Coláiste na Tríonóide, Baile Átha Cliath
Trinity College Dublin
Ollscoil Átha Cliath | The University of Dublin

Faculty of Engineering, Mathematics and Science
School of Computer Science & Statistics

Integrated Computer Science **Trinity Term 2016**
Year 1 Annual Examination

Electrotechnology

Friday 6th May 2016 Drawing Office 14.00 – 16.00

Dr. Eamonn O Nuallain

Instructions to Candidates:
(i) A total of FOUR questions should be attempted.
(ii) All questions carry equal marks.

Materials Permitted for this Examination:
(i) Use of non-programmable calculators and log-tables is permitted.

Q1

With reference to the circuit below, where V1=5V, V2=10V determine:

(i) The impedance as 'seen' by the supply in the leftmost branch (V1).

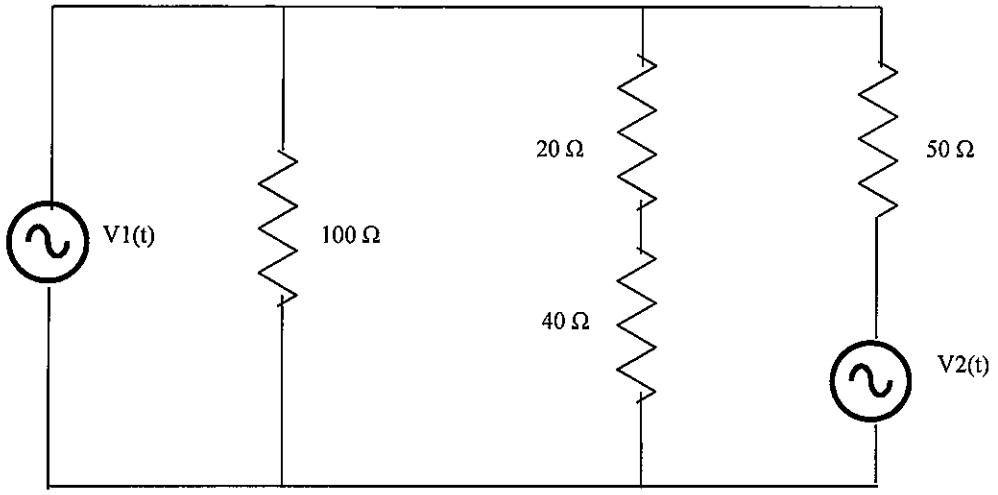
(ii) The current drawn from the supply in the leftmost branch (V1).

(iii) The impedance as 'seen' by the supply in the rightmost branch (V2).

(iv) The current in the rightmost branch

(v) The current through the 100 Ω resistor

(5 X 5 Marks)



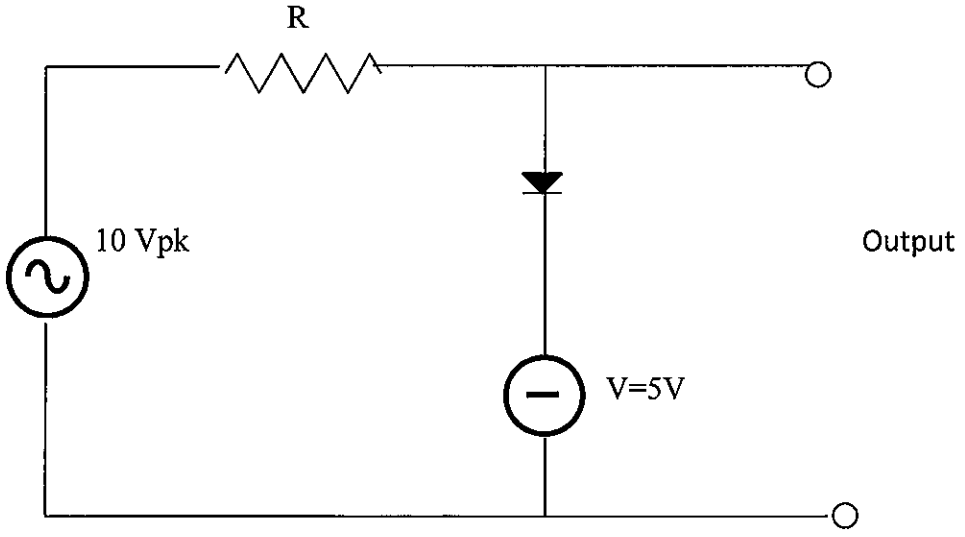
Q2.

Sketch the characteristic curve of the semiconductor diode. Explain the operation of the semiconductor diode with reference to this sketch.

(10 Marks)

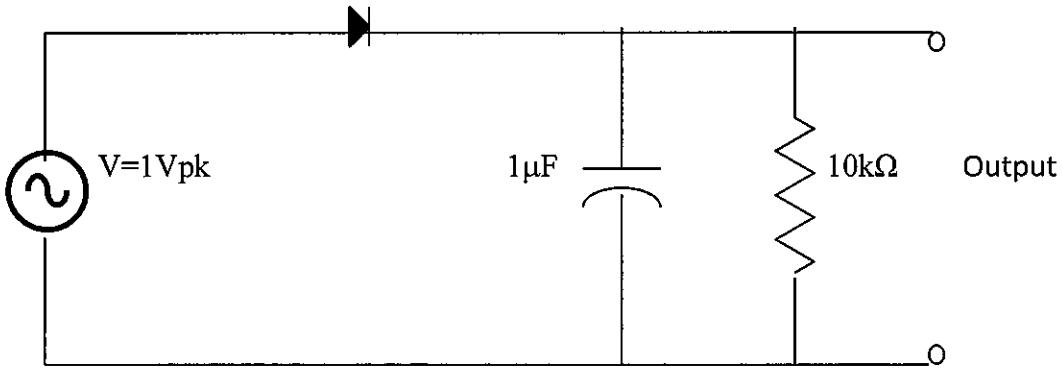
Assuming ideal sources and components (forward voltage drop of diode ~ 0V), sketch the outputs of the following circuits:

(i)



(5 Marks)

(ii)



(5 Marks)

(iii) For this latter circuit, (ii), sketch (approximately) the output where the value of the capacitor is increased and decreased.

(5 Marks)

Q3.

Draw a diagram of the E-MOSFET. For the E-MOSFET sketch the drain current versus drain-source voltage for different gate-source voltages and explain the operation of this device with reference to this sketch.

(10 Marks)

For an n-channel E-MOSFET the manufacturer specifies $v_{GS(th)} = 4V$ and $i_{DS} = 7.2mA$ at $V_{GS} = 10V$. For $V_{DD} = 24V$ and $R_G = 100M\Omega$ specify R_D for operation at $V_{DS} = 8V$.

(15 Marks)

Q4.

An E-MOSFET is biased with a voltage divider. $k = 0.25mA/V^2$ and $V_{GS(TH)} = 1V$. Given that $R_1 = 300k\Omega$, $R_2 = 100k\Omega$ and $R_D = R_S = R$ *where* R_D and R_S are the drain and source resistances respectively. $V_{DD} = 12V$ and $V_{DS} = 10V$.

(i) Draw the circuit diagram.

(ii) Calculate V_{GS}.

(iii) Calculate I_D.

(iv) Calculate R.

(v) Calculate the current flowing through R.

(5X5 Marks)

Q5.

(i) State Coulomb's Law

(2 Marks)

(ii) Determine the resultant force acting on a point charge of $-\mathbf{2.0} \times \mathbf{10^{-6}}\boldsymbol{C}$ situated at the origin of a rectangular coordinate system in the vicinity of point charges $\mathbf{3.0} \times \mathbf{10^{-6}}\boldsymbol{C}$ and $-\mathbf{4.0} \times \mathbf{10^{-6}}\boldsymbol{C}$ at distances 0.12 m along the positive x-axis and 0.08m along the half-line y = x where x, y ≤ 0 respectively.

(10 Marks)

(iii) Starting with the Lorentz Force Law, derive a formula for the force on a current carrying wire, of length $\boldsymbol{l}$, placed in a magnetic field.

(10 Marks)

(iv) A current carrying conductor is situated at right-angles to a magnetic field of 0.3T. If the length of the conductor is 20 cm, what is the force on it when the current is 200A.

(3 Marks)