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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIFTH SEMESTER B.TECH DEGREE EXAMINATION, APRIL 2018

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 Construct the truth table of the following formulas. (3)

i) $(p \rightarrow q) \leftrightarrow (\neg q \rightarrow \neg p)$ ii) *If A then B else C*

2 Let A= $(p \rightarrow q) \leftrightarrow (\neg p \rightarrow \neg q)$ and let I_A be the interpretation, $I_A(p) = F$ and $I_A(q) = T$. Find the truth value, $V_I(A)$?. (3)

3 Define deductive systems and Hilbert systems for propositional logic formula. (3)

4 (a) Write transitivity rule and contrapositive rule in Hilbert systems of propositional logic. (1)

(b) Prove $\vdash (A \rightarrow B) \rightarrow [(B \rightarrow C) \rightarrow (A \rightarrow C)]$ in Hilbert System $\mathcal{H}$. (2)

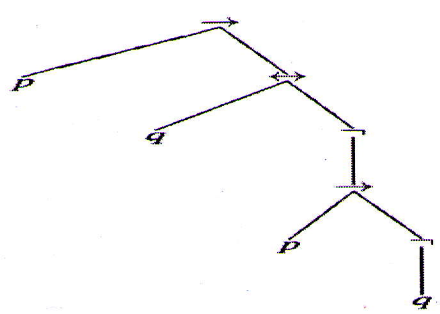
PART B

Answer any two full questions, each carries 9 marks

5 a) Define propositional logic formula. (2)

b) Write an algorithm for representing a formula as strings from a tree and a string in polish notation. (4)

c) Represent the following formula as a string, string with parentheses and a string in polish notation. (3)



6 a) Construct the semantic tableaux for the following propositional logic formula: $(p \vee q) \wedge (\neg p \wedge \neg q)$. (2)

b) Using truth table, prove: (3)

i) $\models (A \leftrightarrow B) \leftrightarrow (A \leftrightarrow (B \leftrightarrow A))$ ii) $A \wedge (B \vee C) \equiv (A \wedge B) \vee (A \wedge C)$

c) Check the following set of clauses, S= $\{p, \bar{p}q, \bar{r}, \bar{p}\bar{q}r\}$ is satisfiable or (4) unsatisfiable by using resolution procedure.

7 a) What is conjunctive normal form (CNF)? What are the steps to convert a propositional logic formula to CNF? (4)

b) Convert the formula $(\neg p \rightarrow \neg q) \rightarrow (p \rightarrow q)$ to CNF and Clausal Form. (2)

c) Write an algorithm for converting CNF to 3CNF. (3)

PART C

Answer all questions, each carries 3 marks

8 Define first order logic formula. Give two examples of formulas in first-order logic. (3)

9 Define interpretation, validity and satisfiability of first-order logic formula. (3)

10 Write the axioms and rules of inference of the Hilbert system for first-order logic. (3)

11 What is Herbrand Universe? Give one example of Herbrand universes. (3)

PART D

Answer any two full questions, each carries 9 marks

12 a) Define binary decision diagram (BDD).Write an algorithm for constructing reduced BDD. (4.5)

b) Construct BDD and reduced BDD for the following formula $A = p \oplus q \oplus r$. (4.5)

13 a) Write the context free grammar for the formulas in first order logic. (2)

b) Construct the semantic tableau for the negation of the following first order logic formula $A = \forall x(p(x) \vee q(x)) \rightarrow (\forall x p(x) \vee \forall x q(x))$, Check the formula is Satisfiable or Valid. (4)

c) Define ground resolution rule in first order logic. (3)

14 a) Write the unification algorithm for transforming a set of term equations into a set of equations in solved form. (4)

b) Check the unifiablity of the following set of two equations: (5)

$g(y) = x, f(x, h(x), y) = f(g(z), w, z)$.

PART E

Answer any four full questions, each carries 10 marks

15 a) Define the following: (6)

i) Temporal logic ii) Modal logic iii) Syntax and semantics of temporal logic

b) What is state transition diagram? Explain with an example. (4)

16 a) What is linear temporal logic (LTL)? Give some equivalent formulas in LTL. (4)

b) Write an algorithm for constructing a semantic tableau of an LTL formula. (6)

17 a) Define the deductive system $\mathscr{L}$ for linear temporal logic and write the derived rules in $\mathscr{L}$. (5)

b) Prove the following: (5)

i)$\vdash \bigcirc(p \wedge q) \leftrightarrow (\bigcirc p \wedge \bigcirc q)$ in $\mathscr{L}$(Distribution Theorem)

ii)$\vdash p \wedge \bigcirc \Box p \rightarrow \Box p$ in $\mathscr{L}$ (Contraction Theorem)

18 a) What is a correctness formula? Give one example. (3)

b) Write different axioms and rules indeductive system $\mathscr{HL}$(Hoare Logic). (5)

c) Define total correctness program. (2)

19 Explain in detail about the program synthesis with an example. (10)

20 a) Write a note onthe following: (6)

i) Program verification. ii) Axiomatic systems of modal logic.

b) Prove the following theorem:$\vdash$ {true} P {x = a . b} in $\mathscr{HL}$. (4)

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