CMR ENGINEERING COLLEGE
UGC AUTONOMOUS
(Approved by AICTE - New Delhi. Affiliated to JNTUH and Accredited by NAAC & NBA)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

COURSE INSTRUCTOR NAME: A.DIVYA REDDY **A.Y:2023-24**

SUBJECT NAME: Formal Languages and Automata Theory **CLASS ROONO:B-217&219**

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SEM START AND SEM END DATES: 21-08-2023 TO 24-12-2023

CONTENTS OF COURSE FILE:

1. DEPARTMENT VISION & MISSION

Vision:

To produce globally competent and industry-ready graduates in Computer Science & Engineering by imparting quality education with the know-how of cutting-edge technology and holistic personality.

Mission:

1. To offer high-quality education in Computer Science & Engineering in order to build core competence for the graduates by laying a solid foundation in Applied Mathematics and program frameworkwith a focus on concept building.

2. The department promotes excellence in teaching, research, and collaborative activities to prepare graduates for a professional career or higher studies.
3. Creating an intellectual environment for developing logical skills and problem-solving strategies, thus developing, an able and proficient computer engineer to compete in the current global scenario.

2. LIST OF PEOs, POs AND PSOs

2.1 Program Educational Objectives (PEO):

PEO 1: Excel in professional career and higher education by acquiring knowledge of mathematical computing and engineering principles.
PEO 2: To provide an intellectual environment for analyzing and designing computing systems for technical needs.
PEO 3: Exhibit professionalism to adapt current trends using lifelong learning with legal and ethical responsibilities.
PEO 4: To produce responsible graduates with effective communication skills and multidisciplinary practices to serve society and preserve the environment.

2.2. Program Outcomes (POs):

Engineering Graduates will be able to satisfy these NBA graduate attributes:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex

engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

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

2.3 Program Specific Outcomes (PSOs):

PSO1: Professional Skills and Foundations of Software development: Ability to analyze, design and develop applications by adopting the dynamic nature of Software developments.
PSO2: Applications of Computing and Research Ability: Ability to use knowledge in cutting edge technologies in identifying research gaps and to render solutions with innovative ideas..

3. LIST OF CO’s (ACTION VERBS AS PER BLOOM'S TAXONOMY)

COURSE OUTCOMES:

COURSE OUTCOMES COURSE NAME: FORMAL LANGUAGES AND AUTOMATA THEORY COURSE CODE: C301	
C301.1	**Define** grammar and automata with rigorously formal mathematical methods.**(Remembering)**
C301.2	**Interpret** regular expressions and context-free grammars accepting or generating a certain language**.(Understanding)**
C301.3	Explain about the language accepted by automata or generated by a regular expression or a context-free grammar. **(Understanding)**
C301.4	Define push down automata to determine acceptance by final state. **(Remembering)**
C301.5	**Design** complex problems and determine decidability of problems**. (Creating)**

REVISED Bloom's Taxonomy Action Verbs

Definitions	**I. Remembering**	**II. Understanding**	**III. Applying**	**IV. Analyzing**	**V. Evaluating**	**VI. Creating**
Bloom's Definition	Exhibit memory of previously learned material by recalling facts, terms, basic concepts, and answers.	Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas.	Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way.	Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations.	Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria.	Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions.
Verbs	• Choose • Define • Find • How • Label • List • Match • Name • Omit • Recall • Relate • Select • Show • Spell • Tell • What • When • Where • Which • Who • Why	• Classify • Compare • Contrast • Demonstrate • Explain • Extend • Illustrate • Infer • Interpret • Outline • Relate • Rephrase • Show • Summarize • Translate	• Apply • Build • Choose • Construct • Develop • Experiment with • Identify • Interview • Make use of • Model • Organize • Plan • Select • Solve • Utilize	• Analyze • Assume • Categorize • Classify • Compare • Conclusion • Contrast • Discover • Dissect • Distinguish • Divide • Examine • Function • Inference • Inspect • List • Motive • Relationships • Simplify • Survey • Take part in • Test for • Theme	• Agree • Appraise • Assess • Award • Choose • Compare • Conclude • Criteria • Criticize • Decide • Deduct • Defend • Determine • Disprove • Estimate • Evaluate • Explain • Importance • Influence • Interpret • Judge • Justify • Mark • Measure • Opinion • Perceive • Prioritize • Prove • Rate • Recommend • Rule on • Select • Support • Value	• Adapt • Build • Change • Choose • Combine • Compile • Compose • Construct • Create • Delete • Design • Develop • Discuss • Elaborate • Estimate • Formulate • Happen • Imagine • Improve • Invent • Make up • Maximize • Minimize • Modify • Original • Originate • Plan • Predict • Propose • Solution • Solve • Suppose • Test • Theory

Anderson, L. W., & Krathwohl, D. R. (2001). A taxonomy for learning, teaching, and assessing, Abridged Edition. Boston, MA: Allyn and Bacon.

Action Words for Bloom's Taxonomy

Knowledge	Understand	Apply	Analyze	Evaluate	Create
define	explain	solve	analyze	reframe	design
identify	describe	apply	compare	criticize	compose
describe	interpret	illustrate	classify	evaluate	create
label	paraphrase	modify	contrast	order	plan
list	summarize	use	distinguish	appraise	combine
name	classify	calculate	infer	judge	formulate
state	compare	change	separate	support	invent
match	differentiate	choose	explain	compare	hypothesize
recognize	discuss	demonstrate	select	decide	substitute
select	distinguish	discover	categorize	discriminate	write
examine	extend	experiment	connect	recommend	compile
locate	predict	relate	differentiate	summarize	construct
memorize	associate	show	discriminate	assess	develop
quote	contrast	sketch	divide	choose	generalize
recall	convert	complete	order	convince	integrate
reproduce	demonstrate	construct	point out	defend	modify
tabulate	estimate	dramatize	prioritize	estimate	organize
tell	express	interpret	subdivide	find errors	prepare
copy	identify	manipulate	survey	grade	produce
discover	indicate	paint	advertise	measure	rearrange
duplicate	infer	prepare	appraise	predict	rewrite
enumerate	relate	produce	break down	rank	role-play
listen	restate	report	calculate	score	adapt
observe	select	teach	conclude	select	anticipate
omit	translate	act	correlate	test	arrange
read	ask	administer	criticize	argue	assemble
recite	cite	articulate	deduce	conclude	choose
record	discover	chart	devise	consider	collaborate
repeat	generalize	collect	diagram	critique	collect
retell	give examples	compute	dissect	debate	devise
visualize	group	determine	estimate	distinguish	express
	illustrate	develop	evaluate	editorialize	facilitate
	judge	employ	experiment	justify	imagine
	observe	establish	focus	persuade	infer
	order	examine	illustrate	rate	intervene
	report	explain	organize	weigh	justify
	represent	interview	outline		make
	research	judge	plan		manage
	review	list	question		negotiate
	rewrite	operate	test		originate
	show	practice			propose
	trace	predict			reorganize
	transform	record			report
		schedule			revise
		simulate			schematize
		transfer			simulate
		write			solve
					speculate
					structure
					support
					test
					validate

4. SYLLABUS COPY AND SUGGESTED/REFERENCE BOOKS

UNIT-I

Fundamentals : Structural Representations,Automata and Complexity, the Central Concepts of Automata Theory-Alphbets, Strings, Languages, Problems.

Non deterministic finite automata: Formal definitions, finite automata model, acceptance of strings, and languages, deterministic finite automaton and non deterministic finite automaton, transition diagrams and Language recognizers.

Finite Automata: NFA with Epsion transitions - Significance, acceptance of languages. Conversions and Equivalence: Equivalence between NFA with and without e-transitions, NFA to DFA conversion, minimization of FSM, equivalence between two FSM's, Finite Automata with output- Moore and Melay machines.

UNIT –II

Regular expressions:

Regular Languages: Regular sets, regular expressions, identity rules, Constructing finite Automata for a given regular expressions, Conversion of Finite Automata to Regular expressions. Pumping lemma of regular sets, closure properties of regular sets (proofs not required).

UNIT – III

Context Free Grammars: Regular grammars-right linear and left linear grammars, equivalence between regular linear grammar and FA, inter conversion, Context free grammar, derivation trees, sentential forms. Right most and leftmost derivation of strings.

Push Down Automata: Push down automata, definition, model, acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence. Equivalence of CFL and PDA, interconversion. (Proofs not required). Introduction to DCFL and DPDA.

UNIT – IV

Context Free Grammars : Ambiguity in context free grammars. Minimisation of Context Free Grammars. Chomsky normal form, Greiback normal form, Pumping Lemma for Context Free Languages. Enumeration of properties of CFL (proofs omitted).

Turing Machine: Turing Machine, definition, model, design of TM, Computable functions, recursively enumerable languages. Church's hypothesis, counter machine, types of Turing machines (proofs not required). linear bounded automata and context sensitive language,

UNIT – V

Undecidability: decidability of, problems, Universal Turing Machine, undecidability of posts. Correspondence problem, Turing reducibility, Definition of P and NP problems, NP complete and NP hard problem.

Text books

T1. "Introduction to Automata Theory Languages and Computation".

Hopcroft H.E. and Ullman J. D. Pearson Education

T2.Introduction to Theory of Computation -Sipser 2nd edition Thomson

REFERENCE BOOKS

R1. Introduction to Computer Theory, Daniel LA. Cohen, John Wiley.

R2.Introduction to languages and the Theory of Computation, John C Martin, TMH

R3."Elements of Theory of Computation", Lewis H.P. & Papadimition C.H. Pearson! PHI.

R4.Theory of Computer Science - Automata languages and computation -Mishra and Chandrashekaran, 2nd edition, PHI

5. INDIVIDUAL TIME TABLE (A. DIVYA REDDY)

Time	9:10AM-10:10AM	10:10 AM-11:00AM	11:00 AM-11:50AM	11:50AM-12:40PM	12:40PM-1:20PM	1:20PM-2:20 PM	2:20PM-3:10PM	3:10PM-4:00PM
Period Day	I	II	III	IV		V	VI	VII
MON						FLAT III B	III B DAA LAB	
TUE		FLAT III D				FLAT III B		
WED		FLAT III B		FLAT III D			FLAT III B	
THU	FLAT III D					FLAT III B		FLAT III D
FRI		FLAT III B		FLAT III D				
SAT	FLAT III B						FLAT III D	

6. SESSION PLAN/LESSON PLAN

S.NO	Topic (JNTU syllabus)	Sub-Topic	NO. OF LECTURES REQUIRED	Actual date	Conducted date	Suggested Books	Teaching Methods
		UNIT – I(14)					
1	**Introduction to Finite Automata**	**Introduction:** Finite Automata	L1	21/8/2023	23/8/2023	**T1**	**M1**
2		Structural Representation, Automata and complexity	L2	24/8/2023	24/8/2023	**T1**	**M1**
3		The Central concepts of Automata Theory : Strings, Alphabet, Language, Operations	L3	25/8/2023	25/8/2023	**T1**	**M1**
4		Finite state machine, definitions, finite automaton model	L4	26/08/2023	26/8/2023	**T1**	**M1**
5		Non Deterministic Finite Automata-Formal definitions	L5	28/08/2023	28/08/2023	**T1,R1**	**M1**
6		Text search, an application, Transition diagrams	L6	31/08/2023	31/08/2023	**T1**	**M1**
7		Finite Automata with Epsilon-Transitions - Significance, acceptance of languages. Conversions and Equivalence	L7-L8	01/09/2023, 02/9/2023	01/09/2023, 02/9/2023	**T1**	**M1**
8		DefinitioN of DFA, how DFA process Strings, Languages,Problems	L9-L10	04/9/2023 07/9/2023	04/9/2023 07/9/2023	**T1,R1**	**M1**
9		Coversion of NFA with Epsilon transitions to NFA without Epsilon transitions	L11	8/9/2023	8/9/2023	**T1**	**M1**
10		Conversion of NFA to DFA	L12	09/9/23	09/9/23	**T1**	**M1**
11	, Finite Automata	Equivalence between two FSM’s, Finite Automata with output-	L13	14/9/23	14/9/23	**T1**	**M1**

	with output	Moore and Melay machines.					
12		Finite Automata with output- Moore and Melay machines.	L14	15/9/23	15/9/23	**T1**	**M1**
13		Exam	Exam	18/9/23	18/9/23		
		UNIT – II(10)					
14	**Introduction to Reg Lang**	Regular expressions, Regular sets	L15	20/09/2023	20/09/2023	**T1**	**M1**
15		Constructing finite Automata and regular expressions	L16	21/09/2023	21/09/2023	**T1**	**M1**
16		Applications of Regular expressions	L17	22/09/2023	22/09/2023	**T1,R2**	**M1**
17		Algebraic Laws of reg lang	L18	23/09/2023	23/09/2023	**T1**	**M1,M18**
18		Conversion of FA to RE	L19-L20	25/09/2023	25/09/2023	**T1**	**M1**
19		Pumping lemma of regular sets, statements of pumping lemma, Applications of pumping lemma	L21-22	29/09/2023	29/09/2023	**T1**	**M1,M6**
20		Closure properties of regular languages	L23-L24	30/09/2023	30/09/2023	**T1**	**M1**
21		Decision properties of Regular Languages	L25	3/10/2023	3/10/2023	**T1**	**M1**
22		Equavalence and Minimization of Automata	L26	04/10/2023	04/10/2023	**T1**	**M1**
23		UNIT 2 EXAM	test	04/10/2023	04/10/2023		
			UNIT-III(12) **Context Free Gramar**				
24		Defintion of Contex-free Grammar		6/10/2023	6/10/2023	**T1**	**M1**
25		Derivations Using a Grammer	L27	10/10/2023	10/10/2023	**T1**	**M1**
26		Leftmost and Rigthmost Derivations	L28	12/10/2023	12/10/2023	**T1,R2**	**M1,M2**
27		The language of a Grammer	L29	13/10/2022	13/10/2022	**T1**	**M1**
28		Sentential Froms	L30	15/10/2022	15/10/2022	**T1**	**M1**

29		Parse tress ,Application of Context-free grammer	L31	26/10/2023	26/10/2023	**T1**	**M1,M12**
30		Ambiguity in Grammer and languages	L32	27/10/2023	27/10/2023	**T1**	**M1**
31		Defintion of the pushdown Automata The language of a PDA	L33	30/10/2023	30/10/2023	**T1**	**M1**
32	**Introduction to Context Free Lnguage**	Equivalence of PDA's and CFG's	L34	02/11/2023	02/11/2023	**T1**	**M1**
33		Acceptance by final state,acceptance by empty stack	L35	03/11/2023	03/11/2023	**T1**	**M1**
34		Deterministic PDA from CFG	L36	04/11/2023	04/11/2023	**T1**	**M1**
35		TEST	TEST	8/11/2023	8/11/2023	**T1**	**M1**
		UNIT-IV(8)					
36	**Introduction to CNF,GNF, Turing M/C**	Elimating usless symbols, Eliminating e-Productions.	L37	10/11/2023	10/11/2023	**TI**	**M1**
37		Chomsky NF, Grieback NF	L38	13/11/2023	13/11/2023	**T1**	**M1**
38		Statement of pumping lemma	L39	16/11/2023	16/11/2023	**T1**	**M1**
39		Closure properties of CFL's	L40	17/11/2023	17/11/2023	**T1,R1**	**M1,**
40		Decision properties of CFL's	L41	18/11/2023	18/11/2023	**T1**	**M1**
41		Introduction to Turing Machine	L42	20/11/2023	20/11/2023	**T1**	**M1**
42		Fromal Description	L43	24/11/2023	24/11/2023	**T1**	**M1**
43		Instantaneous description The language of a Turing machine	L44	25/11/2023	25/11/2023	**T1**	**M1**
44		TEST		04/12/2023	04/12/2023		
		UNIT- V(9)					
45	**Turing M/C Undecidability Problems**	Types of Turing Machines: Turing machines and halting undeciability	L45	06/12/2023	06/12/2023	**T1**	**M1,M10**
46		Undecidability problems	L46	02/12/2023	02/12/2023	**T1**	**M1,M10**
47		A language that is not Recursively enumerable languages	L47	04/12/2023	04/12/2023	**T1**	**M1**

48		An Undecidable problem that is RE	L48	11/12/2023	11/12/2023	**T1**	**M1**
49		Undecidable problems about Turing machine	L49	14/12/2023	14/12/2023	**T1**	**M1**
50		Recursive Languages	L50	15/12/2023	15/12/2023	**T1**	**M1,M12**
52		Properties of Recursive Languages	L51	16/12/23	16/12/23	**T1,R1**	**M1.M8**
53		Post correspondace problem, MODIFIED PCP	L52	18/12/2023	18/12/2023	**T1**	**M1**
54		Other Undecidable problems, Counter Machine	L53	20/12/2023	20/12/2023	**T1**	**M1**
55		TEST	TEST	21/12/2023	21/12/2023		

METHODS OF TEACHING:

M1:Lecture Method	**M11:Tutorial**
M2:Demo Method	**M12:Assignment**
M3:Guest Lecture	**M13:Industry Visit**
M4:Presentation/PPT	**M14:Project Based Learning**
M5:Mind Map	**M15:Mnemonics**
M6:ATL Lab	**M16:Laboratory Improvement Future Trends**
M7:Group Learning	**M17:Collaborative Learning**
M8:One minute Paper	**M18:Think Pair Share**
M9 :Case Study	**M19:NPTEL Video Lectures**
M10:Flipped Classes	**M20:Innovative Assignment**

7. SESSION EXECUTION LOG:

S no	Unit	Scheduled started date	Completed date	Remarks
1	I	24/08/23	16/09/23	COMPLETED
2	II	20/09/23	05/10/23	COMPLETED
3	III	06/10/23	08/11/23	COMPLETED
4	IV	10/11/23	04/12/23	COMPLETED
5	V	06/12/23	22/12/23	COMPLETED

8.LECTURE NOTES – (HAND WRITTEN)

9.ASSIGNMENT QUESTIONS ALONG WITH SAMPLE ASSIGNMENTS SCRIPTS

Mid-1 Assignment

1. a) **Design** NFA which accepts set of all binary strings containing 1100 or 1010 as substrings. **[CO1]**

   b) **Design** a DFA to accept strings of 0's and 1's except those containing the substring aab. **[CO1]**

2. a) **Write** short notes on 5-tuple notation of finite Automata (NFA with Epsilon moves). **[CO1]**

   b) **Describe** the operations on regular expressions and identity rules. **[CO2]**

3. a) **Design** a Moore machine the residues mod 4 for each string treated as integer. **[CO1]**

   b) **Show** with an example equivalence between NFA and DFA**[CO1]**

4. a) **Construct** NFA equivalent to the regular expression 10(0+11)0*1? **[CO2]**

   b) **Write** the regular expression for the language L= {W belongs to (0,1) *1} W has no pair of consecutive 0's. **[CO2]**

5. **Explain** pumping lemma for regular languages with the applications of pumping lemma. Show that L= {a^{2n} | n<0} is not regular. **[CO2]**

Mid-2 Assignment

1. a) Design Push Down Automata for the language L={wcw R | w Є (0+1)*} [CO1] [2+3]

   b)Convert the following Context Free Grammar (CFG) to Chomsky Normal Form

   S→AaB | aaB

   A→€

   B→bbA | € [CO3]

2. a) Construct the Turing machine for the language L={ a n b 2n | n>=1}. [CO1] [2+3]

   b) Enlist various closure Properties of CFL's. [CO3]

3. a) Show that L={a n b n c n n>=0} is not a CFL. [CO2] [2+3]

   b)Design Turing Machine for the Language L={a n b n c n /n≥1}. [CO1]

4. a) Explain about various types of Turing Machine [CO3] [2+3]

   b)Construct a PDA for the following grammar S→AA/a, A→SA/b. [CO1]

5. a)Explain about the Decidability and Undecidability Problems. [CO3] [2+3]

   b)Construct PDA for L={X Є {a,b} * | n a (X)> n b (X)}. [CO1

6. a)Verify whether the following PCP has solutions or not?

   A={ba,ab,a,baa,b},B={bab,baa,ba,a,aba} [CO2][2+3]

   b)Explain about Counter Machines. [CO3]

10. MID EXAM QUESTION PAPERS ALONG WITH SAMPLE ANSWERS SCRIPTS

MID 1

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING-AI & ML

III YEAR I SEM I- MID TERM EXAMINATION SEP-2022

CS504PC-FORMAL LANGUAGES AND AUTOMATA THEORY

(COMMON TO CSE/IT/CSE-AIML/CSD/CSC)

PART-A **5X2=10**

1. Define Transition diagram with example. (CO1)
2. Write about the applications of Finite Automata? (CO1)
3. Write down the differences between Moore Machines and Mealy Machines?(CO1)
4. Defie context free grammar with example. (CO3)
5. State Arden's theorem. (CO2)

PART-B **3X5=15**

6. a)Convert the following NFA with ε to DFA shown in figure 1. (CO1)

	a	b	ε
→P	Φ	P	Q
Q	Q	Φ	R
R	Q	P	Φ

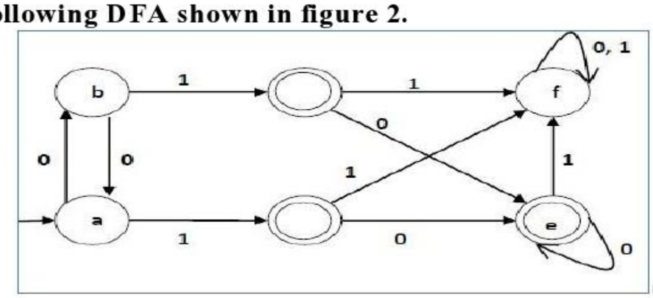
Figure: 1

b)Design Finite Automaton which accepts set of all strings not containing aaa as substring over input alphabet {a,b}. (CO1)

OR

7.a) Design DFA for the language all strings over {0,1} which are ending with 000 . (CO1)

b) Minimize the following DFA shown in figure 2.



(CO2)

Figure: 2

OR

8.a)Convert the following Finite Automata to it's equivalent Regular Expression as shown in figure 3. (CO2)

	a	b
→P	Q	P
(Q)	Q	P

Figure 3.

b)Construct Finite Automata for the regular expression $(0+1)^*(00+11)^*1$. **(CO2)**

OR

9.a)Construct Finite Automata for ((aaa+bbb)*aa)*bba. (CO2)

b) Explain about the identity rules of Regular Expressions. (CO2)

OR

10.a) Write a R.E. for the following DFA: (CO2)

b) Prove that the following language $\{a^p \mid p \text{ is prime}\}$ is not Regular. (CO2)

MID 2

CMR ENGINEERING COLLEGE

UGC AUTONOMOUS

(Approved by AICTE - New Delhi. Affiliated to JNTUH and Accredited by NAAC & NBA)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING-CYBER SECURITY
III YEAR I SEM II- MID TERM EXAMINATION DEC-2023
CS504PC-FORMAL LANGUAGES AND AUTOMATA THEORY
(COMMON TO CSE/IT/CSE-AIML/CSD/CSC)

PART –A

ANSWER ALL THE QUESTIONS

1. Give the closure properties of deterministic context free languages.(CO1)

2. Construct the PDA to the following grammar: (CO3)

S→AB
A→BS/b
B→SA/a

3. Write properties of recursively enumerable languages.(CO2)

4. What do you mean by Halting Problem.(CO1)

5. What are undecidable problems?(CO2)

PART - B

ANSWER ANY THREE QUESTIONS FROM THE FOLLOWING **3X5=15**

6 a. Construct a PDA for the following grammar **S→AA/a, A→SA/b.** [CO1] **[2+3]**

b. Convert the grammar **S→0AA, A→0S/1S/0** to a PDA that Accepts the same Language by Empty Stack. (**OR**)

[CO1]

7. a. Obtain GNF for **S→AB, A→BS/b , B→SA/a**. [CO1] **[2+3]**

b. Enlist various Decision closure Properties of CFL's. [CO3]

8 a. Construct a Turing Machine that will accept the Language consists of all **palindromes of 0's and 1's?.** [CO1] **[2+3]**

b. Give instantaneous description ID of Turing machine. [CO2]

(**OR**)

9. a. Explain about the Decidability and Undecidability Problems. [CO3] **[2+3]**

b. Obtain the solution for the following correspondence system

A={100,0,1},B={1,100,00}[CO2].

10.a)Obtain GNF for **S->AB, A->BS/b , B->SA/a.** **[CO1]**

b)Design a Turing Machine for **L={$0^n1^m0^n1^m$/m,n>=1}.** **[CO2]**

(**OR**)

11.a) Construct a Turing Machine that accepts those strings beginning with a '1'. **[CO3]**

b) Briefly write about Universal Turning Machine (UTM).

11. Scheme of Evaluation

SCHEME OF EVALUATION

Questions Number	Scheme of evaluation	Marks allotted
1	Definition	2
2	Design	2
3	Definition	2
4	Find	2
5	Definition	2
6	a)conversion b)design	2 3
7	a)design b)minimize	3 2
8	a)conversion b)Construct	2 3
9	a)Construct b)Explain	3 2
10	a)Write b)Prove	3 2

12. Mappings of Cos with Pos and PSOs

COURSE	Relationship of Course outcomes to Program Outcomes (PO AVG)												
COPO&PSO MATRIX	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C301.1	3	2	2	-	-	1	-	-	-	-	-	-	1	-
C301.2	2	3	-	-	-	-	-	-	-	-	-	-	1	-
C301.3	-	2	3	-	-	-	-	-	-	-	-	-	1	-
C301.4	2	2	3	1	-	-	-	-	-	-	-	-	1	-
C301.5	1	2	1	3	-	-	-	-	-	-	-	-	1	-

13. Attainment of COs, POs and PSOs

Justification:

CO1 : Define grammar and automata with rigorously formal mathematical methods.
Correlated with PO1 High: Basic Mathematics knowledge such as set theory, relations, functions and proof methods (induction, deduction, and contradiction) are used for verification of properties. Apply theory and principles of computer science engineering to solve an engineering problem.
Correlated with PO2 moderately: As this course outcome provides students identify different utilities but cannot contribute a solution to research problems, Complex Problems. So, overall the correlation of CO1 is good.
Correlated with PO3 moderately: It contributes to identify the problems that arises but, cannot provide a complete solution to Complex problems. Ability to explore design alternatives.
Correlated with PO6 Low: Describe requirement for continuing professional development.
Correlated with PSO1 Low : The skills of designing Finite state machines are relevant to design secure network systems.

CO2:. Interpret regular expressions and context-free grammars accepting or generating a certain language.
Correlated with PO1 moderately: Apply theory and principles of computer science engineering to solve an engineering problem.
Correlated with PO2 High:
Correlated with PSO1 Low: The skills of designing Finite state machines are relevant to design secure network systems..

CO3: Explain about the language accepted by automata or generated by a regular expression or a context-free grammar.
Correlated with PO4 moderately: contribution of this course outcome is weak for providing solutions for complex problems i.e in research area. The correlation is moderate.
Correlated with PO5 moderately: the CO contributes knowledge on different techniques on message passing among processes such that the student gets knowledge on using modern tools. So, the correlation of CO is Good.
Correlated with PO12 moderately: Students get knowledge on different techniques of message

passing so that it motivates student to learn new technologies. The correlation is moderate.
Correlated with PSO1 Low : The skills of designing Finite state machines are relevant to design secure network systems.

CO4:. **Define** push down automata to determine acceptance by final state.
Correlated with PO1 moderately: Because it contributes the knowledge on fundamentals of Linux file processing utilities which makes students get engineering knowledge and student can categorize different utilities. So, overall the correlation of CO1 to PO1 is good.
Correlated with PO2 moderately: as this course outcome provides students identify different Problems that occur when dealing with processes but cannot provide better solution for solving the issues So, overall the correlation of CO1 is good.
Correlated with PO3 High: outcome contributes better for identification of different solutions for problems. So, that the students can apply to build some applications. So the correlation is high.
Correlated with PSO1 Low : The skills of designing Finite state machines are relevant to design secure network systems.

CO5: Design complex problems and determine decidability of problems**. (Creating)**
Correlated with PO1 (low): The outcome contributes to apply the computer science knowledge so that the correlation is very good.
Correlated with PO2 modeately: the outcome will contribute to indentify the problems and design the application so the correlation is very good.
Correlated with PO3(low): outcome contributes for providing solutions for complex problems only. It may not provide scope for research so the outcome is correlated moderately.
Correlated with PO4 High: outcome contributes to limited scope usage of modern tools. So, it is correlated moderately.
Correlated with PSO1 Low : The skills of designing Finite state machines are relevant to design secure network systems.

14. ATTAINMENT OF CO's, PO's AND PSO's (EXCELSHEET):

RESULT NOT RELEASED.

15. Previous Year Question

Code No: R1622055 **R16** SET - 1

II B. Tech II Semester Regular/Supplementary Examinations, November - 2020
FORMAL LANGUAGES AND AUTOMATA THEORY
(Computer Science and Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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PART –A

1.	a)	Why it is important to study Automata Theory for Computer science?	2M
	b)	Write the regular expression for the L={w €_{0,1}* I w has no pair of consecutive zeros?	3M
	c)	Write the advantages of parse tree in identifying ambiguity.	2M
	d)	Write about the model of Push Down Automata.	3M
	e)	What is the name of the test that is used to evaluate whether a machine is intelligent human?	2M
	f)	Prove that integer linear programming is NP-Hard.	2M

PART -B

2.	a)	Describe the procedure of converting NFA to DFA with a suitable example..	7M
	b)	(0/1)*011 for this regular expression draw the NFA with ϵ-closures and convert it into NFA.	7M
3.	a)	Give a regular expression that generates the language L over the alphabet ∑={a, b} where each b in the string is followed by exactly one or three a's.	7M
	b)	Show that L={a^{2n}/n<0} is Regular.	7M
4.	a)	Define Context Free Grammar. State and Explain the closure properties of CFG.	7M
	b)	Discus various steps in signification of context free grammar. What is the need of such signification.	7M
5.	a)	Define Push Down Automata. Explain the basic structure of PDA with a neat graphical representation.	7M
	b)	Construct a PDA which accepts language of word over alphabet {a,b} canting {$a^ib^jc^k$/i,j,k €N,i+k=j}.	7M
6.	a)	Design a turing machines and its transition diagram to accept language greeted by {$a^ib^jc^k$/i,j,k €N,i+k=j}.	7M
	b)	Explain about types of Turing Machine warfare then.	7M
7.	a)	How to determine whether a problem is NP-Hard or P? Illustrate with an example.	7M
	b)	How can the Halting problem of Turing machine be Handled? Explain.	7M
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Code No: R1622055 **R16** SET - 1

II B. Tech II Semester Supplementary Examinations, April - 2021
FORMAL LANGUAGES AND AUTOMATA THEORY
(Computer Science and Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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PART –A

1.	a)	Write short notes on 5-tupple notation of finite automata.	(2M)
	b)	Write the regular expression for arithmetic expressions	(2M)
	c)	Construct a CFG generating all integers with sign	(3M)
	d)	Relate push down automata and instantaneous description languages	(2M)
	e)	Define Turing Machine and explain its model.	(2M)
	f)	Differentiate decidable and un decidable problems.	(3M)

PART –B

2.	a)	Explain the procedure for constructing minimum state DFA with an example.	(7M)
	b)	Design DFA which accepts language L={0,000,00000…….} over {0}	(7M)
3.	a)	What is regular expression? Write the regular expression for the following languages over {0, 1}* i) The set of all strings such that number of 0's is odd ii) The set of all strings that contain exactly three 1's iii) The set of all strings that do not contain 1101	(7M)
	b)	Explain pumping lemma for regular languages with the applications of pumping lemma.	(7M)
4.	a)	is ambiguous grammar? Explain how to eliminate the ambiguity from the grammar? Consider the example grammar from E→**E+E/E-E/E*E E→E/E E→(E)/id**	(7M)
	b)	Eliminate unit productions and ε-production from the grammar S→Aa/B, B→A|bb, A→a|bc|B	(7M)
5.	a)	Design a non deterministic push down automata for the following languages **L1={a^nb^n|n>=0}, L2={ww^R |w in (0+1)*}**	(7M)
	b)	Construct the PDA for the given grammar S→AA|a, A→SA|b	(7M)
6.	a)	Design Turing machine over{a,b} which can compute concatenation function over Σ={1}	(7M)
	b)	Explain the following i)Language of Turing machine ii) Types of Turing machine	(7M)
7.	a)	What is satisfiability problem? How Cook's theorem helps in deciding the NP completeness of problem.	(7M)
	b)	What is NP Problem? Explain with Travelling Sales person problem.	(7M)
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Code No: R1622055 **R16** SET - 1

II B. Tech II Semester Supplementary Examinations, June/July - 2022
FORMAL LANGUAGES AND AUTOMATA THEORY
(Computer Science and Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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PART –A

1.	a)	How to check acceptance of string by finite automata?	3M
	b)	Relate regular grammars and regular expressions.	2M
	c)	Specify the reason for eliminating useless symbols? How to identify them?	2M
	d)	How to convert the grammar to Push down automata?	2M
	e)	What is Turing machine halting problem?	3M
	f)	Give example problems of type NP-Complete.	2M

PART -B

2.	a)	Define Finite Automation? Explain about the model of Finite Automaton.	7M
	b)	Explain the sequence of steps in converting the ∈-NFA obtained in previous question 2(a) to an equivalent DFA.	7M
3.	a)	Explain about the Closure Properties of Regular sets.	7M
	b)	Explain the Pumping Lemma for regular sets. Show that $L=\{a^p \mid p \text{ is a prime}\}$ is not regular.	7M
4.	a)	Write in detail the Chomsky hierarchy of formal languages.	7M
	b)	Construct CNF for the Grammar $S\rightarrow ABC$, $A\rightarrow 0B$, $B\rightarrow CD/0$, $C\rightarrow 1$.	7M
5.	a)	Construct a pushdown automaton which accepts the language of words over the alphabet {a,b} containing more a's than b's.	7M
	b)	Consider the CFG with {S,A,X} as the non-terminal alphabet, {a,b} as the terminal alphabet, S as the start symbol and the following set of production rules $S\rightarrow XS \mid \epsilon$, $A\rightarrow aXb \mid Ab \mid ab$ Construct a PDA for the given CFG	7M
6.	a)	Design a Turing Machine “Parantheses Checker” that outputs 1 or 0 depending on whether the sequence is properly formed or not.	7M
	b)	Discuss in brief about Turing reducibility.	7M
7.	a)	How to determine a problem L is NP-complete? Explain with an example.	7M
	b)	Explain about the Decidability and Undecidability Problems.	7M
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UNIT WISE IMPORTANT QUESTIONS

UNIT1

1. Discuss about Finite automata Structural Representations, Automata and Complexity, the Central Concepts of Automata Theory - Alphabets, Strings, Languages, and problems.
2. Explain about Deterministic Finite Automata: Definition of DFA, How A DFA Process Strings, The language of DFA Conversion of NFA with €-transitions to NFA without €-transitions with example.
3. Conversion of NFA to DFA
4. Explain about Moore and Mealy machines
5. Explain about Nondeterministic Finite Automata: Formal Definition, an application, Text Search, Finite Automata with Epsilon-Transitions.

UNIT 2

1. Write about Regular Expressions: Finite Automata and Regular Expressions, Applications of Regular Expressions, Algebraic Laws for Regular Expressions.
2. Conversion of Finite Automata to Regular Expressions with example
3. Discuss about Pumping Lemma for Regular Languages, Statement of the pumping lemma, Applications of the Pumping Lemma
4. Write about Closure properties of Regular languages, Decision Properties of Regular Languages.
5. Explain about Equivalence and Minimization of Automata.

UNIT 3

1. Discuss about Definition of Context-Free Grammars, Derivations Using a Grammar, Leftmost and Rightmost Derivations, the Language of a Grammar,
2. Write about CFG of Sentential Forms, Parse Tress, Applications of Context-Free Grammars.
3. Write about Ambiguity in Grammars and Languages.
4. Write about Push Down Automata: Definition of the Pushdown Automaton, the Languages of a PDA, Acceptance by final state, Acceptance by empty stack,
5. Discuss about Deterministic Pushdown Automata. Equivalence of PDA's and CFG's, From CFG to PDA, From PDA to CFG.

UNIT 4

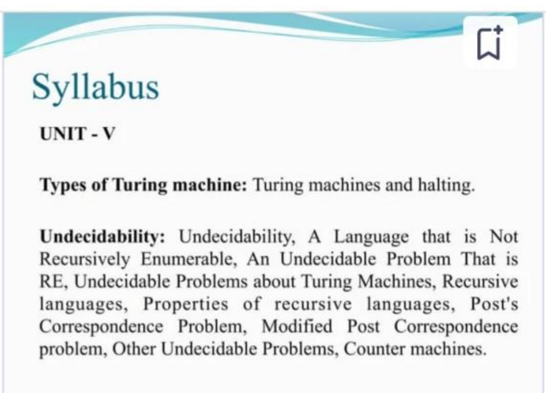
1. Write about Normal Forms for Context- Free Grammars: Eliminating useless symbols, Eliminating E-Productions.
2. Explain about Chomsky Normal form Griebech Normal form.

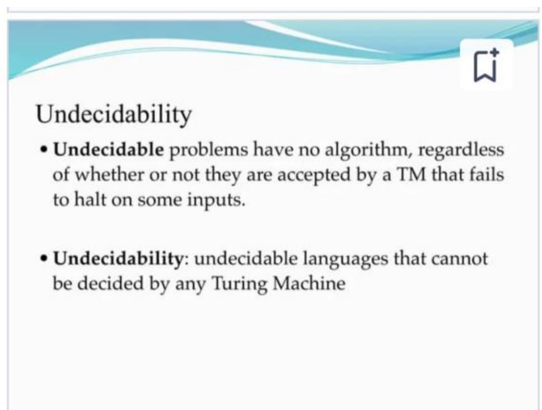
3. Discuss about Pumping Lemma for Context-Free Languages: Statement of pumping lemma. Applications
4. Explain about Closure properties of CFI,"s, Decision Properties of CFL's
5. Write about Introduction to Turing Machine, Formal Description, Instantaneous description, The language of a Turing machine,
6. Write about Turing machines and halting problems.

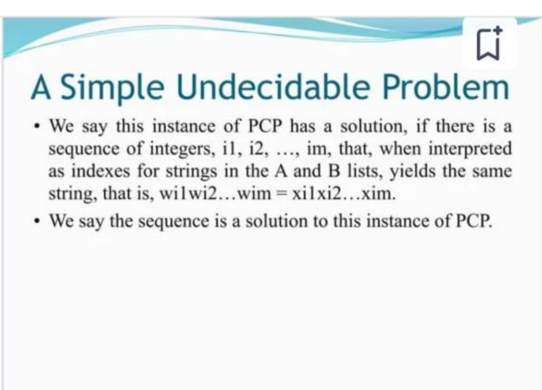
UNIT 5

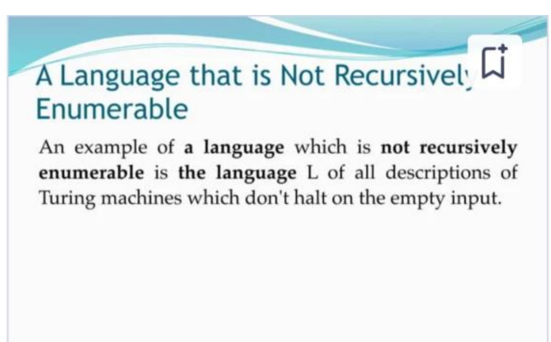
1. Write about Undecidability, A Language that is Not Recursively Enumerable.
2. Write about An Undecidable Problem That is RE, Undecidable Problems about Turing Machines.
3. Write about Recursive languages, Properties of recursive languages.
4. Write about Post's Correspondence Problem, Modified Post Correspondence problem.
5. Write about Other Undecidable Problems.

16. POWER POINT PRESENTATIONS: (SOFTCOPY)









Post's Correspondence Problems (PCP)

Post's Correspondence Problems (PCP): An instance of PCP consists of two lists of strings over some alphabets

- The two lists are of equal length, denoted as A and B.
- The instance is denoted as (A, B).
- We write them as A = w1, w2, …, wk B = x1, x2, …, xk for some integer k.
- For each i, the pair (wi, xi) is said a corresponding pair.

Example 1

	A	B
i	w_i	x_i
1	1	111
2	10111	10
3	10	0

s PCP instance has a solution: 2, 1, 1, 3:
$w_2w_1w_1w_3 = x_2x_1x_1x_3 = 101111110$

Example 2

	A	B
i	w_i	x_i
1	110	110110
2	0011	00
3	0110	110

This PCP instance has a solution: 2,3,1
$w_2w_3w_1 = x_2x_3x_1 = 00110110110$

One more solution:
2,1,1,3,2,1,1,3

PCP Instances

- **PCP Instances** :An instance of PCP is a list of pairs of nonempty strings over some alphabet Σ Say (w1, x1), (w2, x2), …, (wn, xn).
- The answer to this instance of PCP is "yes" if and only if there exists a nonempty sequence of indices i1,…,ik, such that wi1…win = xi1…xin.

Counter Machine

A Counter Machine M = (K, Σ, Δ, s, F)
K is a set of states
Σ is the input alphabet
s ∈ K is the start state
F ⊂ K are Final states
$\Delta \subseteq ((K \times (\Sigma \cup ϱ) \times \{zero, \neg zero\}) \times (K \times \{-1, 0, +1\}))$ Accept if you reach the end of the string, end in an accept state, and have an empty counter.

17. INNOVATIVE TEACHING METHODS IF ANY (ATTACHED INNOVATIVE ASSIGNMENT)

1. What are the applications of Turing machines in real life? Do modern computers use Turing machines?
2. What are the practical implications of the halting problem? Will the halting problem ever be solved?

18. REFERENCES(Text book/websites/journals):

- http://www.cse.chalmers.se/edu/course/TMV027/
- http://books.google.co.in/books?id=tzttuN4gsVgC&source=gbs_similarbook
- http://www.computersciencemcq.com/mcq.
- http://en.wikipedia.org/wiki/Formal_language
- http://en.wikipedia.org/wiki/Automata_theory
- http://cs.fit.edu/~dmitra/FormaLang/