H0010 **Total Pages: 2**

Reg No.:_______________ Name:_______________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B. TECH (HONOURS) DEGREE EXAMINATION, DECEMBER 2017

Course Code: CS367

Course Name: LOGIC FOR COMPUTER SCIENCE (CS)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks. Marks

1		What is a Trivial Clause? Explain how the logical equivalence of a formula is maintained after removing it?	(3)
2		Define the following terms with examples: i) Valid ii) Satisfiable iii) Unsatisfiable.	(3)
3		Derivation tree and Formation tree for $((A \wedge B)\rightarrow C)\rightarrow((A\rightarrow C) \vee (B\rightarrow C))$.	(3)
4		The following formulas are interpreted as True. $p\vee q$, $p\rightarrow r$, $q\rightarrow r$. Prove r is true using resolution.	(3)

PART B

Answer any two full questions, each carries 9 marks.

5	a)	Prove that there is a unique formation tree for every derivation tree.	(4)
	b)	Explain the procedure for resolution with example.	(5)
6	a)	Prove whether the following formulas are satisfiable or not using semantic tableaux $\neg(a\rightarrow b) \wedge (\neg a\vee b)$ and $\neg((p\rightarrow q) \wedge (r\vee \neg(r\vee\neg p)))$	(4)
	b)	Show that: i) $\{(p\wedge (q\wedge r), s\wedge t\} \models q\wedge s$ ii) $\models(a\rightarrow b) \vee(b\rightarrow c)$	(5)
7	a)	Prove that any formula in Propositional logic can be converted into an equivalent formula in Conjunctive Normal Form with examples	(5)
	b)	Prove $\vdash (\neg A\rightarrow A)\rightarrow A$ in H	(4)

PART C

Answer all questions, each carries 3 marks.

8		Find an interpretation which falsifies $\exists xp(x)\rightarrow p(a)$.	(3)
9		For the $\forall x\forall y(\exists zp(z)\wedge \exists u(q(x, u)\rightarrow \exists vq(y, v)))$, describe the Herbrand universe and the Herbrand base.	(3)
10		Prove that ground resolution is sound and complete.	(3)
11		Explain the steps in constructing semantic tableaux for predicate logic with example	(3)

PART D

Answer any two full questions, each carries 9 marks.

12	a)	Construct a reduced Binary Decision Diagram for the formula $A = p \oplus q \oplus r$	(5)
	b)	How can OBDDs be used to check if $A \models B$?	(4)
13	a)	Prove in H : $\vdash \forall x(p(x)\rightarrow q)\leftrightarrow\forall x(\neg q\rightarrow \neg p(x))$.	(4)
	b)	Transform each of the following formulas to clausal form: $\forall x(p(x)\rightarrow\exists yq(y))$ and $\exists x(\neg\exists yp(y)\rightarrow\exists z(q(z)\rightarrow r(x)))$.	(5)
14	a)	Unify the following pairs of atomic formulas. i) p(a, x, f (g(y))), p(y, f (z), f (z))	(4)

ii) p(x, g(f (a)), f (x)), p(f (a), y, y)

iii) p(x, g(f (a)), f (x)), p(f (y), z, y)

iv) p(a, x, f (g(y))), p(z, h(z, u), f (u)).

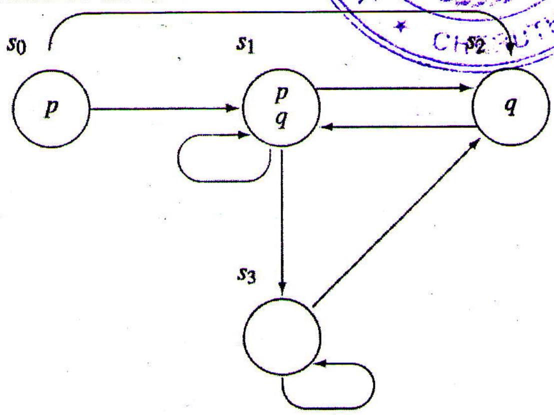
b) Prove: $\models \forall x(A(x) \vee B(x)) \rightarrow \forall x A(x) \vee \exists x B(x)$ (5)

PART E

Answer any four full questions, each carries 10 marks.

15 a) Construct a tableaux and find a model for the negation of $\Box\Diamond p \rightarrow \Diamond\Box p$ (5)

b) Compute the truth value of the formula $\Box p \vee \Box q$ for each state s in fig. (5)



16 a) Define Linear Temporal Logic. How interpretation is done for an LTL formula? (5)

b) What are next and future formulas? And distinguish between $\Box\Diamond p$ and $\Diamond\Box p$ (5)

17 a) Prove that $\vdash \bigcirc(p \wedge q) \leftrightarrow (\bigcirc p \wedge \bigcirc q)$. (5)

b) Prove that $\vdash p \wedge \bigcirc\Box p \rightarrow \Box p$. (5)

18 a) Prove the partial correctness of the following program. (5)

```
{true}
x = 0;
{x = 0}
y = b;
{x = 0 ∧ y = b}
while (y != 0)
   {x = (b − y) · a}
   {
      x = x + a;
      y = y - 1;
   }
{x = a · b}
```

b) Prove that $\vdash \{true\}\ P\ \{x = a \cdot b\}$. (5)

19 a) What is the total correctness of a program. Explain using example. (5)

b) What are the axioms and rules used in deductive system Hoare logic? (5)

20 a) What are rules which recursively define Modal propositions (6)

b) Consider the model M: [w] ⟶ [u] $\Vdash p$. Which of the following mps are true at the world w? (4)

$\Box p \rightarrow \Box\Diamond p$, $\Diamond p \rightarrow \Box\Diamond p$, $\Box p \rightarrow \Diamond\Box p$ $\Diamond p \rightarrow \Diamond\Box p$

****