b.	For the given predicate logic statements draw the parse tree and identify free and bounded variables. (i) . $\exists(x)\big(P(y,x)\wedge(\forall x(\neg Q(x,x)\vee P(x,z)))\big)$ (ii) $\forall x P\big(f(d),h(p,x,y),d,y\big)\rightarrow f(x)$	10	4	3	1,2,3
29. a.	Prove the following sequent of first order logic. (i) $\forall x\big(Q(x)\rightarrow R(x)\big),\exists x\big(P(x)\wedge Q(x)\big)\vdash\exists(x)\big[P(x)\wedge R(x)\big]$ (ii) $\forall x\big(P(x)\rightarrow Q(x)\big),\exists x P(x)\vdash\exists x Q(x)$	10	4	4	1,2,3
	(OR)				
b.	Prove the equivalence of $\neg\forall x P(x)\dashv\vdash\exists x\,\neg P(x)$ using natural deduction.	10	4	4	1,2,3
30. a.	Prove the formula $\Box A\rightarrow A$, $\Box A\rightarrow\Box\Box A$ and $OA\leftrightarrow\neg O\neg A$. Characterize the sets of reflective, transitive and linear frames.	10	3	5	1,2,3
	(OR)				
b.	Discuss on LTL with suitable example.	10	4	5	1,2,3

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Reg. No.														

B.Tech. DEGREE EXAMINATION, MAY 2022
Fifth & Sixth Semester

18CSE351T – COMPUTATIONAL LOGIC
(For the candidates admitted from the academic year 2018-2019 to 2019-2020)

Note:
(i) **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.
(ii) **Part - B** should be answered in answer booklet.

Time: 2½ Hours Max. Marks: 75

	Marks	BL	CO	PO
PART – A (25 × 1 = 25 Marks) Answer **ALL** Questions				
1. Symbol for disjunction is (A) $\vee$ (B) $\wedge$ (C) μ (D) ϕ	1	1	1	1
2. Biconditional ($\leftrightarrow$), is a Boolean operator. (A) Neither true nor false (B) True (C) False (D) Either true or false	1	2	1	1
3. A truth table is a convenient format for displaying the _____. (A) Statement with symbols (B) Values (C) Semantics of a formula (D) Variables	1	1	1	1
4. The formulae of the logic are built from atomic propositions, which are statements that have no _____. (A) External structure (B) Constant values (C) Boolean variables (D) Internal structure	1	2	1	1
5. $A_1\equiv A_2$ IF and only IF $A_1\leftrightarrow A_2$ is true in every interpretation. (A) False (B) Neither true nor false (C) True (D) Either true or false	1	1	1	1
6. A set of literals is satisfiable IF and only IF it does not contain a complementary pair of literals. Is it true? (A) True (B) False (C) Neither true nor false (D) Either true or false	1	1	2	1,2
7. IF $\phi_1,\phi_2....\phi_n\vdash\psi$ is valid, then $\phi_1,\phi_2....\phi_n\models\psi$ holds. This justification is (A) Tautology (B) Soundness (C) Completeness (D) Contradiction	1	2	2	1,2
8. What is the value of $\rightarrow$ if both the values are false? (A) Neither true nor false (B) Either true or false (C) True (D) False	1	1	2	1,2

9. Which of the following value is not true? 1 2 1,2
(A) A≡¬¬A (B) A↔A
(C) A→A (D) A∧¬A

10. Proof role for equality introduction is 1 1 2 1,2
(A) $\frac{}{t=t}=\mathrm{i}$ (B) $\frac{t}{t_1=t}=\mathrm{i}$
(C) $\frac{t_1}{t=t}=\mathrm{i}$ (D) $\frac{t_3}{t_1=t_2}=\mathrm{i}$

11. The first order logic is the extension of 1 2 3 1,2
(A) Temporal logic (B) Propositional logic
(C) Predicate logic (D) Semantic logic

12. _____ is the existential quantifier and is read as there exists. 1 1 3 1,2
(A) ϕ (B) μ
(C) ∀ (D) ∃

13. Which of the following is reflexive property? 1 2 3 1,2
(A) $t_1 = t_1$ (B) $t_1 = t_2$
(C) $t_3 = t$ (D) $t_1 = t_1$'

14. The C-rule is a rule of 1 1 3 1,2
(A) Substitution (B) Inference
(C) Symbols (D) Constants

15. Completeness means that every valid formula has a _____. 1 2 3 1,2
(A) Literals (B) Variables
(C) Symbols (D) Proofs

16. A _____ is a positive unit horn clause A← 1 2 4 1,2,3
(A) Goal clause (B) Program clause
(C) Fact (D) Real

17. A set of procedure is a _____ program. 1 2 4 1,2,3
(A) Logic (B) Coding
(C) Statement (D) Expression

18. Prolog was the _____ logic programming language. 1 1 4 1,2,3
(A) First (B) Second
(C) Third (D) Fourth

19. Validity in first-order logic is 1 2 4 1,2,3
(A) Decidable (B) Undecidable
(C) Predictable (D) Unpredictable

20. Whether ψ holds in all implementations M1 ∈M, the statement is 1 2 4 1,2,3
(A) Consistency checking (B) Multiple checking
(C) Assertion checking (D) Manual checking

21. Temporal logic is a formal system for reasoning about _____. 1 2 5 1,2,3
(A) Velocity (B) Speed
(C) Acceleration (D) Time

22. A transition system models is a system by means of 1 1 5 1,2,3
(A) Statements (B) States
(C) Logicals (D) Graphs

23. CTL allows explicit quantification over 1 2 5 1,2,3
(A) Line (B) Graph
(C) Paths (D) Trees

24. The interpretation with a transtive relation is characterized by the formula _____. 1 1 5 1,2,3
(A) OA → OOA (B) ϕA → ϕϕA
(C) $\Box A \rightarrow \Box\Box A$ (D) εA → εεA

25. _____ are related to formal systems called modal logics on time 1 2 5 1,2,3
(A) Propositional logic (B) First order logic
(C) Temporal logic (D) Temporal and propositional logic

PART – B (5 × 10 = 50 Marks)
Answer **ALL** Questions

Marks BL CO PO

26. a. Check whether the following formula is well formed formula using PROPDET function and draw the parse tree for it. 10 4 1 1
(i) $\big((P \rightarrow \neg Q) \wedge (Q \rightarrow R)\big) \rightarrow (P \rightarrow R)$
(ii) $\big((P \wedge Q) \rightarrow R)\big) \rightarrow \big((Q \rightarrow R) \wedge P\big)$

(OR)

b. Check whether the given equations hold semantic entailment. 10 3 1 1
(i) $\big((P \vee Q) \wedge \neg P\big) \vDash Q$
(ii) $(x \leftrightarrow y) \vDash (x \rightarrow y) \wedge (\neg x \rightarrow \neg y)$

27. a. With the help of natural deduction, identify the rules that can be formed and prove it. 10 3 2 1,2

(OR)

b. Solve the following sequent using natural deduction rules and derived rules. 10 4 2 1,2
(i) $p \rightarrow (q \vee r),\ \neg q,\ \neg r \vdash \neg p$
(ii) $\vdash (p \rightarrow q) \rightarrow \big((r \rightarrow s) \rightarrow (p \wedge r) \rightarrow (q \wedge s)\big)$

28. a. Find the appropriate predicates and translate the following into first order logic. 10 4 3 1,2,3
(i) "All red things are in the box"
(ii) "No animal is both a cat and a dog
(iii) "No lecture was attended by every student"

(OR)