Total number of printed pages – 7 **B. Tech**

CPES 5203

Fourth Semester Examination – 2009

DIGITAL ELECTRONICS CIRCUITS

Full Marks – 70

Time : 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest.*

The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10

   (a) Binary number system is used in digital electronics circuits. Why octal, decimal or hexadecimal number systems are not used in circuit levels ?

   (b) What will be the correct answer during subtraction of unsigned numbers using

P.T.O.

1's complement method for the following ? Mention whether the answer is a positive number or a negative number.

(i) end-carry occurs

(ii) end-carry does not occur

(c) Convert the following function to "product of sums".

$F = A'B'C + AB'C' + AB'C + ABC' + ABC$

(d) What is "Prime Implicant" ? When it is said to be essential ?

(e) "Pair" is a group of two logical 1's in a Karnaugh map. A "pair" eliminates one variable in the product term. Justify how one variable is eliminated ?

(f) Are "NOR-OR" and "OR-NAND" functions equivalent ? justify.

(g) Why both "S" and "R" inputs or a S-R latch should never be "1" simultaneously ?

(h) What will happen if the frequency of the clock signal connected to a flip-flop is increased to a very high value or decrease to a very low value ?

(i) Distinguish the functions of Decoder, Encoder and Multiplexer circuits.

(j) Draw the logic diagram of the digital circuit specified by the following hardware description language.

```
module circt (A, B, C, D, F,) ;
input A, B, C, D ;
output F;
wire w, x, y, z, a, d ;
and (x, B, C, d) ;
and (Y, a, C)
and (w, z, B)
or (z, y, A) ;
or (F, x, w) ;
not (a, A) ;
not (d, D)
endmodule
```

2. (a) In a tabular form, write the "2421" code and "Excess-3" code of decimal digit "0 to 9". What are the special properties of these codes ? 4

(b) Prove the following Boolean theorems using Huntington postulates without using the truth table and the principle of duality.

(i) $x + x = x$ and $x \cdot x = x$

(ii) $x + 1 = 1$ and $x \cdot 0 = 0$ 6

3. (a) Express the Boolean function as a sum-of-min terms. 5

$$F = A + B'C$$

Now, convert the sum-of-min terms to another canonical form.

(b) Simplify the following Boolean function and draw a circuit to represent the function 5

$$F(w, x, y.z) = \sum 0,1,2,4,5,6,8,9,12,13,14$$

4. (a) Implement the following function. 5

$F = A(CD+B)+BC'$ using NAND gates.

$F = (A+B)(C+D)E$ using NOR gates.

(b) Draw the circuit diagram of a 2 bit by 2 bit binary multiplexer using half-adder and logic gates. Explain it's operation. 5

5. (a) Design a combinational circuit that converts a 4-bit Gray code to a 4-bit binary number. Implement the circuit using Exclusive-OR gates. 5

(b) A sequential circuit has two JK flip-flops A and B, and one input x. The circuit is described by the following flip-flop input equations.

$J_A = x \quad K_A = B'$

$J_B = x \quad K_B = A$

Derive the state equations of $A(t+1)$ and $B(t+1)$. Also draw the state diagram of the circuit. 5

6. (a) Design a sequential circuit with two D flip-flops A and B, and one input x. When $x = 0$, the state of the circuit remains the same. When $x = 1$, the circuit goes through the state transitions from 00 to 01 to 11 to 10 back to 00 and repeats. 5

(b) Design a 4-bit binary synchronous counter with D flip-flops. 5

7. (a) How many 32K×8RAM chips are needed to provide a memory capacity of 256 K bytes ? How many lines of the address must be used to access 256 K bytes ? How many of these lines are connected to the address inputs of all chips ? How many lines must be decoded for the chip select input ? Specify the size of the decoder. 5

(b) Describe in brief the construction, circuit diagrams and operations of MOS and CMOS logic circuits. 5

8. Write a brief note on any *two* : 5+5

(a) ASCII code

(b) Magnitude Comparator

(c) Modulo-10 Counter

(d) ROM.