

# **UNIVERSITY OF DUBLIN**

## **TRINITY COLLEGE**

Faculty of Engineering and Systems Sciences

Department of Computer Science

Integrated Computer Science Programme  
Year 1 Annual Examination

Trinity Term 2014

### **CS1025 – Electrotechnology**

**Thursday 1<sup>st</sup> May 2014**

**Luce Upper**

**14:00 – 16:00**

**Dr. Eamonn O Nuallain**

### **Instructions**

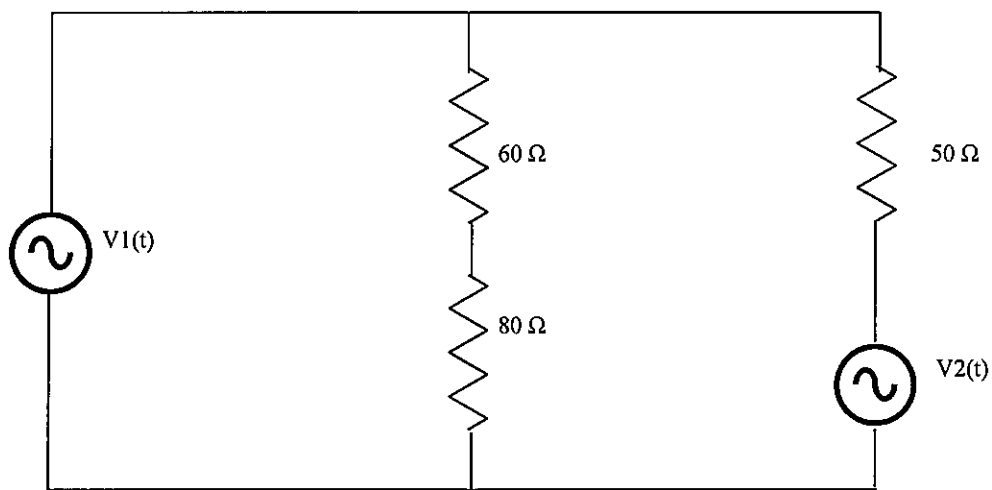
- (i) A total of FOUR questions should be attempted.
- (ii) All questions carry equal marks.
- (iii) Use of non-programmable calculators and log-tables is permitted.  
You must note the make and model of your calculator on your answer book.

Q1

With reference to the circuit below, where  $V_1=2V$ ,  $V_2=5V$  determine:

- (i) The impedance as 'seen' by the supply in the leftmost branch ( $V_1$ ).
- (ii) The current drawn from the supply in the leftmost branch ( $V_1$ ).
- (iii) The impedance as 'seen' by the supply in the rightmost branch ( $V_2$ ).
- (iv) The current in the rightmost branch
- (v) The current in the centre branch.

(5 X 5 Marks)



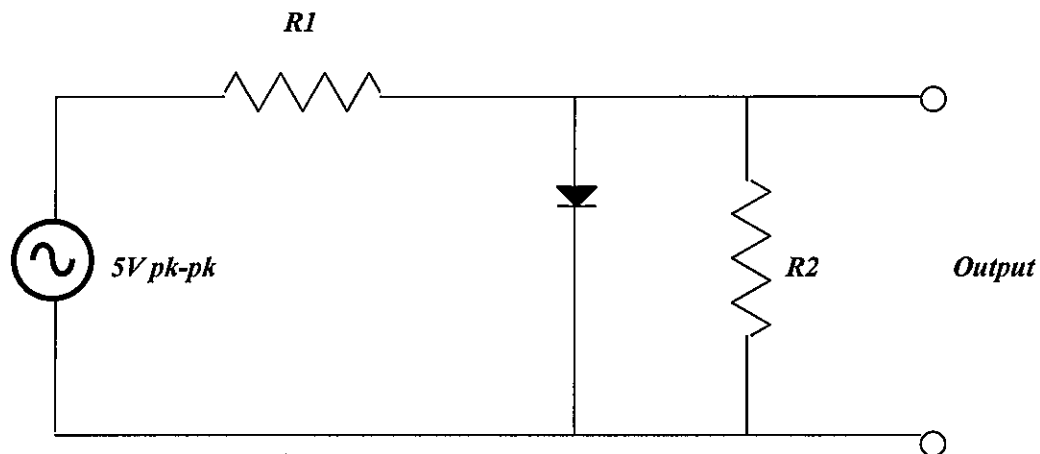
Q2.

- (a) Sketch the characteristic curve of the semiconductor diode. Explain the operation of the semiconductor diode with reference to this sketch.

(15 Marks)

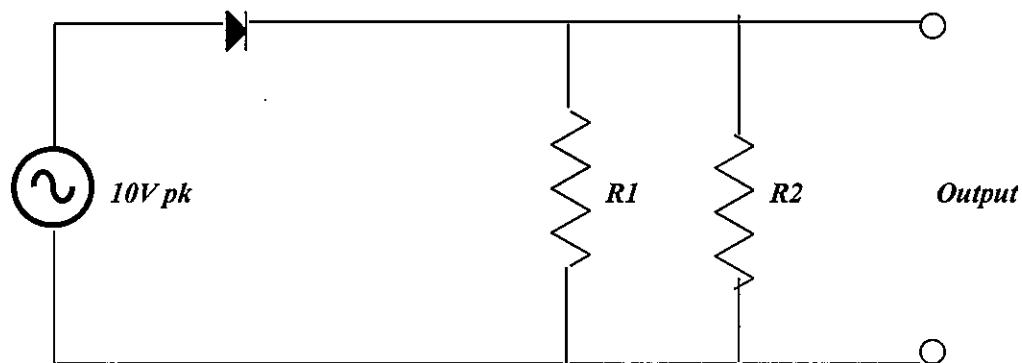
- (b) Assuming ideal sources and components (forward voltage drop of diode  $\sim 0V$ ), sketch the outputs of the following circuits:

(i)



(5 Marks)

(ii)



(5 Marks)

Q3.

- (a) 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)

- (b) 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.

- (a) Two E-MOSFETS are connected in series across a 10V supply. The 'upper' MOSFET has its drain connected directly to its gate. The 'lower' MOSFET is unbiased. The input to the circuit is taken to be the gate of the lower MOSFET and the output is taken to be at the drain of the lower MOSFET.

(5 Marks)

- (b) The upper MOSFET has a resistance of  $2K\Omega$  when its gate-source voltage is 10V. The lower MOSFET has a resistance of  $150\Omega$  when the input voltage is 3V. What is the output of the circuit when the input to the circuit is 0V and 3V respectively?

(20 Marks)

Q5.

(a) State Coulomb's Law.

(2 Marks)

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

(10 Marks)

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

(3 Marks)

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

(10 Marks)

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