In Pursuit of Excellence	Course and Faculty Details	SESSION-2019-2020
		SEM-IV

Faculty Details

Name of the Faculty: **Dr. Lal Pratap Verma**

Designation: **Associate Professor**

Department: **Computer Science and engineering**

Course Details

Name of the Programme: B.Tech. **Batch: 2018-2022**

Branch: CSE **Section: C**

Name of Subject: Theory of Automata and Formal Language **Subject Code: KCS-402**

Category of Course: Core Subject

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In Pursuit of Excellence	**Index**	SESSION-2019-2020
		SEM-IV

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Question Bank	80-84
Final Internal Marks	85-86
Course Outcome Attainment	87-90

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In Pursuit of Excellence	Vision & Mission of Institute	SESSION-2019-2020
		SEM-IV

Vision of Institute

- To develop industry ready professionals with values and ethics for global needs.

Mission of Institute

- To impart education through outcome based pedagogic principles.
- To provide conducive environment for personality development, training & entrepreneurial skills.
- To induct high professional ethics and accountability towards society in students.

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In Pursuit of Excellence	Vision &Mission Of Department	SESSION-2019-2020
		SEM- VII

Vision of Department

To develop globally recognized computer science and engineering graduates with ethical values for need of software industries.

Mission of Department

1. To impart knowledge through well-defined instructional objectives in the field of computer science and engineering.
2. To provide a learning ambience for skills, innovation, leadership and overall personality development.
3. To inculcate professional ethics, teamwork and responsiveness towards society.

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In Pursuit of Excellence	Program Education Objectives	SESSION-2019-2020
		SEM- IV

Program Education Objectives

PEO 1 : The graduates will have entrepreneurial and employable skills in software industries, by adapting themselves in the corporate world by utilizing the defined instructional objectives learnt in the program.

PEO 2 : The graduates will engage in skill enhancement, that would help to work in their own area of interest, individually or in a team.

PEO 3 : The graduates will demonstrate ownership and responsiveness towards the profession and the society.

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In Pursuit of Excellence	Program Outcomes	SESSION-2019-2020
		SEM- IV

Program Outcomes

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, research literature, and analyse 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 public health and safety, and 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 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.

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10. Communication: Communicate effectively on complex engineering activities with the engineering community and with the 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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In Pursuit of Excellence	**Program Specific Outcomes**	SESSION-2019-2020
		SEM- IV

After completing their graduation, students of Computer Science and Engineering will be able to -

PSO 1 : Comprehend the core subjects of CSE and apply them to resolve domain specific tribulations.

PSO 2: Extrapolate the fundamental concepts in engineering and to apply latest technology with programming language skills to develop, test, implement and maintain software products.

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In Pursuit of Excellence	Academic calendar	SESSION-2019-2020
		SEM- IV

Moradabad Institute of Technology

Rajnagar Vihar Phase – II, Moradabad

Date: 16-01-2020

ACADEMIC CALENDAR

Even Semester

Session: 2019 – 2020

S. No.	Particulars	Date	Responsibility
1.	**Time Table** (a) Display on Notice Boards (b) Distribution to concerned Teachers	 18 Jan 2020 18 Jan 2020	O.C. Time Table
2.	Distribution of Students' lists to teachers	18 Jan 2020	Concerned HODs /O.C. Class
3.	Blow up submission to HODs	18 Jan 2020	Concerned Teachers
4.	**Registrations** (a) 2nd and 4th Semester (b) 6th and 8th Semester (b)List of unregistered students to various department (c) Notifying unregistered students for getting registered at the earliest (through class O.Cs. / Faculty)	 20 Jan 2020 21 Jan 2020 27 Jan 2020 29 Jan 2020	 Concerned Teachers OS Academic Concerned HODs
5.	**Commencement of Classes** (a) 2nd and 4th Semester (b) 6th and 8th Semester	 21 Jan 2020 22 Jan 2020	 HODs and Concerned Teachers
6.	Announcement of Test series dates	30 Jan 2020	Dean Academics
7.	Procurement of stationary & materials for Test Series for full semester (a) Requirement (b) Actual Procurement	 10 Feb 2020 15 Feb 2020	Convener Test Series Committee O/S. Academics
8.	(a)Short attendance compilation before Class Test-I (b) Information to parents (c)Undertaking form handed over to students (b)Collection of undertaking form	 20 Feb 2020 21 Feb 2020 21 Feb 2020 22 Feb 2020	 O/C. Class
9.	**1st Test Series**	**24, 25 and 26 Feb 2020**	
	Announcement of Test Series schedule, Invigilation Programme, Seating arrangement etc.	18 Feb 2020	Class Test Committee
	After completion of Test Series (a) Evaluation of test copies & showing of copies to students (b) Report of poor performance of students to class OCs (c)) Submission of test copies in Nodal Centre	 29 Feb 2020 29 Feb 2020 29 Feb 2020	 Concerned Teachers Concerned Teachers Concerned Teachers
10.	(a) Last date for submission of examination forms to office (b) Submission of forms to University	06 March 2020** 07 March 2020**	O/S Academic to take timely action as per University directions.

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11.	Mid Semester break	09 March to 11 March 2020	
12.	Announcement of dues list and its last date for clearing dues (Current semester)	25 March 2020	Accounts/ OS Academic
13.	(a)Short attendance compilation before Class Test-2 (b) Information to parents (c)Undertaking form handed over to students (b)Collection of undertaking form	01 April 2020 03 April 2020 03 April 2020 04 April 2020	O.C. Class
14.	**2nd Test Series**	**07, 08 and 09 April 2020**	
	Announcement of Test Series schedule, Invigilation Programme, Seating arrangement etc.	03 April 2020	Class Test Committee
	After completion of Test Series (a) Evaluation of test copies & showing of copies to students (b) Report of poor performance of students to class OCs (c)) Submission of test copies in Nodal Centre	13 April 2020 13 April 2020 13 April 2020	Concerned Teachers Concerned Teachers Concerned Teachers
15.	Filling of student feedback forms for current semester	22 April 2020	Concerned HODs
16.	Requirement of additional Faculty (to be conveyed to Director) (for even semester)	30 April 2020	Concerned HODs
17.	(a) Floating the electives for even semester (b) Last date for students choice	22 April 2020 23 April 2020	Concerned HODs
18.	Date up to which final attendance is to be counted	26 April 2020	Concerned teachers
19.	Submission of consolidated list of shortage of attendance to Director and information to Parents	27 April 2020	Class O.Cs
20.	**3rd Test Series**	**28,29,30 April 2020**	
	Announcement of Test Series schedule, Invigilation Programme, Seating arrangement etc.	23 April 2020	Class Test Committee
	After completion of Test Series (a) Evaluation of test copies & showing of copies to students (b) Report of poor performance of students to class OCs (c)) Submission of test copies in Nodal Centre	04 May 2020 04 May 2020 04 May 2020	Concerned Teacher Concerned Teachers Concerned Teachers
21.	**Submission of sessional marks:** (a) Meeting of Dean Academics, , all HODs and Director regarding attendance and performance of students.	05 May 2020	Dean Academics
	(b) Checking of Teachers' Records by HODs	06 May 2020	Concerned HODs
	(c) Finalization of sessional marks	08 May 2020	Concerned Teachers
	(d) Submission of Award list after final checking and uploading to OS Academics for further necessary action	As per date announced by AKTU	HODs Concerned Teachers
22.	**Theory Examinations:** (a) Collection of Admit Cards / Roll Nos. from University (b) Preparation of Roll lists (c) Collection of stationery such as copies, practical copies drawing sheets, graph paper etc. from University. (c) Procurement of stationery and other materials locally as necessary.	As per AKTU schedule	OS Academics to take appropriate actions as per University directions.

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23.	**Practical Examinations:**	As per AKTU schedule	Concerned HODs
	(a) Appointment of Internal Examiners	3 days before the practical exam schedule	Concerned HODs
	(b) Obtaining list of panel of External Examiners from AKTU & preparation of schecule of practical examination.	As per AKTU schedule	OS Academics
	(c) Dispatch of letters/contacting the external examiners	Within 7 days of list obtained from AKTU	HODs and concerned teachers
24.	**Preparation for Even Semester** (a) Load Distribution by Department (b) Submission to C.C. Time Table	 15 May 2020 16 May 2020	 Concerned Coordinators O.C. Time Table
25.	Registration for odd semester (2020 – 21)	To be announced**	OS Academic

**May be revised as per AKTU Schedule.

Nitin 16-01-2020
Dean Academics

Director

Copy to:
1. Chairman
2. Secretary
3. P.A to Director Sir/Director's Sister
4. All HODs
5. DOSW
6. Controller of Examination
7. O.C. Time Table
8. Registrar
9. All Faculty Members through HODs
10. O.S. Academics
11. A.S. Examinations
12. Account Section
13. T & P Cell
14. Librarian
15. Convener Test Series

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MORADABAD INSTITUTE OF TECHNOLOGY, MORADABAD

Ram Ganga V[illegible]r Phase-II Moradabad (U.P.)

Approved by AICTE and Affiliated to Dr. A. P. J. Abdul Kalam Technical University, Lucknow

Website: http://mitmoradabad.edu.in

Department Academic Calendar, Even Semester, Session (2019 – 2020)

VISION

To develop globally recognized computer science and engineering graduates with ethical values for need of software industries.

MISSION

M1: To impart knowledge through well defined instructional objectives in the field of computer science and engineering.

M2: To provide a learning ambience for skills, innovation, leadership and overall personality development.

M3: To inculcate professional ethics, teamwork and responsiveness towards society.

JANUARY-2020

Su	M	T	W	Th	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

FEBRUARY-2020

Su	M	T	W	Th	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29

MARCH-2020

Su	M	T	W	Th	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

APRIL-2020

Su	M	T	W	Th	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

MAY-2020

Su	M	T	W	Th	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

JUNE -2020

Su	M	T	W	Th	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

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A	Time Table Display on Notice Boards
B	Blow Up Submission to HODs
C	4th /6th /8h semester registration
D	4th /6th /8h SEM Commencement of Classes
E	Republic Day
F	Expert Lecture on Machine Learning & IOT by Mr. Abhey Kumar Bains & Mr. Aman Kumar Singh, Scope Telecom, Chandigarh
G	Expert Lecture on Image Classification using Machine Learning by Mr. Rahul Pathak, CETPA Noida
H	Event 'Dosto ki Mehfil' by CSSS
I	Maha Shivratri
J	1st Test Series
K	Submission of Test copies in Nodal Center
L	Event 'Filmy Bytes' by CSSS
M	Mid Semester Break(Holi and Birthday of Mohd. Hazrat Ali)
N	Classes Suspended due to Lockdown
O	New Time Table for Online Classes
P	Commencement of Online Classes
Q	Information of CTs to parents and students through Counsellors
R	2nd Test Series
S	Information regarding filling of Examination Form to students
T	Submission of CT 2 Marks on MIT ERP
U	Departmental Meeting on Google Meet
V	Submission of Concept Map by Subject Coordinators
W	Onine Conduction of Event 'Lockdown with Family' by CSSS
X	Online Conduction of Event 'MAA' by CSSS
Y	Webinar on 'Internet Routing' by Dr. Mahesh Kumar organized by CSE Deptt, MIT
Z	Webinar on 'Apache Airflow' by Shivam Saxena organized by CSE Deptt, MIT
AA	Submission of Sessional Marks on AKTU ERP

Month	Dates of Teaching Days (2nd, 3rd & 4th Year)	No. of Teaching Days	No. of Lecture Hours
Jan-2020	22,23,24,25,27,28,29,30,31	09	76 × 6 = 456
Feb-2020	1,3,4,5,6,7,8,10,11,12,13,14,15,17,18,19,20,22,27,28,29	21	
Mar-2020	2,3,4,5,6,7,12,13,14,16,23,24,25,26,27,28,30,31	23	
Apr-2020	1,2,3,4,6,7,8,9,10,11,15,16,17,18,20,21,22,23,24,25,27,28,29,30	24	
May-2020	1,2,4,5,6,7,8,9,11,12,13,14,16	13	
	Total	70	
	Sessional Examinations	06	

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In Pursuit of Excellence	**Course Evaluation Scheme**	SESSION-2019-2020
		SEM- IV

SEMESTER- IV

Sl. No.	Subject Codes	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1	KAS402/ KOE041-48	Maths IV/Engg. Science Course	3	1	0	30	20	50		100		150	4
2	KVE401/ KAS301	Universal Human Values/ Technical Communication	3 2	0 1	0 0	30	20	50		100		150	3
3	KCS401	Operating Systems	3	0	0	30	20	50		100		150	3
4	KCS402	Theory of Automata and Formal Languages	3	1	0	30	20	50		100		150	4
5	KCS403	Microprocessor	3	1	0	30	20	50		100		150	4
6	KCS451	Operating Systems Lab	0	0	2				25		25	50	1
7	KCS452	Microprocessor Lab	0	0	2				25		25	50	1
8	KCS453	Python Language Programming Lab	0	0	2				25		25	50	1
9	KNC402/ KNC401	Python Programming/Computer System Security	2	0	0	15	10	25		50			0
10		MOOCs (Essential for Hons. Degree)											
		Total										**900**	**21**

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In Pursuit of Excellence	Course Syllabus as per University	SESSION-2019-2020
		SEM- IV

Theory of Automata and Formal Languages (KCS-402)

DETAILED SYLLABUS

UNIT-I

Basic Concepts and Automata Theory: Introduction to Theory of Computation- Automata, Computability and Complexity, Alphabet, Symbol, String, Formal Languages, Deterministic Finite Automaton (DFA)-Definition, Representation, Acceptability of a String and Language, Non Deterministic Finite Automaton (NFA), Equivalence of DFA and NFA, NFA with ε-Transition, Equivalence of NFA's with and without ε-Transition, Finite Automata with output- Moore Machine, Mealy Machine, Equivalence of Moore and Mealy Machine, Minimization of Finite Automata, Myhill-Nerode Theorem, Simulation of DFA and NFA

UNIT-II

Regular Expressions and Languages: Regular Expressions, Transition Graph, Kleen's Theorem, Finite Automata and Regular Expression- Arden's theorem, Algebraic Method Using Arden's Theorem, Regular and Non-Regular Languages- Closure properties of Regular Languages, Pigeonhole Principle, Pumping Lemma, Application of Pumping Lemma, Decidability- Decision properties, Finite Automata and Regular Languages, Regular Languages and Computers, Simulation of Transition Graph and Regular language.

UNIT-III

Regular and Non-Regular Grammars: Context Free Grammar(CFG)-Definition, Derivations, Languages, Derivation Trees and Ambiguity, Regular Grammars-Right Linear and Left Linear grammars, Conversion of FA into CFG and Regular grammar into FA, Simplification of CFG, Normal Forms- Chomsky Normal Form(CNF), Greibach Normal Form (GNF), Chomsky Hierarchy, Programming problems based on the properties of CFGs.

UNIT-IV

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Push Down Automata and Properties of Context Free Languages: Nondeterministic Pushdown Automata (NPDA)- Definition, Moves, A Language Accepted by NPDA, Deterministic Pushdown Automata(DPDA) and Deterministic Context free Languages(DCFL), Pushdown Automata for Context Free Languages, Context Free grammars for Pushdown Automata, Two stack Pushdown Automata, Pumping Lemma for CFL, Closure properties of CFL, Decision Problems of CFL, Programming problems based on the properties of CFLs.

UNIT-V

Turing Machines and Recursive Function Theory : Basic Turing Machine Model, Representation of Turing Machines, Language Acceptability of Turing Machines, Techniques for Turing Machine Construction, Modifications of Turing Machine, Turing Machine as Computer of Integer Functions, Universal Turing machine, Linear Bounded Automata, Church's Thesis, Recursive and Recursively Enumerable language, Halting Problem, Post's Correspondance Problem, Introduction to Recursive Function Theory.

Text books:

1. Introduction to Automata theory, Languages and Computation, J.E.Hopcraft, R.Motwani, and Ullman. 2nd edition, Pearson Education Asia
2. Introduction to languages and the theory of computation, J Martin, 3rd Edition, Tata McGraw Hill
3. Elements and Theory of Computation, C Papadimitrou and C. L. Lewis, PHI
4. Mathematical Foundation of Computer Science, Y.N.Singh, New Age Interna

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In Pursuit of Excellence	**Syllabus Adopted by the Program**	SESSION-2019-2020
		SEM-VII

Syllabus

Theory of Automata and Formal Languages (KCS402)

Unit I

Review: Set Theory

Basic Concepts and Automata Theory: Introduction to Theory of Computation- Automata, Computability and Complexity, Alphabet, Symbol, String, Formal Languages, Deterministic Finite Automaton (DFA)-Definition, Representation, Acceptability of a String and Language, Non Deterministic Finite Automaton (NFA), Equivalence of DFA and NFA, NFA with ε-Transition, Equivalence of NFA's with and without ε-Transition, Finite Automata with output- Moore Machine, Mealy Machine, Equivalence of Moore and Mealy Machine, Minimization of Finite Automata, Myhill-Nerode Theorem, Simulation of DFA and NFA

UNIT-II

Regular Expressions and Languages: Regular Expressions, Transition Graph, Kleen's Theorem, Finite Automata and Regular Expression- Arden's theorem, Algebraic Method Using Arden's Theorem, Regular and Non-Regular Languages- Closure properties of Regular Languages, Pigeonhole Principle, Pumping Lemma, Application of Pumping Lemma, Decidability- Decision properties, Finite Automata and Regular Languages, Regular Languages and Computers, Simulation of Transition Graph and Regular language.

Beyond: JFALP Simulator

UNIT-III

Review:

Regular and Non-Regular Grammars: Context Free Grammar(CFG)-Definition, Derivations, Languages, Derivation Trees and Ambiguity, Regular Grammars-Right Linear and Left Linear grammars, Conversion of FA into CFG and Regular grammar into FA, Simplification of CFG, Normal Forms- Chomsky Normal Form(CNF), Greibach Normal Form (GNF), Chomsky Hierarchy, Programming problems based on the properties of CFGs.

Beyond: CFG using JFALP Simulator

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UNIT-IV

Push Down Automata and Properties of Context Free Languages: Nondeterministic Pushdown Automata (NPDA)- Definition, Moves, A Language Accepted by NPDA, Deterministic Pushdown Automata(DPDA) and Deterministic Context free Languages(DCFL), Pushdown Automata for Context Free Languages, Context Free grammars for Pushdown Automata, Two stack Pushdown Automata, Pumping Lemma for CFL, Closure properties of CFL, Decision Problems of CFL, Programming problems based on the properties of CFLs.

Beyond: Simulation of PDA using JFLAP

UNIT-V

Turing Machines and Recursive Function Theory : Basic Turing Machine Model, Representation of Turing Machines, Language Acceptability of Turing Machines, Techniques for Turing Machine Construction, Modifications of Turing Machine, Turing Machine as Computer of Integer Functions, Universal Turing machine, Linear Bounded Automata, Church's Thesis, Recursive and Recursively Enumerable language, Halting Problem, Post's Correspondence Problem, Introduction to Recursive Function Theory.

Beyond: Simulation of Turing Machine using JFLAP

Text books:

1. Introduction to Automata theory, Languages and Computation, J.E.Hopcraft, R.Motwani, and Ullman. 2nd edition, Pearson Education Asia
2. Introduction to languages and the theory of computation, J Martin, 3rd Edition, Tata McGraw Hill
3. Elements and Theory of Computation, C Papadimitrou and C. L. Lewis, PHI
4. Mathematical Foundation of Computer Science, Y.N.Singh, New Age Interna

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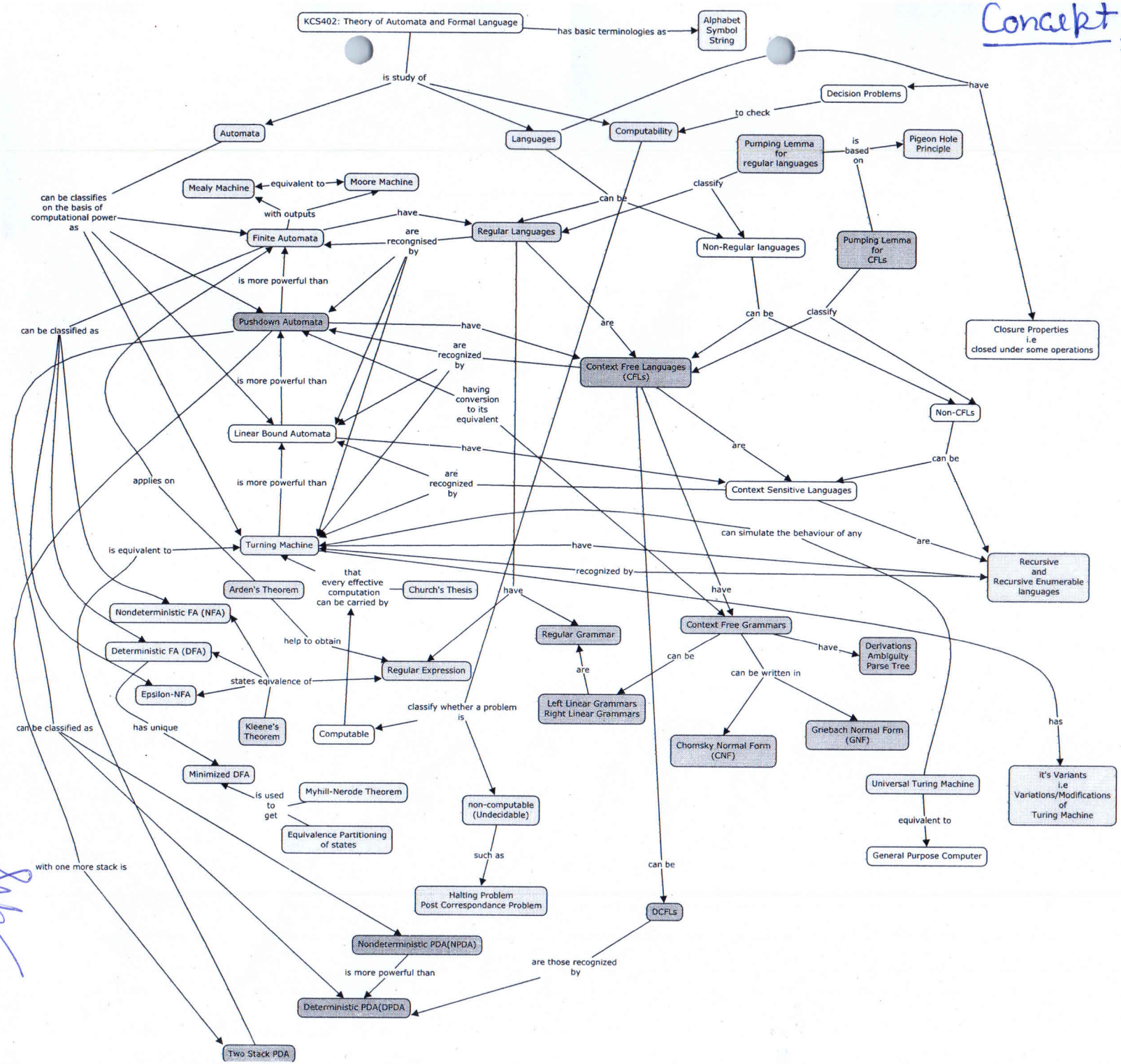
Concept Map



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In Pursuit of Excellence	Course Outcomes	SESSION-2019-2020
		SEM- IV

Course Objectives

The objective of the course is:

1. To introduce the concepts of Automata Theory and Formal Languages, Finite Automaton, Regular Expression and Regular Languages along with its relationship with Finite Automaton.
2. To explain the Context Free Grammars, Context Free Languages and Pushdown Automaton and its relation with Context Free Language
3. To introduce the concepts of Turing Machine and its variants and show the Post Correspondence Problem

Course Outcomes

Upon successful completion of this course student will be able to

1. Design Finite Automata (NFA,DFA, ε-NFA, Minimized DFA) from given Language/ equivalent FA.
2. Obtain Regular Expression from FA using Arden's Theorem and FA from regular expression using Kleene's Theorem
3. Construct Context free Grammar (CFG, Unambiguous CFG, Simplified CFG, CFG in Normal Form) from Equivalent CFG/ given language/FA.
4. Design Pushdown Automata (NPDA, DPDA) for given language/CFG/FA.
5. Design Turing Machine for given language/computation function and Test decidability using Turing Machine.

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In Pursuit of Excellence	**Course Delivery Method**	SESSION-2019-2020
		SEM- IV

Name of Subject: TAFL **Subject Code**: KCS-402

Branch: Computer Science & Engineering

Course Coverage Plan:

Unit 1 by: - Chalk & Talk, Tutorials, and Assignment.

Unit 2 by: - Chalk & Talk, Power Point Presentation, Tutorials, Video Lectures and Assignments

Unit 3 by: - Video Lectures, Tutorials, Assignment, Quiz.

Unit 4 by: - Power Point Presentation, Video Lectures, Tutorials, and Assignment, Quiz.

Unit 5 by: - Power Point Presentation, Video Lectures, Tutorials, and Assignment, Quiz.

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In Pursuit of Excellence	Mapping	SESSION-2019-2020
		SEM-IV

Mapping of Course Outcomes with POs & PSOs:

Sr. No	Course Outcome	PO1	PO 2	PO3	PO 4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O 2
1	CO 1	3	2	3									2	3	
2	CO 2	3		2										3	
3	CO 3	3		2										3	
4	CO 4	3	2	3									2	3	
5	CO 5	3	2	3									2	3	

*3= High *2= Medium *1=Low

Course Outcomes

Upon successful completion of this course student will be able to

1. Design Finite Automata (NFA,DFA, ε-NFA, Minimized DFA) from given Language/ equivalent FA.
2. Obtain Regular Expression from FA using Arden's Theorem and FA from regular expression using Kleene's Theorem
3. Construct Context free Grammar (CFG, Unambiguous CFG, Simplified CFG, CFG in Normal Form) from Equivalent CFG/ given language/FA.
4. Design Pushdown Automata (NPDA, DPDA) for given language/CFG/FA.
5. Design Turing Machine for given language/computation function and Test decidability using Turing Machine.

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In Pursuit of Excellence	**Time Table**	SESSION-2019-2020
		SEM- VII

Day	I	II	III	IV	V	VI	VII
MON							**KCS-402 (T)**
TUE	**KCS-402 (L)**						
WED			**KCS-402 (L)**				
THU						**KCS-402 (T)**	**KCS-402 (T)**
FRI					**KCS-402 (L)**		
SAT	**KCS-402 (L)**						

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In Pursuit of Excellence	**Lecture Plan & Course Coverage**	SESSION-2019-2020
		SEM-IV

Sr. No.	No. of Periods	Topics/Sub Topics	Reference Books	CO Covered	Planned Date	Coverage Date	Sign
UNIT-I: Introduction							
1	1	Set Theory **(Beyond),**	1,2,3	CO-1	21/01//2020	21/01/20	
2	1	Introduction; Alphabets, Strings and Languages		CO-1	22/01/2020	21/01/20 22/01/20	
3	1	Automata and Grammars		CO-1	24/01/2020	24/01/20	
4	1	Deterministic finite Automata (DFA)-Formal Definition		CO-1	25/01/2020	25/01/20	
5	1	Simplified notation: State transition graph, Transition table, Language of DFA,		CO-1	28/01/2020	27/01/20 28/01/20	
6	1	Nondeterministic finite Automata (NFA), ,		CO-1	29/01/2020	29/01/20	
7	1	NFA with epsilon transition, Language of NFA, Equivalence of NFA and DFA		CO-1	31/01/2020	31/01/20	
8	1	Minimization of Finite Automata,		CO-1	01/02/2020	03/02/20	
9	1	Myhill-Nerode Theorem		CO-1	4/02/2020	04/02/20	
UNIT-II: Regular Expressions and Languages							
10	1	Regular expression (RE), Definition,	1,2,3	CO-2	5/02/2020	5/02/20	
11	1	Operators of regular expression and their precedence		CO-2	7/02/2020	7/02/20	
12	1	Algebraic laws for Regular expressions,		CO-2	8/02/2020	8/02/20	
13	2	Kleen's Theorem, Regular expression to FA, DFA to Regular expression,		CO-2	11/02/2020 12/02/2020	11/02/20 12/02/20	
14	1	Arden Theorem,		CO-2	14/02/2020	14/02/20	
15	1	Non Regular Languages, Pumping Lemma for regular Languages, Application of Pumping Lemma,		CO-2	15/02/2020	15/02/20	
16	1	Closure properties of Regular		CO-2	18/02/2020	15/02/20	

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		Languages, Decision properties of Regular Languages,				18/02/20	
17	1	Regular Languages and Computers,		CO-2	19/02/2020	22/02/20	
18	1	JFLAP: Introduction**(Beyond),** Simulation of Transition Graph and Regular language		CO-2	22/02/2020	28/02/20	
UNIT-III: Regular and Non-Regular Grammars							
19	1	Context free grammar (CFG) and Context Free Languages (CFL): Definition, Examples,	1,2,3	CO-3	28/02/2020	29/02/20	
20	1	Derivation, Derivation trees, Ambiguity in Grammar		CO-3	29/02/2020	03/03/20	
21	1	Regular Grammars-Right Linear and Left Linear grammars,		CO-3	3/03/2020	04/03/20	
22	1	Conversion of FA into CFG and Regular grammar into FA,		CO-3	4/03/2020	06/03/20	
23		Normal forms for CFGs: CNF and GNF,		CO-3	6/03/2020 7/03/2020	07/03/20 21/03/20	
24	1	Closure proper ties of CFLs, Decision Properties of CFLs: Emptiness		CO-3	13/03/2020	22/03/20	
25	1	Hierarchy, Programming problems based on the properties of CFGs.		CO-3	14/03/2020	23/03/20	
26	1	Simulation CFG through JFLAP **(Beyond)**		CO-3	24/03/2020	24/03/20 25/03/20	
UNIT-IV: Push Down Automata and Properties of Context Free Languages							
27	1	Nondeterministic Pushdown Automata (NPDA)- Definition, Moves, A Language Accepted by NPDA	1,2,3	CO-4	25/03/2020	26/03/20 27/03/20 28/03/20	
28	1	Deterministic Pushdown Automata(DPDA) and Deterministic Context free Languages(DCFL),		CO-4	27/03/2020	30/3/20 31/3/20	
29	1	Pushdown Automata for Context Free Languages		CO-4	28/03/2020	1/04/20	
30	1	Context Free grammars for Pushdown Automata		CO-4	31/03/2020	2/4/20 3/04/20	
31	1	Two stack Pushdown Automata, Pumping Lemma for CFL		CO-4	01/04/2020	6/04/20 7/04/20	
32	1	Closure properties of CFL, Decision Problems of CFL		CO-4	03/04/2020	8/04/20	

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33	1	Programming problems based on the properties of CFLs **Simulation of PDA using JFALP (Beyond)**		CO-4	4/04/2020	9|4|20 10|4|20 11|4|20	
UNIT-V: Turing Machines and Recursive Function Theory							
34	1	Basic Turing Machine Model, Representation of Turing Machines	1,2,3	CO-5	10/04/2020	12|4|20 15|4|20	
35	1	Language Acceptability of Turing Machines		CO-5	11/04/2020	16|4|20	
36	1	Techniques for Turing Machine Construction, Modifications of Turing Machine		CO-5	14/04/2020	17|4|20 18|4|20	
37	2	Turing Machine as Computer of Integer Functions, Universal Turing machine, Linear Bounded Automata		CO-5	15/04/2020 17/04/2020	20|4|20 21|4|20 22|4|20	
38	1	Church's Thesis, Recursive and Recursively Enumerable language		CO-5	18/04/2020	23|4|20 26|4|20	
39	1	Halting Problem		CO-5	21/04/2020	27|4|20	
40	1	Posts Correspondence Problem		CO-5	22/04/2020	1|5|20	
41	1	Introduction to Recursive Function Theory.		CO-5	24/04/2020	3|5|20	
42	1	Simulation of Turing Machine**(Beyond)**		CO-5	25/04/2020	4|5|20	
43	1	**Revision**		CO-5	27/04/2020	6|5|20	

References:

1. Hopcroft, Ullman, "Introduction to Automata Theory, Languages and Computation", Pearson Education.
2. KLP Mishra and N. Chandrasekaran, "Theory of Computer Science: Automata, Languages and Computation", PHI Learning Private Limited, Delhi India.
3. Peter Linz, "An Introduction to Formal Language and Automata", Narosa Publishing house.

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In Pursuit of Excellence	Tutorial 1	SESSION-2019-2020 SEM-IV

KCS402: Theory of Automata and Formal Languages

Sr. No.	No. of Periods	Topics/Sub Topics	Coverage Date Section C			Sign
			C1	C2	C3	
1.	1	Basic Concepts and Automata Theory Deterministic Finite Automaton (DFA)- Definition, Representation, Acceptability of a String and Language Non-Deterministic Finite Automaton (NFA)	30/01/20	30/01/20	03/02/20	

CO1

1. Define:
   - i) Alphabet, strings (words) and language.
   - ii) Kleene Closure (Kleene star)
   - iii) Positive closure.
   - iv) Regular expression.
2. Differentiate between NFA and DFA.
3. Give Application and limitations of FA.
4. Design a FA that accept strings containing exactly one 1 over alphabet {0, 1}.
5. Design a FA that accepts strings those have a double letter in them, over alphabet {a, b}.

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In Pursuit of Excellence	**Tutorial: 2**	SESSION-2019-2020 SEM-IV

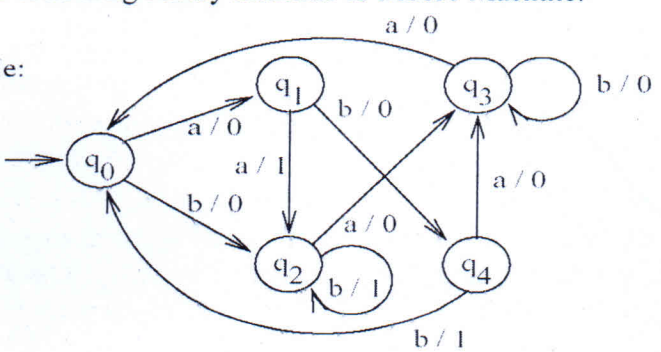
KCS402: Theory of Automata and Formal Languages

Sr. No.	No. of Periods	Topics/Sub Topics	Coverage Date Section C			Sign
			C1	C2	C3	
1.	1	Deterministic Finite Automaton (DFA), Non-Deterministic Finite Automaton (NFA), Equivalence of DFA and NFA, NFA with ε-Transition, Equivalence of NFA's with and without ε-Transition, Finite Automata with output- Moore Machine, Mealy Machine, Equivalence of Moore and Mealy Machine, Minimization of Finite Automata	15/02/20	13/02/20	17/02/20	

CO1

1. Construct a DFA that accepts ONLY that language L= $\{a^n b^m : n>1, m>=0\}$.
2. Design a DFA for $a(a+b)^* \cap (a+b)^*a$.
3. Design a DFA for Union of two languages
   L1: that have a double a.
   L2: Even – even
4. Design a DFA over {a, b} such that the set of string does not end with double letter.
5. Give DFA accepting the set of all strings with 3 consecutive 0's over the alphabet {a, b}.
6. Design an NFA for $(a+b)^*abb$. Convert NFA into DFA. Check whether it is minimal or not? If not, minimize it.
7. Design an FA for 0^*1^* with null move. Covert the FA into DFA without null moves.
8. Convert the following Mealy machine to Moore Machine.

Me:



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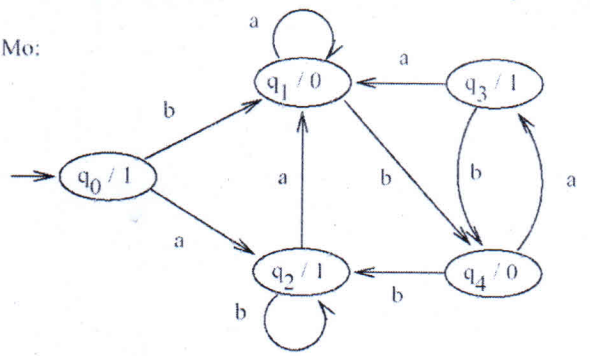
9. Convert the following Moore Machine into Mealy machine

Mo:



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In Pursuit of Excellence	**Tutorial: 3**	SESSION-2019-2020 SEM-IV

KCS402: Theory of Automata and Formal Languages

Sr. No.	No. of Periods	Topics/Sub Topics	Coverage Date Section C			Sign
			C1	C2	C3	
1.	1	Regular Expressions and Languages: Regular Expressions, Algebraic Method, Closure properties of Regular Languages, Decidability- Decision properties	27/02/20	27/02/20	03/03/20	

CO2

1. Find the language for following regular expressions:
   i) a^* , a^+ , aa
   ii) $(ab)^*$, a^*b^*
   iii) $(a+c)b^*$
2. Find the regular expression for language L = {All the words over alphabet $\sum$ = {a, b} that begin with a and end with b}.
3. Find the regular expression for Language L = $\{x^{odd}\}$
4. Find the regular expression for Language over alphabet $\sum$ = {a, b} that contain at least one a.
5. Find the regular expression for Language over alphabet $\sum$ = {a, b} that contain exactly one a.
6. Find the regular expression for Language over alphabet $\sum$ = {a, b} that contain double letter.
7. Find the regular expression for Even –Even language.
8. Find the regular expression for Language that accepts all strings that have an even number of a's and an odd number of b's.
9. Write the regular expression for the language L = $\{a^nb^m$: (n+m) is even }.
10. Explain Algebraic laws for regular expression.
11. Explain Closure properties of regular languages.
12. Explain Decision properties of regular languages.
13. Write the regular expression for the language L = { w : |w| mod 3 = 0 }, w ε $(a, b)^*$.
14. Write the regular expression for the language L = $\{a^n : n \geq 0, n \neq 3\}$.
15. Write the regular expression for the language L = $\{a^{2n} : n \geq 1\}$.
16. Write the regular expression for the language L= $\{a^nb^m : n \geq 1, m \geq 1, nm \geq 3\}$.
17. Prove that $(1 + 00^*1) + (1 + 00^*1)(0 + 10^*1)^*(0 + 10^*1) = 0^*1(0 + 10^*1)^*$
18. State and Prove Arden's theorem.

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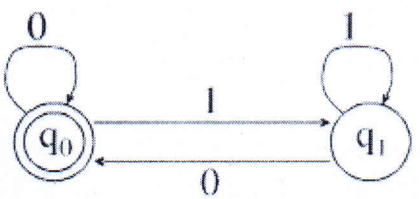
In Pursuit of Excellence	**Tutorial: 4**	SESSION-2019-2020 SEM-IV

KCS402: Theory of Automata and Formal Languages

Sr. No.	No. of Periods	Topics/Sub Topics	Coverage Date Section C			Sign
			C1	C2	C3	
1.	1	Finite Automata and Regular Expression- Arden's theorem Pigeonhole Principle, Pumping Lemma, Application of Pumping Lemma	5/03/20	5/03/20	7/03/20	

CO2

1. Find out whether the language $L = a^n b a^n \; n \geq 0$ is regular or not.
2. Find out whether the language $L = 0^n 1^m : n \leq m$ is regular or not.
3. Find out whether the language $L = 0^n 1 : n \geq 1$ is regular or not.
4. Find out whether the language $L = a^n b^n : n \geq 1$ is regular or not.
5. Find out whether the language $L = ww^R$: w is in $(a+b)^*$ is regular or not.
6. Find out whether the language $L = a^p$: p is a prime no, is regular or not.
7. Find out whether the language $L = a^{2n} : n \geq 1$ is regular or not.
8. Find the regular expression for following FA.



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In Pursuit of Excellence	**Tutorial:5**	SESSION-2019-2020 SEM-IV

KCS402: Theory of Automata and Formal Languages

Sr. No.	No. of Periods	Topics/Sub Topics	Coverage Date Section C			Sign
			C1	C2	C3	
1.	1	Context Free Grammar (CFG)-Definition, Languages	26/03/20	26/03/20	26/09/20	

CO3

1. Obtain a CFG for language L = { wcw^R : w ε (a, b)*}
2. Obtain a CFG for language L = {ww^R : w ε (a, b)* }
3. Obtain a CFG for language L = {a^nb^n : n ≥1}
4. Obtain a CFG for language L = {0^n10^n1 : n ≥1}
5. Write a CFG for following regular expressions
   a. r = a^*
   b. r = a^+
   c. r = $(a+b)^*$
   d. r = $0^*1(0+1)^*$
   e. Even – Even language
   f. Odd Palindrome
   g. Balanced parenthesis
   h. r = $(a+b)^*$ aa$(a+b)^*$
   i. Equal number of a's and b's
6. Design a CFG for language L = { a^nb^m : n ≠ m}.
7. Design a CFG for language L = { $a^{2n}b^m$: n>0 ,m ≥0}
8. Design a CFG for language L = { a^nb^m : (n + m) is even}.
9. Design a CFG for language L = { $a^nb^{2n}c^m$: n ,m ≥0}
10. Design a CFG for language L = {$0^i1^j2^k$: i = j or j = k}

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In Pursuit of Excellence	**Tutorial:6**	SESSION-2019-2020 SEM-IV

KCS402: Theory of Automata and Formal Languages

Sr. No.	No. of Periods	Topics/Sub Topics	Coverage Date Section C			Sign
			C1	C2	C3	
1.	1	Context Free Grammar (CFG)-Definition, Languages, Derivations, Derivation Trees and Ambiguity, Simplification of CFG, Normal Forms- Chomsky Normal Form (CNF), Greibach Normal Form (GNF), Regular Grammars	02/04/20	02/04/20	02/04/20	

CO3

1. Design a CFG for language L = $\{ab(bbaa)^n bba(ba)^n : n \geq 0\}$.
2. Consider the CFG
   S → bB | aA
   A → b | bS | aAA
   B → a | aS | bBB
   For the string bbaababa find
   a. Left most derivation
   b. Rightmost derivation and
   c. Parse tree.
3. If CFG is S → SbS | a , Show that G is ambiguous.
4. Find the reduced grammar that is equivalent to the CFG
   S → aC | SB
   A → bSCa
   B → aSB | bBC
   C → aBC | ad
5. Consider the context free grammar G
   S → AB
   A → a
   B → C | b
   C → D
   D → E
   E → a
   Remove the unit production.

6. Consider the following grammar G

$S \rightarrow ABAC$

$A \rightarrow aA \mid \varepsilon$

$B \rightarrow bB \mid \varepsilon$

$C \rightarrow c$

remove the ε – production from the above grammar.

7. Change the following grammars in to CNF

   a. $S \rightarrow 1A \mid 0B$

   $A \rightarrow 1AA \mid 0S \mid 0$

   $B \rightarrow 0BB \mid 1$

   b. $L = \{ a^{4n} : n \geq 1\}$

8. Convert the following grammars into GNF

   a. $S \rightarrow AB$

   $A \rightarrow BS \mid a$

   $B \rightarrow SA \mid b$

   b. $S \rightarrow XA \mid BB$

   $B \rightarrow b \mid SB$

   $X \rightarrow b$

   $A \rightarrow a.$

9. Consider the following CFG

   $S \rightarrow aA \mid bB$

   $A \rightarrow aS \mid a$

   $B \rightarrow bS \mid b$

Show that the grammar is regular.

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In Pursuit of Excellence	Tutorial:7	SESSION-2019-2020 SEM-IV

KCS402: Theory of Automata and Formal Languages

Sr. No.	No. of Periods	Topics/Sub Topics	Coverage Date Section C			Sign
			C1	C2	C3	
1.	1	Nondeterministic Pushdown Automata (NPDA), Deterministic Pushdown Automata(DPDA)	9/04/20	9/04/20	9/04/20	

CO4

1. Design a PDA which accepts the language $\{a^n b^n \mid n>0\}$.
2. Design a PDA which accepts the language wcw^R.
3. Design a PDA which accepts the language ww^R.
4. Design a PDA which accepts the language $\{a^n b^{2n} \mid n>0\}$.
5. Design a PDA for $L = \{ a^i b^j c^k \mid i = j \text{ or } j = k \}$.
6. Design a PDA for $L = \{ a^i b^j \mid i >=0, j>0 \}$.
7. Design a PDA for Language that accepts strings that contain aa over {a, b}.
8. Design a PDA for language that has the equal number of a's and b's.

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In Pursuit of Excellence	**Tutorial:8**	SESSION-2019-2020 SEM-IV

KCS402: Theory of Automata and Formal Languages

Sr. No.	No. of Periods	Topics/Sub Topics	Coverage Date Section C			Sign
			C1	C2	C3	
1.	1	Nondeterministic Pushdown Automata (NPDA), Deterministic Pushdown Automata(DPDA), Pushdown Automata for Context Free Languages, Context Free grammars for Pushdown Automata	16/04/20	16/04/20	16/04/20	

CO4

1. Design a PDA for language $\{a^n b^m , n \neq m\}$.
2. Design a PDA for the grammar G = { Vn, Vt, P, S }
   Vn = {s}
   Vt = {a, b, c}
   and P is defined as
   $S \rightarrow aSa$
   $S \rightarrow bSb$
   $S \rightarrow c$.
3. Convert the following CFG into PDA
   $S \rightarrow aSbb \mid abb$
4. Convert PDA to CFG. PDA is given by P = ({p,q}, {0,1}, {X,Z}, δ, q, Z), Transition function δ is defined by:

   $\delta(q, 1, Z) = \{(q, XZ)\}$
   $\delta(q, 1, X) = \{(q, XX)\}$
   $\delta(q, \varepsilon, X) = \{(q, \varepsilon)\}$
   $\delta(q, 0, X) = \{(p, X)\}$
   $\delta(p, 1, X) = \{(p, \varepsilon)\}$
   $\delta(p, 0, Z) = \{(q, Z)\}$

5. Convert to PDA , CFG with production
   $S \rightarrow SS \mid (S) \mid \varepsilon$

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6. Construct the corresponding CGF accepting the PDA

$\partial(q_o , a , Z_0) = (q_0 , aZ_0)$
$\partial(q_o , a , a) = (q_0 , aa)$
$\partial(q_o , b , a) = (q_1 , a)$
$\partial(q_1 , b , a) = (q_1 , a)$
$\partial(q_1 , a , a) = (q_1 , \varepsilon)$
$\partial(q_1 , \varepsilon , Z_0) = (q_f , \varepsilon)$

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In Pursuit of Excellence	Tutorial:9	SESSION-2019-2020 SEM-IV

KCS402: Theory of Automata and Formal Languages

Sr. No.	No. of Periods	Topics/Sub Topics	Coverage Date Section C			Sign
			C1	C2	C3	
1.	1	Basic Turing Machine Model, Representation of Turing Machines, Language Acceptability of Turing Machines	23/04/20	23/04/20	23/04/20	

CO5

1. Construct a Turing Machine for $\{a^n b^n \mid n>0\}$.
2. Construct a Turing Machine for $\{a^n b^n c^n \mid n>0\}$.
3. Construct a Turing Machine for $\{a^n b^n a^n \mid n>0\}$.
4. Construct Turing Machine for Even Palindrome.
5. Construct Turing Machine for Odd Palindrome.
6. Construct Turing Machine for General Palindrome.
7. Construct Turing Machine for Even – Even Language.
8. Construct a Turing machine to copy string over {a, b}. (i.e. Implement f(w) = w#w) .
9. Construct a Turing machine to copy reverse string over {a,b}. (i.e.Implement f(w) = $w\#w^R$).

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In Pursuit of Excellence	**Tutorial:10**	SESSION-2019-2020 SEM-IV

KCS402: Theory of Automata and Formal Languages

Sr. No.	No. of Periods	Topics/Sub Topics	Coverage Date Section C			Sign
			C1	C2	C3	
1.	1	Turing Machine as Computer of Integer Functions, Universal Turing machine, Church's Thesis, Recursive and Recursively Enumerable language	01/05/20	01/05/20	01/05/20	

CO5

1. Construct a Turing machine for f(x,y) = x - y . (i.e. $0^m - 0^n = 0^{m-n}$)
2. Construct a Turing machine for f(x,y) = x + y . (i.e. $0^m + 0^n = 0^{m+n}$)
3. Explain the Universal Turing Machine
4. Explain the Church Thesis.
5. Explain Recursive and recursively enumerable language.
6. Prove "If L is a recursive language over $\sum$ show that L'(L' is define as $\sum$ - L) is also recursive".
7. Prove "If L and L' (complement of L) are both recursively enumerable. Show that L and L' are recursive".
8. Prove "Show that the Union of two recursively enumerable languages is recursively enumerable and Union of two recursive languages is recursive".

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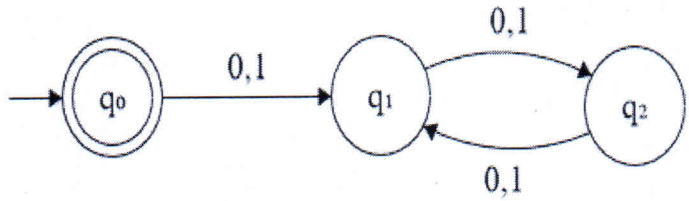
In Pursuit of Excellence	**Assignments:1**	SESSION-2019-2020
		SEM-IV

1. Define the language of the following finite automaton. CO-1



2. Write the steps for minimizing the states in a DFA. Minimize the number of states in the following DFA : CO-1

Present State	Next State	
	Input 0	Input 1
→q_0	q_1	q_3
q_1	q_0	q_3
q_2	q_1	q_4
q_3	q_5	q_5
q_4	q_3	q_3
q_5	q_5	q_5

Given that q3 and q5 are final states.

3. Define Mealy machine. Convert the following Moore machine into equivalent Mealy Machine: CO-1

Present State	**Next State**		**Output**
	Input 0	**Input 1**	
→q_0	q_0	q_1	Y
q_1	q_2	q_3	N
q_2	q_4	q_0	N
q_3	q_1	q_2	N
q_4	q_3	q_4	N

4. Convert following Mealy machine into equivalent Moore machine : CO-1

Present State	Next State			
	a = 0	output	a=1	output
→q_1	q_4	0	q_2	1
q_2	q_2	1	q_3	0
q_3	q_3	0	q_4	0
q_4	q_4	0	q_1	0

5. Design a Mealy machine that calculate residue mod 3 for binary strings. CO-1

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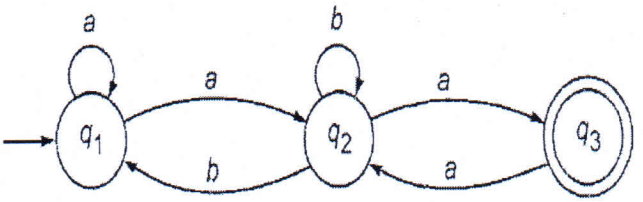
In Pursuit of Excellence	**Assignments:2**	SESSION-2019-2020
		SEM-IV

1. Construct a finite automata equivalent to given regular expression CO-2
   (0+1)*(00+11)(0+1)*
2. Write regular expression for given language CO-2
   (a) The set of all strings containing exactly 2 **a**'s.
   (b) The set of all strings containing at most 2 **a** s.
   (c) The set of strings containing the substring **aa**.
3. Find the regular expression for given automata by using Arden's Theorem CO-2



4. Show that the following language is not regular by using Pumping Leema CO-2

   a. $L=\{a^p \mid p \text{ is a prime number}\}$
   b. $L = \{a^i b^j c^k \mid k > i + j\}$
   c. $L= \{a''b^n \mid n> 0\};$

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In Pursuit of Excellence	**Assignments:3**	SESSION-2019-2020
		SEM-IV

Q1. Construct the grammar for the following languages CO- 3

a) $L=\{a^n cb^m \mid n, m>0\}$
b) $L=\{wcw^R \mid w\epsilon(a, b)^*\}$

Q2. Remover the useless productions from given grammar CO-3

S -> abS | abA | abB
A -> cd
B -> aB
C -> dc

Q3: Remove Unit Production from given grammar CO-3

S -> Aa | B
A -> b | B
B -> A | a

Q4. Remove the Null production from given grammar CO-3

S -> ABCd
A -> BC
B -> bB | λ
C -> cC | λ

Q5. Convert the given CFG to CNF. CO-3

S → a | aA | B
A → aBB | ε
B → Aa | b

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In Pursuit of Excellence	**Assignments:4**	SESSION-2019-2020
		SEM-IV

Q1. What is Pushdown Automata (PDA)? Explain which type of Language is accepted by PDA. CO-4

Q2. Design a PDA which accepting the language CO-4

$$L = \{WcW^R \mid W \in (a,b)^*\}.$$

Q3. Design a PDA which accepting $L=\{0^{n+1}1^n|n>0\}$. CO-4

Q4. NPDA for accepting the language $L = \{a^n b^m c^n \mid m, n>=1\}$ CO-4

Q5. Construct Pushdown automata for $L = \{0^n1^m2^m3^n \mid m, n \geq 0\}$ CO-4

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In Pursuit of Excellence	**Assignments: 5**	SESSION-2019-2020 SEM-IV

Q1. Construct a Turing Machine for language L = {ww^r| w ∈ {0, 1}} CO-5

Q2. Construct a Turing Machine for language L = {$0^n1^n2^n$ | n≥1} CO-5

Q.3: Design a Turing Machine which perform addition and subtraction of two numbers. CO-5

Q.4: Write short notes on following topics with example: CO-5

a) Universal Turing Machine
b) Church's Thesis
c) Recursive and Recursively Enumerable Language
d) Halting Problem of Turing Machine

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In Pursuit of Excellence	**List of Students**	SESSION-2019-2020 SEM-IV

S.No.	Roll No.	Name of Students
1.	1808210131	SANKALP GUPTA
2.	1808210132	SANSKRITI AGARWAL
3.	1808210133	SARTHAK SAXENA
4.	1808210134	SATAKSHI
5.	1808210135	SAURABH KUMAR
6.	1808210136	SAYYDUL MILLAT
7.	1808210137	SHAZAR ZAIDI
8.	1808210138	SHIVANI TYAGI
9.	1808210139	SHIVANSH MATHUR
10.	1808210140	SHIVANSH AGARWAL
11.	1808210141	SHIVANSHU AGARWAL
12.	1808210142	SHREY RUHELA
13.	1808210143	SHREYA CHAUHAN
14.	1808210144	SHUBH BHATNAGAR
15.	1808210146	SHUBHAM YADAV
16.	1808210147	SHUBHIKA SINGH
17.	1808210148	SOURABH SAINI
18.	1808210149	SPARSH RASTOGI
19.	1808210150	SRIJAN PANDEY
20.	1808210151	SUFIYA
21.	1808210152	SUHAIL AHMED
22.	1808210153	SUKRITI SINGH
23.	1808210154	SUMIT KUMAR
24.	1808210155	SUSHANT KUMAR
25.	1808210156	SUSHANT SINGH
26.	1808210157	TANVEER ALAM
27.	1808210158	UDIT RAJPUT
28.	1808210159	UMANG MATHUR
29.	1808210160	UNNATI GANGWAR
30.	1808210161	UNNATI SINGH
31.	1808210162	UTKARSH GUPTA
32.	1808210164	VASU GOEL

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33.	1808210165	VASUNDHRA GUPTA
34.	1808210166	VEDIKA AGARWAL
35.	1808210167	VINAYAK VARSHNEY
36.	1808210168	VIRENDRA MOHAN
37.	1808210170	VISHAL TYAGI
38.	1808210171	YASH AGARWAL
39.	1808210172	ZAMAN ABBAS
40.	1900820109001	ANUJ SHARMA
41.	1900820109002	HADIYA KHALEEQ
42.	1900820109003	SATYAM RASTOGI
43.	1900820109004	UDIT
44.	1900820108001	VISHAL SAINI
45.	1900820109005	ZAREEN AQIQ

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In Pursuit of Excellence	**Record of Monthly Attendance**	SESSION-2019-2020 SEM-IV

S.No.	Roll No.	Name of Students	January 2020	February 2020	March 2020	April and May 2020
			Held(9)	Held (15)	Held (14)	Held (23)
1.	1808210131	SANKALP GUPTA	9	15	12	22
2.	1808210132	SANSKRITI AGARWAL	6	11	11	21
3.	1808210133	SARTHAK SAXENA	6	12	12	22
4.	1808210134	SATAKSHI	5	10	11	21
5.	1808210135	SAURABH KUMAR	8	14	10	21
6.	1808210136	SAYYDUL MILLAT	8	12	11	22
7.	1808210137	SHAZAR ZAIDI	7	14	10	21
8.	1808210138	SHIVANI TYAGI	8	12	13	18
9.	1808210139	SHIVANSH MATHUR	4	13	11	21
10.	1808210140	SHIVANSH AGARWAL	8	15	12	22
11.	1808210141	SHIVANSHU AGARWAL	6	10	14	20
12.	1808210142	SHREY RUHELA	8	15	12	20
13.	1808210143	SHREYA CHAUHAN	6	12	12	18
14.	1808210144	SHUBH BHATNAGAR	8	11	11	21
15.	1808210146	SHUBHAM YADAV	4	12	12	19
16.	1808210147	SHUBHIKA SINGH	7	11	11	22
17.	1808210148	SOURABH SAINI	7	9	13	21
18.	1808210149	SPARSH RASTOGI	7	10	12	21
19.	1808210150	SRIJAN PANDEY	5	9	12	20
20.	1808210151	SUFIYA	5	13	7	22
21.	1808210152	SUHAIL AHMED	4	12	13	20
22.	1808210153	SUKRITI SINGH	7	14	13	20
23.	1808210154	SUMIT KUMAR	8	14	12	20
24.	1808210155	SUSHANT KUMAR	6	12	9	20
25.	1808210156	SUSHANT SINGH	6	10	14	20
26.	1808210157	TANVEER ALAM	4	10	11	21
27.	1808210158	UDIT RAJPUT	6	11	11	21
28.	1808210159	UMANG MATHUR	3	11	12	20
29.	1808210160	UNNATI GANGWAR	8	13	13	20
30.	1808210161	UNNATI SINGH	5	14	12	20
31.	1808210162	UTKARSH GUPTA	6	11	13	21

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32.	1808210164	VASU GOEL	4	15	9	21
33.	1808210165	VASUNDHRA GUPTA	7	10	13	21
34.	1808210166	VEDIKA AGARWAL	7	15	13	21
35.	1808210167	VINAYAK VARSHNEY	9	12	13	22
36.	1808210168	VIRENDRA MOHAN	5	14	10	22
37.	1808210170	VISHAL TYAGI	5	15	12	21
38.	1808210171	YASH AGARWAL	7	9	12	21
39.	1808210172	ZAMAN ABBAS	4	13	11	21
40.	1900820109001	ANUJ SHARMA	8	13	12	22
41.	1900820109002	HADIYA KHALEEQ	5	13	14	22
42.	1900820109003	SATYAM RASTOGI	7	13	13	21
43.	1900820109004	UDIT	5	13	12	23
44.	1900820108001	VISHAL SAINI	8	13	13	19
45.	1900820109005	ZAREEN AQIQ	8	9	13	22

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In Pursuit of Excellence	Class Test Paper and Solutions	SESSION-2019-2020
		SEM-IV

MORADABAD INSTITUTE OF TECHNOLOGY
DEPTT. NAME: COMPUTER SCIENCE AND ENGINEERING
SESSIONAL TEST-1

Course: B.Tech.
Session: 2019-20
Subject: TAFL
Max. Marks: 15

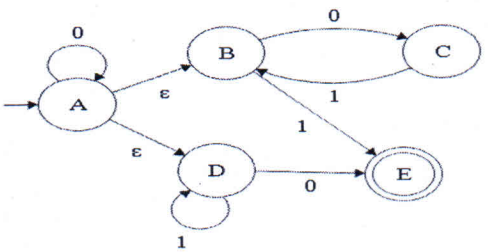
Semester: 4TH
Section: A/B/C
Subject Code: KCS-402
Time: 01Hr 15 Min.

Q. No. :	1	2	3	4	5	6
CO No. :	1	1	1	1	1	2

Section A (6 Marks)

Q1. i. Define Alphabet, String and Language. 02 Marks
ii. Differentiate between NFA and DFA.

Q2.Convert the given NFA into DFA 02 Marks



Q3. Convert the Mealy machine to equivalent Moore machine 02 Marks

Present State	Next State			
	a = 0	output	a=1	output
→q_1	q_4	0	q_2	0
q_2	q_2	1	q_3	1
q_3	q_3	0	q_4	0
q_4	q_4	0	q_1	0

Section B (9 Mark)

Q4. Design the DFA for following languages over the alphabet {a, b}. 03 Marks
i. Language of all strings containing either **aaa** or **bbb** in them.
ii. Language of all strings containing even number of **a's** and odd number of **b's**.
iii. Language of all strings in which fourth symbol is **a**.

Q5. Minimize the following DFA having state q2 as final state: 03 Marks

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Present State	Next State	
	Input 0	Input 1
$\rightarrow q_0$	q_1	q_5
q_1	q_6	q_2
q_2	q_0	q_2
q_3	q_2	q_6
q_4	q_7	q_5
q_5	q_2	q_6
q_6	q_6	q_4
q_7	q_6	q_2

Q6. Construct a regular expression for given languages over the alphabet {a, b}. 03 Marks

i. Language of all words of length **4**

ii. Language of all words starting with **ab** and ending with **bba**.

iii. Language of all the strings that contains at least one **a** and at least one **b**.

CT-1 Solution

SOLUTION CT-1 KCS-402 2019-20 (1/2)

Ans-1 (i) Alphabet : It is a finite, nonempty set of symbols. Conventionally, we use symbol Σ for an alphabet.

ex: $\Sigma = \{0,1\}$ the binary alphabet

String : It is a finite sequence of symbols chosen from some alphabet.

ex: 01001 is an string over the alphabet $\{0,1\}$

Language: It is defined as a set of strings, all of which are chosen from some Σ^* where Σ is an alphabet.

ex: if $\Sigma = \{0,1\}$ and $L = \{\epsilon, 00, 01, 10, 11, 0000, \ldots\}$ then L is a language over Σ as $L \subseteq \Sigma^*$

Ans-1-(ii)

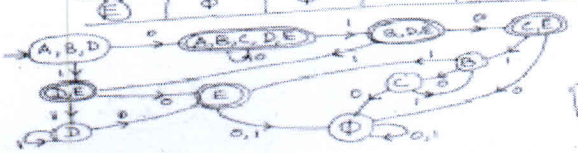
DFA	NFA
1. It is deterministic in nature.	1. It is non-deterministic in nature.
2. Transition function δ is defined as $\delta: Q \times \Sigma \rightarrow Q$	2. Transition function δ is defined as $\delta: Q \times \Sigma \rightarrow 2^Q$
3. Exactly one transition corresponding to each symbol in input alphabet will go out of each state.	3. There is no restriction on number of transitions going out from a state on a particular input symbol.
4. Each string over it will follow a unique path.	4. String may follow multiple paths through it.

Ans-2 State Table for NFA

State/Σ	0	1	ϵ	ECLOSE
$\rightarrow$ A	{A}	ϕ	{B,D}	{A,B,D}
B	{C}	{E}	ϕ	{B}
C	ϕ	{B}	ϕ	{C}
D	{E}	{D}	ϕ	{D}
(E)	ϕ	ϕ	ϕ	{E}

State Table of DFA

State/Σ	0	1
$\rightarrow$ [A,B,D]	[A,B,C,D,E]	[D, E]
[A,B,C,D,E]	[A,B,C,D,E]	[A,D,E]
[D,E]	[E]	[D]
[B,D,E]	[C,E]	[D,E]
(E)	[ϕ]	[ϕ]
[D]	[E]	[D]
(C,E)	[ϕ]	[B]
[ϕ]	[ϕ]	[ϕ]
[B]	[C]	[E]
[C]	[ϕ]	[B]



Resultant DFA

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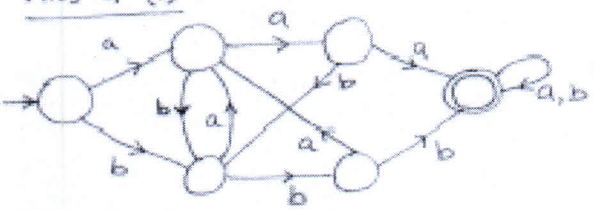
Ans-3 Mealy Machine state table

Present State	After 0		After 1	
	New State	Output	New State	Output
→ q_1	q_4	0	q_2	0
q_2	q_2	1	q_3	1
q_3	q_3	0	q_4	0
q_4	q_4	0	q_1	0

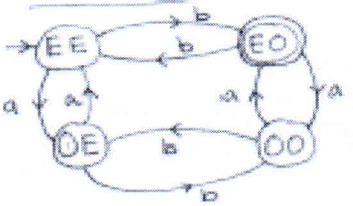
State Table for equivalent Moore machine

Present State	Output	New State	
		after 0	after 1
→ q_1	0	q_4	q_2^0
q_2^0	0	q_2^1	q_3^1
q_2^1	1	q_2^1	q_3^1
q_3^0	0	q_3^0	q_4
q_3^1	1	q_3^0	q_4
q_4	0	q_4	q_1

Ans-4-(i)

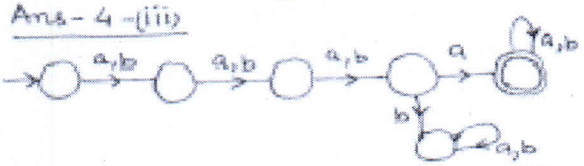


Ans-4-(ii) Four state



EE
EO
OE
OO
↑ no. of a's ↑ no. of b's

Ans-4-(iii)



Ans-5

Present State	Next State	
	Input 0	Input 1
→ q_0	q_1	q_5
q_1	q_6	q_2
q_2	q_0	q_2
q_3	q_2	q_6
q_4	q_7	q_5
q_5	q_2	q_6
q_6	q_6	q_4
q_7	q_6	q_2

State Table of minimized DFA

State/Σ	Input 0	Input 1
→ $[q_0, q_4]$	$[q_1, q_7]$	$[q_3, q_5]$
$[q_1, q_7]$	$[q_6]$	$[q_2]$
$[q_3, q_5]$	$[q_2]$	$[q_6]$
$[q_6]$	$[q_6]$	$[q_0, q_4]$
$[q_2]$	$[q_0, q_2]$	$[q_6]$

$\pi_0 = \{\{q_0, q_1, q_3, q_4, q_5, q_6, q_7\}, \{q_2\}\}$

$\pi_1 = \{\{q_0, q_4, q_6\}, \{q_1, q_7\}, \{q_3, q_5\}, \{q_2\}\}$

$\pi_2 = \{\{\{q_0, q_4\}, \{q_6\}, \{q_1, q_7\}, \{q_3, q_5\}, \{q_2\}\}$

$\pi_3 = \{\{\{q_0, q_4\}, \{q_6\}, \{q_1, q_7\}, \{q_3, q_5\}, \{q_2\}\}$

As $\pi_2 = \pi_3$ so π_2 gives final equivalence classes so we will create a state corresponding to each equivalence class

Ans-6

(i) $(a+b)^4$ or $(a+b)(a+b)(a+b)(a+b)$

(ii) $ab(a+b)^* bba + abba$

(iii) $(a+b)^* a (a+b)^* b (a+b)^*$
$+ (a+b)^* b (a+b)^* a (a+b)^*$

or

$aa^* b (a+b)^* + bb^* a (a+b)^*$

2/2

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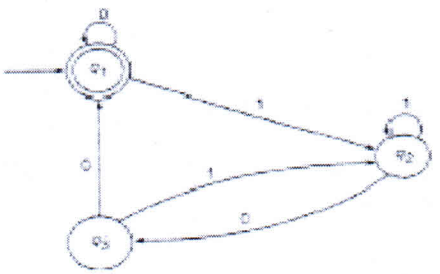
MORADABAD INSTITUTE OF TECHNOLOGY
DEPTT. NAME: COMPUTER SCIENCE AND ENGINEERING
SESSIONAL TEST-II

Course: B.Tech. **Semester: 4TH**
Session: 2019-20 **Section: A/B/C**
Subject: TAFL **Subject Code: KCS-402**
Max. Marks: 15 **Time: 01Hr 15 Min.**

Q. No. :	1	2	3	4	5	6
CO No. :	2	2	2	3	3	3

Section A

Q1. State Arden's Theorem. Obtain the regular expression for given automata by using Arden's Theorem. [3]



Q2. State pumping lemma for regular languages. Show that the following language L= {a^p | p is a prime number} is not regular. [3]

Q3. "Regular languages are closed under complement". Justify. [2]

Or

Prove that Regular languages are closed under Intersection operation.

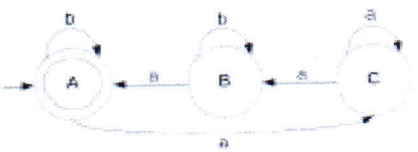
Section B

Q4. Construct the Context free grammar for the following languages. [1+1+1 =3]

i) L= {$a^n b^m$ | n + m is odd.}
ii) L= {wcw^R | w∈{a, b}*}
iii) L= {$a^i b^j c^k$ | i=j or j=k & i, j, k>=1}

Q5. Define Ambiguity. Show that G = ({S}, {a, b}, S, {S→SbS | SaS | Λ}) is ambiguous. [2]

Q6. State Right Linear and Left Linear grammars. Construct the grammar for the given finite automata [2]



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CT-2 Solution

Ans:

Initial state = q_1 = final state.

$q_1 = q_1 a + q_3 a + \varepsilon$

$q_2 = q_1 b + q_2 b + q_3 b$

$q_3 = q_2 a$

Solving the equations:

$q_2 = q_1 b + q_2 b + q_3 b$

$= q_1 b + q_2 b + (q_2 a) b$

$= q_1 b + q_2 (b + ab)$

$= q_1 b (b + ab)^*$

$q_1 = q_1 a + q_3 a + \varepsilon$

$= q_1 a + q_2 a a + \varepsilon$

$= q_1 a + q_1 b (b + ab) aa + \varepsilon$

$= q_1 (a + b (b + ab)^* aa) + \varepsilon$

$= \varepsilon (a + b (b + ab)^* aa)^*$

$= (a + b (b + ab)^* aa)^*$

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Therefore, the regular expression is

$(a + b(b + ab)^* aa)^*$

Arden's theorem:

"If P & Q are two R.E over Σ and if P does not contain ε, then the following equation in R given by $R = Q + RP$ has an unique solution i.e. $R = QP^*$."

Whenever, we get any equation in the form $R = Q + RP$, then, we can directly replaced by $R = QP^*$.

Ans 2: In this, a necessary condition for an input string to belong to a regular set the theorem is the pumping lemma. as it given as method of pumping many input strings from a given string. As pumping lemma gives a necessary condition, it can be used to show that certain sets are not regular.

Q: $L = \{a^p \mid p$ is a prime no.$\}$ is not regular language.

Let L is a regular language, having finite automata with p states.

$w = a^p$ where $|w| = p \geq p$

So, $w = xyz = a^p$ where, $|y| \neq 0$

and $|xy| \leq p$

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So, $\forall i \geq 0$, $xy^i z$ should belong to L.
Take $i = p+1$, $xy^{p+1} z$ should belong to L.
So, $|xy^{p+1} z|$ should be a prime number.

$$|xy^{p+1} z| = |xyz| + |y^p|$$
$$= p + p|y|$$
$$= p(1 + |y|)$$

It will never be a prime number.
$|y| \neq 0$.
So, $xy^{p+1} z \notin L$
So, L is a non-regular language.

Ans3. $L_1 \cap L_2 = \overline{\overline{L_1} \cup \overline{L_2}}$

Regular language are closed under complement so, $\overline{L_1}$ is a regular language and $\overline{L_2}$ is a regular language.
Regular language are also closed under with union so, $\overline{L_1} \cup \overline{L_2}$ is also regular.

Ans4. i) $L = \{ a^n b^m \mid n+m \text{ is odd} \}$.

$S = aAB \mid AbB$
$A = aaA \mid \wedge$.
$B = bbB \mid \wedge$.

iii) $L = \{ a^i b^j c^k \mid i = j \text{ or } j = k \text{ or } i, j, k >= 1 \}$.

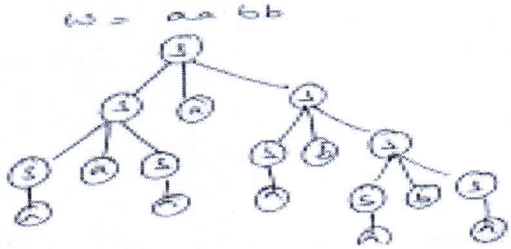
If $i = j \Rightarrow \underbrace{a^n b^n}_{X} \underbrace{c^*}_{C}$
If $j = k \Rightarrow \underbrace{a^*}_{A} \underbrace{b^n c^n}_{Y}$

$S \rightarrow XC \mid AY$
$X \rightarrow aXb \mid ab$
$C \rightarrow cC \mid c$
$A \rightarrow aA \mid a$
$Y \rightarrow bXc \mid bc$

ii) $L = \{ w c w^R \mid w \in (a,b)^* \}$.

Grammar will be
$G = (\{S\}, \{a, b, c\}, P, S)$
Productions :-
$S \rightarrow aSa \mid bSb \mid c$.

Ans5. A grammar is said to be ambiguous if there exist two or more derivation tree for a string w (that means there exist more left derivation trees)
$G = (\{S\}, \{a,b\}, S, \{S \rightarrow SbS \mid SaS \mid \wedge\})$
$w = aabb$



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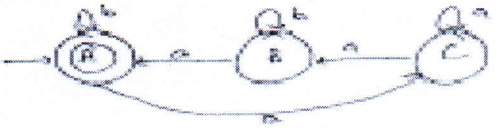
Ans:-



$A \rightarrow bA \mid aB \mid \epsilon$
$B \rightarrow bB \mid aC$
$C \rightarrow aC$

Hence, the context free grammar for given finite automata is

$A \rightarrow bA \mid aB \mid \epsilon$
$B \rightarrow bB \mid aC$
$C \rightarrow aC$

Right Linear Grammar : If all the productions rules are of the form:

Ex :- $A \rightarrow aB \mid bB$
$A \rightarrow a$

If terminal symbol are to the right of non-terminal symbol.

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In Pursuit of Excellence	**Class Test Attendance**	SESSION-2019-2020 SEM-IV

S.No.	Roll No.	Name of Students	CT-1	CT-2
			A/P	A/P
1.	1808210131	SANKALP GUPTA	P	P
2.	1808210132	SANSKRITI AGARWAL	A	P
3.	1808210133	SARTHAK SAXENA	A	P
4.	1808210134	SATAKSHI	A	P
5.	1808210135	SAURABH KUMAR	P	P
6.	1808210136	SAYYDUL MILLAT	A	P
7.	1808210137	SHAZAR ZAIDI	P	P
8.	1808210138	SHIVANI TYAGI	P	P
9.	1808210139	SHIVANSH MATHUR	A	P
10.	1808210140	SHIVANSH AGARWAL	P	P
11.	1808210141	SHIVANSHU AGARWAL	A	P
12.	1808210142	SHREY RUHELA	P	P
13.	1808210143	SHREYA CHAUHAN	A	P
14.	1808210144	SHUBH BHATNAGAR	P	P
15.	1808210146	SHUBHAM YADAV	A	P
16.	1808210147	SHUBHIKA SINGH	A	P
17.	1808210148	SOURABH SAINI	A	P
18.	1808210149	SPARSH RASTOGI	A	P
19.	1808210150	SRIJAN PANDEY	A	P
20.	1808210151	SUFIYA	P	P
21.	1808210152	SUHAIL AHMED	A	P
22.	1808210153	SUKRITI SINGH	A	P
23.	1808210154	SUMIT KUMAR	P	P
24.	1808210155	SUSHANT KUMAR	A	P
25.	1808210156	SUSHANT SINGH	A	P
26.	1808210157	TANVEER ALAM	P	P
27.	1808210158	UDIT RAJPUT	P	P
28.	1808210159	UMANG MATHUR	A	P
29.	1808210160	UNNATI GANGWAR	A	P
30.	1808210161	UNNATI SINGH	A	P
31.	1808210162	UTKARSH GUPTA	A	P
32.	1808210164	VASU GOEL	A	P

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33.	1808210165	VASUNDHRA GUPTA	P	P
34.	1808210166	VEDIKA AGARWAL	A	P
35.	1808210167	VINAYAK VARSHNEY	P	P
36.	1808210168	VIRENDRA MOHAN	A	P
37.	1808210170	VISHAL TYAGI	A	P
38.	1808210171	YASH AGARWAL	P	P
39.	1808210172	ZAMAN ABBAS	A	P
40.	1900820109001	ANUJ SHARMA	A	P
41.	1900820109002	HADIYA KHALEEQ	A	P
42.	1900820109003	SATYAM RASTOGI	P	P
43.	1900820109004	UDIT	A	P
44.	1900820108001	VISHAL SAINI	P	P
45.	1900820109005	ZAREEN AQIQ	A	P

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In Pursuit of Excellence	List of Student having Short Attendance	SESSION-2019-2020 SEM-IV

CT-1

S. No.	Roll No.	Name
1	1808210132	Sanskriti Agarwal
2	1808210134	Satakshi
3	1808210139	Shivansh Mathur
4	1808210146	Shubham Yadav
5	1808210148	Sourabh Saini
6	1808210149	Sparsh Rastogi
7	1808210150	Srijan Pandey
8	1808210152	Suhail Ahmed
9	1808210156	Sushant Singh
10	1808210159	Umang Mathur
11	1808210162	Utkarsh Gupta
12	1808210172	Zaman Abbas
13	1900820109004	UDIT
14	1900820109005	Zareen Aqiq

CT-2

NIL

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In Pursuit of Excellence	Class Test Marks	SESSION-2019-2020 SEM-IV

Class Test-1

S.No.	Roll No.	Name of Students	CO-1					CO-2	
			Q1(2)	Q2(2)	Q3(2)	Q4(3)	Q5(3)	Q6(3)	Total(15)
1.	1808210131	SANKALP GUPTA	2	1	2	2	1.5	1.5	10
2.	1808210132	SANSKRITI AGARWAL							0
3.	1808210133	SARTHAK SAXENA							0
4.	1808210134	SATAKSHI							0
5.	1808210135	SAURABH KUMAR	2		2	1			5
6.	1808210136	SAYYDUL MILLAT							0
7.	1808210137	SHAZAR ZAIDI	2	0	2	1	3	0	8
8.	1808210138	SHIVANI TYAGI	2	0	1.5	2	1	2	8.5
9.	1808210139	SHIVANSH MATHUR							0
10.	1808210140	SHIVANSH AGARWAL	2	1	1.5	3	3	1	11.5
11.	1808210141	SHIVANSHU AGARWAL							0
12.	1808210142	SHREY RUHELA	2		2	2	2	0	8
13.	1808210143	SHREYA CHAUHAN							0
14.	1808210144	SHUBH BHATNAGAR	2	1	1.5	1	0.5	1	7
15.	1808210146	SHUBHAM YADAV							0
16.	1808210147	SHUBHIKA SINGH							0
17.	1808210148	SOURABH SAINI							0
18.	1808210149	SPARSH RASTOGI							0
19.	1808210150	SRIJAN PANDEY							0
20.	1808210151	SUFIYA	2	1.5	2	2.5	3	1.5	12.5
21.	1808210152	SUHAIL AHMED							0
22.	1808210153	SUKRITI SINGH							0
23.	1808210154	SUMIT KUMAR	2	0	2	2		1	7
24.	1808210155	SUSHANT KUMAR							0
25.	1808210156	SUSHANT SINGH							0
26.	1808210157	TANVEER ALAM	2	0	1.5	2	3	0.5	9
27.	1808210158	UDIT RAJPUT	2	1	0	2	1.5	3	9.5
28.	1808210159	UMANG MATHUR							0
29.	1808210160	UNNATI GANGWAR							0
30.	1808210161	UNNATI SINGH							0

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31.	1808210162	UTKARSH GUPTA							0
32.	1808210164	VASU GOEL							0
33.	1808210165	VASUNDHRA GUPTA	2	2	2	2	1.5	2.5	12
34.	1808210166	VEDIKA AGARWAL							0
35.	1808210167	VINAYAK VARSHNEY	2	2	2	2.5	3	2.5	14
36.	1808210168	VIRENDRA MOHAN							0
37.	1808210170	VISHAL TYAGI							0
38.	1808210171	YASH AGARWAL	2	0	2	2.5	3	2.5	12
39.	1808210172	ZAMAN ABBAS							0
40.	1900820109001	ANUJ SHARMA							0
41.	1900820109002	HADIYA KHALEEQ							0
42.	1900820109003	SATYAM RASTOGI	0.5			0.5	0	0.5	1.5
43.	1900820109004	UDIT							0
44.	1900820108001	VISHAL SAINI	2	1.5		2	0	0.5	6
45.	1900820109005	ZAREEN AQIQ							0

Class Test-2

S. No.	Roll No.	Name	CO2	CO2	CO2	CO3	CO3	CO3	
			Q. 1 (3)	Q. 2 (3)	Q. 3 (2)	Q. 4 (3)	Q. 5 (2)	Q. 6 (2)	Total (15)
1	1808210131	Sankalp Gupta	2	2	2	2	1.5	1.5	11
2	1808210132	Sanskriti Agarwal	3	2.5	1.5	3	2	2	14
3	1808210133	Sarthak Saxena	3	2	2	2	2	2	13
4	1808210134	Satakshi	3	2	2	3	2	2	14
5	1808210135	Saurabh Kumar	3	3	1	2.5	1.5	2	13
6	1808210136	Sayydul Millat	2.5	2.5	1.5	2	1.5	2	12
7	1808210137	Shazar Zaidi	3	2.5	1.5	3	2	2	14
8	1808210138	Shivani Tyagi	3	2.5	1.5	3	2	2	14
9	1808210139	Shivansh Mathur	3	1.5	1	2	2	2	11.5
10	1808210140	Shivansh Agarwal	3		2	2	2	2	11
11	1808210141	Shivanshu Agarwal	3	3	2	1.5	1.5	2	13
12	1808210142	Shrey Ruhela	3	3	1	2	2	2	13
13	1808210143	Shreya Chauhan	3	3	1	2	2	2	13
14	1808210144	Shubh Bhatnagar	3	3	1	2	2	2	13
15	1808210146	Shubham Yadav	2	2	1.5	2	2	2	11.5
16	1808210147	Shubhika Singh	3	3	1	2	1	2	12

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17	1808210148	Sourabh Saini	2.5	2	1.5	2	2	2	12
18	1808210149	Sparsh Rastogi	3	2	1	1	2	2	11
19	1808210150	Srijan Pandey	3	3	1	1.5	1.5	2	12
20	1808210151	Sufiya	3	3	2	2.5	1.5	2	14
21	1808210152	Suhail Ahmed	3	3	1	2	1	2	12
22	1808210153	Sukirti Singh	3	2.5	1	2.5	2	2	13
23	1808210154	Sumit Kumar	3	3	2	2	2	2	14
24	1808210155	Sushant Kumar	3	2	1	2	2	2	12
25	1808210156	Sushant Singh	3	3	1	1	2	2	12
26	1808210157	Tanveer Alam	3	3	2	2	2	2	14
27	1808210158	Udit Rajput	3	3		1		2	9
28	1808210159	Umang Mathur	1	2	2	2	1	1	9
29	1808210160	Unnati Gangwar	3	3	1	2	2	2	13
30	1808210161	Unnati Singh	3	3	1	2	2	2	13
31	1808210162	Utkarsh Gupta	2	2	2	2	2		10
32	1808210164	Vasu Goel	2	2	1	2	2	2	11
33	1808210165	Vasundhra Gupta	3	3	2	2	2	2	14
34	1808210166	Vedika Agarwal	3	3	1	2	2	2	13
35	1808210167	Vinayak Varshney	3	3	2	2	2	2	14
36	1808210168	Virendra Mohan	3	3	1	2	2	2	13
37	1808210170	Vishal Tyagi	2	2	2	2	2	2	12
38	1808210171	Yash Agarwal	3	3	1.5	2.5	2	2	14
39	1808210172	Zaman Abbas	3	3	1	2	2	2	13
40	1900820108001	Vishal Saini	3	1	2	2	2	2	12
41	1900820109001	Anuj Sharma	3	2.5	1	1.5	2	2	12
42	1900820109002	Hadiya Khaleeq	3	3	1	2	2	2	13
43	1900820109003	Satyam Rastogi	3	2	1	2	2	2	12
44	1900820109004	Udit	3	2	2	2	2	2	13
45	1900820109005	Zareen Aqiq	2.5	2	1.5	2	2	2	12

In Pursuit of Excellence	**List of Weak Students** **(Action taken for Improvement)**	SESSION-2019-2020 SEM-IV

KCS402: Theory of Automata and Formal Languages

Weak Student

S.No.	Roll No.	Name of Students
1	1808210135	SAURABH KUMAR
2	1900820109003	SATYAM RASTOGI

Action Taken:

1. Doubt removing session were organized and tried to make them comfortable in problem solving.
2. Summarized table for closure and decision properties were provided to help out with mcqs of these important topics.
3. Recorded video lectures were provided. https://www.youtube.com/channel/UC-_bN0suXZSjRiJ-x-YSMwg/playlists

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Closure Properties of Languages

Property	Regular	CFL	DCFL	CSL	Recursive	RE
Union	Yes	Yes	No	Yes	Yes	Yes
Intersection	Yes	No	No	Yes	Yes	Yes
Set Difference	Yes	No	No	Yes	Yes	No
Complementation	Yes	No	Yes	Yes	Yes	No
Intersection with a regular lang.	Yes	Yes	Yes	Yes	Yes	Yes
Concatenation	Yes	Yes	No	Yes	Yes	Yes
Kleen Closure	Yes	Yes	No	Yes	Yes	Yes
Kleen Plus	Yes	Yes	No	Yes	Yes	Yes
Reversal	Yes	Yes	Yes	Yes	Yes	Yes
Homomorphism	Yes	Yes	No	No	No	Yes
ϵ-free Homomorphism	Yes	Yes	No	Yes	Yes	Yes
Inverse Homomorphism	Yes	Yes	Yes	Yes	Yes	Yes
Substitution	Yes	Yes	No	No	No	Yes
ϵ-free Substitution	Yes	Yes	No	Yes	Yes	Yes
Right Quotient with a regular lang.	Yes	Yes	Yes	No	-	Yes
Left Quotient with a regular lang.	Yes	Yes	Yes	No	-	Yes

Grammar: Decidable and Undecidable Problems

Grammar	$w \in L(G)$	$L(G) = \phi$	$L(G) = \Sigma^*$	$L(G_1) \subseteq L(G_2)$	$L(G_1) = L(G_2)$	$L(G_1) \cap L(G_2) = \phi$	$L(G)$ is regular?	$L(G)$ is finite?
Regular Grammar	D	D	D	D	D	D	D	D
Det. Context Free	D	D	D	UD	D	UD	D	D
Context Free	D	D	UD	UD	UD	UD	UD	D
Context Sensitive	D	UD	UD	UD	UD	UD	UD	UD
Recursive	D	UD	UD	UD	UD	UD	UD	UD
Recursively Enumerable	UD	UD	UD	UD	UD	UD	UD	UD

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In Pursuit of Excellence	**List of Bright Students** (Action taken for enhancing performance)	SESSION-2019-2020 SEM-IV

KCS402: Theory of Automata and Formal Languages

Bright Student

S.No.	Roll No.	Name of Students
1	1808210140	SHIVANSH AGARWAL
2	1808210151	SUFIYA
3	1808210165	VASUNDHRA GUPTA
4	1808210167	VINAYAK VARSHNEY
5	1808210171	YASH AGARWAL

Action Taken

1. Shared previous year gate questions PDF https://github.com/GATEOverflow/GO-PDFs and questions https://gateoverflow.in/theory-of-computation and discussed problems time to time during classes.
2. Shared video lecture http://www.aduni.org/courses/theory/index.php?view=cw by Shai Simonson

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GATE Questions

1. Let S and T be language over ={a,b} represented by the regular expressions (a+b*)* and (a+b)*, respectively. Which of the following is true? (GATE CS 2019)

(a) ScT (S is a subset of T)
(b) TcS (T is a subset of S)
(c) S=T
(d) SnT=Ø
Answer: (c).

2. Let L denotes the language generated by the grammar S – OSO/00. Which of the following is true? (GATE CS 2019)
(a) L = O
(b) L is regular but not O
(c) L is context free but not regular
(d) L is not context free
Answer: (b)

3. Consider the following two statements:
S1: { 0^2n |n >= l} is a regu1ar language
S2: { 0^m 0^n 0^(m+n) l m >= 1 and n >= 2} is a regu1ar language
Which of the following statements is correct? (GATE CS 2001)
a) Only S1 is correct
b) Only S2 is correct
c) Both S1 and S2 are correct
d) None of S1 and S2 is correct

Answer: (c)
Explanation:
S1 can be written as (00)^n where n >= 1. And S2 can be written as (00)^(m+n) where m >=2 and n >= 1. S2 can be further reduced to (00)^x where x >= 3.
We can easily write regular grammars for both S1 and S2.
G1 -> G100/00 (For S1)
G2 -> G200/000000 (For S2)

4. Which of the following statements in true? (GATE CS 2018)
(a) If a language is context free it can always be accepted by a deterministic push-down automaton
(b) The union of two context free languages is context free
(c) The intersection of two context free languages is context free
(d) The complement of a context free language is context free
Answer: (b)
Explanation:
Context-free languages are closed under the following operations. That is, if L and P are context-free languages and D is a regular language, the following languages are context-free as well:

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• the Kleene star L * of L
• the image Ø(L) of L under a homomorphism Ø
• the concatenation of L and P
• the union of L and P
• the intersection of L with a regular language D (L n D).

Context-free languages are not closed under complement, intersection, or difference.

Why a) is not true?

The language recognized by deterministic pushdown automaton is deterministic context free language. Not all context-free languages are deterministic. This is unlike the situation for deterministic finite automata, which are also a subset of the nondeterministic finite automata but can recognize the same class of languages (as demonstrated by the subset construction).

5. Given an arbitrary non-deterministic finite automaton (NFA) with N states, the maximum number of states in an equivalent minimized DFA is at least. (GATE CS 2001)

(a) N^2
(b) 2^N
(c) 2N
(d) N!

Answer: (b)

6. For $\Sigma = \{a, b\}$, let us consider the regular language $L = \{x \mid x = a^{2+3k}$ or $x = b^{10+12k}, k \geq 0\}$. Which one of the following can be a pumping length (the constant guaranteed by the pumping lemma) for L? **(GATE CS 2019)**

7. The number of states in the minimum sized DFADFA that accepts the language defined by the regular expression(0+1)*(0+1)(0+1)*(0+1)*(0+1)(0+1)*
is _____. **(GATE CS 2019)**

8. Language L1L1 is defined by the grammar: S1→aS1b|εS1→aS1b|ε
Language L2L2 is defined by the grammar: S2→abS2|εS2→abS2|ε
Consider the following statements:
P:P: L1L1 is regular
Q:Q: L2L2 is regular
Which one of the following is **TRUE**? **(GATE CS 2016)**

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In Pursuit of Excellence	**Previous Year Question Papers**	SESSION-2019-2020 SEM-IV

KCS402: Theory of Automata and Formal Languages

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Printed Pages: 02
Paper Id: 110257

Sub Code: RCS403
Roll No.

B TECH
(SEM-IV) THEORY EXAMINATION 2018-19
THEORY OF AUTOMATA AND FORMAL LANGUAGES

Time: 3 Hours *Total Marks: 70*

Note: Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. **2 x 7 = 14**

a. For the given language $L_1 = \varepsilon$, $L_2 = \{a\}$, $L_3 = \emptyset$. Compute $L_1 L_2^* \cup L_3^*$.
b. Design a FA to accept the string that always ends with 101.
c. Write regular expression for set of all strings such that number of a's divisible by 3 over $\Sigma = \{a,b\}$
d. Construct the CFG for the Language $L = \{a^{2n}b^n \mid n>=3\}$.
e. What do you mean by ε-Closure in FA?
f. Explain Universal TM.
g. Explain Two Stack PDA.

SECTION B

2. Attempt any *three* of the following: **7 x 3 = 21**

a. Construct a minimum state DFA from given FA

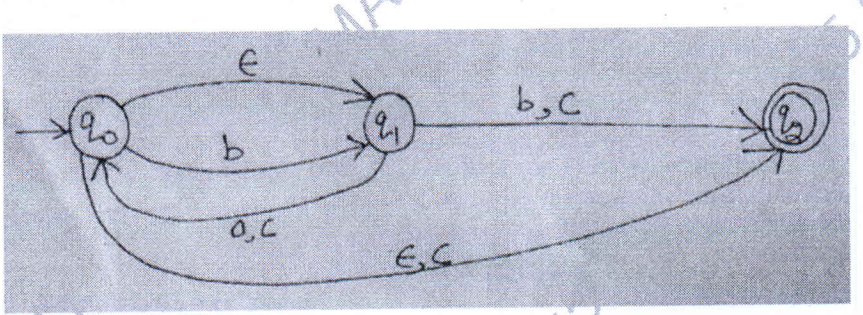

Fig. 1

b. Find the regular expression corresponding to the finite automata given bellow:

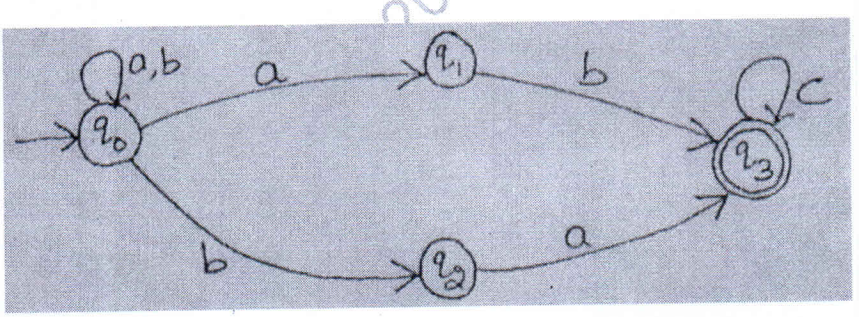

Fig. 2

P.T.O

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DR VIJAY KUMAR GUPTA | 14-May-2019 08:57:27 | 45.115.62.2

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c. Convert the following CFG to its equivalent GNF:
$S \rightarrow AA \mid a$, $A \rightarrow SS \mid b$.

d. Design a PDA for the following language:
$L = \{a^i b^j c^k \mid i = j \text{ or } j = k\}$

e. Design a TM for the following language:
$L = \{ a^{n+2} b^n \mid n > 0 \}$

SECTION C

3. Attempt any *one* part of the following: **7 x 1 = 7**

(a) Design FA for ternary number divisible by 5.

(b) Explain Myhill-Nerode Theorem using suitable example.

4. Attempt any *one* part of the following: **7 x 1 = 7**

(a) Prove that the following Language $L = \{a^n b^n\}$ is not regular

(b) Explain the Closure properties of regular expression.

5. Attempt any *one* part of the following: **7 x 1 = 7**

(a) Design the CFG for the following language:
i) $L = \{0^m 1^n \mid m \neq n \ \& \ m,n \geq 1\}$
ii) $L = \{a^l b^m c^n \mid l + m = n \ \& \ l,m \geq 1\}$

(b) Prove that the following Language $L = \{a^n b^n c^n\}$ is not Context Free.

6. Attempt any *one* part of the following: **7 x 1 = 7**

(a) Design a PDA for the Language $L = \{WW^R \mid W = \{a,b\}^*\}$

(b) Generate CFG for the given PDA M is defined as
$M = (\{q_0, q_1\}, \{0,1\}, \{x, z_0\}, \delta, q_0, z_0, q_1)$ where δ is given as follows:
$\delta(q_0,1, z_0) = (q_0, xz_0)$
$\delta(q_0,1, x) = (q_0, xx)$
$\delta(q_0,0, x) = (q_0, x)$
$\delta(q_0, \varepsilon, x) = (q_1, \varepsilon)$
$\delta(q_1, \varepsilon, x) = (q_1, \varepsilon)$
$\delta(q_1,0, x) = (q_1, xx)$
$\delta(q_1,0, z_0) = (q_1, \varepsilon)$

7. Attempt any *one* part of the following: **7 x 1 = 7**

(a) Design a TM for the following language:
$L = \{ a^n b^n c^n \mid n \geq 1\}$

(b) Write short note on:
i) Recursive Language and Recursively Enumerable Language.
ii) PCP problem and Modified PCP Problem

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DR VIJAY KUMAR GUPTA | 14-May-2019 08:57:27 | 45.115.62.2

Printed Pages: 03
Paper Id: 110433

Sub Code: RCS403
Roll No.

B. TECH
(SEM IV) THEORY EXAMINATION 2017-18
THEORY OF AUTOMATA AND FORMAL LANGUAGES

Time: 3 Hours *Total Marks: 70*

Note: Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. **2 x 7 = 14**

a. Define alphabet, string and language.
b. Design a regular expression that accepts all the strings for input alphabet {a,b} containing exactly 2 a's.
c. Design a NFA that accepts all the strings for input alphabet {a,b} containing the substring abba.
d. Define Chomsky hierarchy.
e. Is context free language closed under union? If yes, give an example.
f. Convert NFA into equivalent DFA by taking any suitable example.
g. Remove useless productions from the given productions: S→AB|ab, A→aA|B|a, B→D|E

SECTION B

2. Attempt any *three* of the following: **7 x 3 = 21**

a. Define Deterministic Finite Automata (DFA) and design a DFA that accepts the binary number whose equivalent is divisible by 5.
b. State recursive definition of regular expression and construct a regularexpression corresponding to the state transition diagram as shown in Fig.1

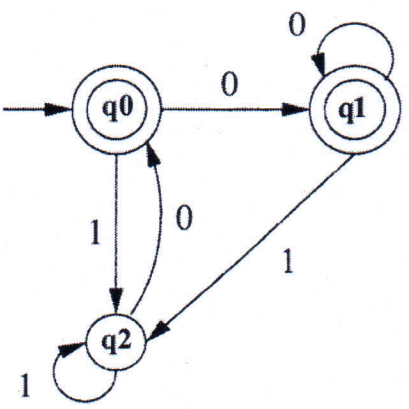

Fig.1

c. Reduce the given grammar G=({S,A,B},{a,b},P,S) to Chomsky Normal Form. Where P is defined as:

$S \rightarrow bA \mid aB$
$A \rightarrow bAA \mid aS \mid a$
$B \rightarrow aBB \mid bS \mid b$

d. What is Push Down Automata (PDA)? Design the PDA for the language $L = \{wcw^R \mid w \in \{a,b\}^*\}$
e. Define Turing Machine (TM). Construct the TM for the language $L = \{a^n b^n \mid n>0\}$.

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SECTION C

3. Attempt any *one* part of the following: **7 x 1 = 7**

(a) Describe Mealy and Moore machines with example. Convert the given Mealy machine as shown in Fig. 2 into Moore Machine.

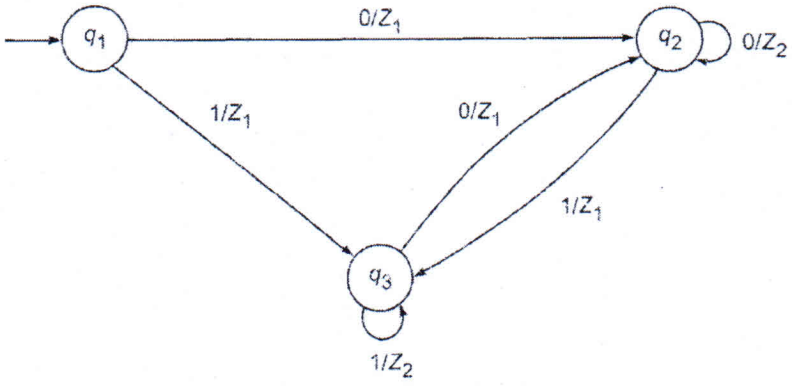

Fig. 2

(b) Construct the minimum state automata equivalent to DFA described by Fig. 3

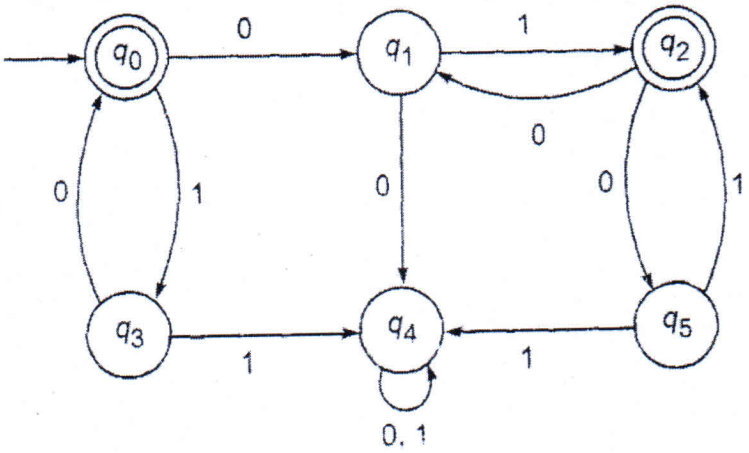

Fig. 3

4. Attempt any *one* part of the following: **7 x 1 = 7**

(a) State Pumping Lemma for regular sets. Show that the set $L=\{a^p | p \text{ is a prime}\}$ is not regular.

(b) Discuss closure properties i.e. concatenation, union, intersection, complement of regular languages.

5. Attempt any *one* part of the following: **7 x 1 = 7**

(a) Discuss inherent ambiguity of context free languages with suitable example. Construct the context free grammar that accepts language $L=\{a^i b^j c^k | i = j \text{ or } j = k; i, j, k \text{ are positive integers}\}$.

(b) Define parse tree. Find parse tree for the string *abbcde* considering the productions-

S→aAcBe

A→Ab

A→b

B→d

Is this ambiguous? Justify.

6. Attempt any *one* part of the following: **7 x 1 = 7**

(a) Differentiate between deterministic PDA (DPDA) and non-deterministic PDA (NPDA) with suitable example. Also discuss two stack PDA with example.

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(b) Construct a PDA equivalent to the following CFG productions:

$S \rightarrow aAA,\ A \rightarrow aS \mid bS \mid a$

7. Attempt any *one* part of the following: **7 x 1 = 7**

(a) Write short notes on the following:
   (i) Halting problem of Turing machine
   (ii) Recursive Language
   (iii) Variants of Turing Machine

(b) Define Post's Correspondence Problem (PCP) and Modified PCP with its applications. Find any three PCP solutions of the lists $x=(b,bab^3,ba)$ and $y=(b^3,ba,a)$.

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Printed Pages : 3 Roll No. | | | | | | | | | | | CS404

B.TECH.

THEORY EXAMINATION (SEM–IV) 2016-17

THEORY OF COMPUTATION

Time : 3 Hours *Max. Marks : 100*

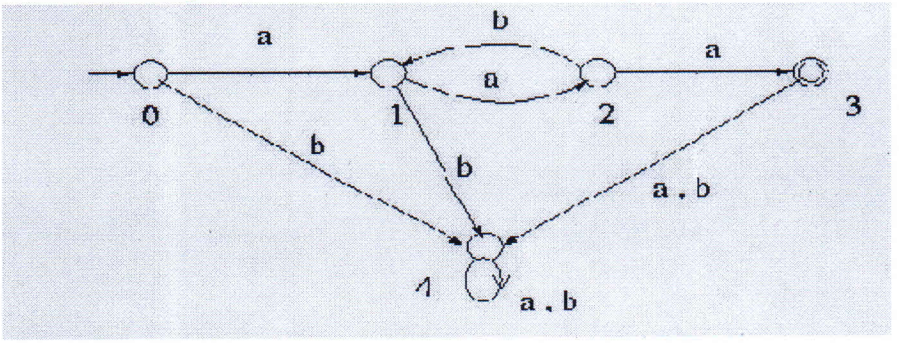
Note : Be precise in your answer. In case of numerical problem assume data wherever not provided.

SECTION – A

1. Explain the following: **10 x 2 = 20**

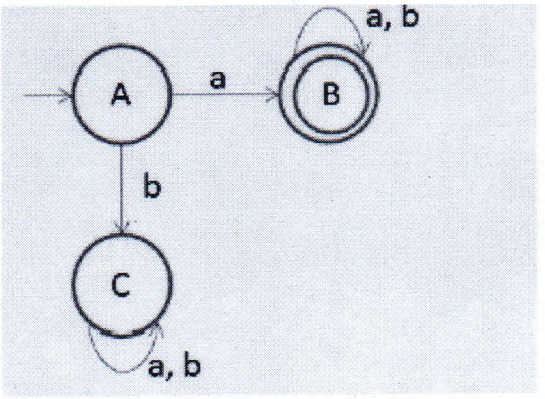
(a) Design the DFA that accepts an even number of a's and even number of b's.

(b) Consider the DFA given below and identify the L accepted by the machine.



(c) State the pumping lemma theorem for regular languages.

(d) Convert the FA given below to left linear grammar.



(e) Check whether the grammar is ambiguous or not.
R-> R+R/ RR/ R*/ a / b / c. Obtain the string w = a+b*c

(f) S->aB/bA A->a/aS/bAA B-> b/bS/aBB. Identify the strings obtained from this grammar.

(g) Define PDA. Draw the graphical representation for PDA.

(h) Design a PDA which accepts set of balanced paranthesis ({ { } }).

(i) Eliminate unit productions in the grammar. S->A/bb A->B/b B->S/a

(j) What are checking off symbols?

SECTION – B

2. Attempt any five of the following questions: **5 x 10 = 50**

(a) (i) Convert the NFA- ε to DFA.

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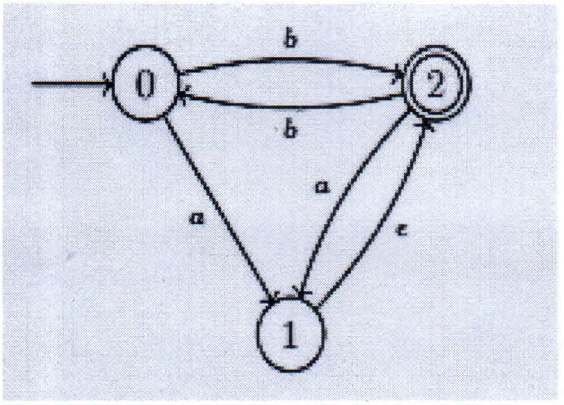
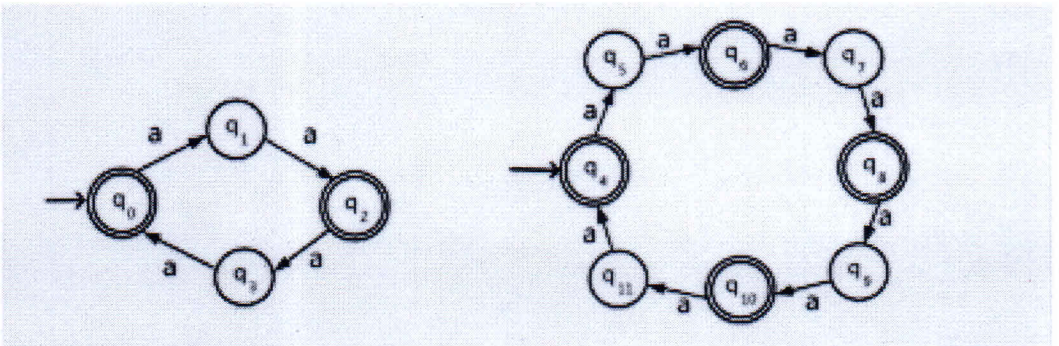


(ii) Check with the comparison method for testing equivalence of two FA given below.



(b) Prove that the compliment, homomorphism and inverse homomorphism, closure of a regular language is regular.

(c) State and prove kleene's theorem with an example.

(d) Consider the grammar with the production S->aSS A->b. Compute the string aababbb with the left most and right most derivation. Draw the derivation tree.

(e) (i) Find out whether the language $L = \{x^n y^n z^n \mid n \geq 1\}$ is context free or not.

(ii) Construct a PDA that accepts $L = \{ ww^R \mid w = (a+b)^* \}$

(f) (i) Convert the following CFG into CNF

$S \rightarrow XY \mid Xn \mid p$

$X \rightarrow mX \mid m$

$Y \rightarrow Xn \mid o$

(ii) Convert the following CFG into CNF $S \rightarrow ASA \mid aB, A \rightarrow B \mid S, B \rightarrow b \mid \varepsilon$

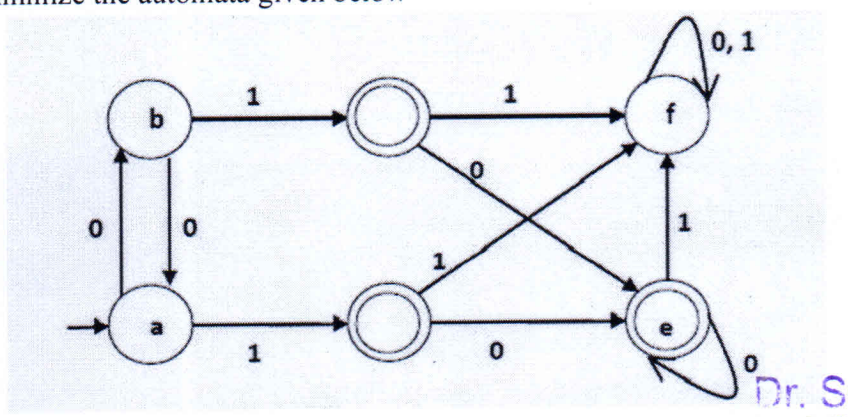
(g) Design a TM to recognize all strings consisting of an odd number of α's.

(h) Prove that the halting problem is undecidable.

SECTION – C

Attempt any two of the following questions: **2 x 15 = 30**

3. (a) Minimize the automata given below



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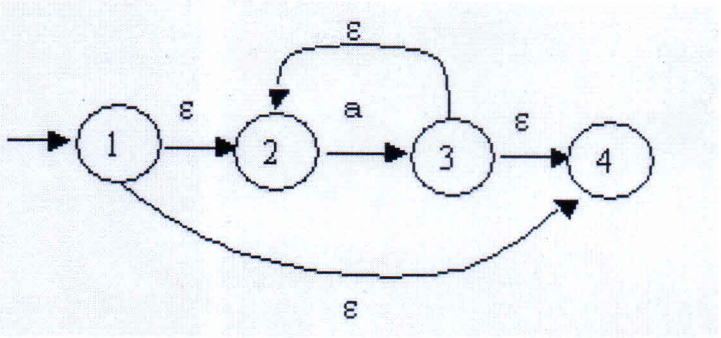
(b) Compute the epsilon- closure for the given NFA. Convert it into DFA.



4. **(a)** Construct PDA to accept $L = \{0^n 1^n \mid n \geq 0\}$

(b) Construct a PDA from the following CFG.

$G = (\{S, X\}, \{a, b\}, P, S)$ where the productions are –

$S \rightarrow XS \mid \varepsilon$, $A \rightarrow aXb \mid Ab \mid ab$

5. **(a)** Prove that single tape machines can simulate multi tape machines.

(b) Design a TM to recognize all strings consisting of an odd number of α's.

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(Following Paper ID and Roll No. to be filled in your Answer Books)

Paper ID : 110407 Roll No. | | | | | | | | | | |

B.TECH.

Theory Examination (Semester-IV) 2015-16

THEORY OF AUTOMATA AND FORMAL LAUNGUAGE

Time : 3 Hours *Max. Marks : 100*

Section-A

Q.1 Attempt all parts. All parts carry equal marks. Write answer of each part in short. (2×10=20)

(a) Design a FA to accept the string that always ends with 00.

(b) Differentiate between the L^* and L^+.

(c) Write regular expression for set of all strings such that number of 0's is odd.

(d) What is a Moore and Mealy machine?

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(e) Construct the CFG for the regular expression $(0+1)^*$.

(f) What are the features of universal Turing machine?

(g) Define the languages generated by Turing machine.

(h) Describe the instantaneous description of a PDA.

(i) Design a DFA to accept the binary number divisible by 3.

(j) What do you understand by Epsilon-closure of sate in finite automata?

Section-B

2. Attempt any five parts. All parts carry equal marks: (5×10=50)

a. Construct a NFA for the language L which accept all the strings in which the third symbol from right end is always an over $\Sigma = \{a, b\}$.

b. State and Prove Pumping Lemma of RE. Show that $L= \{a^p : p \text{ is prime}\}$ is not regular?

c. Explain the parse tree with an example. Reduce the context free grammar into GNF whose productions are $S \rightarrow aSb$. $S \rightarrow ab$.

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d. Define Pushdown automata. Differentiate PDA by empty stack and final state by giving their definitions.

e. Obtain PDA to accept all strings generated by the language $\{a^n b^m a^n, m,n>=1\}$.

f. Construct DFA eauivalent to NFA. where δ is defined in the following table: 1

Q	δ(q,a)	δ(q,b)
A	A,B	C
B	A	B
C*(final stale)	–	A,B

Table: 1

g. Consider the CFG ({S, A, B} {a,b}, P,S) where productions Pare as follows:

S->aABB/ aAA, A→aBB/a, B→bBB / A. Convert the given grammar to PDA that accept the same language by empty stack.

h. Design CFG for the language consisting of all strings of even length over {a, b}.

Section-C

Note:Attempt any two questions from this section.

(2×15=30)

3. Write short notes on the following:

   (a) Halting Problem

   (b) Church's thesis

   (c) Recursively enumerable language

4. What is Chomsky hierarchy? Explain post correspondence problem.

5. Construct a Turing machine which accepts the regular expression, $L = \{0^n1^n | n >= 1\}$.

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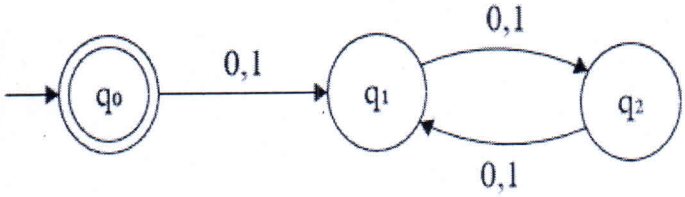
In Pursuit of Excellence	**Questions Bank**	SESSION-2019-2020 SEM-IV

Unit-I **CO-1**

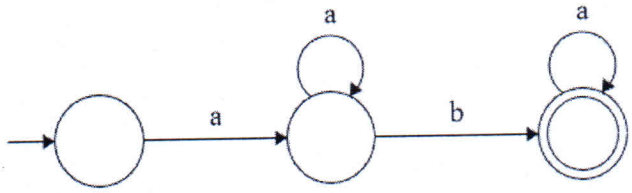
1. What do you mean by Kleene closure of set A?
2. Define the language of the following finite automaton.



3. Define nondeterministic finite automata. How does it differ from deterministic finite automata?
4. Construct a DFA equivalent to NFA where δ is defined in the following table :

q	δ(q, a)	δ(q, b)
→A	A,B	C
B	A	B
C*	-	A,B

5. Design a finite automata which accepts the complement of the language accepted by the following automata:



6. Write the steps for minimizing the states in a DFA. Minimize the number of states in the following DFA :

Present State	Next State	
	Input 0	Input 1
→q_0	q_1	q_3
q_1	q_0	q_3
q_2	q_1	q_4
q_3	q_5	q_5

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q_4	q_3	q_3
q_5	q_5	q_5

Given that q3 and q5 are final states.

7. What do you understand by Epsilon-closure of state in finite automata?
8. Define Mealy machine. Convert the following Moore machine into equivalent Mealy Machine:

Present State	**Next State**		**Output**
	Input 0	**Input 1**	
$\rightarrow q_0$	q_0	q_1	Y
q_1	q_2	q_3	N
q_2	q_4	q_0	N
q_3	q_1	q_2	N
q_4	q_3	q_4	N

9. Convert following Mealy machine into equivalent Moore machine :

Present State	Next State			
	a = 0	output	a=1	output
$\rightarrow q_1$	q_4	0	q_2	1
q_2	q_2	1	q_3	0
q_3	q_3	0	q_4	0
q_4	q_4	0	q_1	0

10. Design a Mealy machine that calculate residue mod 3 for binary strings.

Unit-II **CO-2**

11. Construct a finite automata equivalent to given regular expression
    (0+1)*(00+11)(0+1)*
12. State and prove the Arden Theorem.
13. Explain the closer and decision properties of regular language.
14. Write regular expression for given language
    (a) The set of all strings containing exactly 2 **a**'s.
    (b) The set of all strings containing at least 2 **a**'s.
    c) The set of all strings containing at most 2 **a** s.
    d) The set of strings containing the substring **aa**.

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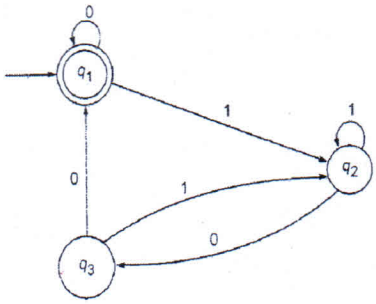
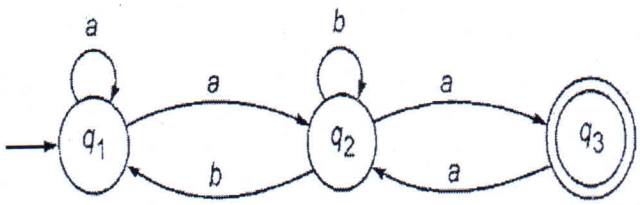
15. Find the regular expression for given automata by using Arden's Theorem



(a)



(b)

16. Show that the following language is not regular by using Pumping Leema

d. $L=\{a^p \mid p \text{ is a prime number}\}$
e. $L = \{a^i b^j c^k \mid k > i + j\}$
f. $L= \{a"b^n \mid n> 0\};$
g. $L=\{a"b^m \mid 0< n < m\}.$

Unit-III **CO-3**

17. Explain hirearchy of grammar in detail.

18. Define Left Most and Right Most Derivation using Derivation tree. Consider the CFG $P \rightarrow 0P0/1P1/\varepsilon$, and build Derivation tree for the string "**0010**" using given grammar.

19. What are Left and Right Recursive Grammars?

20. What do you mean by CNF in CFG. Explain with an example.

21. Convert the given CFG to CNF. Consider the given grammar G1:

$S \rightarrow a \mid aA \mid B$
$A \rightarrow aBB \mid \varepsilon$
$B \rightarrow Aa \mid b$

22. Explain Right Linear and Left Linear grammars with suitable examples.

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23. Construct the grammar for the following languages

a. $L=\{a^n cb^m \mid n, m>0\}$

b. $L=\{wcw^R \mid w\epsilon\{a, b\}^*\}$

24. What is epsilon, unit production, and useless production?

25. Remover the Useless productions production from given grammar

S -> abS | abA | abB
A -> cd
B -> aB
C -> dc

26. Remove Unit Production from given grammar

S -> Aa | B
A -> b | B
B -> A | a

27. Remove the Null production from given grammar

S -> ABCd
A -> BC
B -> bB | λ
C -> cC |

28. Write down the step required to convert into Chomsky Normal Form.Consider the following CFG and find its equivalent CNF and GNF:
S→ASB/ε , A→aSS/a , B→SbS/A/bb

29. How to eliminate useless symbol and unit production in a grammar? Eliminate unit production for the following CFG.
E→E+T/T, T→T*F/F, F→(E)/I, I→a/b/Ia/Ib/I

Unit-IV

CO-4

30. What is Pushdown Automata (PDA)?

31. Which type of Language is accepted by PDA?

32. Write five differences between Finite Automata and Pushdown Automata.

33. Write four differences between Regular language and Context Free Language.

34. Design a PDA which accepting L= {0nc1n|n>0}.

35. Design a PDA which accepts the string {00a11}.

36. Design a PDA which accepting the language

$$L = \{ww^R \mid w \in (a, b)^*\}.$$

37. Design a PDA which accepting L={0n1n|n>0}.

38. Design a PDA which accept the language L= {0na1n|n>0}.

39. Design a PDA which accepting the language

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$L = \{wcw^R \mid w \in (a, b)^*\}$.

Unit-V CO-5

40. What is a Turing Machine? Explain with a block diagram.
41. Write 5 differences between Finite Automata, Pushdown Automata and Turing machine.
42. Construct a Turing Machine for language $L = \{ww^r \mid w \in \{0, 1\}\}$
43. Construct a Turing Machine for language $L = \{0^n1^n2^n \mid n \geq 1\}$
44. Construct a Turing Machine for language $L = \{ww \mid w \in \{0,1\}\}$
45. Construct a Turing Machine for language $L = \{a^ib^jc^k \mid i>j>k;\ k \geq 1\}$
46. Write short notes on following topics with example:

- Universal Turing machine
- Church's Thesis
- Recursive and Recursively Enumerable language
- Halting Problem of Turing Machine

47. State Post Correspondence problem and prove that "PCP is undecidable".
48. Design Turing Machine for the language $L=\{a^ib^jc^k / \ i,k>0$ and $j=2\}$.
49. Explain Universal Turing Machine.
50. Design a Turing Machine for following problem

A. Addition of 3 and 5
B. Addition of 3,6, 8
C. subtraction 10-5
C. Subtraction 8-6

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In Pursuit of Excellence	**Final Sessional Marks**	SESSION-2019-2020 SEM-IV

Subject Name: Theory of Automata and Formal Language						**Subject Code: KCS-402**			**Section: C**	
Sr. No.	**Student Name**	**Roll No.**	**Class Test Marks**			**CT Total (best CT* 2)**	**Attendance (10)**	**Tutorial and assignment (10)**		
			CT-1	**CT-2**	**Best CT**	**CT Total (30)**			**TA (20)**	**Total (50)**
1.	1808210131	SANKALP GUPTA	10	11	11	22	10	8	18	40
2.	1808210132	SANSKRITI AGARWAL	0	14	14	28	7	8	15	43
3.	1808210133	SARTHAK SAXENA	0	13	13	26	8	7	15	41
4.	1808210134	SATAKSHI	0	14	14	28	7	8	15	43
5.	1808210135	SAURABH KUMAR	5	13	13	26	9	7	16	42
6.	1808210136	SAYYDUL MILLAT	0	12	12	24	8	7	15	39
7.	1808210137	SHAZAR ZAIDI	8	14	14	28	9	7	16	44
8.	1808210138	SHIVANI TYAGI	8.5	14	14	28	8	8	16	44
9.	1808210139	SHIVANSH MATHUR	0	11.5	11.5	23	7	7	14	37
10.	1808210140	SHIVANSH AGARWAL	11.5	11	11.5	23	9	8	17	40
11.	1808210141	SHIVANSHU AGARWAL	0	13	13	26	8	7	15	41
12.	1808210142	SHREY RUHELA	8	13	13	26	10	8	18	44
13.	1808210143	SHREYA CHAUHAN	0	13	13	26	7	7	14	40
14.	1808210144	SHUBH BHATNAGAR	7	13	13	26	8	9	17	43
15.	1808210146	SHUBHAM YADAV	0	11.5	11.5	23	9	9	18	41
16.	1808210147	SHUBHIKA SINGH	0	12	12	24	8	7	15	39
17.	1808210148	SOURABH SAINI	0	12	12	24	7	8	15	39
18.	1808210149	SPARSH RASTOGI	0	11	11	22	7	7	14	36
19.	1808210150	SRIJAN PANDEY	0	12	12	24	7	7	14	38
20.	1808210151	SUFIYA	12.5	14	14	28	9	9	18	46
21.	1808210152	SUHAIL AHMED	0	12	12	24	8	9	17	41
22.	1808210153	SUKRITI SINGH	0	13	13	26	8	7	15	41
23.	1808210154	SUMIT KUMAR	7	14	14	28	10	9	19	47
24.	1808210155	SUSHANT KUMAR	0	12	12	24	7	7	14	38

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25.	1808210156	SUSHANT SINGH	0	12	12	24	7	8	15	39
26.	1808210157	TANVEER ALAM	9	14	14	28	7	9	16	44
27.	1808210158	UDIT RAJPUT	9.5	9	9.5	19	8	7	15	34
28.	1808210159	UMANG MATHUR	0	9	9	18	7	8	15	33
29.	1808210160	UNNATI GANGWAR	0	13	13	26	8	8	16	42
30.	1808210161	UNNATI SINGH	0	13	13	26	8	7	15	41
31.	1808210162	UTKARSH GUPTA	0	10	10	20	8	7	15	35
32.	1808210164	VASU GOEL	0	11	11	22	7	7	14	36
33.	1808210165	VASUNDHRA GUPTA	12	14	14	28	9	8	17	45
34.	1808210166	VEDIKA AGARWAL	0	13	13	26	8	8	16	42
35.	1808210167	VINAYAK VARSHNEY	14	14	14	28	10	9	19	47
36.	1808210168	VIRENDRA MOHAN	0	13	13	26	8	7	15	41
37.	1808210170	VISHAL TYAGI	0	12	12	24	8	7	15	39
38.	1808210171	YASH AGARWAL	12	14	14	28	9	8	17	45
39.	1808210172	ZAMAN ABBAS	0	13	13	26	7	7	14	40
40.	1900820109001	ANUJ SHARMA	0	12	12	24	8	9	17	41
41.	1900820109002	HADIYA KHALEEQ	0	12	12	24	8	7	15	39
42.	1900820109003	SATYAM RASTOGI	1.5	13	13	26	9	8	17	43
43.	1900820109004	UDIT	0	12	12	24	8	8	16	40
44.	1900820108001	VISHAL SAINI	6	13	13	26	10	9	19	45
45.	1900820109005	ZAREEN AQIQ	0	12	12	24	7	8	15	39

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डा0 ए0पी0जे0 अब्दुल कलाम प्राविधिक विश्वविद्यालय, उत्तर प्रदेश, लखनऊ

Dr. A.P.J. Abdul Kalam Technical University, Uttar Pradesh, Lucknow

(Formerly Uttar Pradesh Technical University)

500535

Sessional Marks Examination (सैत्रिक अंक)

Sessional Brief (सैत्रिक संक्षिप्त)

Print (प्रिंट करें)

Institute Code & Name	:	MORADABAD INSTITUTE OF TECHNOLOGY,MORADABAD(082)
Course Code & Name	:	B.Tech
Branch Code & Name	:	Computer Science and Engineering
Semester	:	4
FacultyName	:	LAL PRATAP VERMA
SubjectCode	:	KCS402
Marks Type	:	
Is Finally Submitted to University	:	True (* will be **TRUE** after submitting to university by your college.)

Sessional Marks (सैत्रिक अंक)

Sr.no. (क्रम संख्या)	Roll No. (अनुक्रमांक)	Name (नाम)	Obt.(CT) प्राप्त (CT)	Max.(CT) अधिकतम (CT)	Obt. TA (Assign./Att.)	Max. TA (Assign./Att.)	Obt. CT+TA	Max. CT+TA	Remark (टिप्पणी)
1	1808210001	AASHISH PAL	22	30	20	20	42	50	
2	1808210002	ABHAY VARSHNEY	26	30	20	20	46	50	
3	1808210003	ABHAY PRATAP SINGH	20	30	20	20	40	50	
4	1808210005	ABHISHEK	20	30	20	20	40	50	
5	1808210006	ABHISHEK KUMAR	22	30	19	20	41	50	
6	1808210007	ABHISHEK SHARMA	22	30	19	20	41	50	
7	1808210009	ACHAL GUPTA	22	30	19	20	41	50	
8	1808210010	ADARSH UPADHAYAY	20	30	18	20	38	50	
9	1808210011	AHAD NUSRAT	20	30	18	20	38	50	
10	1808210013	AKASH BHATNAGAR	22	30	20	20	42	50	
11	1808210014	AKASH JAUHARI	28	30	20	20	48	50	
12	1808210015	AKASH KUMAR	28	30	20	20	48	50	
13	1808210016	AKHIL KUMAR	24	30	20	20	44	50	
14	1808210017	AKSHITA VERMA	22	30	20	20	42	50	
15	1808210018	AMAN KUMAR	22	30	19	20	41	50	
16	1808210019	AMAN VAISH	24	30	20	20	44	50	
17	1808210020	AMBIKA MALHOTRA	28	30	20	20	48	50	
18	1808210021	AMIR	20	30	20	20	40	50	
19	1808210022	AMOL JAIN	20	30	16	20	36	50	
20	1808210025	ANIKET SINGH	20	30	19	20	39	50	
21	1808210026	ANIL KUMAR	20	30	18	20	38	50	
22	1808210027	ANIL KUMAR	22	30	20	20	42	50	
23	1808210028	ANKIT CHANDRA	20	30	19	20	39	50	
24	1808210029	ANKIT KUMAR	20	30	18	20	38	50	
25	1808210030	ANKUSH TYAGI	24	30	20	20	44	50	
26	1808210031	ANSHDEEP TYAGI	22	30	19	20	41	50	
27	1808210032	ANSHIKA GOEL	26	30	20	20	46	50	
28	1808210033	ANUBHAV MISHRA	22	30	19	20	41	50	
29	1808210034	ANUBHAV SHUKLA	20	30	19	20	39	50	
30	1808210036	ASEEM GUPTA	28	30	20	20	48	50	
31	1808210037	AVNISH KUMAR	22	30	19	20	41	50	
32	1808210038	AYUSH KUMAR SINGH	20	30	19	20	39	50	
33	1808210039	AYUSH SHARMA	24	30	19	20	43	50	
34	1808210040	BHASKAR SAINI	20	30	19	20	39	50	
35	1808210041	BHUVNESH KUMAR SHARMA	24	30	20	20	44	50	
36	1808210042	BILAL SAIFI	20	30	19	20	39	50	
37	1808210043	BOBI KHAN	20	30	18	20	38	50	
38	1808210044	CHANDR VEER SINGH	20	30	19	20	39	50	
39	1808210046	DEEKSHA SINGH	24	30	20	20	44	50	
40	1808210047	DEEPENDRA SINGH RAGHAV	20	30	19	20	39	50	
41	1808210048	DEVAL JHINGRAN	24	30	20	20	44	50	
42	1808210050	DEVESH BHARDWAJ	26	30	19	20	45	50	
43	1808210051	GAGAN	24	30	19	20	43	50	
44	1808210052	GARVIT BHOLA	24	30	20	20	44	50	
45	1808210053	GAURANG GUPTA	24	30	19	20	43	50	
46	1808210054	GAURANGEE BHARDWAJ	28	30	20	20	48	50	
47	1808210055	GAURAV BHATNAGAR	20	30	20	20	40	50	
48	1808210056	GAURAV KUMAR	22	30	19	20	41	50	
49	1808210057	GEETIKA GUPTA	28	30	20	20	48	50	
50	1808210058	HAMMAD HUSSAIN	22	30	20	20	42	50	
51	1808210059	HARSH GUPTA	28	30	20	20	48	50	
52	1808210060	HARSH VARDHAN	24	30	20	20	44	50	
53	1808210061	HARSHBEER SINGH	28	30	20	20	48	50	
54	1808210062	HARSHIT KUMAR	20	30	19	20	39	50	
55	1808210063	HARSHIT PANDEY	22	30	20	20	42	50	
56	1808210064	HONEY TYAGI	22	30	19	20	41	50	
57	1808210066	IRAM RAFI	24	30	20	20	44	50	
58	1808210067	ISHAN SAXENA	28	30	20	20	48	50	
59	1808210068	ISHITA AGARWAL	25	30	18	20	43	50	
60	1808210069	ISHITA RASTOGI	22	30	18	20	40	50	
61	1808210070	ISHVINDER SINGH	25	30	18	20	43	50	
62	1808210071	JATIN TYAGI	23	30	17	20	40	50	
63	1808210072	JUHI CHAUHAN	22	30	17	20	39	50	
64	1808210073	KARTIK TIWARI	23	30	17	20	40	50	
65	1808210074	KARTIK SHARMA	23	30	18	20	41	50	
66	1808210075	KM RISHITA CHAUDHARY	26	30	17	20	43	50	
67	1808210076	KM VEENA RAJPOOT	25	30	18	20	43	50	
68	1808210077	KRITI SHUKLA	27	30	19	20	46	50	
69	1808210078	KSHITIZ VERMA	26	30	18	20	44	50	
70	1808210079	KSHITIZ AGARWAL	26	30	19	20	45	50	
71	1808210080	LOKESH YADAV	18	30	18	20	36	50	
72	1808210081	MAHIMA SINGH	24	30	20	20	44	50	
73	1808210082	MALLIKA SHARMA	25	30	19	20	44	50	
74	1808210083	MANISH KUMAR	29	30	20	20	49	50	
75	1808210084	MANJEET SINGH	19	30	18	20	37	50	

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76	1808210085	MANU TYAGI	27	30	18	20	45	50	
77	1808210086	MANVEE TIWARI	25	30	18	20	43	50	
78	1808210087	MAYANK AGARWAL	22	30	16	20	38	50	
79	1808210088	MAYANK KUMAR	20	30	16	20	36	50	
80	1808210089	MINAL SAGAR	28	30	18	20	46	50	
81	1808210091	MOHD ARIF	22	30	18	20	40	50	
82	1808210092	MOHD MOIN	23	30	18	20	41	50	
83	1808210093	MOHD SUHAIL	28	30	20	20	48	50	
84	1808210094	MOHD ABDUL QADIR	19	30	17	20	36	50	
85	1808210095	MOHD NAZEEF SHAN	23	30	18	20	41	50	
86	1808210096	MUHAMMAD FAIZAN	22	30	18	20	40	50	
87	1808210097	MUKUL	22	30	17	20	39	50	
88	1808210098	MUKUL YADAV	26	30	17	20	43	50	
89	1808210099	MURSHAD ALI	22	30	17	20	39	50	
90	1808210100	MUSKAN BHATNAGAR	24	30	17	20	41	50	
91	1808210101	MUSKAN SRIVASTAVA	22	30	17	20	39	50	
92	1808210102	NAJMUS SAQIB	22	30	17	20	39	50	
93	1808210103	NIRBHAY ARORA	28	30	18	20	46	50	
94	1808210104	OSHIBA ALI	27	30	17	20	44	50	
95	1808210105	PALLAVI TYAGI	30	30	17	20	47	50	
96	1808210106	PANKAJ KUMAR VERMA	14	30	16	20	30	50	
97	1808210107	PARAS NEGI	22	30	16	20	38	50	
98	1808210108	PARAS PANDEY	28	30	18	20	46	50	
99	1808210110	PAVEE CHOUDHARY	23	30	17	20	40	50	
100	1808210111	PEEYUSH KUMAR	25	30	18	20	43	50	
101	1808210113	PRACHI SAGAR	23	30	17	20	40	50	
102	1808210114	PRACHI CHAUHAN	28	30	17	20	45	50	
103	1808210115	PRASHANT BANSAL	28	30	20	20	48	50	
104	1808210116	PRIYANSHU MURARI	16	30	14	20	30	50	
105	1808210117	RAHUL	17	30	17	20	34	50	
106	1808210118	RASHI TYAGI	25	30	16	20	41	50	
107	1808210119	RASTOGI SURBHI	22	30	17	20	39	50	
108	1808210120	RITIK SRIVASTAVA	26	30	18	20	44	50	
109	1808210121	RITIKA CHAUDHARY	23	30	18	20	41	50	
110	1808210122	RITVIK TYAGI	20	30	20	20	40	50	
111	1808210123	RIYA JAIN	30	30	19	20	49	50	
112	1808210124	RIZWAN	27	30	16	20	43	50	
113	1808210125	ROHIT GAUTAM	25	30	16	20	41	50	
114	1808210126	SACHIN DIVAKER	14	30	16	20	30	50	
115	1808210129	SAMARTH PATHAK	30	30	19	20	49	50	
116	1808210130	SANJANA DUBEY	30	30	19	20	49	50	
117	1808210131	SANKALP GUPTA	22	30	18	20	40	50	
118	1808210132	SANSKRITI AGARWAL	28	30	15	20	43	50	
119	1808210133	SARTHAK SAXENA	26	30	15	20	41	50	
120	1808210134	SATAKSHI	28	30	15	20	43	50	
121	1808210135	SAURABH KUMAR	26	30	16	20	42	50	
122	1808210136	SAYYDUL MILLAT	24	30	15	20	39	50	
123	1808210137	SHAZAR ZAIDI	28	30	16	20	44	50	
124	1808210138	SHIVANI TYAGI	28	30	16	20	44	50	
125	1808210139	SHIVANSH MATHUR	23	30	14	20	37	50	
126	1808210140	SHIVANSH AGARWAL	23	30	17	20	40	50	
127	1808210141	SHIVANSHU AGARWAL	26	30	15	20	41	50	
128	1808210142	SHREY RUHELA	26	30	18	20	44	50	
129	1808210143	SHREYA CHAUHAN	26	30	14	20	40	50	
130	1808210144	SHUBH BHATNAGAR	26	30	17	20	43	50	
131	1808210146	SHUBHAM YADAV	23	30	18	20	41	50	
132	1808210147	SHUBHIKA SINGH	24	30	15	20	39	50	
133	1808210148	SOURABH SAINI	24	30	15	20	39	50	
134	1808210149	SPARSH RASTOGI	22	30	14	20	36	50	
135	1808210150	SRIJAN PANDEY	24	30	14	20	38	50	
136	1808210151	SUFIYA	28	30	18	20	46	50	
137	1808210152	SUHAIL AHMED	24	30	17	20	41	50	
138	1808210153	SUKRITI SINGH	26	30	15	20	41	50	
139	1808210154	SUMIT KUMAR	28	30	19	20	47	50	
140	1808210155	SUSHANT KUMAR	24	30	14	20	38	50	
141	1808210156	SUSHANT SINGH	24	30	15	20	39	50	
142	1808210157	TANVEER ALAM	28	30	16	20	44	50	
143	1808210158	UDIT RAJPUT	19	30	15	20	34	50	
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145	1808210160	UNNATI GANGWAR	26	30	16	20	42	50	
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148	1808210164	VASU GOEL	22	30	14	20	36	50	
149	1808210165	VASUNDHRA GUPTA	28	30	17	20	45	50	
150	1808210166	VEDIKA AGARWAL	26	30	16	20	42	50	
151	1808210167	VINAYAK VARSHNEY	28	30	19	20	47	50	
152	1808210168	VIRENDRA MOHAN	26	30	15	20	41	50	
153	1808210170	VISHAL TYAGI	24	30	15	20	39	50	
154	1808210171	YASH AGARWAL	28	30	17	20	45	50	
155	1808210172	ZAMAN ABBAS	26	30	14	20	40	50	
156	1900820108001	VISHAL SAINI	26	30	19	20	45	50	
157	1900820109001	ANUJ SHARMA	24	30	17	20	41	50	
158	1900820109002	HADIYA KHALEEQ	24	30	15	20	39	50	
159	1900820109003	SATYAM RASTOGI	26	30	17	20	43	50	
160	1900820109004	UDIT	24	30	16	20	40	50	
161	1900820109005	ZARREEN AQIQ	24	30	15	20	39	50	

Director's Signature

Faculty Signature

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In Pursuit of Excellence	Course Outcome Attainment	SESSION-2019-2020 SEM-IV

Course Name	Theory of Automata and Formal Languages
Course Code	KCS402
Batch	2018 2022
Semester	4
Session	2019 2020
L:T:P	3.1.0

CO Attainment and Analysis

Direct CO Attainment using Continuous Internal Examination (CIE)

Course Code	CO	CO Attained (% of students getting ≥ 60% marks)	CO Attained (On Scale of 3)
KCS402	CO1	86.96	2.61
	CO2	99.38	2.98
	CO3	100	3
	CO4	100	3
	CO5	100	3

Direct CO Attainment using Semester End Examination (SEE)

Course Code	CO	CO Attained (% of students getting ≥ 60% marks)	CO Attained (On Scale of 3)
KCS402	CO1	49.69	1.49
	CO2	49.69	1.49
	CO3	49.69	1.49
	CO4	49.69	1.49
	CO5	49.69	1.49

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Direct CO Attainment (CO_Direct)

Course Code	CO	CO Attained Using CIE (CO_CIE)	CO Attained using SEE (CO_SEE)	Direct CO Attainment (CO_Direct = 0.33*CO_CIE + 0.67*CO_SEE)	Direct CO Attainment (On Scale of 3)
KCS402	CO1	86.96	49.69	61.99	1.86
	CO2	99.38	49.69	66.09	1.98
	CO3	100	49.69	66.29	1.99
	CO4	100	49.69	66.29	1.99
	CO5	100	49.69	66.29	1.99

Indirect CO Attainment (CO_Indirect)

Course Code	CO	Indirect CO Attainment (CO_Indirect)	Indirect CO Attainment(On scale of 3)
KCS402	CO1	97.52	2.93
	CO2	95.03	2.85
	CO3	88.82	2.66
	CO4	98.14	2.94
	CO5	96.27	2.89

CO Attainment

Course Code	CO	Direct CO Attainment (CO_Direct)	Indirect CO Attainment (CO_Indirect)	CO Attainment (CO = 0.9*CO_Direct + 0.1*CO_Indirect)	CO Attainment (On scale of 3)	Y/N
KCS402	CO1	61.99	97.52	65.54	1.97	Y
	CO2	66.09	95.03	68.98	2.07	Y
	CO3	66.29	88.82	68.54	2.06	Y
	CO4	66.29	98.14	69.48	2.08	Y
	CO5	66.29	96.27	69.29	2.08	Y

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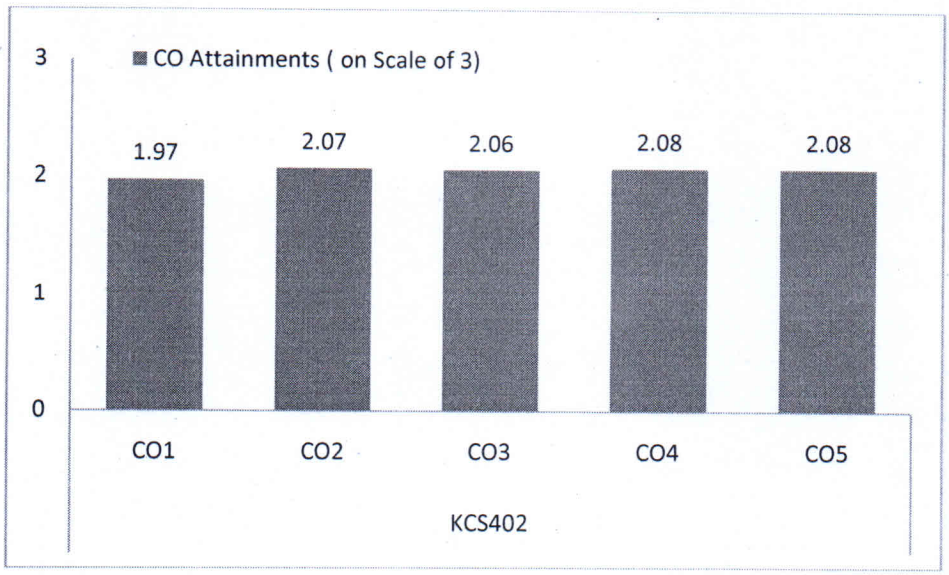
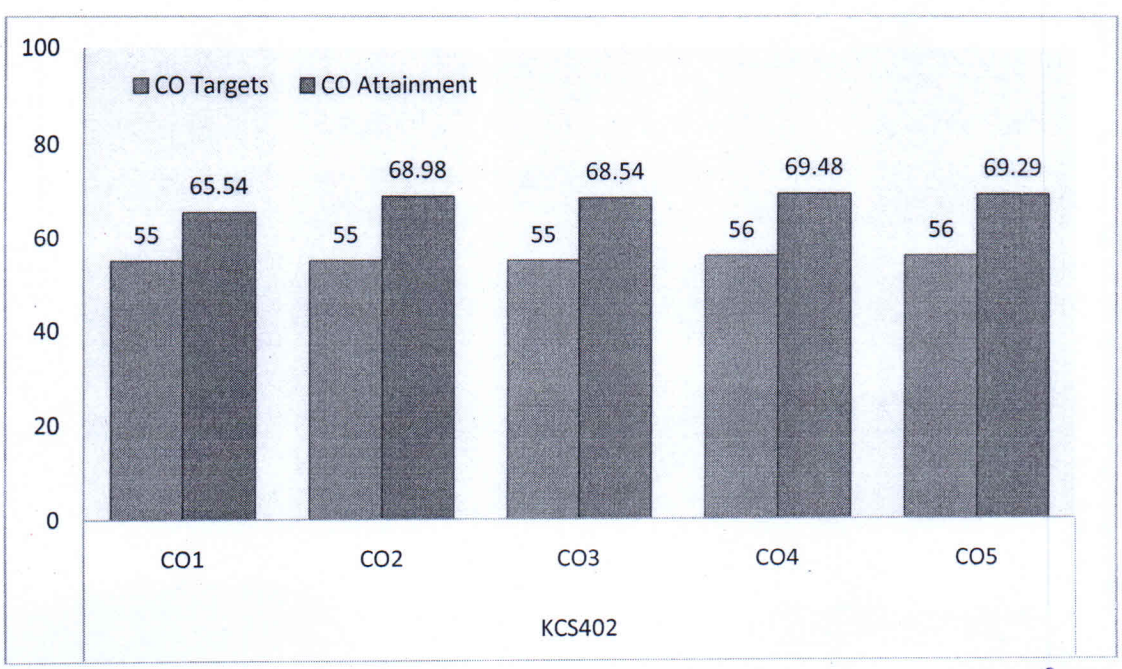


Course Code	CO	CO Targets	CO Attainment	Y/N
KCS402	CO1	55	65.54	Y
	CO2	55	68.98	Y
	CO3	55	68.54	Y
	CO4	56	69.48	Y
	CO5	56	69.29	Y



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Closure of Quality Loop

Course Code	CO	CO Targets	CO Attainment Gap	Action proposed to bridge the gap where targets are not achieved	Modification of targets where Achieved
KCS402	CO1	55	-10.54		Target will increased to 57%
	CO2	55	-13.98		Target will increased to 57%
	CO3	55	-13.54		Target will increased to 57%
	CO4	56	-13.48		Target will increased to 58%
	CO5	56	-13.29		Target will increased to 58%

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Sample Teaching –Learning Resources

Minimization of DFA

(Theory of Automata and Formal Language)

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Deptt. Computer Science &Engineering
Moradabad Institute of Technology, Moradabad
(UP)

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Minimization of DFA

- DFA minimization is the process of converting a given DFA to its equivalent DFA with minimum number of states.

- What is requirement of DFA Minimization?

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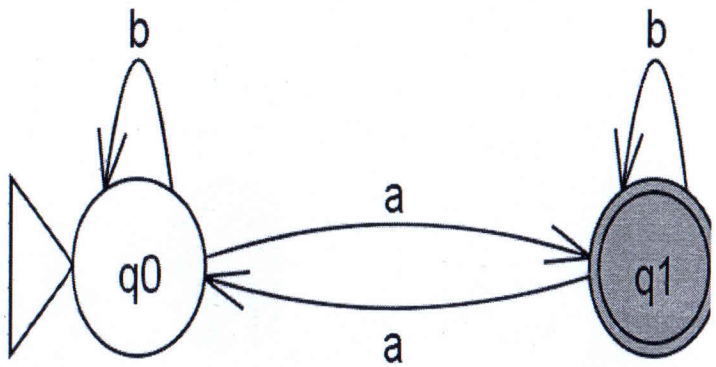
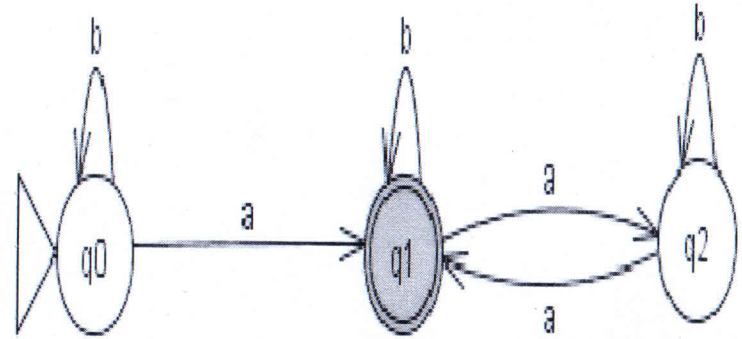
Minimization of DFA

- Problem: Design a DFA which accept odd number of ‘a’ over the ∑={a , b}.





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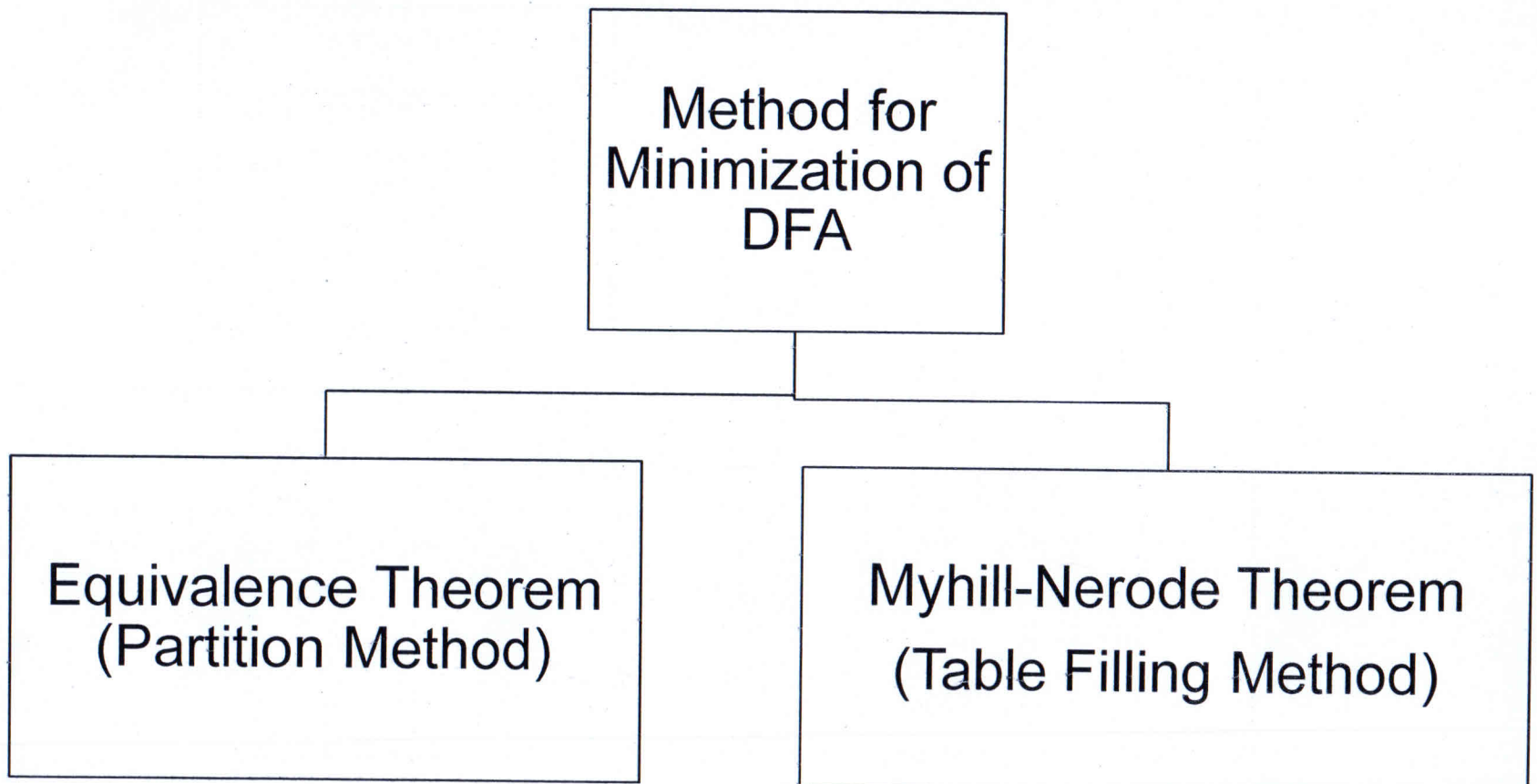
Minimization of DFA



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Minimization of DFA

- Two states will be equivalent
  $\delta(p,w) \in F \Rightarrow \delta(q,w) \in F$
  $\delta(p,w) \notin F \Rightarrow \delta(q,w) \notin F$

- If p and q are equivalent then we can combine them into 1 state.

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Minimization of DFA

- Type of equivalence:
  - If |w|=0, then p and q is said to be 0 equivalence
  - If |w|=1, then p and q is said to be 1 equivalence
  - If |w|=2, then p and q is said to be 2 equivalence
  - .
  - If |w|=n, then p and q is said to be n^{th} equivalence

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