# TRINITY COLLEGE DUBLIN
# THE UNIVERSITY OF DUBLIN

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

Integrated Computer Science
Year 1 Annual Examination

Trinity Term 2015

**CS1025 – Electrotechnology**

**Saturday 9 May 2015 RDS – Main Hall 09:30 – 11:30**

Dr. Eamonn O'Nuallain

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## Instructions to Candidates

- A total of FOUR questions should be attempted.
- All questions carry equal marks.

## Materials Permitted for this examination:

- Use of non-programmable calculators and log-tables is permitted.
  You must note the make and model of your calculator on your answer book.

Q1

With reference to the circuit below, where V1=4V, V2=5V determine:

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

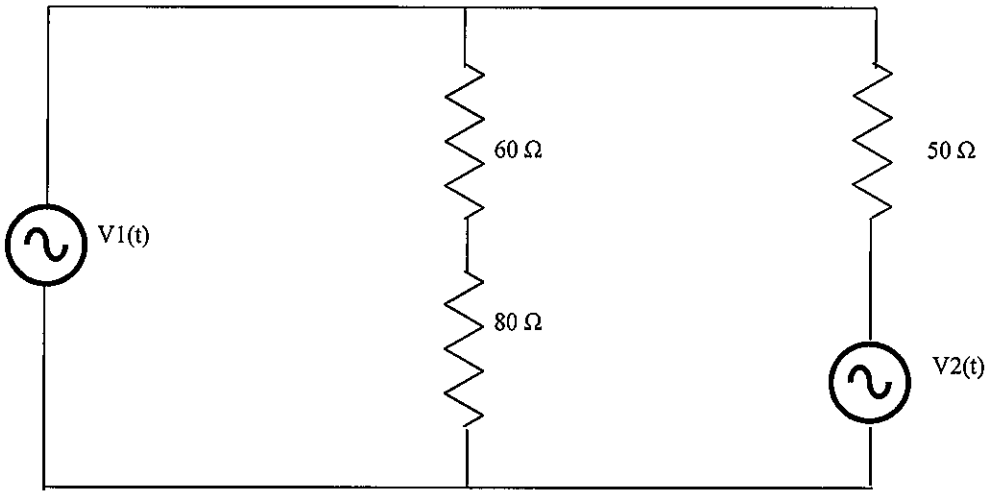
(ii) The current drawn from the supply in the leftmost branch (V1).

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

(iv) The current in the rightmost branch

(v) The current in the centre branch.

(5 X 5 Marks)



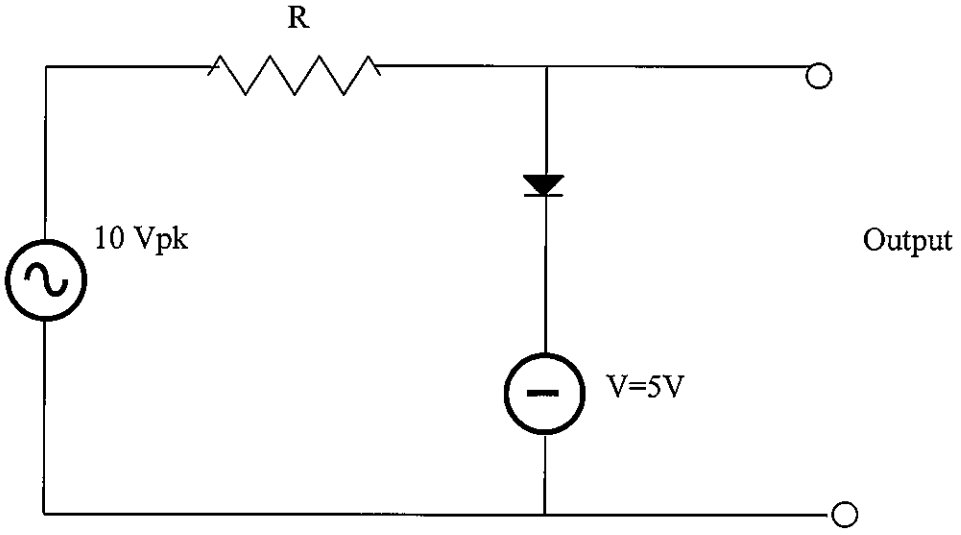
Q2.

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

(10 Marks)

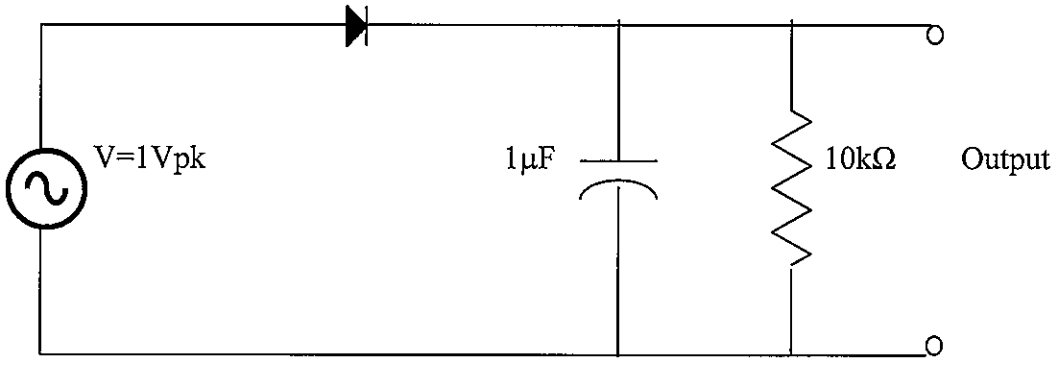
Assuming ideal sources and components (forward voltage drop of diode ~ 0V), sketch the outputs of the following circuits:

(i)




(5 Marks)

(ii)




(5 Marks)

(iii) For this latter circuit, 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.

(15 Marks)

For a drain feedback E-MOSFET amplifier the data sheet specifies $I_{D(on)} = 3mA$ for $V_{DS(on)} = 10V$. If $V_{DD} = 25V$ select a value of $R_D$ that allows the MOSFET operate at the specified Q-point.

(10 Marks)

Q4.

(i) For a drain feedback biased E-MOSFET we are given the following information: $V_{DS} = \frac{1}{2}V_{DD}$, $I_{D(sat)} = 4mA$ and $V_{GS(th)} = 6V$.
Find $V_{DD}$ and $R_D$.

(10 Marks)

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

(15 Marks)

Q5.

(i) State the Law of Faraday and Lenz.

(2 Marks)

(ii) An airplane having a wing span of 50 m is flying horizontally at a speed of 600 km/h. Assuming that the vertical component of the earth's magnetic field is 40 μT, calculate the e.m.f. generated between the wing tips.

(10 Marks)

(iii) State Ampere's Law for an infinite straight wire.

(3 Marks)

(iv) There exists a current of 5.0A flowing in the $\hat{a}_y$ direction at x = 2m, z = -2m where $\hat{a}_y$ is the unit vector in the y-direction. Find the magnetic field strength at the origin.

(10 Marks)