, 86, 31, 20, 11, 47, 52, 54	9
26/10/19	Turing Machine	Students Request	33, 47, 20, 31, 52, 54	6

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Name and Signature of Course Faculty

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GAP IN THE SYLLABUS

Programme: B.Tech in COMPUTER SCIENCE		
SEM:V		Syllabus Version: 2015
Theory Course: Theory of Computation		
Course handled by: Aneesh Chandran		
Module	**Proposed topics**	**Method**
1	Introduction to formal proof (needed for proving equivalence).	Seminar
2	Ardens's theorem	Class

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Designation:	ASSISTANT PROFESSOR	Semester	S5	Batch	B
Subject Name:	THEORY OF COMPUTATION		Subject Code:	CS301	

Internal Split up	Series Test		Retest	Assignment		Final Internal
	First	Second		First	Second	
	20	20	50	5	5	50

Register No	Name	Atten-dance %	Series Test		Retest	Assignment		Final Internal
			First	Second	Retest	First	Second	
			50	50	50	10	10	50
[illegible]6CS026	ANN MARIYA	79.31	29	17		7	7	25
JEC16CS102	SANALNADH M	70.69	43	33		9		35
JEC17CS055	JEVIN PAULY KURISSERY	98.28	25	37		7	6	31
JEC17CS057	JOSEPH JOEL C P	93.1	35	37		8	10	38
JEC17CS059	JOSHUA JOSEPH	81.03	43	36		7	9	40
JEC17CS060	JOSIN GEORGE	70.69	26	15		6	7	23
JEC17CS061	KARTHIK PC	89.66	19	38		7	10	31
JEC17CS063	MANEESH MANOJ	93.1	48	35		9	9	42
JEC17CS064	MARY JOSE	84.48	37	A	38	7	7	37
JEC17CS066	MEERA E THIMOTHY	86.21	38	31		8	10	37
JEC17CS067	MELVIN THOMAS	70.69	20	21		6	10	24
[illegible]7CS068	MOHAMED NAJEEB V K	84.48	23	24		7	9	27
JEC17CS069	M P ADITHYA VIJAYAN	98.28	35	36		8	6	35
JEC17CS070	MUHAMMED AFTHAB V U	75.86	31	7		8	7	23
JEC17CS071	MUHAMMMED RANEESH CM	91.38	41	41		8	9	41
JEC17CS072	NAIR ANJALI VALSALAN	75.86	33	31		8	10	35
JEC17CS073	NAVEEN P R	82.76	34	29		9	10	35
JEC17CS074	NEETHUU N	77.59	A	29	19	9	9	28
JEC17CS075	NITHIN PETER	89.66	41	32		7	9	37
JEC17CS077	NIVA DILEEP	91.38	47	43		9	10	46
JEC17CS078	NOVA DILEEP	93.1	48	40		7	10	44
JEC17CS079	RASHI M	86.21	44	47		8	9	45
JEC17CS080	RASMIYA C U	75.86	24	21		7	10	30

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JEC17CS081	RESHMA R	87.93	33	24		9	9	32
JEC17CS083	RONDY THOMAS K	84.48	30	38		9	10	37
JEC17CS084	SANDRA DAVID	91.38	39	36		7	10	39
JEC17CS086	SANGEETHA C P	89.66	42	32		9	10	39
JEC17CS087	SANGEETHA P	81.03	37	23		9	10	34
JEC17CS088	SANJANA S	89.66	41	31		9	10	38
JEC17CS089	SAN JOSE	81.03	14	27		7	8	24
JEC17CS090	SARANYA . K	86.21	31	31		9	10	34
JEC17CS091	KUMAR	82.76	31	9		9	7	24
JEC17CS092	SHIBANA	84.48	43	34		9	10	40
JEC17CS093	SHILPA SIVADAS	84.48	40	32		7	10	37
JEC17CS094	SHINOZ MOHAMMED P P	94.83	36	23		8	9	32
JEC17CS095	SIDHARTH U	86.21	32	10		9	10	26
JEC17CS096	SIJIN.K	86.21	30	23		8	10	30
JEC17CS097	SREEHARI	93.1	39	27		8	10	35
JEC17CS098	SREELAKSHMI.C	89.66	46	45		10	10	46
JEC17CS099	SREERAG R NANDAN	91.38	21	39		8	8	32
JEC17CS100	SRUTHI ELSA SHAJI	77.59	30	30		7	10	33
JEC17CS101	TEENA JOY PJ	82.76	39	23		7	10	33
JEC17CS102	TESSA SHYJU	89.66	43	33		8	10	39
JEC17CS103	THUSHARA P	79.31	9	25		8	10	23
JEC17CS104	VINCY ANTO	84.48	35	15		8	8	28
JEC17CS105	V J VISHNU	79.31	33	9		5	10	24
JEC17CS106	YASHIF V S	81.03	24	13		8	10	24

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2) Aneesh chandran

2) Aswathy wilson

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Sobha Xavier P

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Subject Name:	THEORY OF COMPUTATION		**Subject Code:**	CS301	

Internal Split up	Series Test			Assignment		Final
	First	Second	Retest	First	Second	Internal
	20	20	50	5	5	50

Register No	Name	Atten-dance %	Series Test			Assignment		Final
			First	Second	Retest	First	Second	Internal
			50	50	50	10	10	50
JEC17CS001	AAYUSH P REJI	88.71	23	26		7	10	28
JEC17CS002	ABHIJITH E MORRIES	0	A	A			A	0
JEC17CS003	ABHIJITH V J	95.16	36	26		8	7	32
JEC17CS004	ABHIRAM BHASKAR	75.81	26	23		7	10	28
JEC17CS005	ABIN M K	80.65	23	13		7	10	23
JEC17CS006	ADITHYAN K	75.81	24	24		8	10	28
JEC17CS008	AISWARYA SAJEEV	88.71	11	25		8	9	23
JEC17CS009	AISWARYA SURESH	87.1	39	29		5	10	35
JEC17CS010	AJIN N D	95.16	37	35		8	10	38
JEC17CS011	AJITH SANKAR O	90.32	42	25		6	9	34
JEC17CS012	AKASH KUMAR	85.48	27	14		6	10	24
JEC17CS013	AKHIL MR	79.03	25	24		8	10	29
JEC17CS014	ALEENA SHAJI	82.26	45	30		8	10	39
JEC17CS015	ALPHIN GEORGE ANSON	82.26	30	33		8	9	34
JEC17CS016	AMALA.K.S	85.48	49	36		8	10	43
JEC17CS017	AMALA MARIA NELSON	82.26	33	24		8	10	32
JEC17CS018	AMAL TOM	88.71	49	38		8	10	44
JEC17CS019	ANAGHA N M	96.77	45	29		8	10	39
JEC17CS020	ANAKHA. K. R	95.16	37	26		5	10	33
JEC17CS021	ANILA T A	95.16	32	23		7	10	31
JEC17CS022	ANILJITH MS	90.32	34	26		8	10	33
JEC17CS023	ANJALI ANNE PRATHAP	93.55	45	34		8	10	41
JEC17CS024	ANJITHA M J	93.55	36	24		8	10	33

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JEC17CS025	ANJU VINCENT V	87.1	19	25		8	10	27
JEC17CS027	ARCHANA C K	79.03	13	24		7	10	23
JEC17CS028	ARCHANA S	90.32	34	37		8	10	37
JEC17CS029	ARJUN J	91.94	44	34		6	10	39
JEC17CS030	ARNOLD MANUEL JOSEPH	98.39	47	27		8	10	39
JEC17CS031	ARUN RAJU	93.55	34	27		8	10	33
JEC17CS032	ARYA MANOJ	91.94	26	30		8	10	31
JEC17CS033	ASHIK A U	79.03	18	20		6	10	23
JEC17CS034	ATHIRA. C	85.48	A	41	35	8	10	39
JEC17CS035	AVIN JOSEPH	85.48	36	43		8	10	41
JEC17CS036	BIBIN THOMAS	90.32	39	34		8	10	38
JEC17CS037	BINWIN VIJU	95.16	29	30		8	10	33
JEC17CS038	BIVIN BABU CHALISSERY	83.87	26	27		8	10	30
JEC17CS039	CECILIA JOE	88.71	35	34		8	10	37
JEC17CS040	CHARLES JOSHY	85.48	31	21		7	10	29
JEC17CS041	CHRISTY SUNIL	88.71	42	25		8	10	36
JEC17CS042	DEEPAK.K.V	77.42	12	23		7	10	23
JEC17CS043	DHANYA R	87.1	39	31		8	10	37
JEC17CS044	DIVYA PETER	100	47	25		7	10	37
JEC17CS045	ELJO JOY	85.48	20	29		6	10	28
JEC17CS046	GLADEES C B	80.65	A	16	21	6	10	23
JEC17CS047	GODSTIN PAUL	83.87	36	8		8	10	27
JEC17CS048	HANEENAH V A	88.71	37	27		7	9	34
JEC17CS049	HARIPRASAD C	85.48	23	28		8	9	29
JEC17CS050	HARISH S	75.81	4	30		9	10	23
JEC17CS051	HIMA T.	87.1	36	34		8	10	37
JEC17CS052	JACKSON JAMES	91.94	11	24		8	10	23
JEC17CS053	JAICOB JOHN A	87.1	23	A	17	8	10	25
JEC17CS054	JASMINE SHAJ	98.39	30	23		8	10	30

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