KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS

2010/2011 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF SCIENCE IN TELECOMMUNICATIONS

COURSE CODE: **PHYS 126**

COURSE TITLE: **ELECTRICITY AND ELECTRONIC SYSTEMS**

STREAM: **Y1S2**

DAY: **FRIDAY**

TIME: **2.00 – 4.00 P.M**

DATE: **10/12/2010**

INSTRUCTIONS:

- *Answer Question **ONE** and any other **THREE** Questions. Question One carries **20marks** while each of the other Two 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 Iron $\rho = 9.68 \times 10^{-8} \Omega m$

PLEASE TURN OVER

QUESTION 1 (20 marks)

a) i) Define potential difference of a source. (1mk)

ii) A charge of 90C is moved when energy of 40J is applied between two points. Find the potential difference between the two points. (2mks)

iii) State two properties of voltage and current sources. (2mks)

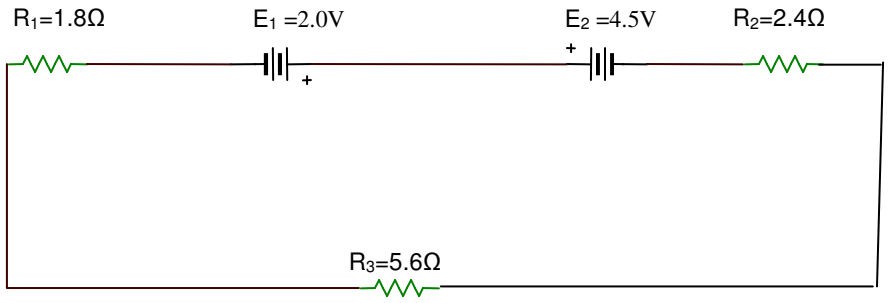
b) Sketch a circuit diagram showing how a.c. full wave rectification can be achieved using a bridge rectifier (2mks)

c) i) A rectangular block of Iron has dimensions 1.5cm by 1.5cm by 20cm. Find the resistance of the block between the two square ends. (2mks)

ii) Explain how minority charge carriers are produced in extrinsic semiconductors. (1mk)

d) i) State Kirchhoff's voltage law. (1mk)

ii) Calculate the current in the given circuit (3mks)



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

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

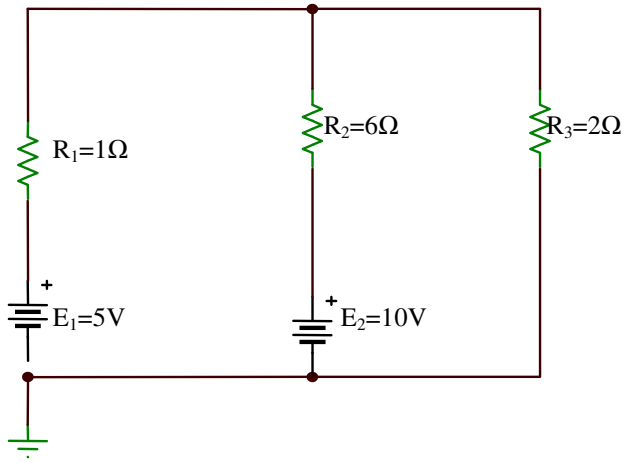
ii) A linear system is described by

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

Find the system poles and zeros (3mks)

QUESTION 2 (10 marks)

a) By applying mesh analysis, find the current through each branch in the given circuit (5mks)



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 time constant of an RC circuit (1mk)

ii) Derive the expression of charge (Q) at any time (t) of a capacitor during the discharging phase, hence show that time constant (τ) during this phase is 37% of maximum value. (6mks)

QUESTION 4 (10 marks)

a) An RL circuit with an inductor L=8mH and a resistor R=10Ω is connected to a battery of 15V. Calculate for this circuit,

i). The rate of increase of current at the instant when current I=0.5A (2mks)

ii). The current 0.5 seconds after the circuit was switched on. (3mks)

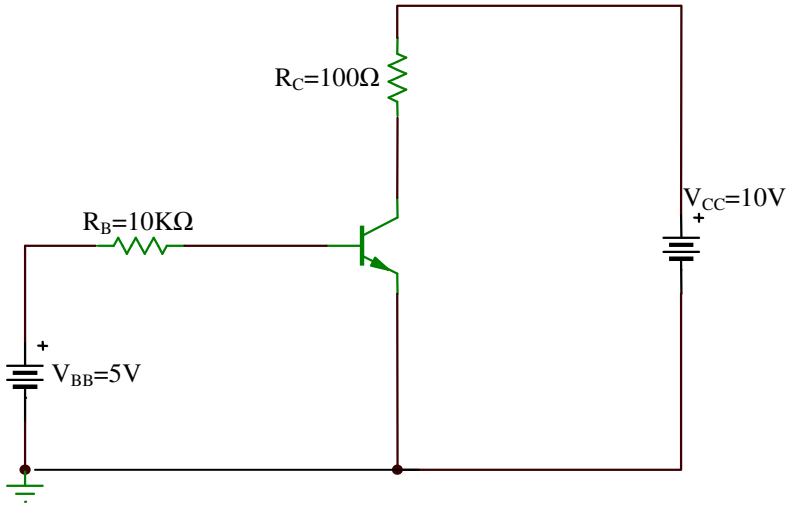
b) A series RLC circuit is driven by an a.c of the form $V = V_{max} Sin\omega t$. Given that R=200Ω, L= 0.8mH, C= 0.5μF, f= 50Hz and V_{max}=240V. Find for this circuit

i). The amplitude current (3mks)

ii). The phase angle (2mks)

QUESTION 5 (10 marks)

a) Consider the given transistor circuit



Given that for this transistor, $V_{BE} = 0.7V$ and $\beta_{DC} = 150$, determine for the circuit;

i). Collector current (I_C) (3mks)

ii). Collector-emitter voltage (V_{CE}) (2mks)

b) i) Sketch a schematic diagram of an operational amplifier integrator circuit (2mks)

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