Examinations Commencing from from 7th January 2021 to 20th January 2021

Program: **Computer Engineering**

Curriculum Scheme: 2016

Examination: Third Year Semester: V

Course Code: CSC504 and Course Name: Theoretical Computer Science

Time: 2 hour Max. Marks: 80

Q1	**Choose the correct option for following questions. All the Questions are compulsory and carry equal marks**
1.	The smallest finite automata which accepts the language {x | length of x is divisible by 5} has
Option A:	6 states
Option B:	5 states
Option C:	4 states
Option D:	3 states
2.	The functions used to represent working of Finite State Machine are _____.
Option A:	Output Function and State Function
Option B:	Machine Function and State transition Function
Option C:	Transition Function and Machine Function
Option D:	Output Function and Machine Function
3.	Which of the following regular expression over {0,1} denotes the sets of all strings not containing '100' as substring?
Option A:	0*(1+0)*
Option B:	0*1010*
Option C:	0* 1 01
Option D:	0*(10 + 1)
4.	Which of the following pair of Regular Expression is equivalent?
Option A:	(a+b)* = (a+b)*+(a+b)*
Option B:	(x+y) =x.y
Option C:	0*1=1
Option D:	(a.b)* = a*b*
5.	Identify Turing machine model:
Option A:	Multi tape turing machine
Option B:	Multi Stack turing machine
Option C:	Multi Queue turing machine
Option D:	No tape turing machine
6.	The transition function of NFA is represented as_____
Option A:	$\delta : Q \times \Sigma \rightarrow Q$
Option B:	$\delta : Q \times \Sigma \rightarrow 2^Q$
Option C:	$\delta : Q \times \Sigma \rightarrow \Sigma$

Option D:	$\delta : Q \times \Sigma \rightarrow Q^2$
7.	Which of the following Turing machine reproduce other Turing machine?
Option A:	Nested Turing Machine
Option B:	Universal Turing Machine
Option C:	Multi Tape Turing Machine
Option D:	Single Tape Turing Machine
8.	Which of the following is valid action while designing PDA for $L=\{a^n b^{n+1}, n \geq 1\}$
Option A:	For first 'b' perform no-operation
Option B:	For first 'b' perform push
Option C:	For first 'b' perform pop
Option D:	For first 'b' pop 'a'
9.	Consider the following two statements: S1: $\{0^{2n} \mid n \geq 1\}$ is a regular language S2: $\{0^m 1^n 0^{m+n} \mid m \geq 1 \text{ and } n \geq 1\}$ is a regular language Which of the following statement is true?
Option A:	Only S1
Option B:	Only S2
Option C:	Both S1 and S2
Option D:	Neither S1 nor S2
10.	Which of the following statements are true? S1: Halting problem is solvable. S2: Rice's theorem is used to prove some undecidable problems for TMs. S3: Post's Correspondence Problem is to find the correspondence sequence of integers. S4: Recursively enumerable languages are closed under complementation.
Option A:	S4 only
Option B:	S1 only
Option C:	S2 only
Option D:	S2 and S3
11.	For minimizing DFA which of the following statements are true? **Statement 1:** We can replace initial state. **Statement 2:** Any final state can be replaced by other final state only. **Statement 3:** Any non-final state can be replaced by other non-final state only. **Statement 4:** We cannot replace initial state.
Option A:	1 and 2
Option B:	1, 2 and 3
Option C:	2, 3 and 4
Option D:	1 and 3
12.	Which of the following statements is true? S1: Every context free grammar can be transformed into CNF S2: It is possible to obtain an equivalent unambiguous grammar for every ambiguous CFG. S3: CNF is more powerful than GNF

	S4: A CFG is normalized in order to remove ambiguity.
Option A:	S1 and S2
Option B:	S1 only
Option C:	S4 only
Option D:	S2 and S3
13.	Choose the correct statement
Option A:	There exists a universal TM, which can simulate any TM M on its input w.
Option B:	There does not exists a universal Turing machine, which can simulate any TM M on its input w.
Option C:	The universal language is recursive.
Option D:	The universal language is ambiguous.
14.	If M is a DFA accepting a language consisting of 0's and 1's that end in either '00' or '11'. What is the minimum number of states in M?
Option A:	2
Option B:	3
Option C:	4
Option D:	5
15.	Consider CFG G, which is defined as: S → aB | bA A → a | aS | bAA B → b | bS | aBB where S is the starting symbol. How many steps are required in LMD to generate "bbaaba"?
Option A:	5
Option B:	6
Option C:	7
Option D:	4
16.	The set of productions for the grammar G is P = {A -> a b | a A; a A b -> a B C b}. Hence, G is :
Option A:	Type-3 grammar
Option B:	Type-2 grammar
Option C:	Type-1 grammar
Option D:	Type-0 grammar
17.	If A is a class of problems solved by a TM that always halts and B is a class of problems solved by TMs that may not halt for an invalid input, then, which of the following statements is false?
Option A:	A is a recursive language
Option B:	B is a recursively enumerable language
Option C:	B is undecidable
Option D:	A is undecidable
18.	Which of the following identity is not correct in case of regular languages?
Option A:	R+R=R
Option B:	ε.R = R. E = R

Option C:	R*R=R
Option D:	(R*)* = R*
19.	What are the stack symbols in case of PDA for L = { $a^n b^m c^n$ n ≥ 1 }.
Option A:	Γ = { a, b, Z_0 }
Option B:	Γ = { a, Z_0 }
Option C:	Γ = { a, b, c, Z_0 }
Option D:	Γ = { a, b, c }
20.	What does the following transition of Turing Machine represent? (q_2, 0) → (q_3, *, S)
Option A:	Replace 0 by *, change state to q_3 and Halt
Option B:	No change on input tape
Option C:	Replace 0 by *
Option D:	Replace 0 by * , no change in state and Halt

Q2 (20 Marks)	**Solve any Four out of Six questions Each** **5 Marks**
A	Construct FSM to determine whether the binary number is divisible by 4.
B	State Arden's Theorem and Construct Regular Expression for the given Finite Automata. state | 0 | 1 →q1 | q1 | q2 *q2 | q2 | q3 q3 | q3 | q3
C	For the string "aabbabba" find the following: (i) Leftmost Derivation (ii) Rightmost Derivation (iii) Parse Tree Given the following grammar: S → aB| bA S → a|as | bAA S → b | bS |aBB
D	Express the following grammar CFG using CNF. S → ABA A → aA | ε B → bB | ε

E	Give the formal definition of pumping lemma for Regular language and use it to prove that the language $L=\{0^n1^n \mid n>0\}$ is not regular.
F	Write a short note on the Halting Problem.

Q3 (20 Marks)	**Solve any Two out of Three questions** **10 Marks Each**
A	Convert (0+ε) (10)*(ε+1) into NFA with ε-moves and obtain DFA.
B	Construct Turing Machine that accepts the language $L = \{ a^n b^n c^n : n \geq 1 \}$.
C	Construct a PDA for the language $L = \{wcw^r \mid w \in \{0, 1\}^*\}$ where w^r is the reverse of w.