# KABARAK UNIVERSITY

## UNIVERSITY EXAMINATIONS

## 2010/2011 ACADEMIC YEAR

## FOR THE DEGREE OF BACHELOR OF TELECOMMUNICATION

**COURSE CODE:** PHYS 126

**COURSE TITLE:** ELECTRICITY AND ELECTRONIC SYSTEMS

**STREAM:** Y1S2

**DAY:** TUESDAY

**TIME:** 9.00 – 12.00 P.M.

**DATE:** 22/03/2011

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**INSTRUCTIONS:**

- *Answer Question **ONE** and any other **THREE** Questions. Question One carries **20marks** while each of the other Three Questions carry **10marks**.*
- ***The following constants may be useful***
  - Permeability of free space $\mu_0 = 4\pi \times 10^{-7} Wb/A$
  - Permittivity of free space $\varepsilon_0 = 8.85 \times 10^{-12} C^2/NM^2$
  - Resistivity of Steel $\rho = 1.6 \times 10^{-8} \Omega m$

**PLEASE TURN OVER**

**QUESTION 1 (20 marks)**

a) Define the following terms (2mks)

i). Electric current

ii). Resistance

b) i) State and explain any two factors that affect the resistance of a metallic conductor. (2mks)

ii) A rectangular block of Steel has dimensions 2.5cm by 2.5cm by 40cm. Find the conductance of the block between the two square ends. (2mks)

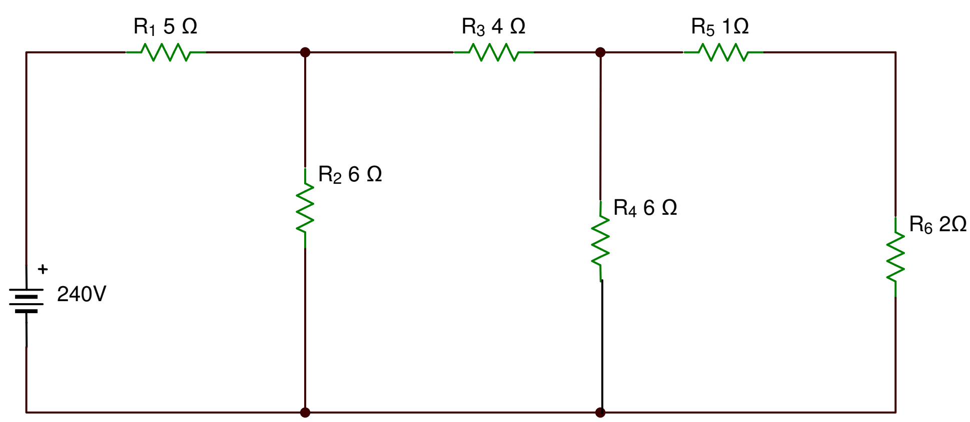
c) A charge of 240C is moved when energy of 45J is applied between two points. Find the voltage between the two points. (2mks)

e) Sketch a circuit diagram showing how a.c. full wave rectification can be achieved using a bridge rectifier (2mks)

f) Explain why for good conductors, increase in temperature leads to decrease in conductivity while for semiconductors, the opposite is true (1mk)

g) i) State Kirchhoff's current law. (1mk)

ii) Determine the voltage across $R_6$ in the given circuit (3mks)




e) Differentiate between extrinsic and intrinsic semiconductors (1mk)

f) i) Differentiate between poles and zeros of a system. (1mk)

ii) A linear system is described by

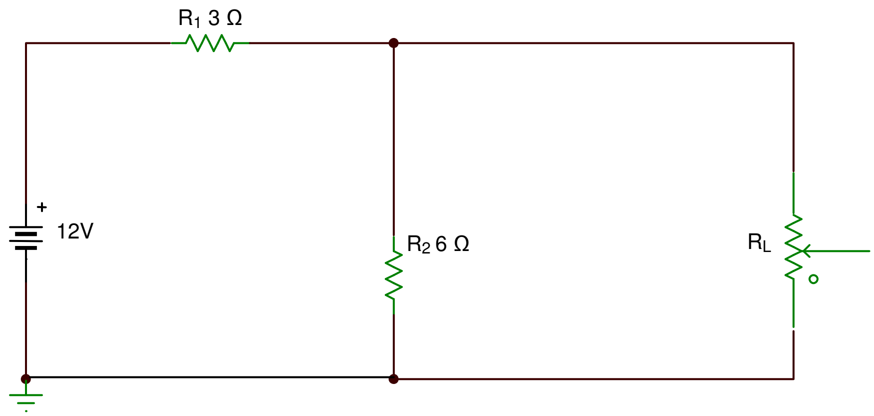
$$\frac{d^2y}{dt^2} + 5\frac{dy}{dt} + 6y = 2\frac{du}{dt} + u$$

Find the system poles and zeros (3mks)

## QUESTION 2 (10 marks)

a) i) State Thevenin's theorem (1mk)

ii) Find the Thevenin equivalent circuit for the given network, hence find the current through $R_L$ for $R_L = 10\Omega$ (4mks)




b) State maximum power transfer theorem and hence show that $P_{L_{max}} = \frac{E_{Th}^{\ 2}}{4R_{Th}}$ (5mks)

## QUESTION 3 (10 marks)

a) i) What is capacitance? (1mk)

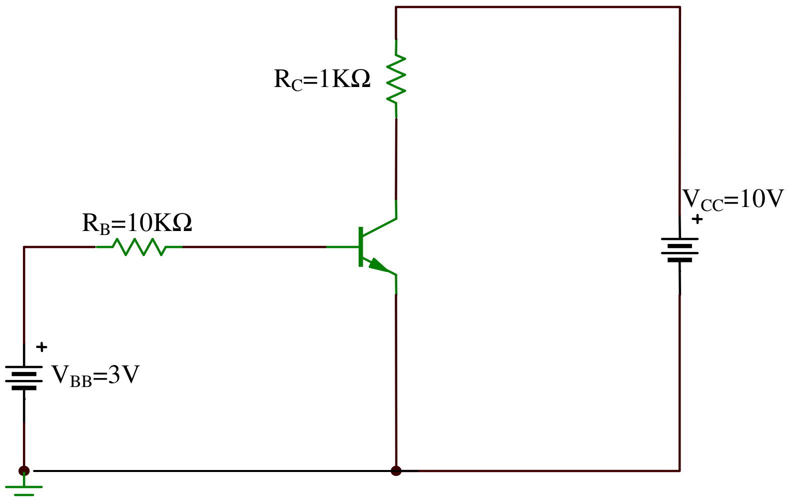
ii) A potential difference of 4KV is applied across the plates of a capacitor of capacitance 25µF. Calculate the charge in the capacitor. (2mks)

b) i) Define transient period of an RC circuit (1mk)

ii) Derive the expression of finding the current (I) at any time (t) of a capacitor during the transient growth, hence show that time constant (τ) during this phase is 63% of maximum value. (6mks)

## QUESTION 4 (10 marks)

a) Determine the operating region of the transistor in the given circuit. Given that for this transistor $V_{CE(sat)} = 0.2V$ , $V_{BE} = 0.7V$ and $\beta_{DC} = 50$ (4mks)




b) Sketch a schematic diagram of an inverting operational amplifier and derive its closed-loop gain ($A$). (3mks)

c) Derive the transfer function of an operational amplifier integrator circuit (3mks)

**QUESTION 5 (10 marks)**

a) A series RLC circuit is driven by an a.c of the form $V = V_{max} Sin\varpi t$. Given that R=250Ω, L= 0.8mH, C= 2.5μF, f= 50Hz and $V_{max}$=200V. Find for this circuit

i). The amplitude current (3mks)

ii). The phase angle (2mks)

b) Define quality (Q) factor of a series RLC circuit and show that the Q-factor for series RLC circuit is given by

$$Q_s = \frac{1}{R}\sqrt{\frac{L}{C}}$$ (3mks)

c) Define resonance frequency of a series RLC circuit and show that this frequency is given by

$$\varpi = \frac{1}{\sqrt{LC}}$$ (2mks)