

GUJARAT TECHNOLOGICAL UNIVERSITY**M. E. IST Semester–Remedial Examination – July- 2011****Subject code: 712605N****Subject Name: Physics of MOS Transistor****Date: 12/07/2011****Time: 10:30 am – 01:00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Define Fermi Potential and Junction Potential. Derive the equation for depth of the depletion region in n^+p abrupt semiconductor. **07**
- (b) Explain following: **07**
1. contact potential across several materials in series
 2. two well-known isolation techniques

- Q.2** (a) Derive simplified general expressions for inversion and depletion charges for MOS capacitor system and plot them as a function of surface potential. **07**
- (b) Draw energy band diagram for three-terminal MOS structure (p-type substrate) for 1. $V_{CB} = 0$ and 2. $V_{CB} > 0$. Assume $V_{GB} > V_T$. Also, obtain expressions electrons and holes concentration as a function of V_{CB} and surface potential. **07**

OR

- (b) Define “pinch-off” voltage in three-terminal MOSFET device and derive its expression. Obtain expression for inversion charge in strong inversion region as a function of pinch-off voltage. **07**

- Q.3** (a) Derive weak inversion drain current MOSFET model and show that $V_{DS,sat} = 3\phi_t$ for MOSFET device operating in weak inversion region. **07**
- (b) Discuss the effects of temperature change on ‘ON’ current, leakage current, and V_T of MOSFET device with necessary diagrams. **07**

OR

- Q.3** (a) Define α parameter used in simplified charge sheet model. Discuss the effect of α parameter on the accuracy of simplified strong inversion model. **07**
- (b) Define effective mobility and discuss various scattering phenomena. Derive expression for effective mobility in terms of inversion and depletion charges. **07**

- Q.4** (a) What do you understand by hot carrier effect? How does it affect drain and bulk current? Draw a plot of I_{DB} as a function of V_{GS} at different values of V_{DS} . How can we reduce hot carrier effect? **07**
- (b) Discuss poly-depletion and quantum mechanical effects. How do they change V_T of MOSFET? Write necessary equations. **07**

OR

- Q.4** (a) Discuss different components of source/drain resistance and derive expression for I_{DS} taking into account effects of source/drain resistance. **07**
- (b) Explain constant field downscaling technique. Show that the voltage drop across metal line does not change with downscaling. **07**

- Q.5** **(a)** Discuss limitations of quasi-static model. **07**
 (b) How would you measure/estimate ΔL , ΔW , and summation of drain and **07**
 source resistance? Explain in detail with necessary diagrams and
 equations.

OR

- Q.5** **(a)** The gate of MOSFET is applied with pulse signal having finite rise and fall **07**
 time. Assume that the rise time is greater than the fall time. Also assume that
 the frequency of input signal is very low and MOSFET operates in quasi-static
 region. Plot drain and source currents as a function time. Make important
 comments.
 (b) What are the different types of MOSFET models? Discuss merits and **07**
 demerits of each type of MOSFET models.
