ME | ETRX | II (RS) VLSI Design
21 | 5 | 12

72 : 1st half-12-(h)JP

Con. 3317-12. **BB–3146**

(3 Hours) **[Total Marks : 100**

N.B. (1) Question No. **1** is **compulsory**.
(2) Out of remaining **six** questions solve any **four**.
(3) **Each** question carries **20** marks and sub-questions carry **equal** marks.
(4) Assume suitable data if **required**.
(5) Useful physical constants are given in following table.

Name	Symbol	Value	Units
Boltzmann's constant	**k**	1.38×10^{-23}	J/K
Dielectric constant of vacuum	ε_o	8.854×10^{-14}	F/cm
Dielectric constant of Silicon	εsi	$11.7 \times \varepsilon_o$	F/cm
Dielectric constant of SiO_2	εox	$3.97 \times \varepsilon_o$	F/cm
Intrinsic carrier concentration of silicon	ni	1.45×10^{10} at 27 °c	cm^{-3}

Que 1:- (A) Realize NAND gate using NMOS pass transistors.

(B) Write short notes on Clock tree in integrated circuits.

(C) Explain photolithography using negative photoresist.

(D) An NMOS transistor with device transconductance $K = 20\mu A/V^2$ and threshold voltage of 1.5 V is operated at $V_{GS} = 5V$ and $I_D = 100\ \mu A$. Find V_{DS}.

Que 2:- (A) Calculate the zero-bias threshold voltage for an NMOS Silicon-gate transistor that has well doping = $5 \times 10^{15}\ cm^{-3}$, gate doping = $N_D = 10^{20}\ cm^{-3}$, gate- oxide thickness = 100 A^o, and 3×10^{10} / cm^2 singly charged positive ions at the oxide-Silicon interface.

Also calculate the ion- implant doses needed to achieve a threshold voltage of -1 V.

(B) Compare NMOS logic family with Enhancement mode and Depletion mode pull up.

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Que3:- Draw a circuit diagram, stick diagram of 2 input NMOS NAND gate having depletion mode pull-up. Use self registered buried contact and take output on diffusion. Draw its mask layout considering lambda based design rules.

Que4:-(A) Explain DOMINO CMOS 2 input OR gate.

(B) Draw 6 transistor SRAM cell and explain its operation.

Que5:- (A) Implement the following functions using NMOS NOR-NOR PLA :

$F_1 = f(A,B,C) = \Sigma m\,(0,1)$

$F_2 = f(A,B,C) = \Sigma m\,(0,1,6,7)$

$F_3 = f(A,B,C) = \Sigma m\,(2,3,4,5)$

(B) CMOS complex logic circuit is given by the eq. $Y = \overline{(A+B+C)(D+E)}$. Draw the circuit diagram and find an equivalent CMOS inverter circuit for simultaneous switching of all inputs. Assume (W/L) ratio of P and N channel transistors 15 and 10 respectively.

Que6:- (A) Explain lambda based design rules for (I) polysilicon crossing diffusion to have MOSFET and (II) metal pattern over contact cut. Discuss the faults created, if the rules are not followed.

(B) Draw circuit diagram and stick diagram of 4 :1 multiplexer using pass transisters.

Que 7:- Discuss the processing sequence of a CMOS inverter with the help of cross-sectional views.

ME | ETRX - II 25/5/12

Power Electronics

Con. 3219-12. **BB-3149**

(4 Hours) **[Total Marks : 100**

N.B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions from remaining **six** questions.
(3) **Figures** to the **right** indicate **full** marks.
(4) Assume suitable **data** if **required**.

1. Answer the following :— 20
   (a) What are the most important specifications of power diode ? Which factors decides the speed of power diode ?
   (b) What are the unique features of power MOSFET ? Why the ON state resistance of MOSFET has +ve temperature coefficient ? What is significance of PTC in MOSFET ?
   (c) Explain the working of basic series Inverter, state its drawbacks and suggest how to overcome these drawbacks.
   (d) Discuss various control strategies of DC to DC Choppers as supplied to control DC motors.

2. (a) A small separately excited d.c. motor is supplied *via* a half controlled, single phase bridge rectifier. The supply is 240 V, the thyristors are triggered at 110°, and the armature current continues for 50° beyond the voltage zero. Determine the motor speed at a torque of 1·8 N-m, given the motor torque characteristics is 1 ON m/A and its armature resistance is 6 Ω. Neglect all converter losses. 10
   (b) Draw the equivalent circuit of a separately excited d.c. motor and derive the expressions for motor torque and armature voltage. 10

3. (a) Describe the basic principle of working of a single phase to single phase cycloconverter for both continious and discontinious conductions for a bridge type converter. Mark the conduction of various thyristors also. 10
   (b) Explain why a PWM inverter is superior to a square wave inverter. List different voltage control and PWM techniques used in 1-phase inverter. 10

4. (a) State the explain various methods of speed control of Induction Motor. 10
   (b) A three phase, 400 V, 50 Hz, 6-pole, star connected round roter synchronous motor has a synchronous reactance of $\chi s = 2{\cdot}0\ \Omega$ per phase and the armature resistance is negligible. The load torque which is proportional to the speed squared, is $T_L = 300$ N-m, at 100 rpm. The power factor is maintained at unity by field control and the voltage to frequency ratio is kept constant at the rated value. If the inverter frequency is 40 Hz and the motor speed is 560 rpm, determine — 10
   (a) The input voltage E_a, (b) The armature current I_a, (c) The excitation voltage E_f, (d) The torque angle δ and (e) The pull-out torque T_P.

5. (a) Explain the working principle of stepper motor. What are different types of stepper motor ? Discuss in detail about permanent magnet stepper motor. 10
   (b) Explain in detail how a choice of drive can be made. Also explain the advantages and disadvantages of ac and dc drives. 10

6. (a) Why is it essential to operate and induction motor between the synchronous speed and the breakdown speed, when it is used to holding an active load by the regenerative braking ? 10

   (b) What is self control mode of synchronous motors ? Draw and explain the block diagram of a self controlled synchronous motor fed from a three-phase inverter. 10

7. Write short notes on the following :— 20

   (a) MCT
   (b) FCT
   (c) IGBT
   (d) RCT.