Continuous Assessment Test II – October 2023

Programme	: B.Tech CSE	Semester	: FALL 2023-24
Course	: Theory of Computation	Code	: BCSE304L
		Slot	: F2+TF2
Faculty	: Dr. S. Suseela	Class Nbr	: CH2023240101111
	Dr. Amutha S		CH2023240100885
	Dr. Karmel A		CH2023240101109
Time	: 90 Minutes	Max. Marks	: 50

Answer ALL the questions

Q. No.	Questions	Marks
1.	Ram has to distribute the magazines in a locality only for five houses per day. He makes sure that the first and the last house will be distributed with the equal number of magazines. Similarly, the second and the fourth houses will have the same count of magazines. The third house will be supplied with only one magazine.	
	a. Define a language, L for the given problem. [2 marks]	2
	b. Design a push-down automaton, P that accepts L. [6 marks]	6
	c. Justify that the PDA designed in (1b), accepts the strings in L. [2 marks]	2
2.	a. Is the language $L = \{S_k \mid k > 0,$ where $S_0 = \varepsilon$ and $S_k = S_{k-1}a^k b^k$ for all $k > 0\}$ regular? Justify your answer.	5
	b. Is the language generated by the grammar, $G=(\{S,A\}, \{a,b,c,\varepsilon\}, \{S \rightarrow aSc \mid A, A \rightarrow bAc \mid \varepsilon\}, S)$ regular? Justify your answer.	5
3.	Given the language, $L = \{w \mid w$ is an element of $ab(ab)^n b(ba)^n \mid n >= 0\}$	6
	a. Construct the context-free grammar G for the given language L	
	b. Derive any two words from L.	4
4.	Given the languages, $L_1 = \{w \mid w$ is an element of $(ab)^i (c)^{2j} (d)^{2i} \mid i,j \geq 1\}$, $L_2 = \{a^m b^n c^k \mid k \geq m+n$ and n, m, k are non-zero integers$\}$ Design a push-down automaton that accepts $L_1 \cup L_2$	

Consider the context-free grammar G: ({S, T, X, U, Y, I}, {x, a, c, i, v, ε} P, S) with the set of productions P given below.

$$S \rightarrow xTU \mid aX \mid X$$
$$T \rightarrow c \mid a$$
$$X \rightarrow xX \mid U$$
$$U \rightarrow iY \mid vI \mid I$$
$$Y \rightarrow x \mid v$$
$$I \rightarrow iI \mid \varepsilon$$

Construct an equivalent grammar G' which is in Chomsky Normal Form.

5.

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VIT

Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

Continuous Assessment Test II – October 2023

Programme	: B.Tech CSE	Semester	:	FALL 2023-24
Course	: Theory of Computation	Code	:	BCSE304L
		Slot	:	F1+TF1
Faculty	: Dr. S. Suseela	Class Nbr	:	C112023240101110
	Dr. K. Sathyarajasekaran			C112023240101108
Time	: 90 Minutes	Max. Marks	:	50

Answer **ALL** the questions

Q.No.	Questions	Marks
1.	Design a Push Down Automata for the following language, a) $L = \{a^{2n} b^m c^p d^q e^{n+p} \mid n, m, p, q > 0\}$ (8 Marks) b) Validate a sample string of your choice for the given language over your machine. (2 marks)	10
2.	Let the language L be defined as, $L \rightarrow L_1 L_2$ Where, $(ab)^* a (b \mid a)^+$ is the regular expression for the language L_1 $(a^* \mid b^*) \mid (ab \mid ba)^*$ is the regular expression for the language L_2 Construct a Context-Free Grammar that generates all strings in L.	10
3.	Prove whether the following languages are regular or not regular. a) $L = \{w \mid w \ \{a, b\}^*$ and for every arrival of "a" there should be two "b's" in the string.(5 Marks) b) $L = \{0^i \ 1^{j+i} \ 2^{i+j} \mid i,j \geq 0\}$ (5 Marks)	10

4.	Given the following Context Free Grammar $G_1 = (\{X, Y, Z, S, T\}, \{0,1\}, P, X)$ with the set of all productions,
	
	 P= {
	 X→0Y1 | 1Y0 | Z11 | Y
	 Y→0Y | 1Y | ε | Z
	 Z→0Z0 | 1Z1
	 S→ZS | SY
	 T→ZSY | YSZ | S
	 }
		10

a) For the above given grammar G_1 provide an equivalent grammar G_2 in a simplified form. (6 Marks)

b) Write any two words generated by L (G_2). For the 1st generated word, perform LMD and RMD. (4M)

NOTE: word length should be greater than 7.

5.	$L = \{a^i b^{2j} \ / \ i, j>0 \text{ and } i=2j\}$ a) Construct Context Free Grammar G_1 for L. (4 Marks) b) For the generated CFG G_1 in question **5(a)** derive an equivalent grammar G_2 in Chomsky Normal Form. (6 Marks)	10

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CHENNAI

Continuous Assessment Test (CAT) – II   APRIL 2024

Programme	:	BTech Computer Science and Engineering	Semester	:	WIN 23-24
Course Code & Course Title	:	BCSE304L THEORY OF COMPUTATION	Class Number	:	CH2023240501827 CH2023240501829 CH2023240501831 CH2023240501832
Faculty	:	Dr. SATHYARAJASEKARAN K Dr. UMMITY SRINIVASA RAO Dr. B V A N S S PRABHAKAR RAO Dr. SARAVANAN P	Slot	:	C2+TC2
Duration	:	90 MINUTES	Max. Mark		50

General Instructions:
- Write only your registration number on the question paper in the box provided and do not write other information.
- Use statistical tables supplied from the exam cell as necessary
- Use graph sheets supplied from the exam cell as necessary
- Only non-programmable calculator without storage is permitted

Answer all questions

Q. No	Sub Sec.	Description	Marks
1.		Let $L=\{(abc)^n/n>0\}$ be a language. We know that $L^+=L \cup L^2 \cup L^3 \cup \dots$ Is L^+ regular? Justify your answer by writing a grammar if it is regular. Otherwise, show that L^+ is not a regular language.	10

Answer all questions

Q. No	Sub Sec.	Description	Marks
1.		Let $L=\{(abc)^n / n>0\}$ be a language. We know that $L^+=L \cup L^2 \cup L^3 \cup \ldots$. Is L^+ regular? Justify your answer by writing a grammar if it is regular. Otherwise, show that L^+ is not a regular language.	10
2.		Write a Context-Free Grammar (CFG) for the following: a) $(a^*\mid b^+)\, ba^*\, ab^2\, (a\mid b)^+$ (5 Marks) b) $L=L_1 L_2$, where $L_1 = \{(ab)^n\, ba\, (ab)^{2n} \mid n>0\}$, $L_2 = \{(ba)^m\, (ab)^n \mid n>m, m>0\}$. (5 Marks)	10
3.		Design a Pushdown Automaton that recognize the following language $L = \{x0y1 \,/\, x, y \in \{0, 1\}^*, \mid x\mid = \mid y\mid\}$.	10
4.		Check whether the following language regular or not. Justify your answer. $L = \{0^i 1^j 2^k \mid i>2j, j>k, k>0\}$.	10
5.		Given a Context-Free Grammar (CFG), $G=(N,T,P,S)$, where N is a finite set of non-terminals and $A \subset N$, T is a finite set of terminals, S is the start symbol, and production rules are of the form $A \rightarrow N^+$ or $A \rightarrow T^+$. Write an algorithm to convert G into Chomsky Normal Form (CNF). Illustrate the functionality of the algorithm with a suitable grammar.	10

***********All the best *************

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Answer all questions (00)

o	Description	Marks
	Let $L=\{(a)^{2n}/n>0\}$ be a language. We know that $L^+=L \cup L^2 \cup L^3 \cup \dots$ and $L^* = L^+ \cup \{\varepsilon\}$. Is $L*L^+$ regular? Justify your answer by writing a grammar to recognize the language $L*L^+$ is regular, Otherwise, show that $L*L^+$ is not a regular language.	10
	Given a Context-Free Grammar (CFG) $G= (N, T, P, S)$, where N is a finite set of non-terminals and $A \in N$, T is a finite set of terminals, S is the start symbol and production rules are of the form $A \to N^+T^+$ or $A \to T^+N^+$. Write an algorithm to convert G into Chomsky Normal Form (CNF). Illustrate the functionality of the algorithm with a suitable grammar.	10
	Let $L= \{5x^{2n}+2x^n / n \geq 0\}$ be a language, where input alphabet $\Sigma= \{5, 2, +, x\}$. Write a Context-Free Grammar (CFG) that recognize the language L.	10
	Design a Pushdown Automaton that recognize the following languages. (i) $L= \{0^n1^{2n+4} / n>0\}$ (5 marks) (ii) $L= \{a^mb^nc^k/ m, n, k>0\}$ (5 marks)	10
	A **palindrome** is a sequence of letters, numbers, or whole words that reads the same forwards as it does backwards. $L=\{wc0,1\}*/$ w is not a palindrome$\}$. Is L regular? Justify your answer.	10

***********All the best **************

Continuous Assessment Test (CAT) – II – APR 2024

Programme	:	B.Tech.(CSE Specialization in BAI, BRS & BPS)	Semester	:	Winter 23-24
Course Code & Course Title	:	BCSE304L & Theory of Computation	Class Number	:	CH2023240503053 CH2023240503057 CH2023240503055 CH2023240503349
Faculty	:	Dr.A.MENAKA PUSHPA, Dr.S. DEEPA NIVETHIKA, Dr. R. RENUKA DEVI, Prof. B. NATARAJAN	Slot	:	F2+TF2
Duration	:	90 Minutes	Max. Mark		50

General Instructions: Write only your registration number on the question paper in the box provided and do not write other information.

Answer all questions

Q. No	Sub Sec.	Description	Marks
1		A leading company wants to recruit some employees for a certain role and publishes an application form. The applicants are requested to sign up by filling the following basic information. (i) User Name: The first letter of the name should be in Capital Letters (No Space allowed in between the letters) **(2 Marks)** (ii) Indian Mobile Number: +91 followed by 10 digit mobile number (Starts with 8/9) **(2 Marks)** (iii) Email ID: (The email ID may consist of Capital Letters, Small Letters, Numbers, Symbols like –, _, dot. Example email ID's gmail.com, yahoo.in, vit.ac.in) **(3 Marks)** (iv) Password: The first Character is upper case followed by lower case alphabets, but only one digit could be allowed in between the lower cases. **(3 Marks)** Form the regular expressions to check the above-given patterns.	10
2		Build a context-free grammar for the Language over the alphabets {a,b,c} with strings that start and end with either b or c and divide them by a. The number of occurrences of each symbol in the string is one. Ensure the grammar is built with at least three variables. Use the CYK algorithm to check the membership and non-membership of the two input strings for the constructed CFG.	10
3		The Context Free Language comprises binary input symbols, where the language is built over 'i' times of zeros followed by 'j' times of ones followed by 'k' times of zeros where 'i' is less than 'j', which is less than 'k' for all the positive integer numbers. Construct the language and justify whether it is context-free or not.	10
4	a	Construct the Pushdown Automata over the input strings {a, b, c}, where the language process n numbers of a's followed by m number of b's and further it should be compared with m+n times of c's.	10
5	b	The job assigned to you is to create a pushdown automaton (PDA) that can identify strings over the alphabet {a, b} in which the number of occurrences of "a" is greater than the number of "b" occurrences. (i) Construct the language for the above given description. **(3 Marks)** (ii) Build the PDA and explain how it works and provide a thorough solution that explains the PDA's operation and includes the state transition diagram and transition rules. **(7 Marks)**	10

**********All the best***********

Continuous Assessment Test (CAT) – II – APR 2024

Programme	:	B.Tech.(CSE Specialization in BAI, BPS &BPS)	Semester	:	Winter 23-24
Course Code & Course Title	:	BCSE 304L & Theory of Computation	Class Number	:	CH2023240501052 CH2023240501056 CH2023240501054 CH2023240501175
Faculty	:	Dr. A MENAKA PUSHPA, Dr.S. DEEPA NIVETHIKA, Dr. R. RENUKA DEVI, Prof. B. NATARAJAN	Slot	:	F1+TF1
Duration	:	90 Minutes	Max. Mark	:	50

General Instructions: Write only your registration number on the question paper in the box provided and do not write other information.

Answer all questions

Q. No	Sub Sec.	Description	Marks
1		Consider two languages L_1 and L_2, where L_1 is the set of all strings that end with 01 and L_2 is the set of all strings that end with 001 and construct FA to accept the languages $L_1 \cup L_2$ and L_1.	10
2.		Construct a context-free grammar for Language L with a set of strings built over the symbols {a,b,c} that start with 'a' and end with 'c' in an equal and even number of occurrences starting from 2. The symbols a and c are separated by 2 b's. If the build CFG is not in Chomsky Normal Form then convert it into CNF.	10
3.	(a)	Consider the Language L contains the set of strings built over the alphabets {a, b, c} that starts with n number of a's followed by m number of b's and k number of c's. Where k is not equivalent to the addition of n and m. Using the pumping lemma shows whether the language L is CFL or not. Examine various choices of v and x. **(5 Marks)**	10
	(b)	Prove the Context-Free Grammar $S \rightarrow aSb|SS|\varepsilon$ is ambiguous using the maximum number of derivation trees for the string w, where $|w| >= 6$. **(5 Marks)**	
4.		In a web application, you create a system for processing and validating Extensible Markup Language (XML) documents. You must verify as part of the validation process that each XML document's beginning tag has a matching ending tag and is correctly nested. To handle the XML documents further, you must also extract specific data from them. To effectively validate the XML documents and extract the necessary data, create a nondeterministic pushdown automaton (NPDA). (i) Design the structure of the NPDA including states, input alphabet, stack alphabet, start state, accept state(s), and any additional states required for data extraction. **(3 Marks)** (ii) Define transition rules for the NPDA to validate XML tags and data extraction. **(3 Marks)** (iii) Explain the operation of the NPDA, detailing how it validates XML documents and extracts the required data. **(4 Marks)**	10
5		Create a Pushdown Automaton (PDA) tasked with recognizing strings according to the following criteria. A valid string in L starts with n times of a's, followed by exactly 4n times of b's, and m times of c's followed by exactly 3m times of d's. Verify the transition diagram using valid and invalid inputs.	10

***********All the best ************