

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**FIFTH SEMESTER B.TECH DEGREE EXAMINATION(S), MAY 2019**

**Course Code: CS367**

**Course Name: LOGIC FOR COMPUTER SCIENCE**

Max. Marks: 100

Duration: 3 Hours

**PART A**

*Answer all questions, each carries 3 marks.*

Marks

- |   |  |     |
|---|--|-----|
| 1 | Using Truth table check whether the given statement is valid or not.<br>“If it rains there won’t be cricket match and cricket will be played if no rain” | (3) |
| 2 | Prove $((A \rightarrow B) \rightarrow A) \rightarrow A$ in Hilbert system  | (3) |
| 3 | Convert the formula $[(a \vee b) \wedge (d)]$ into 3CNF  | (3) |
| 4 | Draw the tree representation of the formula $(p \rightarrow (q \rightarrow r)) \rightarrow ((p \rightarrow q) \rightarrow (p \rightarrow r))$            | (3) |

**PART B**

*Answer any two full questions, each carries 9 marks.*

- |   |   |     |
|---|---|-----|
| 5 | a) Explain the clausal representation of propositional formulas and the concept of resolution.  | (5) |
|   | b) Resolve the set of clauses, $S_1 = \{pqr, \neg q, p \neg rs, qs, p \neg s\}$ and $S_2 = \{p \neg q, q \neg r, rs, p \neg s\}$      | (4) |
| 6 | a) Prove $\vdash (A \rightarrow B) \rightarrow [(B \rightarrow C) \rightarrow (A \rightarrow C)]$ in Hilbert system.                  | (5) |
|   | b) Explain the following cases for a Propositional logic formula i) Satisfiability ii) Validity iii) Falsifiability iv) Contradiction | (4) |
| 7 | a) Give an algorithm to construct semantic tableaux for Propositional Logic formula.  | (5) |
|   | b) Prove that construction of semantic tableaux for a formula A in propositional logic always terminates.                             | (4) |

**PART C**

*Answer all questions, each carries 3 marks.*

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|----|---|-----|
| 8  | Construct the formation tree for the formula $\exists x(\neg \forall y P(x,y) \wedge \neg \forall y P(y,x))$  | (3) |
| 9  | Define any 3 possible interpretations for the formula $\exists x P(a,x)$ and find the truth value of the formula under each of the interpretations. | (3) |
| 10 | Explain the concept of ground resolution with an example.   | (3) |
| 11 | What are Herbrand bases?. Give the Herbrand bases for the following set of clauses $S = \{P(a, f(x,y)), \neg P(b, f(x,y))\}$                        | (3) |

**PART D***Answer any two full questions, each carries 9 marks.*

- 12 a) What is the relevance of Binary Decision Diagrams? (3)
- b) Create a reduced ordered BDD for the formula  $(p \vee q) \wedge (\neg q \vee r)$  with an order  $(p, q, r)$ . Check the satisfiability of the formula. (6)
- 13 a) Write down the algorithm for construction of semantic tableaux for first-order logic. (5)
- b) Using tableaux check the satisfiability of the formula  $\forall x (p(x) \vee q(x)) \rightarrow (\forall x p(x) \vee \forall x q(x))$  (4)
- 14 a) Explain unification algorithm (4)
- b) Check whether the following sets of clauses are unifiable with the help of unification algorithm (5)
- $\{p(f(a), f(x, y, z)), \neg p(x, f(y, f(a), g(b)))\}$
- If unifiable find out most general unifier  $\sigma$ .

**PART E***Answer any four full questions, each carries 10 marks.*

- 15 a) What are the similarities and differences between PTL and LTL formulas. (4)
- b) Explain how interpretations are defined in PTL. Define satisfiability and validity of formulas in PTL. (6)
- 16 a) Explain PTL formulas with examples. What are the operators used in PTL (5)
- b) Check the satisfiability of the formula  $\Diamond p \wedge \Box q$  for the following state transition (5)

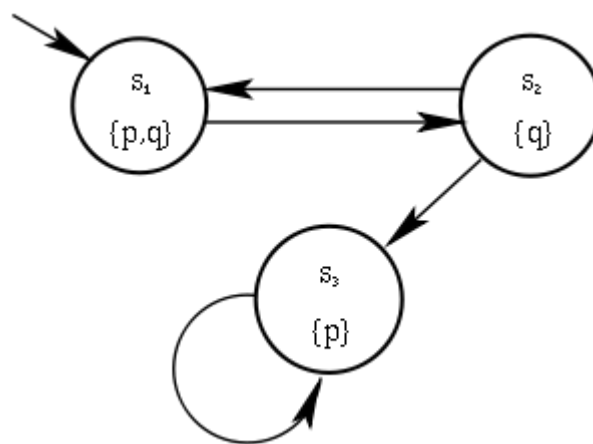


diagram given

- 17 a) Explain the algorithm for construction of semantic tableaux for LTL formulas (5)
- b) Check the satisfiability of  $(p \wedge q) \wedge \bigcirc (\neg p \vee \neg q)$  using semantic tableaux (5)
- 18 a) Explain correctness of formulas with an example. (4)

- b) Explain the axioms of Hoare Logic. (6)
- 19 a) Use Hoare Logic to prove partial correctness of following program (7)
- ```
{a ≥ 0}  
x = 0; y = 1;  
while (y ≤ a)  
{  
  x = x + 1;  
  y = y + 2*x + 1;  
}  
{0 ≤ x2 ≤ a < (x + 1)2}
```
- b) How to perform program synthesis using program correctness? (3)
- 20 a) Explain axiom schemes and axiomatic systems in KC. (6)
- b) Draw the parse tree for  $\Box(\Diamond(\neg p \leftrightarrow p) \wedge (\Box(p \rightarrow q) \vee \neg q))$  (4)

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