Reg No.:_______________ Name:_______________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fifth Semester B.Tech Degree (S,FE) Examination January 2023 (2015 scheme)

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		Prove the satisfiability of $A = p \wedge (\neg q \vee \neg p)$ using semantic tableaux method.	(3)
2		Compute the truth value of $(p \rightarrow q) \leftrightarrow (\neg q \rightarrow \neg p)$ for the interpretation I (p) = T and I (q) = F.	(3)
3		Prove in Hilbert system $\vdash (A \rightarrow B) \rightarrow [(B \rightarrow C) \rightarrow (A \rightarrow C)]$.	(3)
4		Compare CNF and 3CNF representations in propositional logic	(3)
5		Explain clausal representaion and transform the set of formulas $\{p, p\rightarrow((q \vee r)\wedge\neg(q \wedge r)), p\rightarrow((s \vee t) \wedge\neg (s \wedge t)), s \rightarrow q, \neg r \rightarrow t, t \rightarrow s\}$ into clausal form and refute using resolution.	(9)
6	a)	Explain the deduction rules in Hilbert system.	(4.5)
	b)	Prove $A \wedge (B \vee C) \equiv (A \wedge B) \vee (A \wedge C)$	(4.5)
7	a)	Prove the following a) $\models (A \rightarrow B) \vee (B \rightarrow C)$. b) $A \rightarrow B \equiv \neg(A \wedge \neg B)$	(9)

PART C

Answer all questions, each carries 3 marks.

8		Show the tree representation of the formula: $\forall x(\neg\exists y p(x,y) \vee \neg\exists y p(y,x))$.	(3)
9		Write the unification algorithm.	(3)
10		How can you determine if two formulas are identical using BDD?	(3)
11		Define the terms validity and satisfiability of first order logic.	(3)

PART D

Answer any two full questions, each carries 9 marks.

12	a)	Explain how universal and existential quantifiers are represented in BDD's	(4.5)
	b)	What are ordered binary decision diagrams?	(4.5)
13	a)	State Herbrand's theorem.Prove the validity of the formula $\exists x\forall y p(x,y) \rightarrow \forall y\exists x p(x,y)$.	(9)

14 a) Prove the validity of $A = \forall x(p(x) \rightarrow q(x)) \rightarrow (\forall x p(x) \rightarrow \forall x q(x))$ using semantic tableaux. (4.5)

b) Convert into clausal form $\forall x(p(x) \rightarrow q(x)) \rightarrow (\forall x p(x) \rightarrow \forall x q(x))$ (4.5)

PART E

Answer any four full questions, each carries 10 marks.

15 a) Explain the deductive system for linear temporal logic. (10)

16 a) $\vdash \bigcirc(p \wedge q) \leftrightarrow (\bigcirc p \wedge \bigcirc q)$. (5)

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

17 a) Let $M = (W, R, \varphi)$, where $W = \{u, v, w\}$, $R = \{(u, w), (u, w),(v, v),(v, w), (w, v)\}$, and $\varphi(u) = \{q\}$, $\varphi(v) = \{p, q\}$, $\varphi(w) = \{p\}$. Which of the following hold? (10)

(a) $M \models \Box(p \wedge q) \rightarrow (\Box p \wedge \Box q)$ (b) $M \models \Box p \wedge \Box q \rightarrow \Box(p \wedge q)$

18 a) Explain how program synthesis is done from a formal specifiacation. (10)

19 a) Draw the structure for $\Box(\Diamond(p \wedge q) \wedge \Diamond(\neg p \wedge q) \wedge \Diamond(p \wedge \neg q))$ (5)

b) Write an algorithm for the construction of semantic tableaux for LTL formulas. (5)

20 a) Define a model of K. (5)

b) Define a valid modal proposition. (5)

****