COMPUTER SCIENCE TRIPOS Part IA – 2026 – Paper 2

1 Digital Electronics (ijw24)

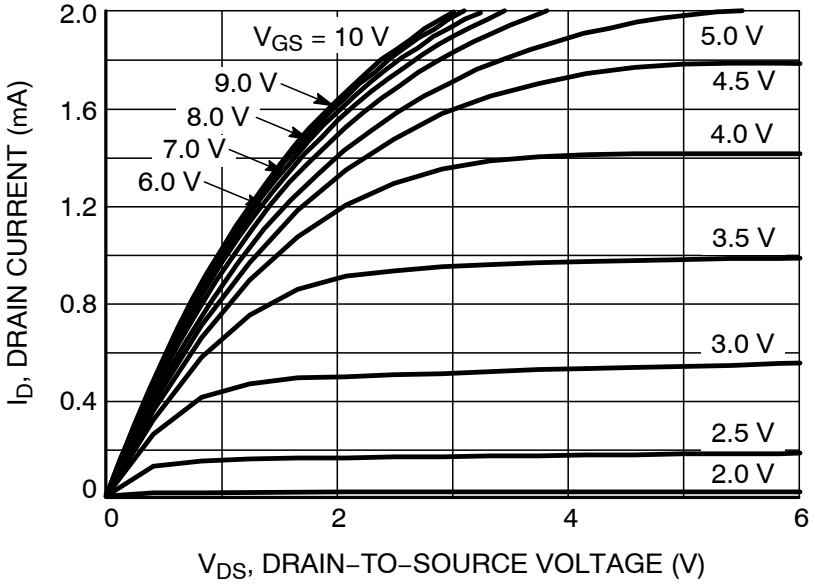
(*a*) Show that the following Boolean function can be simplified to a two term sum-of-products form where each term has two variables either in complemented or uncomplemented form.

$$F(X,Y,Z) = \overline{\overline{\overline{\overline{X.\overline{X.\overline{\overline{Y}}}.X.\overline{Y}.\overline{Y}}.Z}.X.\overline{Y}.\overline{Y}.Z}}$$

[6 marks]

(*b*) A four variable Boolean function $G(A,B,C,D)$ has the following minterms $\{1,2,4,7,8,11,13,14\}$ (decimal), where A is the most significant bit of the equivalent binary reprsentation. Show G can be expressed using only exclusive OR operations. [4 marks]

(*c*) A NOT gate comprises an n-channel MOSFET and a resistor R. Assume the power supply voltage (V_{DD}) is 5 V and $R = 5100\ \Omega$. The MOSFET has the I_{D} - V_{DS} characteristic given in the following figure.



(*i*) Draw the circuit diagram of the NOT gate. [3 marks]

An extra copy of the figure above is attached to the back of this paper. This should be detached, amended as requested below, and handed in with your answer.

(*ii*) Plot the curve for R on the MOSFET I_{D} - V_{DS} characteristic. [3 marks]

(*iii*) Determine the voltage levels at the output of the NOT gate for input voltage levels of 2.5 V and 4 V. Sketch the input voltage to output voltage characteristic for the NOT gate over an input voltage range from 0 V to 5 V. Reasonable variability in the answer will not be penalised. [4 marks]